SECTION 46 01 01

INSTALLATION OF CITY SUPPLIED EQUIPMENT

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. The Contractor shall provide all services to install the City Supplied Equipment (High Rate Clarification (HRC) Equipment, and Free-Moving Media Screens and Aeration System (IFAS) Equipment) as shown in the Drawings and in Appendix A.

B. The term “HRC Equipment” in this contract is inclusive of the HRC system including but not limited to mixers, clarifier mechanisms, lamella system and effluent troughs, pumps, ballast, ballast recovery system, ballast addition system , air scour blower, valves and operators, ancillaries and instrumentation & control components, and associated mounting/connecting hardware.

C. The term “IFAS Equipment” in this contract is inclusive of the IFAS system including but not limited to free-moving media, media retention screens, aeration headers and associated mounting/connecting hardware, and aeration diffusers and associated mounting/connecting hardware.

D. The Contractor shall supply and install all components, connections, accessories, etc. required to complete the installation of the HRC and IFAS Equipment.

E. Supervise, organize, coordinate and direct construction operations of Sub-trades and Suppliers.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. This Section covers the work necessary by the Contractor to install the HRC Equipment and IFAS Equipment.

B. Contractor shall unload and install the City-Supplied Products and accessories at the Site according to the Manufacturer’s written instructions, Shop Drawing Submittals, and Contract Drawings. City-Supplied Products Shop Drawings and Bills of Material are included in Appendix A.

C. The Contractor shall repair / replace any damaged materials caused during unloading, storage and/or installation.

PART 2 PRODUCTS

2.1 CITY-SUPPLIED PRODUCTS

A. Provide all products required to complete the work under this section, except where specifically designated as provided by the City. This designation is described in the Drawings and City Supplied Equipment Shop Drawings and bill of materials.

B. The additional items required to meet the installation detail shall be provided by the Contractor.

C. Connection hardware such as anchor bolts, washers, nuts, etc. are provided with the City-Supplied Products by the Supply Contractor. Supply any additional hardware and pipes not specifically stated in the manufacturer's bill of materials (Appendix A). Additional hardware shall be Type 316 stainless steel in accordance with Section 05 50 00, Metal Fabrications (Basic). Number and size as recommended by the Supply Contractor.

PART 3 EXECUTION

3.1 INSPECTION PRIOR TO OFF-LOADING

A. Prior to transfer of the City-Supplied Products to the Contractor, the Contractor, Supply Contractor, City, and Contract Administrator shall jointly inspect all shipments on arrival at site for damages and check against shipping information to ensure all parts, boxes, crates, bundles or items have been received.

1. Record in writing the products transferred to Contractor's care. Provide listing of the materials and/or equipment received, and provide written statement to Contract Administrator that materials and/or equipment were received in good condition.
2. Report damage to or loss of materials and/or equipment immediately to Contract Administrator.
3. Do not off-load products to be returned to Supply Contractor for repair or replacement, unless necessary to expedite return shipping.
4. Contractor is responsible for unpacking, repacking and handling of equipment as required.
5. Provide trucking company with signed shipping manifest, signed by the Contractor, prior to allowing the trucking company to leave the site.

3.2 OFF-LOADING OF EQUIPMENT

A. After any damage or loss is reported, off-load the equipment only with approval by the Contractor Administrator in accordance with the Supply Contractor's instructions.

3.3 STORAGE AND PROTECTION OF CITY SUPPLIED EQUIPMENT

A. Following the transfer of the City Supplied Equipment and until final acceptance of the completed work, protect, store and maintain products to prevent damage or loss in accordance with the Supply Contractors' instructions and as specified in Section 01 61 00, Common Product Requirements and Section 01 64 00, City-Supplied Products. Contractor shall replace

all materials and/or equipment that are lost or damaged while in the custody of the Contractor. Replacement materials and/or equipment shall be acceptable to the Contract Administrator, City and the Supply Contractor.

3.4 INSTALLATION OF EQUIPMENT

A. In accordance with Supply Contractors' instructions.

B. Anchor Bolts: Accurately place using templates furnished by the Supply Contractors and as specified in Section 05 50 00, Metal Fabrications (Basic).

C. Provide stainless steel spacers, shims, and other accessories necessary for complete and proper installation of the City Supplied Equipment.

D. Install all anchor bolts after the placement and curing of concrete.

E. Furnish "As-Built" drawings for the constructed facilities.

3.5 FUNCTIONAL TESTING AND PERFORMANCE VERIFICATION

A. The Contractor shall perform functional and performance testing with assistance provided by the Supply Contractor.

B. Supply all necessary samplers, temporary equipment and instruments, and pay for costs of functional and performance testing (except performance test sample analysis) to complete the functional and performance testing of the City-Supplied Products.

3.6 SUMMARY OF SUPERVISORY AND ON-SITE SERVICES PROVIDED BY SUPPLY CONTRACTOR

A. Supply Contractors are responsible for providing:
   1. Co-ordination with the Contractor, City, and the Contract Administrator.
   2. Instructions for off-loading and equipment storage conditions.
   3. Witnessing of delivery, unloading and storage of delivered equipment and completion of Form 100 "Certificate of Equipment Delivery".
   4. Meeting with the Contractor to provide instructions for equipment installation, and completion of Form 101 "Certificate of Readiness to Install".
   5. Supervision and inspection of installation of City Supplied Equipment, and completion of Form 102 "Certificate of Satisfactory Installation"
   6. Preparation of an approved Performance Demonstration Plan for the City Supplied Equipment.
   7. Participation in functional and performance testing of the City Supplied Equipment, and completion of Form 103 "Certificate of Equipment Satisfactory Performance" and Form 104 "Certificate of Satisfactory Process Performance".

8. Operator Training: Development of training materials and provision of training of the City's operations and maintenance staff and completion of forms T-1 "Certificate of Satisfactory Classroom Training" and T-2 "Certificate of Satisfactory Field Training".

END OF SECTION

SECTION 46 21 11

SCREENING EQUIPMENT

EQUIPMENT AND COMPONENT NUMBERS

ID No.	Equipment Description
SCR-G211	Mechanical Screen
SCR-G212	Mechanical Screen
SCR-G213	Mechanical Screen
SCR-G214	Mechanical Screen
XV-G2311	Sluice Outlet Valve
XV-G2321	Sluice Outlet Valve
WCP-G231	Screenings Washer/Compactor
WCP-G232	Screenings Washer/Compactor

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. American Bearing Manufacturers Association (ABMA):
      a. 9, Load Ratings and Fatigue Life for Ball Bearings.
      b. 11, Load Ratings and Fatigue Life for Roller Bearings.
   2. American Gear Manufacturers Association (AGMA):
      a. 2000, Gear Classification and Inspection Handbook Tolerances and Measuring Methods for Unassembled Spur and Helical Gears.
      b. 6034, Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors.
      c. 9005, Industrial Gear Lubrication.
   3. American Society for Testing Materials (ASTM):
      a. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
      b. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
      c. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
      d. A269/A269M, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
      e. A276/A276M, Standard Specification for Stainless Steel Bars and Shapes.
      f. A380/A380M, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
      g. C582, Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.

h. D3917, Standard Specification for Dimensional Tolerance of Thermosetting Glass-Reinforced Plastic Pultruded Shapes.

4. American Welding Society (AWS):
   a. B2.1/B2.1M, Standard for Welding Procedure and Performance Qualification.
   b. D1.1/D1.1M, Structural Welding Code – Steel.
   c. D1.2/D1.2M, Structural Welding Code – Aluminum.
   d. D1.3/D1.3M, Structural Welding Code – Sheet Steel.
   e. D1.6/D1.6M, Structural Welding Code – Stainless Steel.
   f. QC1, Standard for AWS Certification of Welding Inspectors.
5. American Water Works Association (AWWA):
   a. C207, Steel Pipe Flanges for Waterworks Services, Sizes 4 Inches Through 144 Inches.
6. Canadian Electrical Code (CEC).
7. National Electrical Manufacturer's Association (NEMA): MG 1, Motors and Generators.
8. 2010 National Building Code of Canada (NBC) with 2011 Manitoba Amendments.
9. Occupational Health and Safety Act (OHSA).

1.2 DEFINITIONS

A. Screenings: Debris typically removed from municipal raw wastewater by fine screening process, including but not limited to, rags, stringy material, fibrous material, pieces of wood, metal objects, garbage, paper, rocks, sand, grit, glass, plastics, coarse waste solids, organic waste solids, oils, fats, and grease.

1.3 SUBMITTALS

A. Furnish submittals in accordance with requirements of Section 01 33 00, Submittal Procedures.

B. Action Submittals:
   1. Shop Drawings:
      a. Manufacturer’s catalog information, descriptive literature, specifications, and identification of materials for construction.
      b. Detailed general arrangement drawings including dimensioned plans and sections, equipment fabrication details, material thicknesses, structural member sizes, connections to other work, equipment weights, loads on supporting structures, and details of anchorages and connections.
      c. Details of motors and gear reducers.
      d. Complete motor nameplate data as defined by NEMA, motor manufacturer, and any motor modifications. See Section 26 20 00, Low-Voltage AC Induction Motors, for submittal requirements.
      e. Detailed functional description or control narrative of internal and external instrumentation and controls including list of parameters monitored, controlled, or alarmed, sequence of operation, operator adjustable settings, interlocks (both software and hard-wired), and fault responses.
      f. All applicable submittals in Section 40 99 90, Package Control Systems.
      g. Shop painting systems, including manufacturer’s descriptive technical catalog literature and specifications.
      h. External utility requirements for air, water, power, drain, etc., for each component.

i. Submit written certification from Professional Engineer licensed in Province of Manitoba stating that support systems, anchorage, and equipment have been designed for post-disaster structures according to requirements of NBC with Manitoba Amendments, at time of Shop Drawing submittals.

C. Informational Submittals:
1. Written factory test report of inspection.
2. Manufacturer's Certificate of Compliance for factory-applied coating system.
3. Special shipping, storage and protection, and handling instructions.
4. Manufacturer's installation instructions.
5. Routine maintenance requirements prior to plant startup.
6. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Contractor Field Services.
7. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
8. Field functional test reports.

1.4 MANUFACTURER'S WARRANTY

A. The equipment shall be warrantied to be free from defects in workmanship, design, and material for a period of one year from the date of Substantial Performance. Any defects discovered during the warranty period shall be replaced or repaired at no cost to the City. Duties and obligations for correction or removal and replacement of defective work shall be as specified in General Conditions.

1.5 SPECIAL GUARANTEE

A. Provide manufacturer's extended guarantee or warranty in writing, with the City named as beneficiary, as special guarantee. Special guarantee shall provide for correction, or at option of the City, removal and replacement of Work specified in this Specification section found defective during period of 5 years after date of Substantial Performance. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in General Conditions.

1.6 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts and special tools:

Item	Quantity
Perforated screen panels	Two per screen
Screen panel mounting bolts	Two sets per screen
Screen panel side seals	One complete set
Rebuild kit for rotating brush	One
Screen shaft end bearings	Two complete sets
Washer/compactor guide bars	One complete set
Washer/compactor cleaning brush	One

Item	Quantity
Solenoid valves	One of each different size/configuration
Special tools required to maintain or dismantle equipment	One complete set

B. Delivery: In accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Equipment and accessories specified in this section shall be products of:
   1. Huber Technology, Inc.
   2. Veolia/John Meunier.
   3. Enviro-Care/FSM.

B. No “or-equal” or substitute products will be considered.

C. Equipment specified herein shall be end product of one responsible system manufacturer. Manufacturer shall select all components of system to ensure compatibility, ease of installation, and efficient operation and maintenance. Manufacturer shall coordinate selection and design of all system components such that all equipment furnished, including equipment specified elsewhere but referenced in this specification section, is compatible and operates properly to achieve performance requirements specified. Sales agents, representatives, or distributors that are not a direct component of manufacturer will not be acceptable as substitute for manufacturer in meeting this requirement. This requirement for unit responsibility shall in no way relieve Contractor of responsibility to the City for performance of system.

D. Design shown on Drawings depicts intended configuration and layout of screening equipment and may not be representative of actual equipment provided, nor is it intended to show all details of equipment supply and installation. Contractor is responsible for implementing and coordinating all changes to design shown on Drawings to accommodate equipment provided including, but not limited to, layout changes and interface connections to other work and equipment which are different from that shown on Drawings.

2.2 SYSTEM DESCRIPTION

A. In general, screening system shall consist of four (4) perforated plate screens, screenings sluice, two (2) screenings washer/compactors, custom control panels, and all appurtenances necessary for complete operating system. Screens shall capture and separate screenings from wastewater flow, and elevate and discharge screenings to screenings sluice. Screenings sluice shall transport screenings to washer compactors using grit tanks effluent water. Screenings washer/compactors shall compact, wash, and dewater screenings and discharge compacted and dewatered screenings to storage bins.

B. Each screen shall generally consist of structural frame, travelling perforated filter panels, rotating cleaning brush, wash water system, covers, sprockets, shafts, bearings, drive motors, gear reducers, drive chain, and other components.

C. Screenings sluice shall generally consist of sluice trough, covers, supports, and diversion tee with automated knife gate valves.

D. Each screenings washer/compactor shall generally consist of inlet hopper, covers, rotating compactor screw(s), screw housing, drain trough, discharge tube, wash water system, drive motor, gear reducer, and other components.

2.3 CONDITIONS OF SERVICE

A. Material Handled: Municipal raw wastewater and screenings.

B. Operating Environment:
   1. Equipment Location: Indoors.
   2. Exposure: Variable concentrations of hydrogen sulfide, methane, hydrocarbons, and other compounds typically found in municipal wastewater.
   3. Ambient Air Temperature: 5 to 40 degrees C.
   4. Relative Humidity: Up to 100 percent.
   5. Electrical Hazardous Area Classification: As shown on Drawings.

C. Available Wash Water Supply Pressure: 480-620 kPag.

2.4 DESIGN REQUIREMENTS

A. General:
   1. Construction Sequencing and Installation Coordination:
      a. Screening equipment will be installed in existing operating headworks facility with limited headroom and limited access openings for maneuvering equipment into building.
      b. Contractor, assisted by screening equipment manufacturer’s representative, shall field verify location, dimensions, concrete surface tolerances, and other relevant aspects of existing facilities in which screening equipment will be installed, prior to preparation of Shop Drawings and fabrication of equipment, to ensure that equipment is suitable for conditions existing at Site.
      c. Each screen shall be fabricated and delivered to Site in two or more major assemblies that can be readily moved into building and assembled within existing screen channels.
      d. Existing screens shall be removed and replaced with new screens one at a time, and existing screens must remain in operation, or ready for operation, during installation of new screens and screenings sluice. New screens shall be commissioned in sequence as they are installed.
      e. Screenings sluice shall be fabricated and installed in sections to facilitate sequential commissioning of screens.
      f. Refer to Section 01 52 10, Construction Sequencing, for detailed construction sequence and constraints.

2. Equipment shall be designed to permit easy disassembly and reassembly of any pieces which must be removed to service the system. Such disassembly and reassembly shall not require any special tools.
3. All materials of construction shall be suitable for continuous operation in contact with corrosive and abrasive wastewater and screenings, as well as corrosive gases associated with septic raw sewage.
4. Provide abrasion-resistant components and linings in high wear areas and moving parts.
5. Where stainless steel is provided, grade shall be Type 316L unless otherwise specified. Anchors and fasteners shall be Type 316 stainless steel.
6. All equipment supplied shall fit within general overall dimensions shown on Drawings.
7. Design of screens shall ensure that repair or replacement of damaged or worn parts, including screen panels, drive chain, drive mechanism, and rotating brush, can be carried out with screen installed in channel, and that all routine maintenance can be carried out from the operating floor level.
8. Design shown on Drawings is based on 400 mm wide screenings sluice trough. Manufacturer is responsible for determining final width of trough as required to satisfy manufacturer's specific equipment requirements and the specified design and performance requirements. Manufacturer shall coordinate with Contractor regarding any required changes to design shown on Drawings due to a different trough width including, but not limited to, screens service platform, sluice water pumps (P-G221, P-G222), and sluice isolation valve (XV-G2301).

B. Perforated Plate Screens:
1. Perforation Size: 6 mm diameter.
2. Maximum Flow Rate per Screen: 140 ML/d with downstream liquid depth of 1750 mm.
3. Minimum Flow Rate per Screen: 20 ML/d with downstream liquid depth of 1000 mm.
4. Screen Inclination Angle: 60 to 65 degrees from horizontal.
5. Discharge Chute Outlet Height: ± 3500 mm above operating floor.
6. Discharge Chute Side Slope: Minimum 60 degrees from horizontal.
7. Screen Travel Speed: 3 to 5 m/min low speed, 6 to 9 m/min high speed.
8. Duty Cycle: Suitable for both intermittent and continuous operation.
9. Wash Water Requirement per Screen: 2.5 L/s maximum.
10. Wash Water Supply Temperature: 10 to 50 degrees C.
11. Screen Channel Dimensions:
    a. Channel Invert Elevation: ± 232.870 m.
    b. Operating Floor Elevation/Top of Channel: ± 235.915 m.
    c. Channel Depth: ± 3045 mm.
    d. Channel Width:
        1) Screens SCR-G211, SCR-G212, SCR-G213: ± 1830 mm.
        2) Screen SCR-G214: ± 1680 mm.
    e. Contractor to field verify all dimensions prior to fabrication.

C. Screenings Sluice:
1. Trough Width: 400 mm, or as otherwise recommended by manufacturer.
    1. Trough Depth: 600 mm.
    2. Trough Invert Elevation at Upstream End: 238.320 m (2440 mm above Screen Room operating floor).

3. Trough Invert Elevation at Downstream End (at connection to Washer/Compactor WCP-G232): 237.935 m (1100 mm above Grit and Screenings Platform operating floor).
4. Trough Slope: 1.0 percent.
5. Sluice Water Flow Rate: 18.9 L/s or as otherwise recommended by manufacturer.
6. Trough and supports shall be designed to be full of water up to top of trough.

7. Trough interior shall have polished smooth surface with no projecting fasteners, protrusions, or leading edges that could potentially catch screenings.

D. Screenings Washer/Compactors:
1. Continuous Wet Screenings Inlet Capacity (each): 8 m^3/hr minimum.
2. Screw Conveyor Diameter: 350 mm minimum.
3. Wash Water Requirement (each): 3.0 L/s maximum.
4. Sluice Water Capacity (each): Up to 18.9 L/s or as otherwise required by manufacturer.

2.5 PERFORMANCE REQUIREMENTS

A. Perforated Plate Screens:
1. Capable of automatically capturing, removing, and elevating screenings from raw wastewater flowing through concrete channels and automatically discharging screenings to screenings sluice.
2. Removal Efficiency: 100 percent of all screenings larger than 6 mm in size.
3. Maximum Head Loss:
   a. 270 mm at 105 ML/d per screen with flow passage area 40 percent blocked and downstream liquid depth of 1800 mm.
   b. 500 mm at 140 ML/d per screen with flow passage area 40 percent blocked and downstream liquid depth of 1500 mm.
4. Operation and normal cleaning of screens shall not be negatively impacted by presence of fats, oils, grease, or grit in wastewater.
5. Automatically and mechanically self-cleaning without requiring manual removal of screenings by plant operations personnel under normal operating conditions.

B. Screenings Sluice:
1. Capable of receiving wet screenings discharged from all four screens operating simultaneously at maximum capacity, and hydraulically transporting screenings to washer/compactors using carrier water (grit tanks effluent) without plugging or fouling.

C. Screenings Washer/Compactors:
1. Each capable of receiving wet screenings and carrier water from sluice with all four screens operating simultaneously at maximum capacity, washing, compacting, and dewatering screenings, separating carrier water, wash water, and drainage water from screenings by gravity, and discharging compacted and dewatered screenings to disposal bin.
2. Wet Screenings Capacity: Up to 8 m^3/hr.
3. Screenings Volume Reduction: 50 percent minimum.
4. Moisture Content of Discharged Screenings: 65 percent maximum (by weight).
5. Capable of processing normal amounts of grit, small rocks, and storm related debris discharged from screens without adverse impacts on operation or equipment life.

6. Operation and normal cleaning of washer/compactor shall not be negatively impacted by presence of fats, oils, or grease
7. Automatically and mechanically self-cleaning without requiring manual removal of wet or compacted screenings by plant operations personnel under normal operating conditions.

2.6 MATERIALS OF CONSTRUCTION

A. Materials specified are considered minimum acceptable for purposes of durability, strength, and resistance to erosion and corrosion. Manufacturer may propose alternative materials in accordance with B8 for purpose of providing greater strength or to meet required stress limitations. However, alternative materials must provide at least equivalent qualities to those specified.

B. Stainless Steel:
1. Plate, Sheets, and Strips: ASTM A240/A240M, Type 316L, 2D finish.
2. Bars and Shapes: ASTM A276/A276M, Type 316L.
3. Tubing: ASTM A269/A269M, Type 316.
4. Bolts: ASTM A193/A193M, Type 316.
5. Nuts: ASTM A194/A194M, Type 316.

C. All components fabricated from stainless steel shall be pickled and passivated in accordance with ASTM A380.

2.7 GENERAL COMPONENT REQUIREMENTS

A. Equipment Supports: Design equipment, anchorage, and support systems for vertical and lateral loading in accordance with NBC and Manitoba Amendments. Design shall be stamped and signed by Professional Engineer registered in province of Manitoba.

B. Service Factors: Service factors shall be applied in selection and design of components where so indicated. Where not indicated, minimum service factor shall be 1.25, except for gears and gear drives as specified herein.

C. Safety Devices: Provide all necessary permanent safety devices, such as machinery guards, emergency stops, and similar items required by OHSA and other federal, provincial, and local health and safety regulations.

D. Materials: All metallic items routinely wetted during operation shall be Type 316 stainless steel (Type 316L for all welded items) unless specified otherwise, and hardened as required to limit abrasive wear. Where this Section requires stainless steel, it shall be Type 316/316L, unless specified otherwise.

E. Welding:
1. Except where specified otherwise, welding shall comply with AWS D1.1, D1.2, D1.3, and D1.6, as applicable.
2. Welding shall be performed using process allowed by applicable AWS code for material being welded. Qualification of weld procedures, welders, and welding operators shall conform to AWS standards.

3. Composite fabricated steel assemblies which are to be erected or installed inside a hydraulic structure, including any fixed or movable structural components of mechanical equipment, shall have continuous seal welds and shall prevent entrance of air or moisture.
4. Welding shall be performed by a method as described in AWS “Welding Handbook”, as supplemented by other AWS standards.
5. During assembly and welding, component parts shall be clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall comply with AWS code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance with uniform weld contours and dimensions. Sharp corners of material which is to be painted or coated shall be ground to a minimum of 0.8 mm on the flat.
6. All welds on stainless steel shall be pickled and passivated in accordance with ASTM A380.

F. Bearings: Bearings shall conform to ABMA standards. Except where otherwise indicated, bearings for process equipment shall have minimum L-10 life expectancy of 100,000 hours.

G. Gears and Gear Drives:
1. Except where specified otherwise, gears shall be of helical or spiral-bevel type, designed and manufactured in accordance with AGMA standards, with anti-friction bearings, minimum service factor (thermal and mechanical) of 1.7, minimum L-10 bearing life of 100,000 hours, and minimum efficiency of 94 percent.
2. Gear reducers shall be designed for continuous 24-hour operation in accordance with AGMA recommendations for Class II service.
3. Gear reducers or increasers shall be enclosed type, oil- or grease-lubricated and fully sealed, with breather to allow air to escape but keep dust and dirt out. Casing shall be cast iron or heavy-duty steel construction with lifting lugs and inspection cover for each gear train. For oil-lubricated drives, provide oil level sight glass and oil flow indicator for easy reading.
4. Gears and gear drives as part of an equipment assembly shall be shipped fully assembled for field installation.
5. Material selections shall comply with AGMA values and manufacturer’s recommendations. Input and output shafts shall be properly designed for service and load requirements. Gears shall be computer-matched for minimum tolerance variation. Output shall have two positive seals to prevent oil leakage.
6. Oil level and drain locations shall be readily accessible. When oil drain is not at low point of gear box, provide suitable oil pump for draining and changing oil. Oil coolers or heat exchangers with all required appurtenances shall be included where indicated.
7. Where gear drive output shafts connect to couplings or sprockets, gear drive manufacturer shall supply matching key.
8. Each motor shall be sized based on requirements of driven load with consideration given to all drive train components. Comply with requirements of Section 26 20 00, Low-Voltage AC Induction Motors.
9. Motors shall be premium efficiency and sufficiently sized such that there will be no overload on motor above rated nameplate horsepower under any condition of operation. Torque and heat dissipation shall be sufficient for continuous operation.
10. Motors shall be capable of starting under full operational loading conditions.
11. Gear reducers shall be SEW Eurodrive or approved equal in accordance with B8.

2.8 PERFORATED PLATE SCREENS

A. Screen Frame and Supports:
   1. Screen frame shall be constructed from Type 316L stainless steel having minimum thickness of 5.0 mm.
   2. Frame shall be supported from operating floor level (top of channel). All anchors shall be minimum 19 mm diameter Type 316 stainless steel.
   3. Provide Type 316L stainless steel support system for screen frame. Screen shall be mounted at its base with supports anchored to top of concrete channel walls.
   4. Provide neoprene flaps to seal screen frame to channel walls, bolted to frame with Type 316 stainless steel fasteners.
   5. Provide frame with ports to access spray header for maintenance.

B. Screen Panels:
   1. Traveling screen panels shall be constructed from minimum 3 mm thick Type 316 stainless steel perforated plate with 6 mm diameter perforations and minimum perforation open area of 45 percent.
   2. Deflection of screen panels shall be limited to 3.0 mm under maximum differential head of 1.5 m.
   3. Provide screen side seals fabricated from polypropylene, polyethylene, or neoprene with Type 316L stainless steel side plates to prevent screenings from bypassing screen panels.
   4. Clearance between adjacent screen panels shall not exceed 2.0 mm at any point throughout their travel.
   5. Clearance between screen panels and side seals shall not exceed 3.0 mm.
   6. Provide intermittent screen panels with tines, ledges, lifters, or other means to lift and discharge larger solids.

C. Chains:
   1. Screen panels shall be fastened to two continuous chain loops, one on each side of screen.
   2. Chains shall be fabricated from Type 316 stainless steel of high tensile strength and resistance to corrosion. Chain pins shall be constructed of stainless steel and hardened to Rockwell 26 HRC.
   3. Chains shall be provided with chain guides securely fixed to the side members of screen frame for full length of travel. Location of chain guides shall minimize obstruction to flow.

D. Chain Sprockets and Shafts:
   1. Upper and lower chain sprockets shall be fabricated from Type 316 stainless steel or polyamide nylon.
   2. Upper chain sprockets shall be mounted on Type 316 stainless steel drive shaft, supported on each end by grease lubricated bearing with externally accessible grease fitting. Bearings shall incorporate a chain take-up assembly. Drive shaft shall be capable of withstanding 200 percent of normal input torque.
   3. Lower chain sprockets shall be mounted on Type 316 stainless steel stub shafts and designed to operate in submerged condition. Self-lubricating bearings shall be polyethylene with ceramic or hardened steel collar bonded to stub shaft and shall be maintenance-free. Grease lubricated bearings shall have grease line terminating at operating floor level with grease fitting.

4. Screen manufacturer shall select appropriate sprocket diameter, pitch, tooth width, and hub diameter to meet specified performance requirements.
5. Lower sprockets shall operate in recess of frame and shall not be directly exposed to incoming flow.

E. Cleaning Brush:
1. Screen panels shall be cleaned by a motorized rotating brush. Brush support assembly shall be self-adjusting to maintain constant pressure on screen panels.
2. Brush shall have minimum diameter of 450 mm and be driven by constant speed electric motor.

F. Wash Water System:
1. Provide spray wash manifold to backwash entire width of the screen panels following brush cleaning. Dislodged screenings and wash water shall be discharged to the screenings sluice.
2. Spray wash manifold shall be fabricated from Type 316 stainless steel with brass or stainless steel spray nozzles.
3. Spray nozzles shall be non-plugging and suitable for use with filtered plant effluent water having solids up to 150 microns in size.
4. Provide type V308 ball valve with NEMA 7 electric motor actuator, in accordance with Section 40 27 02, Process Valves and Operators, for each screen to control wash water supply to screen.

G. Screen Drive:
1. Inverter duty electric motor direct coupled to helical gear reducer, suitable for variable speed operation.
2. Refer to Motor Data Sheet at end of section for motor requirements.

H. Brush Drive:
1. Electric motor direct coupled to helical gear reducer.
2. Refer to Motor Data Sheet at end of section for motor requirements.

I. Screen Covers:
1. Provide easily removable covers on the front and back of each screen above the operating floor level.
2. Covers shall be fabricated from minimum 2 mm thick Type 316L stainless steel sheet, suitably stiffened and reinforced as required, and fastened to screen frame with stainless steel bolts.
3. At all locations where cover is bolted to screen frame, provide backing plates of minimum 10-gauge thickness to prevent distortion of cover at bolting location.
4. Provide hinged inspection door on front of each screen to provide quick access to screen panels. Inspection door shall be full width of screen and located 1000 mm above operating floor level. Access door shall have continuous piano hinge, handles, quick closing toggle clamps, and two gas cylinders to aid opening and closing.
5. Provide 100 mm diameter stainless steel flanged nozzle connection at top of screen for connection of odour control duct. Refer to Drawings for location.

J. Discharge Chute:
   1. Provide discharge chute to fully enclose discharge section of screen and to direct screenings and wash water into screenings sluice.
   2. Fabricated from minimum 3 mm thick Type 316L stainless steel sheet, suitably stiffened and reinforced as required. Inside surface of chute shall be highly polished.
   3. All interior surfaces of chute shall be vertical to extent possible. Sloped surfaces shall not be less than 60 degrees from horizontal. Chutes shall be same width as screen. Interior of chute shall have no projecting fasteners or other protrusions or leading edges that could potentially catch screenings.
   4. Provide removable access door on chute to provide complete access to cleaning brush and spray wash manifold. Access door shall be full width of screen and shall have handles and quick-closing toggle clamps.

K. Manufacturers and Products:
   1. Huber Technology, Inc.; EscaMax.
   2. Veolia/John Meunier; Escalator.
   3. Enviro-Care/FSM; Perforated Filter Screen.

2.9 SCREENINGS SLUICE

A. Trough:
   1. Trough shall be U-shaped and fabricated from minimum 3 mm thick Type 316L stainless steel.
   2. Interior of trough shall have no projecting fasteners or other protrusions or leading edges that could potentially catch screenings. All welds shall be ground smooth.
   3. Provide bends with mitered joints having deflection angle not exceeding 22.5 degrees.
   4. Provide tee or wye connection with two electric motor actuated knife gate valves for diverting screenings to either washer/compactor. Valve diameter shall match trough width. Provide smooth trough flow profile through valves to prevent catching and accumulation of screenings. Locate valves as close as possible to crotch of tee or wye to minimize dead zones in trough when either valve is closed.
   5. Knife Gate Valves:
      a. Type 316 stainless steel body, gate and stem, ASME Class 150 flanged ends, PTFE packing, EPDM or PTFE seats and seals.
      b. Manufacturer and Model: Trueline F8112, Dezurik KCB, Stafsjo XV, or approved equal in accordance with B8.
   6. Electric Motor Actuators:
      a. NEMA 7, suitable for 575/3/60 power supply, with open and closed limit switches, torque switches, valve position indicator, LOCAL/OFF/REMOTE and OPEN/STOP/CLOSE selector switches, PROFIBUS DP option card, contacts for remote indication of valve position and control mode, and manual override handwheel.
      b. Manufacturer and Model: Rotork IQ3 c/w PROFIBUS DP option card.
      c. Provide remote control station in accordance with Section 40 27 02, Process Valves and Operators, for each actuator.
   7. Where trough passes through fire-rated wall between existing Screen Room and new Grit and Screenings Platform, transition trough to Schedule 10 Type 316L stainless steel pipe as shown on Drawings. Pipe section shall be flanged at both ends to facilitate installation

through wall. Trough design shall accommodate installation of motorized gate valve at end of pipe section. Coordinate with General Contractor for dimensions and weight of valve. Design trough supports with adequate strength to support weight of valve.

8. For connection of trough to screen discharge chutes and washer/compactors, and for joining adjacent sections of trough, provide minimum 6.0 mm thick Type 316L stainless steel flanges with 3.0 mm thick premium grade neoprene gasket.
9. For connection of trough to valves, provide Type 316L stainless steel flanges having dimensions conforming to AWWA C207 Class D steel ring flanges with 3.0 mm thick premium grade neoprene gasket.
10. Provide top of trough with flanges for connection of covers.
11. Provide upstream end of trough with minimum 12 mm thick Type 316 stainless steel head plate equipped with 150 mm diameter flanged nozzle for connection of carrier water supply piping. Nozzle shall be located at trough centerline with invert of nozzle flush with invert of trough.
12. Provide 300 mm diameter flanged overflow nozzle at location shown on Drawings. Locate invert of overflow nozzle at EL 238.365 m.
13. Design and fabricate trough in multiple sections to facilitate shipping, installation, and commissioning. Sections shall be connected together with flanged, gasketed, and bolted joints. Design, fabrication, and installation of trough shall permit sequential startup of screens as described in Section 01 52 10, Construction Sequencing.

B. Trough Supports:
1. Provide all required supports for securely mounting and supporting trough. Supports shall prevent excessive movement or vibration of trough under all operating conditions.
2. Within Grit and Screenings Platform area, trough shall be supported from floor. Within existing Screen Room area, trough shall be supported from screens access platform, as generally shown on Drawings. Coordinate design of trough supports with design of access platform.
3. Supports shall be fabricated from minimum 6.0 mm thick Type 316L stainless steel structural shapes and plates.
4. Floor support base plates shall be fastened to floor with anchor bolts and shall allow for minimum 25 mm of grout under base plate for leveling.
5. Coordinate design and location of supports to avoid interference with other equipment, piping, electrical cable trays, and other items.

C. Trough Covers:
1. Provide covers over full length of trough for odour control.
2. Covers shall be fabricated from minimum 2.0 mm thick Type 316 stainless steel sheet.
3. Covers shall be easily removable and secured to trough by vertical-handle quick-release toggle clamps. Covers shall be installed in sections no greater than 1.5 m in length per section.
4. Provide 3.0 mm thick closed cell neoprene sponge gaskets between cover and trough flanges.

D. Trough Inlet Chutes:
1. Provide screenings inlet chutes between outlet of each screen discharge chute and top of trough. Chutes shall connect to outlet of screen and to top of trough with flanged and gasketed connections to prevent leakage and release of odours.

2. Chutes shall be fabricated from minimum 3 mm thick Type 316L stainless steel sheet, suitably stiffened and reinforced as required. Inside surface of chutes shall be highly polished.
3. All interior surfaces of chutes shall be vertical to extent possible. Sloped surfaces shall not be less than 60 degrees from horizontal. Length of chutes shall match width of screen discharge chute. Interior of chutes shall have no projecting fasteners or other protrusions or leading edges that could potentially catch screenings.
4. Provide hinged access door in each chute to provide access to screenings trough. Access door shall have continuous piano hinge, handle, and quick closing toggle clamps.

E. Manufacturers and Products:
1. Huber Technology, Inc.
2. Veolia/John Meunier.
3. Enviro-Care/FSM.

2.10 SCREENINGS WASHER/COMPACTORS

A. Screenings Inlet Hopper:
1. Provide inlet hopper to receive screenings and carrier water from sluice and to direct screenings into screw conveyor housing.
2. Fabricated from minimum 3 mm thick Type 316L stainless steel, suitably stiffened and reinforced as required. Inside surfaces of hopper shall be highly polished.
3. Inlet hopper shall be flanged, gasketed, and bolted to top of screw conveyor housing to provide watertight connection.
4. Provide flanged, gasketed, and bolted connection on side of hopper for attachment of screenings sluice. Coordinate location of connection with slope and elevation of sluice.
5. Provide 300 mm diameter flanged overflow connection on opposite side of hopper as shown on Drawings. Locate invert of overflow at EL 238.190 m.
6. Interior of hopper shall have no projecting fasteners or other protrusions or leading edges that could potentially catch screenings.
7. Provide removable odour containment cover on top of hopper including hinged inspection door with continuous piano hinge, handle, and quick-closing toggle clamps.

B. Screw Conveyor Housing:
1. Fabricated from Type 316L stainless steel, with flanged opening for connection of inlet hopper and support legs suitable for mounting on concrete pads as shown on Drawings.
2. Washing and compaction zones fabricated from perforated plate to drain water and organic material from screenings.
3. Equipped with wash water system to remove organic material from screenings, and drain pan to collect and discharge screenings filtrate water, wash water, and sluice carrier water. Drain pan shall be easily removable for inspection and cleaning.
4. Equipped with replaceable hardened alloy steel guide bars to support auger and prevent rotation of screenings within housing.

C. Auger(s):
1. Designed to transport screenings from washing zone into compaction zone and to force compacted and dewatered screenings through discharge tube.
2. Provide single or dual auger unit as recommended by manufacturer to meet specified design wet screenings capacity.

3. Shafted screw fabricated from hardened alloy steel, or Type 316L stainless steel with hardened steel edges in compaction zone.
4. Equipped with rotating nylon brush to maintain drainage perforations free of debris.

D. Wash Water System:
1. Provide wash water manifold to wash organic material from the screenings and flush debris from the drain pan of the screw conveyor housing.
2. Fabricated from Type 316L stainless steel pipe and fittings.
3. Provide all required solenoid valves and controls for automatic operation of the wash water system.

E. Discharge Tube:
1. Designed to transport washed, dewatered, and compacted screenings from compaction zone to discharge chute without plugging.
2. Fabricated from Type 316L stainless steel, tapered for ease of solids transport.
3. Connected to outlet of screw conveyor housing with long radius bend fitting, and angled upward to connection point on discharge chute.

F. Drive:
1. Gear motor, or close-coupled motor and speed reducer, directly connected to washer/compactor drive shaft.
2. Refer to Motor Data Sheet at end of section for motor requirements.

G. Discharge Chute:
1. Provide discharge chute for each washer/compactor to receive and discharge compacted screenings to disposal bin as generally shown on Drawings.
2. Fabricated from Type 316L stainless steel, suitably reinforced and stiffened as required, and supported from floor above bin.
3. Adequately sized to prevent bridging or jamming of screenings within chute.
4. Provide removable cover on top of chute including hinged inspection door with continuous piano hinge, handle, and quick-closing toggle clamps.

H. Manufacturers and Products:
1. Huber Technology, Inc.; Rotamat WAP.
2. Veolia/John Meunier; Rotopac Type RCW Combiwash.
3. Enviro-Care/FSM; Screw Wash Press Model SPW.

2.11 ELECTRICAL COMPONENTS AND ACCESSORIES

A. General: Provide all necessary electrical components and wiring for a complete, functional system. Electrical components shall be provided in accordance with requirements of Division 26, Electrical. All electrical components shall be suitable for hazardous area classification, as shown on Drawings, within which component will be located.

B. Wiring: All wiring shall meet requirements of Section 26 05 21, Wires and Cables (0-1000V) - Electrical, and CEC. All insulation shall be rated 600V, minimum. Twisted shielded pair cable shall be used for all low-voltage (24V dc) signals.

C. Electrical Raceways: All electrical wiring shall be installed in conduit meeting requirements of Section 26 05 34, Conduits, Conduit Fasteners, and Conduit Fittings. All raceways shall be installed in accordance with Section 26 05 34, Conduits, Conduit Fasteners, and Conduit Fittings, and CEC.

D. Motors: Provide squirrel-cage AC induction motors meeting requirements of Section 26 20 00, Low-Voltage AC Induction Motors, and as specified herein.

E. Electrical Responsibilities: Manufacturer/supplier shall be responsible for all electrical conduits, wiring, and electrical appurtenances located on equipment, including terminal junction boxes for power and control circuits.

F. Variable Frequency Drives: In accordance with Section 26 29 23, Variable Frequency Drives, supplied by equipment manufacturer and factory installed, connected, configured, and tested inside package control panels.

2.12 INSTRUMENTATION AND CONTROLS

A. General:
1. Provide all controls and control panels in accordance with requirements of Section 40 99 90, Package Control Systems.
2. Provide complete and functional system, including interfaces with plant Process Control System (PCS).
3. Provide variable frequency drives and full-voltage starters in package control panels for package system components. Motor starters shall be equipped with electronic overloads in all three phases. Overloads shall be resettable without opening panel.
4. Segregate analog wiring in dedicated raceways.
5. Control components shall operate on 120Vac or 24Vdc power.
6. Provide all instrumentation in accordance with Section 40 99 90, Package Control Systems, unless specified otherwise. Provide industrial grade instruments suitable for intended service and environment.
7. Instrumentation and controls specified herein are minimum requirements. Equipment manufacturer shall provide additional components and features necessary to achieve intended function and provide safe and reliable operation of equipment supplied.

B. Control Panels:

Panel No.	**Name**	**NEMA 250 Rating**	**Enclosure Material**	**Mounting**
CP-G211	Mechanical Screen SCR-G211 Main Control Panel	12	Steel	Wall
CP-G212	Mechanical Screen SCR-G212 Main Control Panel	12	Steel	Wall

Panel No.	Name	NEMA 250 Rating	Enclosure Material	Mounting
CP-G213	Mechanical Screen SCR-G213 Main Control Panel	12	Steel	Wall
CP-G214	Mechanical Screen SCR-G214 Main Control Panel	12	Steel	Wall
LCP-G211	Mechanical Screen SCR-G211 Local Control Panel	7	Cast aluminum	Stanchion
LCP-G212	Mechanical Screen SCR-G212 Local Control Panel	7	Cast aluminum	Stanchion
LCP-G213	Mechanical Screen SCR-G213 Local Control Panel	7	Cast aluminum	Stanchion
LCP-G214	Mechanical Screen SCR-G214 Local Control Panel	7	Cast aluminum	Stanchion
CP-G231	Screenings Washer/Compactor WCP-G231 Main Control Panel	12	Steel	Wall
CP-G232	Screenings Washer/Compactor WCP-G232 Main Control Panel	12	Steel	Wall
LCP-G231	Screenings Washer/Compactor WCP-G231 Local Control Panel	4X	Type 316 stainless steel	Stanchion
LCP-G232	Screenings Washer/Compactor WCP-G232 Local Control Panel	4X	Type 316 stainless steel	Stanchion

1. Screens Main Control Panels (CP):
   a. Main disconnect switch for 600V power supply, with lockable handle and interlocked with panel door.
   b. Control power transformer.
   c. Variable frequency drive for screen motor.
   d. Full-voltage magnetic motor starter for brush motor.
   e. Overload and over-current protection for screen and brush drives.

f. Programmable logic controller (PLC) for all screen functions.
g. Power Supply to Panels: Single 600V, 3-phase, 60 Hz supply to each panel. Power supply to all motors and instruments shall be obtained from associated panel.
h. Operator Controls and Indicators:
   1) Operator interface terminal (OIT).
   2) LOCAL/OFF/REMOTE selector switch.
   3) System RESET pushbutton.
   4) REMOTE Mode indicating light.
   5) Screen ON indicating light.
   6) System FAULT indicating light.
   7) Channel Level HIGH indicating light.
   8) Channel Level Differential HIGH indicating light.
i. External Interfaces:
   1) Provide all required inputs and outputs for interfacing with associated LCP, screen motors, and instruments.
   2) Provide all required inputs and outputs for interfacing with washer/compactors control panels.
   3) Plant PCS Interface:
      a) Provide clearly labeled terminals for interface to plant PCS, including but not limited to:
         (1) Dry contact, rated 5A at 120 VAC, for plant PCS discrete input signals:
            (a) “Remote Mode” (CP in REMOTE mode and LCP in REMOTE mode).
            (b) “Screen Running”.
            (c) “System Ready”.
            (d) “System Fault”.
            (e) “Hot Wash Running".
         (2) 24 VDC relay coil for plant PCS discrete output signals:
            (a) “Run Enable” command.
            (b) “Hot Wash Start” command.
      b) Provide Modbus TCP interface to plant PCS for monitoring all statuses, set-points, and alarms, including but not limited to:
         (1) Screen drive VFD speed and status.
         (2) Brush drive motor status.
         (3) Wash water valve status.
         (4) Screen channel downstream level.
         (5) Screen channel upstream level.
         (6) Screen channel differential level.
         (7) Screen channel high upstream level status.
         (8) Screen channel high differential level set-point.
         (9) Screen channel low differential level set-point.
         (10) Screen repeat cycle time set-point.
         (11) Screen run time set-point.
         (12) Hot wash run time set-point.
j. Functional Requirements:
   1) When LOCAL/OFF/REMOTE selector switch at CP is in LOCAL position (and LOCAL/REMOTE selector switch at LCP is in REMOTE position),

screen and brush drives shall run and wash water valve shall open. In REMOTE position, screen shall be automatically controlled by CP as follows:

a) Plant PCS will determine number of duty screens required to be in service at any given time depending on plant influent flow rate and will issue "Run Enable" command to each duty screen. Screens shall not operate unless "Run Enable" command is received from plant PCS (except as otherwise indicated below).
b) Each duty screen shall start upon high differential level (operator adjustable), high upstream level, or expiration of repeat cycle time (operator adjustable), whichever occurs first.
c) High upstream level shall override "Run Enable" command from plant PCS and start screen immediately.
d) Operating speed of screen shall be adjusted automatically based on level differential and upstream level.
e) Each duty screen shall stop upon low differential level (operator adjustable) and absence of high upstream level, or expiration of run time (operator adjustable) if operation was started by repeat cycle timer.
f) If screen is running when "Run Enable" command is removed by PCS, screen shall continue to run until stopped by one of above normal stopping conditions.
g) Upon receipt of "Hot Wash Start" command from plant PCS:
    (1) Plant PCS will control supply of hot water to screen during hot wash.
    (2) If screen is not running, screen shall start and run for hot wash run time (operator adjustable).
    (3) If screen is running, screen shall continue to run until expiration of hot wash run time.
    (4) Normal conditions for stopping screen shall be overridden while hot wash is in progress.
    (5) Provide "Hot Wash Running" indication to plant PCS while hot wash is in progress.
    (6) Hot wash run time shall allow for up to two complete revolutions of screening elements at low speed.
    (7) If hot wash is in progress when "Run Enable" command is removed by PCS, screen shall continue to run until hot wash is complete.

2) "System Ready" indication shall signify screen is ready for normal operation and shall include following conditions:
    a) LOCAL/REMOTE selector switch at LCP is in REMOTE position.
    b) LOCAL/OFF/REMOTE selector switch at CP is in REMOTE position.
    c) Absence of any "System Fault" condition.
3) Upon overload of screen or brush motor, system shall stop and alarm shall be activated at CP, in both manual and automatic operating modes.
4) Upon over-current (jamming) of screen drive, system shall stop and alarm shall be activated at CP, in both manual and automatic operating modes. Provide timers and relays to override over-current protection during motor starting.
5) In event of "System Fault" (any abnormal condition that stops operation of screen), operation of system shall be disabled until cause of fault is corrected and system RESET pushbutton at CP is pressed.

6) In event of power supply failure while system is operating, system shall automatically resume operation upon restoration of power supply. In event of power supply failure during system fault, system shall remain in fault condition upon restoration of power supply.

2. Screens Local Control Panels (LCP):
   a. Operator Controls and Indicators:
      1) LOCAL/REMOTE selector switch.
      2) Screen ON/OFF selector switch.
      3) Brush ON/OFF selector switch.
      4) Wash Water ON/OFF selector switch.
      5) EMERGENCY STOP pushbutton.
   b. External Interfaces: Provide all required inputs and outputs for interfacing with associated CP.
   c. Functional Requirements:
      1) When LOCAL/REMOTE selector switch is in LOCAL position, screen drive, brush drive, and wash water valve shall be manually controlled by associated ON/OFF selector switch (LOCAL mode is intended for maintenance and testing purposes only). In REMOTE position, screen drive, brush drive, and wash water valve shall be controlled by associated CP.
      2) When EMERGENCY STOP pushbutton is pressed, screen and brush drives shall stop and wash water valve shall close, in both LOCAL and REMOTE positions. Operation of screen shall be disabled until system RESET pushbutton at associated CP is pressed.
3. Screenings Washer/Compactors Main Control Panels (CP):
   a. Main disconnect switch for 600V power supply, with lockable handle and interlocked with panel door.
   b. Control power transformer.
   c. Full-voltage reversing magnetic motor starter with overload and over-current protection.
   d. Programmable logic controller (PLC) for all washer/compactor functions.
   e. Power Supply to Panels: Single 600V, 3-phase, 60 Hz supply to each panel. Power supply to all motors and instruments shall be obtained from associated panel.
   f. Operator Controls and Indicators:
      1) Operator interface terminal (OIT).
      2) LOCAL/OFF/REMOTE selector switch.
      3) System RESET pushbutton.
      4) REMOTE Mode indicating light.
      5) Washer/Compactor ON indicating light.
      6) System FAULT indicating light.
      7) Inlet Hopper Level HIGH indicating light.
      8) Inlet Hopper Level HIGH-HIGH indicating light.
   g. External Interfaces:
      1) Provide all required inputs and outputs for interfacing with associated LCP, washer/compactor motors and instruments.
      2) Provide all required inputs and outputs for interfacing with screens control panels.

3) Plant PCS Interface:
   a) Provide clearly labeled terminals for interface to plant PCS, including but not limited to:
      (1) Dry contact, rated 5A at 120 VAC, for plant PCS discrete input signals:
         (a) “Remote Mode” (CP in REMOTE mode and LCP in REMOTE mode).
         (b) “Washer/Compactor Running”.
         (c) “System Ready”.
         (d) “System Fault”.
         (e) “Inlet Hopper Level High-High”.
      (2) 24 VDC relay coil for plant PCS discrete output signals:
         (a) “Run Enable” command.
   b) Provide Modbus TCP interface to plant PCS for monitoring all statuses, set-points, and alarms, including but not limited to:
      (1) Drive motor status.
      (2) Wash water valve status.
      (3) Inlet hopper high level status.
      (4) Inlet hopper high-high level alarm.
      (5) Automatic clearing sequence mode.
      (6) Washer/compactor run time set-point.
      (7) Screens accumulated run time set-point.

h. Functional Requirements:
   1) When LOCAL/OFF/REMOTE selector switch at CP is in LOCAL position (and LOCAL/REMOTE selector switch at LCP is in REMOTE position), washer/compactor shall run and wash water valves shall open. In REMOTE position, washer/compactor shall be automatically controlled by CP as follows:
      a) Plant PCS will determine number of duty washer/compactors required to be in operation at any given time and will issue “Run Enable” command to each duty washer/compactor. Washer/compactor shall not operate unless “Run Enable” command is received from plant PCS (except as otherwise indicated below).
      b) Each duty washer/compactor shall start upon accumulated run time of duty screens (operator adjustable) or high water level in screenings inlet hopper, whichever occurs first, or other suitable criteria as recommended by screening equipment vendor.
      c) Washer/compactor CPs shall communicate as required with screen CPs to obtain screens operating data and parameters required by vendor for controlling operation of washer/compactors.
      d) High-high water level in hopper shall override “Run Enable” command and start washer/compactor immediately.
      e) Provide logic, counters, and timers (all operator adjustable) to sequence forward/reverse operation of auger and open/close operation of wash water valves to optimize washing, compaction, and dewatering of screenings.
      f) Each duty washer/compactor shall stop upon expiration of run time (operator adjustable) or other suitable criteria as recommended by screening equipment vendor.

g) If washer/compactor is running when “Run Enable” command is removed by PCS, washer/compactor shall continue to run until stopped by one of above normal stopping conditions.
h) Provide current monitor to detect high load condition and initiate automatic clearing sequence utilizing repeated forward/reverse cycles. If high load condition is cleared, system shall return to normal operation. If high load condition remains following allowable number of forward/reverse cycles (operator adjustable), system shall stop and alarm shall be activated at CP.

2) “System Ready” indication shall signify washer/compactor is ready for normal operation and shall include following conditions:
a) LOCAL/REMOTE selector switch at LCP is in REMOTE position.
b) LOCAL/OFF/REMOTE selector switch at CP is in REMOTE position.
c) Absence of any “System Fault” condition.

3) Upon overload of auger drive, system shall stop and alarm shall be activated at CP, in both manual and automatic operating modes.

4) Upon over-current (jamming) of auger drive, system shall stop and alarm shall be activated at CP, in both manual and automatic operating modes. Provide timers and relays to override over-current protection during motor starting.

5) In event of “System Fault” (any abnormal condition that stops operation of washer/compactor), operation of system shall be disabled until cause of fault is corrected and RESET pushbutton at CP is pressed.

6) In event of power supply failure while system is operating, system shall automatically resume operation upon restoration of power supply. In event of power supply failure during system fault, system shall remain in fault condition upon restoration of power supply.

4. Washer/Compactors Local Control Panels (LCP):
a. Operator Controls and Indicators:
1) LOCAL/REMOTE selector switch.
2) Auger FWD/OFF/REV selector switch.
3) Wash Water ON/OFF selector switch(es).
4) EMERGENCY STOP pushbutton.
b. External Interfaces: Provide all required inputs and outputs for interfacing with associated CP.
c. Functional Requirements:
1) When LOCAL/REMOTE selector switch is in LOCAL position, auger drive and wash water valves shall be manually controlled by associated ON/OFF selector switch (LOCAL mode is intended for maintenance and testing purposes only). In REMOTE position, auger drive and wash water valves shall be controlled by associated CP.
2) When EMERGENCY STOP pushbutton is pressed, auger drive shall stop and wash water valves shall close, in both LOCAL and REMOTE positions. Operation of washer/compactor shall be disabled until system RESET pushbutton at associated CP is depressed.

C. Instrumentation:
   1. Screens Differential Level Sensors:
      a. Provide ultrasonic type level sensing system for each screen to measure water level differential across screen.
      b. Transducers:
         1) Provide separate level transducers for continuously monitoring upstream and downstream levels.
         2) Suitable for Class I, Zone 1, Group IIA hazardous area.
         3) Provide mounting brackets and instructions for transducer mounting.
         4) Provide NEMA 7 junction box mounted on screen for termination of transducer cable.
      c. Transmitter:
         1) Shipped loose to be field mounted on Electrical Room wall.
         2) Provide power for transmitter from terminals within CP (24 VDC or 120 VAC).
         3) Utilize 4-20 mA analog output(s) as required for control of system within CP.
         4) Provide PROFIBUS DP communication module for connection to Plant PCS.
      d. Manufacturer and Product:
         1) Siemens/Miltronics; Multiranger 100 with Echomax XPS-15 transducers.
         2) No alternatives will be allowed as the City has standardized on these transmitters.
   2. Screens High Level Switches:
      a. Provide float type level switch for each screen to detect high water level upstream of screen.
      b. Set switch to activate at EL 234.77 m (1.9 m above channel invert).
      c. Suitable for Class I, Zone 1, Group IIA hazardous area.
      d. Provide NEMA 7 junction box mounted on screen for termination of level switch cable.
      e. Provide Intrinsically Safe Barrier within CP for level switch. Clearly label intrinsically safe wiring within CP.
      f. Manufacturer and Product:
         1) Flygt; ENM-10.
         2) Or approved equal in accordance with B8.
   3. Screenings Sluice High Level Switch:
      a. Provide float type level switch located near overflow nozzle to detect high water level in sluice.
      b. Set switch to activate at EL 238.365 m.
      c. Suitable for Class I, Zone 1, Group IIA hazardous area.
      d. Provide NEMA 7 junction box mounted next to level switch for termination of level switch cable.
      e. Manufacturer and Product:
         1) Flygt; ENM-10.
         2) Or approved equal in accordance with B8.
   4. Screenings Washer/Compactors High Level Switches:
      a. Provide level switches for each washer/compactor to detect HIGH and HIGH-HIGH water levels in inlet hopper.
      b. Type of switch as recommended by manufacturer for the application.
      c. Suitable for Class I, Zone 1, Group IIA hazardous area.
      d. Set HIGH level switch to activate at EL 237.935 m.

e. Set HIGH-HIGH level switch to activate at EL 238.190 m.
f. Provide junction box mounted near washer/compactor for termination of level switch cable.

2.13 ACCESSORIES

A. Furnish lifting lugs for equipment assemblies and components weighing over 45 kg.

B. Equipment Identification Plates: In accordance with Section 40 05 53, Identification Labels for Equipment, Fabricated Tanks, Valves and Piping Systems.

C. Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer, and as specified in Section 05 50 00, Metal Fabrications (Basic).

D. Lubrication Points: All lubrication points shall be piped to easily accessible location and must be clearly labeled.

2.14 FABRICATION

A. Equipment shall be fabricated and factory-assembled to the extent possible and shipped in maximum permissible sizes with respect to installation constraints and construction sequencing. Fabrication shall include shop drilling and reaming of all field-assembled connections and fabrication of all support frames. Exposed surfaces shall have smooth finish and sharp, well-defined lines.

B. Support frames shall be fabricated to withstand equipment and material loads. Frame sections shall be assembled in maximum lengths for shipment. Frame sections shall be drilled for easy field assembly and erection. Support frames shall be fabricated to be installed on concrete floor or where indicated on the structural steel.

C. Welded Construction: In accordance with Section 05 05 23, Welding-Quality Assurance. Comply with AWS D1.1 for procedures, appearance, and quality of welds, and methods used in correcting welding.

2.15 FINISHES

A. Prepare, prime, and finish coat ferrous metal surfaces in accordance with Section 09 90 00, Painting and Coating.

B. Stainless steel shall be cleaned and passivated following fabrication in accordance with ASTM A380.

2.16 SOURCE QUALITY CONTROL

A. Factory Inspections: Inspect control panels for required construction, electrical connection, and intended function.

B. Factory Tests and Adjustments:
   1. Test each screen assembly, in its operating position, to ensure meshing of rake and bar rack, and operation of protective devices and override controls.
   2. Run equipment and test for minimum of 6 hours. Testing shall be done in factory with unit oriented in its installed position.

C. All structural stainless steel components shall be fabricated in the United States and shall conform to the requirements of "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" published by the American Institute of Steel Construction.

D. Fabricate all parts and assemblies from sheets and plates of AISI Type 304L stainless steel conforming to AISI 304L and ASTM A666, unless noted otherwise. Fabricate all rolled or extruded shapes to conform to ASTM A276. Fabricate all tubular products and fittings to conform to ASTM A269, A351 and A403.

E. All welding in the factory shall use shielded arc, inert gas, MIG or TIG method. Add filler wire to all welds to provide for a cross-section equal to or greater than the parent metal. Fully penetrate butt welds to the interior surface and provide gas shielding to interior and exterior of the joint.

F. Field welding of stainless steel will not be permitted.

G. Bolts, nuts and washers shall be AISI 304L stainless steel furnished in accordance with ASTM A193.

H. All surfaces that are specified to be machined shall be designed and fabricated to provide a runout of not more than 0.005-inch and a concentricity to within 0.005 inch.

I. All major system components shall be factory tested for compliance with the requirements herein, and a certification of the results of these tests shall be submitted to the City.

J. Balancing: Rotating elements of equipment, except small, commercially packaged equipment, shall be statically and dynamically balanced at the factory prior to final assembly. The supplier shall furnish certified copies of all test results.

K. Witnesses: Contract Administrator reserves the right to witness factory tests.

PART 3 EXECUTION

3.1 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. In accordance with Section 01 61 00, Common Product Requirements.

3.2 INSTALLATION

A. In accordance with manufacturer’s written instructions.

B. Anchor Bolts: Accurately place using templates provided by manufacturer and as specified in Section 05 50 00, Metal Fabrications (Basic).

C. Construction Sequencing and Work Restrictions: Special work restrictions and sequencing of construction apply to installation and startup of the screening equipment. Refer to Section 01 52 10, Construction Sequencing, for details. This will require multiple trips to the Site beyond what is normally required.

3.3 FIELD FINISHING

A. Touchup damaged areas of painted ferrous metal in accordance with and as specified in Section 09 90 00, Painting and Coatings.

3.4 FIELD QUALITY CONTROL

A. Conduct testing as specified in Section 01 91 14, Equipment Testing and Facility Startup.

B. Functional Tests:
1. Conduct on each screen, washer/compactor, and screenings sluice.
2. Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.
3. Verify that all internal and external system protective functions are operational.
4. Review and verify that the specified control strategies as implemented in the plant control system, to ensure proper protection and operation of all components, systems, interlocks, etc. Written acceptance of controls implementation by the manufacturer shall be submitted prior to startup.
5. The equipment shall be installed and tested under the direction of factory employed service technician.
6. Manufacturer's recommendations for prestart preparation and preoperational checkout procedures.

C. Performance Tests:
1. Conduct on each screen, washer/compactor, and screenings sluice.
2. Perform under normal operating conditions.
3. Test for continuous 6-hour period without malfunction.
4. Demonstrate compliance with specified performance requirements. If equipment fails to meet performance requirements, modify equipment as required and repeat testing until compliance is demonstrated.
5. Use of plant instrumentation is allowed for tests. Provide additional instrumentation as required to obtain required test data.
6. Test Records and Report: Prepare and submit complete test report along with test records.

3.5 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at Site or classroom designated by the City for minimum person-days listed below, travel time excluded:
1. Ten person-days for installation assistance and inspection.
2. Five person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.

3. Four person-days for pre-startup classroom and field training.
4. Four person-days for facility startup.
5. Two person-days for post-startup training. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by the City and Contract Administrator.

B. See Section 01 43 33, Contractor Field Services and Section 01 91 14, Equipment Testing and Facility Startup.

3.6 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are part of this Specification:
1. Motor Data Sheets.

END OF SECTION

MOTOR DATA SHEET
MECHANICAL SCREENS SCR-G211/G212/G213/G214 – SCREEN DRIVE

Project: City of Winnipeg SEWPCC Upgrading/Expansion Project

Process/Facility: Screen Building

Service: Screening

Equipment Name: Mechanical Screens

Equipment Tag Number(s): SCR-G211, SCR-G212, SCR-G213, SCR-G214

Type: Squirrel-cage induction meeting requirements of NEMA MG 1.

Manufacturer: For multiple units of same type of equipment, furnish motors and accessories from single manufacturer.

Hazardous Location: ☒ Furnish motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark.

Motor Size (kW): TBD by mfr.	Guaranteed Minimum Efficiency at Full Load (%): Per CAN/CSA-C390 Table 3
Voltage: 575	Guaranteed Minimum Power Factor at Full Load (%): Mfr.'s std.
Phase: 3	Service Factor (at rated max. ambient temperature): ☐ 1.0 ☒ 1.15
Frequency (Hz): 60	Enclosure Type: TEXP
Synchronous Speed (rpm): TBD by mfr.	Mounting Type: ☒ Horizontal ☐ Vertical
☐ Constant Speed	Vertical Shaft: ☐ Solid ☐ Hollow
☐ Two-speed Speed (rpm): Slow _____ Fast _____	Vertical Thrust Capacity (N): Up _____ Down _____
☒ Multi-speed Speed (rpm): Min. _____ Max. _____	☒ Adjustable Speed Application (inverter duty rated) In accordance with Section 26 29 23, Variable Frequency Drives. Operating Speed Range: 50 to 100 % of rated speed
Variable Speed Load Classification: ☐ Variable Torque ☐ Constant Torque ☐ Constant Power	☒ Thermal Protection: Thermostats ☐ Space Heater: _____ volts, single phase ☒ Oversize main terminal (conduit) box for motors ☒ Terminal for connection of equipment grounding wire in each terminal box
Winding: ☒ One ☐ Two	

ADDITIONAL REQUIREMENTS

☒ In accordance with Section 26 20 00, Low-Voltage AC Induction Motors.

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MOTOR DATA SHEET
MECHANICAL SCREENS SCR-G211/G212/G213/G214 – BRUSH DRIVE

Project: City of Winnipeg SEWPCC Upgrading/Expansion Project

Process/Facility: Screen Building

Service: Screening

Equipment Name: Mechanical Screens

Equipment Tag Number(s): SCR-G211, SCR-G212, SCR-G213, SCR-G214

Type: Squirrel-cage induction meeting requirements of NEMA MG 1.

Manufacturer: For multiple units of same type of equipment, furnish motors and accessories from single manufacturer.

Hazardous Location: ☒ Furnish motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark.

Motor Size (kW): TBD by mfr.	Guaranteed Minimum Efficiency at Full Load (%): Per CAN/CSA-C390 Table 3
Voltage: 575	Guaranteed Minimum Power Factor at Full Load (%): Mfr.'s std.
Phase: 3	Service Factor (at rated max. ambient temperature): ☐ 1.0 ☒ 1.15
Frequency (Hz): 60	Enclosure Type: TEXP
Synchronous Speed (rpm): TBD by mfr.	Mounting Type: ☒ Horizontal ☐ Vertical
☒ Constant Speed	Vertical Shaft: ☐ Solid ☐ Hollow
☐ Two-speed Speed (rpm): Slow _____ Fast _____	Vertical Thrust Capacity (N): Up _____ Down _____
☐ Multi-speed Speed (rpm): Min. _____ Max. _____	☐ Adjustable Speed Application (inverter duty rated) In accordance with Section 26 29 23, Variable Frequency Drives. Operating Speed Range: _____ to _____ % of rated speed
Variable Speed Load Classification: ☐ Variable Torque ☐ Constant Torque ☐ Constant Power	☐ Thermal Protection: _____ ☐ Space Heater: _____ volts, single phase ☒ Oversize main terminal (conduit) box for motors ☒ Terminal for connection of equipment grounding wire in each terminal box
Winding: ☒ One ☐ Two	

ADDITIONAL REQUIREMENTS

☒ In accordance with Section 26 20 00, Low-Voltage AC Induction Motors.

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MOTOR DATA SHEET
SCREENINGS WASHER/COMPACTORS WCP-G231/G232

Project: City of Winnipeg SEWPCC Upgrading/Expansion Project

Process/Facility: Grit and Screenings Building

Service: Screening

Equipment Name: Screenings Washer/Compactors

Equipment Tag Number(s): WCP-G231, WCP-G232

Type: Squirrel-cage induction meeting requirements of NEMA MG 1.

Manufacturer: For multiple units of same type of equipment, furnish motors and accessories from single manufacturer.

Hazardous Location: ☒ Furnish motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark.

Motor Size (kW): TBD by mfr.	Guaranteed Minimum Efficiency at Full Load (%): Per CAN/CSA-C390 Table 3
Voltage: 575	Guaranteed Minimum Power Factor at Full Load (%): Mfr.'s std.
Phase: 3	Service Factor (at rated max. ambient temperature): ☐ 1.0 ☒ 1.15
Frequency (Hz): 60	Enclosure Type: TEFC
Synchronous Speed (rpm): TBD by mfr.	Mounting Type: ☒ Horizontal ☐ Vertical
☒ Constant Speed	Vertical Shaft: ☐ Solid ☐ Hollow
☐ Two-speed Speed (rpm): Slow _____ Fast _____	Vertical Thrust Capacity (N): Up _____ Down _____
☐ Multi-speed Speed (rpm): Min. _____ Max. _____	☐ Adjustable Speed Application (inverter duty rated) In accordance with Section 26 29 23, Variable Frequency Drives. Operating Speed Range: _____ to _____ % of rated speed
Variable Speed Load Classification: ☐ Variable Torque ☐ Constant Torque ☐ Constant Power	☐ Thermal Protection: _____ ☐ Space Heater: _____ volts, single phase ☒ Oversize main terminal (conduit) box for motors ☒ Terminal for connection of equipment grounding wire in each terminal box
Winding: ☒ One ☐ Two	

ADDITIONAL REQUIREMENTS

☒ In accordance with Section 26 20 00, Low-Voltage AC Induction Motors.

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SECTION 46 23 23

VORTEX GRIT CHAMBER EQUIPMENT

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. American Society of Mechanical Engineers (ASME):
      a. B16.5, Pipe Flanges and Flanged Fittings.
      1. Canadian Electrical Code (CEC).
   2. Hydraulic Institute (ANSI/HI).
   3. National Building Code of Canada (NBC) with Manitoba Amendments.

1.2 SUBMITTALS

A. Furnish submittals in accordance with requirements of Section 01 33 00, Submittal Procedures.

B. Action Submittals:
   1. Shop Drawings:
      a. Make, model, and weight of each equipment assembly.
      b. Manufacturer's catalog information, descriptive literature, specifications, and identification of materials of construction.
      c. Detailed drawings showing the equipment fabrications and interface with other items. Include dimensions, size, and locations of connections to other work, and weights of associated equipment.
      d. External utility requirements such as air, water, power, drain, etc., for each component.
      e. Shop and Field Painting Systems Proposed:
         1) Include Manufacturer's descriptive technical catalog literature and specifications.
         2) Where system proposed is different from that specified or where, in manufacturer's opinion, proposed coating system exceeds requirements specified, submit complete technical literature of proposed system to Contract Administrator for review.
      f. Submit written certification from Professional Engineer licensed in Province of Manitoba stating that support systems, anchorage, and equipment have been designed for post-disaster structures in accordance with requirements of NBC with Manitoba Amendments, at time of Shop Drawing submittals.

C. Informational Submittals:
   1. Manufacturer's reference listing of previous installations as specified herein.
   2. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
   3. Certification that the factory-applied coating system(s) is identical to the requirements specified.

4. Special shipping, storage and protection, and handling instructions.
5. Manufacturer's written/printed installation instructions.
6. Routine maintenance requirements prior to plant startup.
7. Performance test procedures and sample test log.
8. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Contractor Field Services.
9. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
10. Service records for maintenance performed during construction.

1.3 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts and special tools:

Item	Quantity
Special tools required to maintain or dismantle equipment	One complete set

B. Delivery: In accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:
   1. Hydro International; Eutek Headcell.

B. No "or equal" or substitute products will be considered.

2.2 CONDITIONS OF SERVICE

A. Material Handled: Screened municipal raw wastewater.

B. Operating Environment:
   1. Equipment Location: Outdoors, installed in covered concrete tanks.
   2. Ambient Air Temperature: Minus 35 to 40 degrees C.
   3. Relative Humidity: Up to 100 percent.
   4. Electrical Hazardous Area Classification: As shown on Drawings.

2.3 DESIGN REQUIREMENTS

A. Number of Units: Two.

B. Wastewater Flow per Unit:
   1. Minimum Flow: 10 ML/d.
   2. Average Daily Flow: 47.5 ML/d.
   3. Peak Flow: 110 ML/d.

C. Grit Characteristics and Quantities: Typical municipal wastewater grit characteristics and quantities for western Canada region.

2.4 PERFORMANCE REQUIREMENTS

A. Grit Removal Efficiency: Minimum 85 percent of grit having specific gravity of 2.65 or greater and size of 150 mesh or larger.

B. Headloss: Maximum 200 mm w.c. at peak flow.

C. Loading Rate: Maximum 10.1 L/s per m^2 of surface area at peak flow.

2.5 EQUIPMENT DESCRIPTION

A. Grit Separation Equipment:
1. Non-aerated, hydraulically induced vortex flow type generally consisting of multiple trays, influent duct, distribution header, supports, and other items necessary for a complete grit separation assembly.
2. Capable of separating grit from screened wastewater and suitable for installation in a concrete basin as shown on Drawings.
3. Equipment shall have no moving parts that require lubrication or will be subject to wear or blockage.
4. Distribution header shall evenly distribute the tangential feed among multiple polyethylene conically-shaped trays, establishing a vortex flow pattern and allowing grit to settle out by gravity along the sloped surface of the trays to a common grit collection sump.
5. Type 316 stainless steel support base, influent duct, distribution header, and grit collection sump with ASME B16.5 Class 150 flanged outlet nozzle and fluidizing water inlet connection.
6. Type 316 stainless steel hardware and fasteners.

2.6 WELDING

A. Welded connections subjected to submerged conditions shall be seal welded.

2.7 ACCESSORIES

A. Lifting Lugs: Provide suitably attached for equipment assemblies and components weighing over 45 kg.

B. Equipment Identification Plates: In accordance with Section 40 05 53, Identification Labels for Equipment, Fabricated Tanks, Valves and Piping Systems.

C. Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer, and as specified in Section 05 50 00, Metal Fabrications.

2.8 PAINTING

A. Factory prepare, prime, and finish in accordance with Section 09 90 00, Painting and Coating.

PART 3 EXECUTION

3.1 INSTALLATION

A. In accordance with manufacturer's written instructions.

B. Anchor Bolts: Accurately place using templates furnished by equipment manufacturer and as specified in Section 05 50 00, Metal Fabrications.

3.2 FIELD QUALITY CONTROL

A. Functional Test:
1. Conduct on each unit.
2. Alignment: Prior to facility startup, test complete assemblies for correct rotation, proper alignment and connection.
3. Operate for a continuous 3-hour period without malfunction.

B. Performance Test:
1. Conduct on one unit.
2. Perform under actual or approved simulated operating conditions.
3. Perform manufacturer's standard grit removal efficiency test to demonstrate compliance with specified performance requirements. Submit test procedure for review minimum two weeks prior to start of test.
4. Testing shall be performed by representative of equipment manufacturer with Contractor's assistance.
5. Provide all necessary samplers, analyzers, instruments, connections, hoses, and other items required to perform the test.
6. Conduct test with unit operating under continuous steady flow conditions
7. Test Log: Upon completion of test, record information listed on sample test log.
8. Adjust, realign, or modify units and retest if necessary.

3.3 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at Site or classroom designated by the City for minimum person-days listed below, travel time excluded:
1. 2 person-days for installation assistance and inspection.
2. 2 person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
3. 2 person-days for pre-startup classroom or field training.
4. 2 person-days for facility startup.
5. 2 person-days for post-startup training. Training shall not commence until accepted detailed lesson plan for each training activity has been reviewed by the City and Contract Administrator.

B. See Section 01 43 33, Contractor Field Services and Section 01 91 14, Equipment Testing and Facility Startup.

END OF SECTION

SECTION 46 23 27

CYCLONE SEPARATORS AND GRIT WASHERS

EQUIPMENT AND COMPONENT NUMBERS

ID No.	Equipment Description
GRP-G341	Grit Classifier
GRP-G341-1	Cyclone
GRP-G341-2	Cyclone
GRP-G341-3	Cyclone
GRP-G342	Grit Classifier
GRP-G342-1	Cyclone
GRP-G342-2	Cyclone
GRP-G342-3	Cyclone

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. American National Standards Institute (ANSI).
   2. American Society of Mechanical Engineers (ASME):
      a. B16.1, Grey Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250.
   3. Canadian Electrical Code (CEC).
   4. National Electrical Manufacturers' Association (NEMA):
      a. MG 1, Motors and Generators.
   5. Occupational Health and Safety Act (OHSA).
   6. 2010 National Building Code of Canada, with 2011 Manitoba Amendments (NBC).

1.2 SUBMITTALS

A. Shop Drawings:
   1. Make, model, weight, and horsepower of each equipment assembly.
   2. Manufacturer's catalog information, descriptive literature, specifications, and identification of materials of construction.
   3. Detailed drawings showing the equipment fabrications and interface with other items. Include dimensions, size, and locations of connections to other work, and weights of associated equipment.
   4. External utility requirements such as air, water, power, drain, etc., for each component.
   5. Power and control wiring diagrams, including terminal numbers.
   6. Shop and Field Painting Systems Proposed: Include manufacturer's descriptive technical catalog literature and specifications.
      a. Where system proposed is different from that specified or where, in the manufacturer's opinion, the coating system exceeds requirements specified, submit

complete technical literature of the proposed system to Contract Administrator for review.

7. Submit written certification from Professional Engineer licensed in Province of Manitoba stating that support systems, anchorage, and equipment have been designed for post-disaster structures according to requirements of NBC with Manitoba Amendments, at time of Shop Drawing submittals.

B. Informational Submittals:
1. Special shipping, storage and protection, and handling instructions.
2. Manufacturer's written/printed installation instructions.
3. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
4. Certification that factory-applied coating system is identical to requirements specified.
5. Routine maintenance requirements prior to plant startup.
6. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Contractor Field Services.
7. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
8. Service records for maintenance performed during construction.

1.3 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts and special tools:

Item	**Quantity**
Drive belts or chains	Two complete sets
Lower shaft seals	Two complete sets
Apex liner	Two
Liners for inlet head, vortex finder, cylinder, and cone	Two complete sets
Gaskets	Two complete sets
Special tools required to maintain or dismantle equipment	One complete set

B. Delivery: In accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide cyclone separators and grit washers including, but not limited to, cyclones, settling tank, screw conveyor, drive assembly, wash water assembly, spare parts, and miscellaneous appurtenances as necessary for a complete operating system.

B. Where possible, provide end products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, replacement, and manufacturer's service.

C. Design equipment with due regard to safety of operation, accessibility, and durability of parts, and compliance with applicable OHSA, provincial, and local safety regulations.

D. Design equipment, anchorage, and support systems for vertical and lateral loading in accordance with NBC.

2.2 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:
   1. Wemco.
   2. WesTech Engineering Inc.

2.3 CONDITIONS OF SERVICE

A. Each grit classifier unit shall consist of a grit washer and three cyclone separators. Two of the cyclones will receive grit slurry pumped continuously from two vortex type grit removal units, and the third cyclone will receive grit slurry pumped intermittently from two aerated grit tanks during high plant influent flows. Each grit classifier unit will receive grit slurry from three sources. Size units to handle grit slurry from one, two, or all three sources simultaneously.

B. Operating Environment:
   1. Equipment Location: Indoors in heated building.
   2. Ambient Air Temperature: 5 to 40 degrees C.
   3. Relative Humidity: Up to 100 percent.
   4. Electrical Hazardous Area Classification: As shown on Drawings.

2.4 DESIGN REQUIREMENTS

A. Number of Grit Classifier Units: Two.

B. Feed Slurry Flow, Total per Unit: Up to 204.3 m^3/h (68.1 m^3/h per cyclone).

C. Inlet Pressure at Cyclones: 63 to 70 kPag.

D. Feed Slurry Concentration Range: 0.5 to 4.0 percent.

2.5 PERFORMANCE REQUIREMENTS

A. Grit Classifier Unit Removal Efficiency: Each grit classifier unit shall remove minimum 85 percent of grit having specific gravity of 2.65 or greater and size of 150 mesh or larger from feed slurry.

B. Maximum Underflow from Each Cyclone: Not to exceed 9.7 m^3/h.

2.6 EQUIPMENT DESCRIPTION

A. General:
1. Each complete unit shall consist of three cyclone separators mounted on grit washer mechanism and arranged as shown on Drawings.
2. Provide structural frames, mounting brackets, and piping transitions for a complete operational unit.
3. Overall dimensions of each complete unit shall not exceed 5500 mm long by 2500 mm wide by 2500 mm high.

B. Cyclone Separators:
1. Heavy-duty cast iron volute feed chamber with cylindrical and conical sections of steel and aluminum to reduce overhung weight.
2. Each section lined with replaceable neoprene liner, minimum 19 mm thick. Construct cyclone such that each liner section can be replaced independently.
3. Involute feed entry with minimum 100 mm diameter feed inlet and 150 mm diameter overflow outlet with adapter pieces as required to suit piping layout shown on Drawings. Connections shall be ASME B16.1 Class 125 flat face cast iron flanges.
4. Vortex Finder: Abrasion-resistant alloy with minimum hardness of 500 Brinell.
5. Apex Size: Minimum 50 mm diameter.
6. Provide hinge and quick disconnect clamp between apex assembly and lower cone section to allow cleaning apex without disconnecting cyclone piping.
7. Tap feed inlet for 25 mm NPT gauge connection. Provide pressure gauge with diaphragm seal.
8. Mount cyclones on classifier with Type 316 stainless steel fabricated support.
9. Provide leak-tight connection between cyclone underflow outlet and classifier feedbox.

C. Grit Washer:
1. Designed to maintain necessary velocities to retain organic matter in suspension while removing inorganic material of size retained on 150 mesh screen at design flow.
2. Settling Tank:
   a. Full flare configuration.
   b. Fabricated from minimum 6 mm thick Type 316 stainless steel plate, reinforced and mounted on Type 316 stainless steel supports at trough slope of not more than 300 mm per meter.
   c. Design settling compartment where grit separation takes place with minimum full-water depth of 150 percent of screw diameter.
   d. Weir Overflow: Discharge into launder box equipped with grooved end pipe fitting for connection to drain.
   e. Cover: Removable air-tight cover fabricated from Type 316 stainless steel, gasketed and clamped to settling tank, over full length of settling tank and screw conveyor trough. Provide 100 mm diameter flanged nozzle for connection of odour control ductwork.
   f. Provide feedbox to receive underflow from each cyclone, fabricated from Type 316 stainless steel with hinged inspection cover and quick-release clamps, neoprene-lined to protect against abrasion, designed to dissipate energy from cyclone underflow and minimize disruption to settling tank pool, and located to minimize short-circuiting to overflow weir.

3. Discharge Chute:
   a. Provide discharge chute for grit classifier to receive and discharge dewatered grit to disposal bin as generally shown on Drawings.
   b. Fabricated from Type 316 stainless steel, suitably reinforced and stiffened as required, and supported from floor above bin.
   c. Provide hinged inspection door on side of chute with continuous piano hinge, handle, and quick-closing toggle clamps.
4. Screw Conveyor:
   a. Heavy-walled pipe shaft, Type 316 stainless steel construction.
   b. Shaft shall be rigidly supported by bearings at each end. There shall be sufficient clearance between screw and tank so that a buildup of sand or grit will provide a bed for the screw, eliminating tank wear and providing drainage are for conveyed grit.
   c. Provide Type 316 stainless steel flights continuously seal welded to shaft and provided with replaceable hardened alloy steel wear shoes per manufacturer's standard.
   d. Screw Speed: 8 rpm maximum.
   e. Lower Support Bearing:
      1) Support lower end of screw by submerged bearing housed in watertight enclosure with oil fill and drain plugs, suitable for completely submerged operation in grit service.
      2) Sealed bronze sleeve type bearing running completely submerged in oil, requiring only yearly inspection and oil change.
      3) Provided with permanent, self-compensating stellite seals to prevent oil leakage and infiltration of grit and water.
      4) Provide manually operated lifting device attached to lower bearing to allow screw conveyor and bearing to be raised above water level for inspection and maintenance without draining settling tank.
5. Drive Assembly:
   a. Pivoted at shaft centerline such that screw assembly can be raised for inspection.
   b. Motor:
      1) In accordance with Section 26 20 00, Low Voltage AC Induction Motors.
      2) Connected to speed reducer through V-belt drive with drive guard.
      3) Refer to Motor Data Sheet at end of section for additional requirements.
   c. Speed Reducer:
      1) Connected to upper end of screw conveyor using flanged, rigid coupling.
      2) Cycloidal type designed such that torque is transmitted by rollers and capable of withstanding shock loads of 500 percent rated loading.
      3) Designed to take radial and thrust loads from shaft. At maximum load provide minimum B-10 bearing life of 50,000 hours.

2.7 INSTRUMENTATION AND CONTROLS

A. General:
   1. Provide complete and functional system, including interfaces with plant PCS.
   2. Control components shall operate on 120V ac power.
   3. Provide industrial grade instruments suitable for intended service and environment.
   4. Provide instruments in accordance with Section 40 91 01, Instrumentation and Control Components unless specified otherwise.

5. Instrumentation and controls specified herein are minimum requirements. Equipment manufacturer shall provide additional components and features necessary to achieve intended function and provide safe and reliable operation of equipment supplied.

B. Instrumentation:
1. Pressure Gauges:
   a. Provide pressure gauge with diaphragm seal on grit slurry inlet to each cyclone.
   b. Manufacturer and Product: Ashcroft or approved equal in accordance with B8.
2. Emergency Rope Switch:
   a. Provide Class I, Zone 2 rated cable-actuated safety stop switch for each grit classifier, with two single-pole double-throw contacts rated 5A at 120V ac, one for use in grit classifier control circuit and one for remote indication of switch status to plant PCS.
   b. Switch shall be equipped with positive safety lock requiring unit to be manually reset.
   c. Provide orange-coloured vinyl- or nylon-coated aircraft type cable running full periphery of classifier with stainless steel end fittings, supported by stainless steel eye bolts and connected to safety stop switch.
   d. Manufacturer and Product:
      1) Conveyor Components Co.; Model RS-2X.
      2) Or approved equal in accordance with B8.
3. Motion Monitor:
   a. Provide motion monitor for each grit classifier to detect rotation of screw conveyor and provide under-speed indication to plant PCS.
   b. Provide mounting bracket and hardware for sensor mounting.
   c. Provide adjustable startup time delay and output contact rated minimum 5A at 120V ac.
   d. NEMA 4X stainless steel enclosure.
   e. Manufacturer and Product: Siemens/Milltronics MFA-4P with MSP-12 probe, or approved equal in accordance with B8.

2.8 ACCESSORIES

A. Lifting Lugs: Provide suitably attached for equipment assemblies and components weighing over 45 kg.

B. Equipment Identification Plates: In accordance with Section 40 05 53, Identification Labels for Equipment, Fabricated Tanks, Valves and Piping Systems.

C. Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer, and as specified in Section 05 50 00, Metal Fabrications.

2.9 FACTORY FINISHING

A. Factory prepare, prime, and finish coat all exposed ferrous metal surface in accordance with manufacturer’s standard epoxy coating system.

2.10 SOURCE QUALITY CONTROL

A. Factory Inspections: Inspect all equipment supplied for required construction, electrical connection, and intended function.

B. Factory tests may be witnessed by Contract Administrator and/or the City at their discretion. Provide minimum two weeks notice prior to commencement of testing.

C. Functional Tests:
   1. Test all equipment actually furnished.
   2. Perform manufacturer's standard production tests.
   3. Motor Tests: In accordance with Section 26 20 00, Low-Voltage AC Induction Motors.

D. Factory Performance Test:
   1. Test one grit classifier unit actually furnished.
   2. Test shall demonstrate compliance with specified performance requirements.
   3. Submit detailed written test procedure for review minimum four weeks prior to start of test.
   4. Provide all necessary pumps, tanks, piping, valves, sampling points, calibrated instrumentation, and other devices required to carry out test. Test equipment shall provide flow rate and pressure at inlet of cyclones equal to that specified.
   5. Test equipment using slurry of water and sand in such proportion to achieve sand concentration of approximately one percent by weight at inlet of cyclones.
   6. Allow flow rate and sand concentration to stabilize before obtaining samples.
   7. Measure flow rate at inlet of cyclones and at settling tank overflow.
   8. Obtain minimum of five samples at each cyclone inlet, cyclone overflow, and settling tank weir during test.
   9. Analyze each sample for total solids concentration and particle size distribution. Sample analysis shall be performed by independent third party laboratory.
   10. Calculate grit classifier unit removal efficiency using results of sample analysis.
   11. If test results do not meet specified performance requirements, make any necessary modifications and adjustments to equipment and repeat test until specified performance requirements are met.
   12. Test Records and Report: Prepare and submit complete test report along with test records, certified correct by authorized representative of equipment manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

A. In accordance with manufacturer's written instructions.

B. Anchor Bolts: Accurately place using templates furnished by manufacturer and as specified in Section 05 50 00, Metal Fabrications.

3.2 FIELD QUALITY CONTROL

A. Functional Test:
   1. Conduct on each grit classifier unit.
   2. Alignment: Prior to facility startup, test complete assemblies for correct rotation, proper alignment and connection.
   3. Operate for a continuous 3-hour period without malfunction.

B. Performance Test:
   1. Conduct on each grit classifier unit.
   2. Perform under actual or approved simulated operating conditions.
   3. Test for a continuous 3-hour period without malfunction.
   4. Perform with the Contract Administrator present.
   5. Test Log: Upon completion of test, record information listed on sample test log.
   6. Adjust, realign, or modify units and retest if necessary.

3.3 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at Site or classroom designated by the City for minimum person-days listed below, travel time excluded:
   1. 2 person-days for installation assistance and inspection.
   2. 2 person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
   3. 2 person-days for pre-startup classroom or field training.
   4. 2 person-days for facility startup.
   5. 2 person-days for post-startup training. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by the City and Contract Administrator.

B. See Section 01 43 33, Contractor Field Services and Section 01 91 14, Equipment Testing and Facility Startup.

3.4 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this Specification.
   1. Motor Data Sheet.

END OF SECTION

MOTOR DATA SHEET
GRIT CLASSIFIERS GRP-G341, GRP-G342

Project: City of Winnipeg SEWPCC Upgrading/Expansion Project

Process/Facility: Grit and Screenings Building

Service: Grit Slurry

Equipment Name: Grit Classifiers

Equipment Tag Number(s): GRP-G341, GRP-G342

Type: Squirrel-cage induction meeting requirements of NEMA MG 1.

Manufacturer: For multiple units of same type of equipment, furnish motors and accessories from single manufacturer.

Hazardous Location: ☐ Furnish motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark.

Motor Size (kW): 1.5 ☒ Min. ☐ Max.	Guaranteed Minimum Efficiency at Full Load (%): Per CAN/CSA-C390 Table 3
Voltage: 575	Guaranteed Minimum Power Factor at Full Load (%): Mfr.'s std.
Phase: 3	Service Factor (at rated max. ambient temperature): ☐ 1.0 ☒ 1.15
Frequency (Hz): 60	Enclosure Type: TEFC
Synchronous Speed (rpm): 1800 max.	Mounting Type: ☒ Horizontal ☐ Vertical
☒ Constant Speed	Vertical Shaft: ☐ Solid ☐ Hollow
☐ Two-speed Speed (rpm): Slow _____ Fast _____	Vertical Thrust Capacity (N): Up _____ Down _____
☐ Multi-speed Speed (rpm): Min. _____ Max. _____	☐ Adjustable Speed Application (inverter duty rated) In accordance with Section 26 29 23, Variable Frequency Drives. Operating Speed Range: _____ to _____ % of rated speed
Variable Speed Load Classification: ☐ Variable Torque ☐ Constant Torque ☐ Constant Power	☐ Thermal Protection: _____ ☐ Space Heater: _____ volts, single phase ☒ Oversize main terminal (conduit) box for motors ☒ Terminal for connection of equipment grounding wire in each terminal box
Winding: ☒ One ☐ Two	

ADDITIONAL REQUIREMENTS

☒ In accordance with Section 26 20 00, Low-Voltage AC Induction Motors.

SECTION 46 33 33.03

DRY POLYMER MAKE DOWN AND FEED SYSTEMS

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Section 26 05 01, Common Work Results

B. Section 26 20 00, Low Voltage AC Induction Motor

C. Section 26 29 23, Variable Frequency Drives

1.2 SUMMARY OF WORK

A. The work of this Section includes design, fabrication, factory testing, installation and on Site testing/commissioning/training of the following dry polymer make down and feed systems complete with control panels as specified herein. Scope of packages to be supplied by the Vendor are referenced within the boundary of the polymer systems as listed below:

Dry Polymer Make Down System	**Polymer Feed Systems**	**Reference P&ID No.**
FPS/HRC Polymer Make Down S-C404	FSL RDT Polymer Pump Skid No. 1 S-C410-1, Pump Skid No. 2 S-C410-2	1-0102-PPID-C401, 402, 403 & 404
WAS Polymer Make Down S-C424	WAS RDT Polymer Pump Skid S-C430	1-0102-PPID-C405, 406, & 407
HRC Polymer Make Down S-C444	HRC Polymer Pump Skid S-C450	1-0102-PPID-C408, 409 & 410
Secondary Clarifier Polymer Make Down S-C464	Secondary Clarifier Polymer Pump Skid S-C470	1-0102-PPID-C411 & 412

B. Unit Responsibility: The work requires that the polymer make down and feed systems listed above be skid mounted by the Vendor where possible, complete with dry polymer powder feeder, hydration system, mixing and storage tanks, handling system for dry polymer, transfer pumps, motors, piping, valves, control panels and all associated instrumentation and accessories as shown on the referenced P&IDs be the end product of one responsible system Vendor. The Vendor shall furnish all components and accessories of the chemical system as necessary to ensure compatibility, ease of operation and maintenance and to place the system into operation in conformance with the specified performance, features, and functions.

C. See P&IDs referenced above for the chemical system's supply details.

1.3 REFERENCE CODES AND STANDARDS

A. All Work and materials shall comply with the Canadian Electrical Code and all applicable local regulations and ordinances. All panels and enclosures shall be provided with labels from either the Canadian Standard Association (CSA) or the Underwriter Laboratories of Canada (ULC or cUL).

B. The following is a list of standards and standards organizations which may be referenced in this section:
1. Institute of Electrical and Electronics Engineers (IEEE): 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
2. Hydraulic Institute Standards.
3. National Electrical Manufacturer's Association (NEMA): MG 1, Motors and Generators.
4. American Society of Mechanical Engineers (ASME):
   a. B31.1, Power Piping
   b. B31.3, Process Piping
5. Canadian Electrical Code (CEC).
6. Nationally Recognized Testing Laboratories (NRTL).
7. Occupational Safety and Health Administration (OSHA).
8. The Canadian Standards Association (CSA).
9. Underwriters Laboratories Inc. of Canada (ULC).
10. Manitoba Building Code (MBC).
11. Electrical Equipment Manufacturer's Association of Canada (EEMAC).

C. All electrical components shall be CSA or cUL approved.

1.4 DEFINITIONS

A. Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards.

1.5 QUALITY ASSURANCE

A. The essential parts of all equipment of the chemical feed systems shall be made by manufacturers who have a minimum of five (5) years of experience in the design, construction and operation of such equipment for the intended use in water/wastewater facilities.

B. Dry polymer make down and feed systems shall be furnished, coordinated, and tested by one Vendor. Systems shall be completely shop assembled, skid mounted, and shop tested prior to shipment. Interconnecting piping and wiring shall be contained complete within the skids limits.

C. Fabricator's Quality Assurance Supervisor: Minimum of 10 years' experience in the fabrication of chemical systems of similar size and usage.

1.6 DELIVERY STORAGE AND HANDLING

A. All materials fabricated to this Specification must be packaged, crated, or protected in such manner to prevent damage in handling and while in transit. Details of these procedures shall be the responsibility of the Vendor.

1.7 SUBMITTALS

A. Review Submittals:
1. Certified detailed process mechanical drawings with general arrangement showing the complete skid of each equipment assembly with principal dimensions, weights of equipment, base plates, anchor bolt size and location.
2. Performance specifications of all items of equipment.
3. Process schematics associated with all items of equipment.
4. Details of the control systems and components.
5. Wiring diagrams, control panels information. Identify point-to-point connections and field wiring requirement.
6. Submittals as specified in Section 40 99 90, Package Control Systems.
7. Instrument data sheets.
8. Motor data sheets with nameplate markings which meet NEMA and CSA requirements for all motors
9. Layout drawings for skid mounted local controls panels including the door layout, interior layout clearly identifying all components with item number and Bill of Material (BOM), electrical ladder diagram, interconnects to all components of the panel, and structural and mounting details.
10. Electrical single line diagram showing all power requirements.
11. Manufacturer's materials compatibility information, confirming compatibility of wetted parts with specified pumped chemicals.
12. A list of spare parts furnished.
13. A list of special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
14. A list of configurable parameters with factory default settings, settings as shipped and blank spaces for each field adjustable value.
15. Factory finish system.
16. Factory Functional and Performance Test Plan.
17. Field Functional and Performance Test Plan.
18. List and installation details of all field mounted devices.

B. Product Data Submittals: for each dry polymer make down and feed system, submit the following
1. Provide catalogue cuts or equipment data sheets showing the manufacturer's complete descriptive information of each equipment assembly which includes but is not limited to, product literature, equipment make and model, material of construction, weight of product specifications, electrical requirements, electrical and mechanical components including instrumental and control devices.
2. Performance data on pumps, including curves showing flow rates at various pump speeds.

3. Pump data sheet confirming pump capacity in litres per minute and pressure in kPag, pipe connection sizes, materials, testing requirements, intermediate fluid type, and appurtenances to be provided with pumps.
4. Detailed dimensional drawings for pumps and drivers, including piping connection sizes and locations.

C. Quality Control Submittals:
1. Factory Functional and Performance Test Reports.
2. Field Functional and Performance Test Reports.
3. Certificate of Proper Installation.
4. Special shipping, storage and protection, and handling instructions.
5. Manufacturer's printed installation instructions.
6. Suggested spare parts list to maintain the equipment in service for a period of 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
7. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
8. Training Instructions, Operating and Maintenance Manuals.
9. Draft Operating and Maintenance manuals shall be submitted with the initial shop drawing submission. A draft commissioning and start up plan, and draft training material shall be submitted with the initial Shop Drawing submission. Provide a draft training plan with content, to be followed by a draft training manual. An approved training manual shall be in place before commissioning. No training will be conducted without an approved manual, nor will payment be approved.
10. Contract Closeout Submittals: Submit service records for repairs performed throughout the period of construction, startup and commissioning.
11. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
12. Submittals as specified in Section 40 99 90, Package Control Systems.

1.8 SPARE PARTS

A. Provide spare parts per manufacturer’s recommendation for 5 years operation.

1.9 PREPARATION FOR SHIPMENT

A. Equipment shall be factory assembled and tested insofar as is practical.

B. Parts and assemblies that are shipped unassembled out of necessity shall be packaged and tagged in a manner that will protect equipment from damage and facilitate final assembly in the field.

PART 2 PRODUCTS

2.1 DESIGN PARAMETERS

Dry Polymer Make Down and Feed Systems	**Polymer Type**	**Dry Polymer Feed Rates**	**Make Down Concentration**	**Post Dilution Concentration**	**Operation**
FPS/HRC Polymer Make Down S-C404	Cationic	34.7 kg/day (average) 273 kg/day (maximum)	0.25%	0.02%	24 hr/day
WAS Polymer Make Down S-C424	Cationic	30.2 kg/day (average) 43.5 kg/day (maximum)	0.25%	0.02%	24 hr/day
HRC Polymer Make Down S-C444	Cationic	22 kg/day (average) 540 kg/day (maximum)	0.25%	0.05%	24 hr/day and intermittently for wet weather flow treatment
Secondary Clarifier Polymer Make Down S-C464	Cationic	47.5 kg/day (average) 113 kg/day (maximum)	0.25%	0.02%	24 hr/day

2.2 GENERAL SYSTEMS CONFIGURATION

A. Dry polymer make down systems including handling systems and mixing tanks shall be located on the ground floor. Aging tanks and polymer feed systems are located in the basement of the Chemical and Generator Building with a height restriction of 3 meters from floor to ceiling. Polymer transfer from mixing tanks to aging tanks is by gravity.

2.3 EQUIPMENT MANUFACTURERS

A. Veolia Water Technolgies (Hydra-Pol)

B. Metcon Sales and Engineering Ltd. (Tomal Polyrex)

C. SNF Canada, (Flovac DB Series)

D. UGSI (PolyBlend).

2.4 POLYMER MAKE DOWN AND FEED SYSTEM DESCRIPTION

A. Each polymer make down and feed system shall include, but not be limited to, one dry polymer powder feeder, one hydration system, mixing and aging tanks, system control panel (s), one handling system for dry polymer (bulk handling), feed pump skid (s) and local control panels, including instrumentation and other accessories as required, shown on PIDs and specified here in.

B. Polymer make down system shall be capable of automatically batching polymer solution in the polymer mixing and aging tanks from a dry supply source. The control panel shall control the dry polymer powder feeder and hydration system; control all associated automatic valves; and control polymer mixers in the polymer mixing tank(s).

2.5 POLYMER POWDER FEEDER

A. The polymer powder feeder shall be supplied complete and ready for operation, and be capable of providing a smooth, consistent and homogeneous dry polymer feed to the hydration system. The feeder shall consist of a polymer storage hopper and screw feeder.

B. The feeder operation and solution preparation shall be batch based. Geared motor rotating at a fixed speed drives the screw feeder.

C. The feeder outlet shall have an outlet gate.

D. Arrangement shall be such that the discharge of polymer powder to the hydration system is by gravity.

E. Storage hopper shall be provided with a low-level switch.

2.6 HYDRATION SYSTEM

A. The hydration system shall consist of a wetting cone, an ejector, a preparation water system and a static mixer. The ejector is provided at the outlet of the wetting cone to effectively suck down, mix and transport the polymer solution into the mixing tank.

B. A preparation water system shall be provided to include as a minimum but not limited to: a shut-off valve, pressure reducing valve, filter, pressure switch/gauge/transmitter, solenoid valve (s) and constant flow regulator.

C. A static mixer shall be provided at the outlet of the ejector to ensure a homogenized solution at the discharge point.

2.7 POLYMER MIXING/AGING TANK

A. The aging tanks shall be FRP with the same volume: 4,000 L each tank and 1.8 m height limit.

B. The mixing tanks shall be sized to provide up to 60 minutes of retention at 0.25% polymer concentration. Tanks shall be FRP and provided with ladder and top railing. Mixing tanks shall have flat top, designed for personnel roof load.

C. Mixer shall be supplied with each mixing tank:
   1. Mixer diameters shall be as large as possible to fit inside tank diameter, guaranteeing the uniform distribution of mixing energy.
   2. Mixer support shall be provide so that operating load does not transfer to mixing tank.

D. Both mixing and aging tanks shall be provided with level transmitter. Transmitter shall provide 4-20mA analog feedback of tank level.

2.8 BULK HANDLING SYSTEM

A. System shall provide means of handling 1000 kg bulk bag of dry polymer to the feed hopper and screw feeder.

B. Bulk bag support frame shall be constructed of carbon steel with epoxy coating.

C. Bulk bag shall be lifted into place by electric hoist, rated for 1000 kg capacity and run on support beam integral to bulk bag frame.

D. Hygienic bulk bag clamp or Iris valve shall be provided to eliminate the risk of dry polymer spillage.

2.9 POLYMER FEED SYSTEMS

A. Pumps:
   1. Type of pumps: progressive cavity.
   2. Pumps shall provide a constant flow rate for a particular drive speed. Pumps' speed shall be kept at a maximum of 1750rpm.
   3. Pumps selected shall come with a history of installations proven successful and reliable performance for the application.
   4. Provide pumps with motors suitable for inverter duty and variable frequency operation. Reference Section 26 20 00, Low Voltage AC Induction Motors for requirements. Motors speed shall be 1750 rpm or less.
   5. Combined pump, motor and variable frequency controller system to be capable of 100:1 flow control turndowns and accuracy of plus 5 percent of the full range of the pump package.

B. Pumps' Skid:
   1. Provide skid mounted chemical feed systems as shown on P&IDs.
   2. Each pump shall be provided with a local control panel as per Section 2.11C.2, mounted on the pumps skid and be accessible from the front
   3. Pumps skid shall be constructed of carbon steel with epoxy coating. If C-channels, metal clamps or hangers are used for securing equipment on the pumps skid, these must be locked tight and checked prior to shipment. Pump suction line shall sloped immediately prior to pump suction valve with the low point at pump suction valve.

4. Pumps' skids connections: one piece, molded hug type PVC, Schedule 80 flat face flange in accordance with ASTM D2466 and ASTM D2467 for socket weld type, ANSI B16.1 drilling.
5. All piping and fittings shall be PVC Schedule 80. Piping shall be supported in accordance with relevant piping standards and shall not bear weight or horizontal thrust on the pumps.
6. All components mounted on each skid shall be easily accessible from the front of the skid. Magnetic flow meters shall be installed with transmitter oriented so that it can easily be seen from the access walk way. Transmitters shall not face the back of the skid.
7. Pump accessories listed below shall be provided by the pumps' manufacturer and mounted on each skid and tested at the factory prior to shipment. Accessories for each pump to include as a minimum:
   a. Isolation valves (suction side)
   b. Flushing connection with isolation valve (suction side)
   c. Pressure gauge with suitable diaphragm seal (suction side)
   d. Pressure relief valve (discharge side)
   e. Isolation valves (discharge side)
   f. Ball check valve (discharge side)
   g. Pressure switch and pressure gauge with suitable diaphragm seal (discharge side)
   h. Flow meter (discharge side)

C. Valves:
1. Adjustable external pressure relief (PSV) type installed on pump discharge pipeline. Size as recommended by the manufacturer. Pressure relief valves shall be pump manufacturer's standard product.
2. Manual isolation valves shall be PVC ball valve:
   a. Rated 1,035 kPag (150 psig) at 23 degrees C (73 degrees F), with ASTM D1784, Type I, Grade 1 polyvinyl chloride body, ball and stem, end entry, double union design, solvent-weld soket ends, elastomer seat Viton seals to block flow in both directions.
   b. Manufacturers and Products:
      1) Chemline; Type 21
      2) Hayward Z-Ball True Union Valve
      3) Watts: Series TPBV-D
      4) Nibco-Chemtrol; PVC Model D
3. PVC Ball Check Valve:
   a. ASTM D1784, Type I, Grade 1 polyvinyl chloride body, dual union socket weld ends, rated 1035 kPag at 22 degrees C and Viton seat and seal.
   b. Manufacturers and Products:
      1) Chemtrol Tru Union; U45BC
      2) Hayward TC Series True Union Ball Check
      3) Chemline; Series BT-A-OXX-V-S
      4) Spears; True Union 2000 Standard Ball Valve

2.10 ELECTRICAL COMPONENTS AND ACCESSORIES

A. Components, wiring methods and standards of acceptance shall meet the requirements of all the other specifications, which form part of the overall contract. This includes, but is not limited to Section 26 05 01 and Section 26 20 00.

B. All components and assemblies shall be CSA or cUL rated. IEC rated components are not acceptable.

C. All wiring shall be RW 90, copper and shall be installed in rigid aluminum conduit or liquid tight flexible aluminum conduit. In lien of RW90 in conduit, Teck 90 cables may be installed.

D. Aluminum armored, type Teck 90 cables with copper conductors may be installed where applicable. Armored cabling shall be properly secured to the skid / frame structure in a neat and professional manner. Cabling shall be run such that it does not interfere with the operation or maintenance of the systems (ie/ shall not block or obstruct maintenance or repair of the system). Cabling shall be secured in accordance with Code requirements.

E. All wiring shall be a type recognized by the CEC permitted for the application.

F. All work shall comply with the CEC.

G. Exposed hardware, fittings and enclosures shall be aluminum, hot-dip galvanized steel or stainless steel. Electroplated steel maybe used when protected inside waterproof enclosures.

H. All enclosures shall be NEMA 4X, corrosion resistant, sealed and gasketted.

I. All motor starter components shall be fully rated for a minimum of 42,000 A interrupting capacity. The acceptable manufacturer of components is Schneider.

J. Circuit breakers shall be a minimum of 10 kAIC rated, or higher as required.

K. All components shall be identified with engraved phenolic labels attached with stainless steel screws. All wiring shall be identified at both ends with heat shrink or snap-on labels. Adhesive attached labels or wire markers are not acceptable.

L. Polymer Make Down System:
   1. Motors:
      a. Reference Section 26 20 00, Low Voltage AC Induction Motors for requirements.
   2. Provide all wiring for equipment located on polymer make down skid to the associated control panel. For supplied loose items such as mixers and level transmitters, provide onsite wiring.

2.11 INSTRUMENTATION AND CONTROL SYSTEM

A. Polymer Make Down System Control Panel
   1. General: All instrumentation and control components provided as part of the Control Panel shall be in accordance with the requirements and component qualities specified in Section 40 99 90, Custom Package Control Systems.
   2. Provide Control Panels as follows:
      a. Provide a NEMA 4X enclosure factory assembled and wired such that field wiring shall consist only of connection to panel terminals.
      b. The controller shall be a Schneider M580 with one Modbus TCP Ethernet connection to the Plant Control System. No alternates will be accepted. All monitoring points shall be available via Modbus TCP.
      c. Provide panel mounted Operator Interface Terminal (OIT), consistent with the City document 612620-0015-40ER-0001 "HMI Layout and Animation Plan". OIT shall be a Schneider Magelis XBT or GTO panel and have a 300mm or greater display.
   3. Provide full read/write access to PLC and OIT programs.
   4. The polymer make down system controller interface to the Plant Control System is as follows:
      a. Dry contact with less than 2 mA minimum switching current at 24 VDC for Plant Control System discrete input signals:
         1) System Run Status
         2) System Fault Status (fail-safe)
         3) "Product Available" signal
         4) "Low Low Aging Tank Level" alarm for tripping post dilution pumps (fail-safe)
         5) "Hopper Level Low" signal
      b. 24 VDC relay coil for Plant Control System discrete output signals:
         1) Run Command
   5. One 600 VAC, 3 phase power feed will be brought to the control panel. This will be used to power the motors and other process loads. Provide a 120 VAC step-down transformer as integral to the control panel, and distribute power as required. Each control valve shall be separately fed from dedicated breakers.
   6. One 120 VAC UPS power feed will be brought to the control panel. Provide redundant 24 VDC power supplies fed from the UPS power supply and internal transformer for control system equipment with alarms to the control system for power supply failure.
   7. Provide device fusing/circuit breakers as required.
   8. All 600 VAC equipment including breakers, motor starters and overloads shall be Schneider brand equipment. No alternates will be accepted.
   9. Control Panel shall be mounted on the associated polymer make down system skid. Coordinate location of panels to allow for access to panel in installed location.

B. Polymer Make Down System
   1. Instrumentation:
      a. Refer to 40 91 01 Instrumentation and Control Components for requirements.
   2. Provide all wiring for equipment located on polymer make down skid to the associated control panel.

C. Pump Skids
   1. The provision of the VFDs and PLC interface will be by others.
   2. Local control panels: One per pump
      a. Enclosure:
         1) Materials: Type 304 stainless steel.
         2) Ingress Protection: NEMA 4X.
         3) Location: Skid mounted with pumps
      b. Provide the operator controls listed below on the local control station for each chemical feed pump:
         1) HAND/OFF/REMOTE hand switch
         2) Speed adjustment knob (1 to 10 kΩ variable resistor).
         3) EMERGENCY STOP push button
      c. Provide an additional EMERGENCY STOP push button mounted at the back of the skid and wired in conduit to the local control panel.
   3. Provide wiring and terminals as per the motor schematic and wiring drawings. All signals shall be terminated on clearly marked terminal blocks for connection to external system. Label devices as per the Drawings. Instrumentation:
      a. Refer to 40 91 01 Instrumentation and Control Components for requirements.
      b. Magnetic flow meters shall be Siemens MAG 3100 with MAG600 transmitter. No alternates will be accepted.
      c. Install magnetic flow meters as per manufacturers installation requirements.

2.12 AUTOMATIC VALVES

A. Polymer system manufacturer shall furnish all automated valves per PIDs, complete with all necessary appurtenances such as actuators and limit switches per Section 40 27 02, Process Valves and Operators.

2.13 STATIC MIXERS

A. Static mixers shall be supplied loose for each polymer feed systems, size to suit the maximum required flow for post dilution concentration of each polymer system as indicated above. Mixers shall be selected base on lowest head loss possible.

B. Manufacturer: Statiflo or Koflo.

2.14 APPURTENANCES

A. Equipment Identification Plates: 1.5 mm stainless steel with 9.5 mm engraved and black enamel filled equipment tag number securely mounted in a readily visible location.

B. Lifting Lugs: Equipment over 45 kg in weight shall be provided with lifting lugs.

C. Anchor Bolts: Anchor bolts shall be Type 316 stainless steel and at least 13 mm in diameter. Coordinate required size with final Shop Drawings.

2.15 FABRICATION

A. Finish of all metalwork shall be of the highest grade and equal to the best practice of modern shops.

B. Exposed surfaces shall have smooth finish and sharp, well defined lines.

C. Methods of fabrication not specified herein shall be adequate for the service encountered, and as reviewed by Contract Administrator.

2.16 FACTORY FINISHING

A. Prepare and prime coat in accordance with Section 09 90 00, Painting and Coating, System No. 5.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in strict conformance with Manufacturer's recommendations.

3.2 FIELD TEST

A. Functional Test: Prior to plant startup, inspect all equipment for proper installation, quiet operation, and proper connection.

B. Performance Test:
1. Perform under actual or approved simulated operating conditions.
2. Test for a minimum continuous 3-hour period without malfunction.
3. Performance will be deemed satisfactory when Contractor has verified, by means of a performance test in the presence of Contract Administrator, that the dry polymer feeder, polymer wetting system, and polymer feed pumps can deliver the capacity specified herein. Contractor shall also verify satisfactory operation of all polymer system controls, including the polymer mixers. Cycle units twice prior to placing in service.

3.3 FIELD FINISHING

A. Equipment as specified in Section 09 90 00, Painting and Coating, System No. 5.

3.4 CONTRACTOR'S SERVICES

A. A Contractor's representative for the equipment specified herein shall be present at the Job Site and/or classroom designated by the City for the minimum person-days listed for the services herein under, travel time excluded:
1. Two (2) person days for installation assistance and inspection per polymer system.
2. One (1) person-day per polymer system for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.

3. 1/2 person-day per polymer system for pre-startup training of the City's personnel.
4. 1/2 person-day per polymer system for facility startup.
5. 1/2 person-day per polymer system for post-startup training of the City's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by the City.

B. Allow for a minimum of one trip per polymer system.

C. Startup services shall be at such times as requested by Contractor and as approved by the City.

D. Training of the City's personnel shall be at such times as requested by the City.

E. See Section 01 43 33, Contractors Field Services, and Section 01 91 14, Equipment Testing and Facility Startup.

END OF SECTION

SECTION 46 33 42

CHEMICAL METERING DIAPHRAGM PUMP SKIDS

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Section 26 05 01, Common Work Results

B. Section 26 20 00, Low Voltage AC Induction Motor

C. Section 26 29 23, Variable Frequency Drives

1.2 SUMMARY OF WORK

A. The work of this Section includes design, fabrication, factory testing, installation and on Site testing/commissioning/training of the following skid mounted chemical feed systems complete with local control stations as specified herein. Limits of packages to be supplied by the Vendor are referenced within the boundary of the chemical skids as listed below:

Chemical Skid	**No. Pumps**	**Flow**	**Tag Numbers**	**Reference P&ID No.**
Ferric Chloride Pump Skid No. 1 (S-C110-1)	3 (2 duty, 1 standby)	0.06-4.6 L/min	P-C111, P-C112, P-C113	1-0102-PPID-C102
Ferric Chloride Pump Skid No. 2 (S-C110-2)	3 (2 standby, 1 duty)	0.06-4.6 L/min	P-C114, P-C115, P-C116	1-0102-PPID-C103
Ferric Chloride Pump Skid No. 3 (S-C120)	3 (2 duty, 1 standby)	0.36-7.4 L/min	P-C121, P-C122, P-C123	1-0102-PPID-C104
Ferric Chloride Pump Skid No. 4 (S-C130)	3 (2 duty, 1 standby)	0.36-7.4 L/min	P-C131, P-C132, C133	1-0102-PPID-C105

B. Unit Responsibility: The work requires that the chemical feed systems listed above be skid mounted by the Vendor, complete with pumps, motors, piping, valves, control stations and all associated instrumentation and accessories as shown on the referenced P&IDs be the end product of one responsible system Vendor. The Vendor shall furnish all components and accessories of the chemical system as necessary to ensure compatibility, ease of operation and maintenance and to place the system into operation in conformance with the specified performance, features, and functions.

C. See P&IDs referenced above for the chemical feed system's supply details.

D. Equipment and accessories specified in this section shall be products of the same manufacturer for Section 46 33 42.13 Chemical Metering Gear Pump Skids.

1.3 REFERENCE CODES AND STANDARDS

A. All Work and materials shall comply with the Canadian Electrical Code and all applicable local regulations and ordinances. All panels and enclosures shall be provided with labels from either the Canadian Standard Association (CSA) or the Underwriter Laboratories of Canada (ULC or cUL).

B. The following is a list of standards and standards organizations which may be referenced in this section:
   1. Institute of Electrical and Electronics Engineers (IEEE): 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
   2. Hydraulic Institute Standards.
   3. National Electrical Manufacturer's Association (NEMA): MG 1, Motors and Generators.
   4. American Society of Mechanical Engineers (ASME):
      a. B31.1, Power Piping
      b. B31.3, Process Piping
   5. Canadian Electrical Code (CEC).
   6. Nationally Recognized Testing Laboratories (NRTL).
   7. Occupational Safety and Health Administration (OSHA).
   8. The Canadian Standards Association (CSA).
   9. Underwriters Laboratories Inc. of Canada (ULC).
   10. Manitoba Building Code (MBC).
   11. Electrical Equipment Manufacturer's Association of Canada (EEMAC).

C. All electrical components shall be CSA or cUL approved.

1.4 QUALITY ASSURANCE

A. The essential parts of all equipment of the chemical feed systems shall be made by manufacturers who have a minimum of five (5) years of experience in the design, construction and operation of such equipment for the intended use in water/wastewater facilities.

B. Chemical feed systems shall be furnished, coordinated, and tested by one Vendor. Systems shall be completely shop assembled, skid mounted, and shop tested prior to shipment. Interconnecting piping and wiring shall be contained complete within the skids limits.

C. Fabricator's Quality Assurance Supervisor: Minimum of 10 years' experience in the fabrication of chemical feed systems of similar size and usage.

1.5 DELIVERY STORAGE AND HANDLING

A. All materials fabricated to this Specification must be packaged, crated, or protected in such manner so as to prevent damage in handling and while in transit. Details of these procedures shall be the responsibility of the Vendor.

1.6 SUBMITTALS

A. Review Submittals:
   1. Certified detailed process mechanical drawings with general arrangement showing the complete skid assembly with principal dimensions, weights of equipment, base plates, anchor bolt size and location.
   2. Wiring diagrams, control stations information. Identify point to point connections and field wiring requirement.
   3. Submittals as specified in Section 40 99 90, Package Control Systems.
   4. Instrument data sheets.
   5. Motor data sheets with nameplate markings which meet NEMA and CSA requirements for all motors
   6. Layout drawings of skid mounted local control panels including the door layout, interior layout clearly identifying all components with item number and Bill of Material (BOM), electrical ladder diagram, interconnects to all components of the panel, and structural and mounting details.
   7. Electrical single line diagram showing all power requirements.
   8. Manufacturer's materials compatibility information, confirming compatibility of wetted parts with specified pumped chemicals.
   9. A list of spare parts furnished.
   10. A list of special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
   11. A list of configurable parameters with factory default settings, settings as shipped, and blank spaces for each field adjustable value.
   12. Factory finish system.

B. Product Data Submittals: for each chemical feed system, submit the following
   1. Provide catalogue cuts or equipment data sheets showing the manufacturer's complete descriptive information which includes but is not limited to, product literature, pump make and model, material of construction, weight of product specifications, electrical requirements, electrical and mechanical components including instrumental and control devices.
   2. Performance data on pumps, including curves showing flow rate versus pump stroke setting (in percent) at specified maximum speed in strokes per minute and at minimum pump speed. Provide this hydraulic performance information applicable to the liquid to be pumped by each set of pumps.
   3. Pump data sheet confirming pump capacity in liters per minute and pressure in kPag, required backpressure valve setting, pumped chemical characteristics, pipe connection sizes, stroke rate, materials, testing requirements, intermediate fluid type, and appurtenances to be provided with pumps.
   4. Detailed dimensional drawings for pumps and drivers, including piping connection sizes and locations.

C. Quality Control Submittals:
   1. Factory Functional and Performance Test Reports.
   2. Field Functional and Performance Test Reports.
   3. Certificate of Proper Installation.
   4. Special shipping, storage and protection, and handling instructions.

5. Manufacturer's printed installation instructions.
6. Suggested spare parts list to maintain the equipment in service for a period of 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
7. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
8. Training Instructions, Operating and Maintenance Manuals.
9. Draft Operating and Maintenance manuals shall be submitted with the initial shop drawing submission. A draft commissioning and start up plan, and draft training material shall be submitted with the initial shop drawing submission. Provide a draft training plan with content, to be followed by a draft training manual. An approved training manual shall be in place before commissioning. No training will be conducted without an approved manual, nor will payment be approved.
10. Contract Closeout Submittals: Submit service records for repairs performed throughout the period of construction, startup and commissioning.

1.7 EXTRA MATERIALS

A. Furnish the following:
   1. One diaphragm back pressure control valve for each feed line. The valve will be installed by others near the application point
   2. One complete set of any special tools required to dismantle pump.

PART 2 PRODUCTS

2.1 GENERAL

A. Equipment and instrumentation located on the chemical feed system shall be skid mounted as shown on the referenced P&IDs, preassembled, pre-piped, prewired, and tested to the maximum extent possible.

B. Acceptable suppliers and metering pump manufacturers and representatives:
   1. Veolia Water Technologies (Pulsafeeder)
   2. Metcon Sales and Engineering Ltd. (Prominent)
   3. Mequipco Ltd. (Pusafeeder)

C. Equipment and accessories specified in this section shall be products of the same supplier for Section 46 33 42.13 Chemical Metering Gear Pumps Skids.

D. Variable frequency drives shall be provided per Section 26 29 23 and not part of the chemical metering gear pump skids scope. Furnish coordinated operating systems complete with pumps, drives, and speed controllers.

E. Service condition: Chemical feed systems will be installed in a Chemical Building, heated to 15 degrees C.

2.2 PUMPS

A. Mechanically Driven Diaphragm Pumps: positive displacement simplex, motor-driven, reciprocating, mechanically-actuated diaphragm type.

B. Pumps shall be equipped either with a manual stroke length adjusting device, adjustable with the pump operating from 0 to 100 percent of stroke length, or with a manual stroke length adjusting device, adjustable with the pump operating over a 10 to 1 capacity range. Stroke length adjustment shall be independent of stroke speed. Pump stroking speed shall varied with a variable frequency drive. Stroke speed shall be adjustable from 0 to 100 percent while the pump is idle or operating.

C. Take into account the specific gravity, viscosity, corrosivity and temperature of the fluid being pumped.

D. Provide a constant flow rate for a particular drive speed and provide linear pulsation-free output flow or mount a pulsation dampener on the discharge pipe.

E. Pump parts in contact with the chemical being pumped shall be made from materials suitable for the chemical application. Pumps selected shall come with a history of installations proven successful and reliable performance for the chemical application.

F. Provide pumps with motors suitable for inverter duty and variable frequency operation. Reference Section 26 20 00, Low Voltage AC Induction Motors for requirements

G. Combined pump, motor and variable frequency controller system to be capable of 1000:1 flow control turndowns.

2.3 PUMPS' SKID

A. Provide skid mounted chemical feed systems as shown on P&IDs. For a duplex pumps skid, maximum overall dimensions, including local control stations shall be 1.5m (W) x 1.8m (L) x 1.8m (H). For a triplex pumps skid, maximum overall dimensions, including local control stations shall be 2.0m (W) x 2.0m (L) x 2.2m (H).

B. Each pump shall be provided with a local control panel with details as per Section 2.8B and shall be mounted on the pumps skid and be accessible from the front.

C. Pumps skid shall be constructed of carbon steel with epoxy coating. If C-channels, metal clamps or hangers are used for securing equipment on the pumps skid, these must be locked tight and checked prior to shipment. Pump suction line shall sloped immediately prior to pump suction valve with the low point at pump suction valve.

D. Pumps' skids connections: one piece, molded hug type PVC, Schedule 80 flat face flange in accordance with ASTM D2466 and ASTM D2467 for socket weld type, ANSI B16.1 drilling.

E. All piping and fittings shall be Chemflare type. Piping shall be supported in accordance with relevant piping standards and shall not bear weight or horizontal thrust on the pumps.

F. All components mounted on each skid shall be easily accessible from the front of the skid. Metering pumps shall be oriented so that pump heads do not face the back of the skid. Pumps shall be installed at a height of 500mm above grade on pumps skid. Magnetic flow meters shall be installed with transmitter oriented so that it can easily be seen from the access walk way. Transmitters shall not face the back of the skid.

G. All chemical feed system pumps skids shall be provided with 6mm thick minimum translucent front doors (Lexan or approved equal in accordance with B8) with hinges and handles.

H. Local control stations shall be mounted on the skid and accessible from the front without the need to open the translucent front doors. Cut outs to the front doors shall be made to suit these local control stations for access as shown on Contract Drawings.

I. Pump accessories listed below shall be provided by the pumps' manufacturer and mounted on each skid and tested at the factory prior to shipment. Accessories for each pump to include as a minimum:
   1. Isolation valves (suction side)
   2. Strainer (suction side)
   3. Flushing connection with isolation valve (suction side)
   4. Pressure relief valve (discharge side)
   5. Isolation valves (discharge side)
   6. Ball check valve (discharge side)
   7. Flushing connection with isolation valve (discharge side)
   8. Pressure indicating transmitter with suitable diaphragm seal (discharge side upstream of ball check valve)
   9. Removable PVC or PP collection tray to be placed underneath of flushing connections for ease of maintenance.

2.4 PULSATION DAMPENERS

A. Pulsation dampeners shall be single diaphragm design and mounted on discharge piping as shown on P&IDs for pneumatic-hydraulic pulsation dampening. Size for pump stroke volume. Body material and liner/diaphragm shall be chemically inert to corrosive effects of the chemical be pumped.

B. Dampeners shall be sized for each pump maximum stroke volume so as to dampen pump flow variations by a minimum of 95 percent.

C. Equip with air charging valve.

2.5 VALVES

A. Adjustable external pressure relief (PSV) type installed on pump discharge pipeline. Materials of construction shall be compatible with Service Conditions defined in the Pump Data Sheets. Setting as noted in the Pump Data Sheets attached. Size as recommended by the manufacturer. Pressure relief valves shall be pump manufacturer's standard product.

B. Manual isolation valves shall be PVC ball valve:
   1. Rated 1,035 kPag (150 psig) at 23 degrees C (73 degrees F), with ASTM D1784, Type I, Grade 1 polyvinyl chloride body, ball and stem, end entry, double union design, solvent-weld soket ends, elastomer seat Viton seals to block flow in both directions.
   2. Manufacturers and Products:
      a. Chemline; Type 21
      b. Hayward Z-Ball True Union Valve
      c. Watts: Series TPBV-D
      d. Nibco-Chemtrol; PVC Model D

C. PVC Ball Check Valve:
   1. ASTM D1784, Type I, Grade 1 polyvinyl chloride body, dual union socket weld ends, rated 1035 kPag at 22 degrees C and Viton seat and seal.
   2. Manufacturers and Products:
      a. Chemtrol Tru Union; U45BC
      b. Hayward TC Series True Union Ball Check
      c. Chemline; Series BT-A-OXX-V-S
      d. Spears; True Union 2000 Standard Ball Valve

2.6 ELECTRICAL COMPONENTS AND ACCESSORIES

A. Components, wiring methods and standards of acceptance shall meet the requirements of all the other specifications which form part of the overall contract. This includes, but is not limited to Section 26 05 01 and Section 26 20 00.

B. All components and assemblies shall be CSA or cUL rated. IEC rated components are not acceptable.

C. All wiring shall be RW 90, copper and shall be installed in rigid aluminum conduit or liquid tight flexible aluminum conduit. In lien of RW90 in conduit, Teck 90 cables may be installed.Aluminum armored, type Teck 90 cableswith copper conductors may be installed where applicable..Armored cabling shall be properly secured to the skid / frame structure in a neat and professional manner. Cabling shall be run such that it does not interfere with the operation or maintenance of the systems (i.e. shall not block or obstruct maintenance or repair of the system). Cabling shall be secured in accordance with Code requirements.

D. All wiring shall be a type recognized by the CEC permitted for the application.

E. All work shall be in compliance with the CEC.

F. Exposed hardware, fittings and enclosures shall be aluminum, hot-dip galvanized steel or stainless steel. Electroplated steel maybe used when protected inside waterproof enclosures.

G. All enclosures shall be NEMA 4X, corrosion resistant, sealed and gasketted.

H. All components shall be identified with engraved phenolic labels attached with stainless steel screws. All wiring shall be identified at both ends with heat shrink or snap-on labels. Adhesive attached labels or wire markers are not acceptable.

2.7 STROKE LENGTH ADJUSTMENT

A. Manual Stroke Length Adjustment: Provide manual stroke length adjustment through adjustment knob on unit that provides adjustment accuracy of 1 percent. Adjustment shall be self-locking, and shall be operable whether or not pump is running.

2.8 INSTRUMENTATION AND CONTROL SYSTEM

A. The provision of the VFDs and PLC interface will be by others.

B. Local control panels: One per pump
   1. Enclosure:
      a. Materials: Type 304 stainless steel.
      b. Ingress Protection: NEMA 4X.
      c. Location: Skid mounted with pumps
   2. Provide the operator controls listed below on the local control station for each chemical feed pump:
      a. HAND/OFF/REMOTE hand switch
      b. Speed adjustment knob (1 to 10 kΩ variable resistor).
      c. EMERGENCY STOP push button
   3. Provide an additional EMERGENCY STOP push button mounted at the back of the skid and wired in conduit to the local control panel.

C. Provide wiring and terminals as per the motor schematic and wiring drawings. All signals shall be terminated on clearly marked terminal blocks for connection to external system. Label devices as per the drawings.

D. Instrumentation:
   1. Refer to 40 91 01 Instrumentation and Control Components for requirements.
   2. Flow meters shall be magnetic flow meter type.
      a. Provide flow tube suitable for flow rate and chemical
      b. Flow meters shall be Siemens MAG 1100 with MAG6000 transmitter. No alternates will be accepted.
      c. Install magnetic flow meters as per manufacturer's installation requirements.

2.9 APPURTENANCES

A. Provide valves, instrumentation and pipe connections for each pump skid as shown on Contract Drawings.

B. Equipment Identification Plate: 1.5 mm stainless steel with 6 mm die-stamped equipment tag number securely mounted in a readily visible location.

C. Lifting Lugs: Equipment weighing over 45 kg.

D. Anchor Bolts: sized by equipment manufacturer and as specified in Section 05 50 00, Metal Fabrications (Basic). Coat in accordance with Section 09 90 00, Painting and Coating.

E. Gauge Connections: Tapped and plugged suction and discharge gauge connections on piping headers adjacent to pumps.

F. Screens or Guards: Mesh size of less than 13 mm, exposed rotating shafts, rotors, couplings, pulley, wheel, bolts, chains, or similar components. Where guards/screens are over grease fittings, couplings, or other items requiring maintenance, provide a means for ready access.

G. Calibrated Cylinder: Graduated in 50 mL increments, constructed of clear polypropylene and PVC with ball type shutoff valve. Calibration cylinders shall be sized to provide capacity for at least a 30-second drawdown test for pumps greater than 7.6 LPH. For pumps less than 7.6 LPH capacity, provide 60-second capacity.

2.10 FACTORY FINISHING

A. Prepare, prime, and finish coat in accordance with System No. 4:
1. System No. 4 Exposed Metal – Highly Corrosive:

Surface Preparation	Paint Material	Minimum Coats, Coverage
SP-10, near-white blast cleaning	Epoxy primer, ferrous metal	1 coat, 2.5 MDFT
	Polyamide High Build Epoxy	2 coats, 7 MDFT
	Polyurethane enamel	1 coat, 3 MDFT

B. Equipment Supplier standard coating and linings maybe substituted for the specified coating system if they are of similar quality to the specified system and subject to Contract Administrator approval.

C. Stainless steel and plastic surfaces shall not be coated unless otherwise specified.

2.11 SOURCE QUALITY CONTROL

A. Factory Inspections: Inspect local control stations for required construction, electrical connection, and intended function.

B. Factory Tests and Adjustments: Test all equipment and local control stations furnished together in their completed state.

C. Factory Test Report: Include test data sheets.

D. Functional Test: Perform manufacturer's standard test on equipment.

PART 3 EXECUTION

3.1 INSTALLATION

A. All piping, appurtenances, and instruments specified herein as part of the skid mounted systems shall be installed by the Vendor. Systems shall be provided with specific piping

connection points at the limits of the skids for connection of facility piping as specified on Contract Drawings. All equipment shall be locked tight to skids.

B. Mount local control stations as shown on the Contract Drawings.

C. Anchor Bolts: Accurately place using equipment templates.

3.2 FIELD FINISHING

A. Equipment as specified in Section 09 90 00, Painting and Coating.

3.3 FIELD QUALITY CONTROL

A. Conduct tests on each pump.

B. Functional Test:
   1. Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.

C. Performance Test:
   1. Perform under actual or approved simulated operating conditions.
   2. Test for a continuous 3-hour period without malfunction.

3.4 CONTRACTOR’S SERVICES

A. Contractor's Representative: Present at Site or classroom designated by the City for minimum person-days listed below, travel time excluded:
   1. Two (2) person-days per chemical system for installation assistance and inspection.
   2. One (1) person-day per chemical system for functional and performance testing and completion of Contractor's Certificate of Proper Installation.
   3. Two (2) person-days per chemical system for facility startup.
   4. One (1) person-day per chemical system for training of the City's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by the City.

B. Allow for a minimum of one trip per chemical system.

C. Startup services shall be at such times as requested by Contractor and as approved by the City.

D. Training of the City’s personnel shall be at such times as requested by the City.

E. See Section 01 43 33, Contractor Field Services and Section 01 91 14, Equipment Testing and Facility Startup.

3.5 SUPPLEMENTS

A. Supplement listed below, following "End of Section," are part of this Specification.
   1. Ferric Chloride Pump Skid No. 1 & 2 (S-C110-1, S-C110-2) – Data Sheet
   2. Ferric Chloride Pump Skid No. 3 & 4 (S-C120, S-C130) – Data Sheet

END OF SECTION

FERRIC CHLORIDE (40%) FEED PUMPS

FERRIC CHLORIDE PUMP SKID NO. 1 & 2 (S-C110-1, S-C110-2) – DATA SHEET

No. of Pumps: 6

Tag Numbers: P-C111, P-C112, P-C113, P-C114, P-C115 & P-C116

Pump Name: Bioreactor Ferric Chloride Feed Pump

Manufacturer and Model Number: Pulsafeeder, Oberdorfer, Prominent

SERVICE CONDITIONS

Liquid Pumped (Material and Percent): Ferric Chloride (40%)

Pumping Temperature (Fahrenheit): Normal: 2-10 deg C Max 35 deg C Min 0 deg C

Fluid Specific Gravity: 1.38-1.42

Fluid Viscosity at min temp: 10 cps

Liquid pH: < 2.0

Abrasive (Y/N) N Possible Scale Buildup (Y/N): N

Min NPSHa, absolute (kPa) : 170

Altitude (m msl): m Area Classification: Non-hazardous

Location (indoor/outdoor): Indoor

Minimum discharge pressure required, gauge (kPag): 345

PERFORMANCE REQUIREMENTS

Capacity (L/min): 0.0.6 to 4.6 Rated discharge pressure, gauge (kPag): 345

Maximum pump speed at rated capacity (strokes/min): __

Normal Operating Pressure (kPa): 345

Back Pressure Control Valve Set Pressure, gauge (kPag): ___

External Hydraulic Bypass Relief Valve Set Pressure, gauge (kPag): 518

DESIGN AND MATERIALS (Manufacturer to supply missing data)

NPSHr (psig): 5

Pump Type: Single Diaphragm (Y/N) Y

Tubular (double) Diaphragm (Y/N) _____ Other _____

Wet End Material: PVC Tubular Diaphragm Housing Material: _____

Check Valve Material: PVC Configuration (Single/Double): _____

Diaphragm Material: Teflon Primary: _____ Tubular: _____

Calibration Cylinder: Quantity: 1 Material: PVC Units: milliliters Capacity: 5000ml

Diaphragm Actuation Type: Mechanical Y Solenoid _____

Stroke Position Adjustment: Manual Y Automatic _____

Pump Speed Control: Constant Variable Y

Adjustable Speed Drive, see Section 26 29 23, Variable Frequency Drive

DRIVE MOTOR (Manufacturer to supply missing data)

Max Horsepower (kW): 0.75 Voltage: 120 Phase: 1 Synchronous Speed (rpm)_____

Service Factor: 1.15

Motor nameplate horsepower shall not be exceeded at any head-capacity point on pump curve.

Enclosure: DIP _____ EXP _____ ODP _____ TEFC _____ CISD-TEFC Y
TENV _____WPI _____ WPII _____ SUBM _____

TESTING

Pump Tests: Factory Functional (Y/N) Y Factory Performance (Y/N) N

Field Functional (Y/N) Y Field Performance (Y/N) Y

Motor Test: Short Commercial (Y/N) Y Other_____

REMARKS:

FERRIC CHLORIDE (40%) FEED PUMPS

FERRIC CHLORIDE PUMP SKID NO. 3 & 4 (S-C120, S-C130) – DATA SHEET

No. of Pumps: 6

Tag Numbers: P-C121, P-C122, P-C123, P-C131, P-C132 & P-C133

Pump Name: HRC Ferric Chloride Feed Pump

Manufacturer and Model Number: Pulsafeeder, Oberdorfer, Prominent

SERVICE CONDITIONS

Liquid Pumped (Material and Percent): Ferric Chloride (40%)

Pumping Temperature (Fahrenheit): Normal: 2-10 deg C Max 35 deg C Min 0 deg C

Fluid Specific Gravity: 1.38-1.42

Fluid Viscosity at min temp: 10 cps

Liquid pH: < 2.0

Abrasive (Y/N) N Possible Scale Buildup (Y/N): N

Min NPSHa, absolute (kPa) : 170

Altitude (m msl): m Area Classification: Non-hazardous

Location (indoor/outdoor): Indoor

Minimum discharge pressure required, gauge (kPag): 345

PERFORMANCE REQUIREMENTS

Capacity (L/min): 0.36 to 7.4 Rated discharge pressure, gauge (kPag): 345

Maximum pump speed at rated capacity (strokes/min): __

Normal Operating Pressure (kPa): 345

Back Pressure Control Valve Set Pressure, gauge (kPag): ___

External Hydraulic Bypass Relief Valve Set Pressure, gauge (kPag): 518

DESIGN AND MATERIALS (Manufacturer to supply missing data)

NPSHr (psig): 5

Pump Type: Single Diaphragm (Y/N) Y

Tubular (double) Diaphragm (Y/N) _____ Other _____

Wet End Material: PVC Tubular Diaphragm Housing Material: _____

Check Valve Material: PVC Configuration (Single/Double): _____

Diaphragm Material: Teflon Primary: _____ Tubular: _____

Calibration Cylinder: Quantity: 1 Material: PVC Units: milliliters Capacity: 5000ml

Diaphragm Actuation Type: Mechanical Y Solenoid _____

Stroke Position Adjustment: Manual Y Automatic _____

Pump Speed Control: Constant Variable Y

Adjustable Speed Drive, see Section 26 29 23, Variable Frequency Drive

DRIVE MOTOR (Manufacturer to supply missing data)

Max Horsepower (kW): 0.75 Voltage: 120 Phase: 1 Synchronous Speed (rpm)_____ Service Factor: 1.15

Motor nameplate horsepower shall not be exceeded at any head-capacity point on pump curve.

Enclosure: DIP _____ EXP _____ ODP _____ TEFC _____ CISD-TEFC Y
TENV _____WPI _____ WPII _____ SUBM _____

TESTING

Pump Tests: Factory Functional (Y/N) Y Factory Performance (Y/N) N

Field Functional (Y/N) Y Field Performance (Y/N) Y

Motor Test: Short Commercial (Y/N) Y Other_____

REMARKS:

SECTION 46 33 42.13

CHEMICAL METERING GEAR PUMP SKIDS

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Section 26 05 01, Common Work Results

B. Section 26 20 00, Low Voltage AC Induction Motor

C. Section 26 29 23, Variable Frequency Drives

1.2 SUMMARY OF WORK

A. The work of this Section includes design, fabrication, factory testing, installation and on Site testing/commissioning/training of the following skid mounted chemical feed systems complete with local control stations as specified herein. Limits of packages to be supplied by the Vendor are referenced within the boundary of the chemical skids as listed below:

Chemical Skid	**No. Pumps**	**Flow**	**Tag Numbers**	**Reference P&ID No.**
Sodium Hydroxide Pump Skid (insulate & heat trace)	2 (1 duty, 1 standby)	0.02-3.2 L/min	P-C231, P-C232	1-0102-PPID-C202
Sodium Hypochlorite Pump Skid No. 1	2 (1 duty, 1 standby)	0.04-0.4 L/min	P-C241, P-C242	1-0102-PPID-C203
Sodium Hypochlorite Pump Skid No. 2	2 (1 duty, 1 standby)	8.0-11.9 L/min	P-C211, P-C212	1-0102-PPID-C204
Sodium Hypochlorite Pump Skid No. 3	3 (2 duty, 1 standby)	1.2-19.6 L/min	P-C221, P-C222, C223	1-0102-PPID-C205
Sodium Bisulphite Pump Skid (insulate and heat trace)	2 (1 duty, 1 standby)	0.3-6.6 L/min	P-C311, P-C312	1-0102-PPID-C301

B. Unit Responsibility: The work requires that the chemical feed systems listed above be skid mounted by the Vendor, complete with pumps, motors, piping, valves, control stations and all

associated instrumentation and accessories as shown on the referenced P&IDs be the end product of one responsible system Vendor. The Vendor shall furnish all components and accessories of the chemical system as necessary to ensure compatibility, ease of operation and maintenance and to place the system into operation in conformance with the specified performance, features, and functions.

C. See P&IDs referenced above for the chemical feed system's supply details.

D. Equipment and accessories specified in this section shall be products of the same manufacturer for Section 46 33 42 Chemical Metering Diaphragm Pump Skids.

1.3 REFERENCE CODES AND STANDARDS

A. All Work and materials shall comply with the Canadian Electrical Code and all applicable local regulations and ordinances. All panels and enclosures shall be provided with labels from either the Canadian Standard Association (CSA) or the Underwriter Laboratories of Canada (ULC or cUL).

B. The following is a list of standards and standards organizations which may be referenced in this section:
   1. Institute of Electrical and Electronics Engineers (IEEE): 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
   2. Hydraulic Institute Standards.
   3. National Electrical Manufacturer's Association (NEMA): MG 1, Motors and Generators.
   4. American Society of Mechanical Engineers (ASME):
      a. B31.1, Power Piping
      b. B31.3, Process Piping
   5. Canadian Electrical Code (CEC).
   6. Nationally Recognized Testing Laboratories (NRTL).
   7. Occupational Safety and Health Administration (OSHA).
   8. The Canadian Standards Association (CSA).
   9. Underwriters Laboratories Inc. of Canada (ULC).
   10. Manitoba Building Code (MBC).
   11. Electrical Equipment Manufacturer's Association of Canada (EEMAC).

C. All electrical components shall be CSA or cUL approved.

1.4 DEFINITIONS

A. Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards.

1.5 QUALITY ASSURANCE

A. The essential parts of all equipment of the chemical feed systems shall be made by manufacturers who have a minimum of five (5) years of experience in the design, construction and operation of such equipment for the intended use in water/wastewater facilities.

B. Chemical feed systems shall be furnished, coordinated, and tested by one Vendor. Systems shall be completely shop assembled, skid mounted, and shop tested prior to shipment. Interconnecting piping and wiring shall be contained complete within the skids limits.

C. Fabricator's Quality Assurance Supervisor: Minimum of 10 years' experience in the fabrication of chemical feed systems of similar size and usage.

1.6 DELIVERY STORAGE AND HANDLING

A. All materials fabricated to this Specification must be packaged, crated, or protected in such manner so as to prevent damage in handling and while in transit. Details of these procedures shall be the responsibility of the Vendor.

1.7 SUBMITTALS

A. Review Submittals:
1. Certified detailed process mechanical drawings with general arrangement showing the complete skid assembly with principal dimensions, weights of equipment, base plates, anchor bolt size and location.
2. Wiring diagrams, control stations information. Identify point to point connections and field wiring requirement.
3. Submittals as specified in Section 40 99 90, Package Control Systems.
4. Instrument data sheets.
5. Motor data sheets with nameplate markings which meet NEMA and CSA requirements for all motors
6. Layout drawings of skid mounted local control panels including the door layout, interior layout clearly identifying all components with item number and Bill of Material (BOM), electrical ladder diagram, interconnects to all components of the panel, and structural and mounting details.
7. Electrical single line diagram showing all power requirements.
8. Manufacturer's materials compatibility information, confirming compatibility of wetted parts with specified pumped chemicals.
9. A list of spare parts furnished.
10. A list of special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
11. A list of configurable parameters with factory default settings, settings as shipped, and blank spaces for each field adjustable value.
12. Factory finish system.

B. Product Data Submittals: for each chemical feed system, submit the following
1. Provide catalogue cuts or equipment data sheets showing the manufacturer's complete descriptive information which includes but is not limited to, product literature, pump make and model, material of construction, weight of product specifications, electrical requirements, electrical and mechanical components including instrumental and control devices.
2. Performance data on pumps, including curves showing flow rate versus pump stroke setting (in percent) at specified maximum speed in strokes per minute and at minimum

pump speed. Provide this hydraulic performance information applicable to the liquid to be pumped by each set of pumps.

3. Pump data sheet confirming pump capacity in litres per minute and pressure in kPag, required backpressure valve setting, pumped chemical characteristics, pipe connection sizes, stroke rate, materials, testing requirements, intermediate fluid type, and appurtenances to be provided with pumps.
4. Detailed dimensional drawings for pumps and drivers, including piping connection sizes and locations.

C. Quality Control Submittals:
1. Factory Functional and Performance Test Reports.
2. Field Functional and Performance Test Reports.
3. Certificate of Proper Installation.
4. Special shipping, storage and protection, and handling instructions.
5. Manufacturer's printed installation instructions.
6. Suggested spare parts list to maintain the equipment in service for a period of 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
7. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
8. Training Instructions, Operating and Maintenance Manuals.
9. Draft Operating and Maintenance manuals shall be submitted with the initial Shop Drawing submission. A draft commissioning and start up plan, and draft training material shall be submitted with the initial Shop Drawing submission. Provide a draft training plan with content, to be followed by a draft training manual. An approved training manual shall be in place before commissioning. No training will be conducted without an approved manual, nor will payment be approved.
10. Contract Closeout Submittals: Submit service records for repairs performed throughout the period of construction, startup and commissioning.

1.8 EXTRA MATERIALS

A. Furnish for each set of pumps the following extra materials:
1. Complete set of bearings.
2. Complete set of gaskets and O-ring seals
3. Complete set of keys, dowels, pins, etc.
4. One set of gear impellers
5. One complete set of any special tools required to dismantle pump.

PART 2 PRODUCTS

2.1 GENERAL

A. Equipment and instrumentation located on the chemical feed system shall be skid mounted as shown on the referenced P&IDs, preassembled, pre-piped, prewired, and tested to the maximum extent possible.

B. Acceptable metering pump manufacturers and representatives:
   1. Veolia Water Technologies (Pulsafeeder)
   2. Metcon Sales and Engineering Ltd. (Tuthill)
   3. Mequipco Ltd. (Oberdorfer)

C. Equipment and accessories specified in this section shall be products of the same manufacturer for Section 46 33 42.13 Chemical Metering Gear Pumps Skids.

D. Variable frequency drives shall be provided per Section 26 29 23 and not part of the chemical metering gear pump skids scope. Furnish coordinated operating systems complete with pumps, drives, and speed controllers.

E. Service condition: Chemical feed systems will be installed in a Chemical Building, heated to 15 degrees C.

2.2 PUMPS

A. Type of pumps: magnetically coupled and driven, gear type pumps compatible with the chemical being pumped.

B. Pumps shall provide a constant flow rate for a particular drive speed and provide linear pulsation-free output flow. Pumps' speed shall be kept at a maximum of 1750rpm.

C. Pump parts in contact with the chemical being pumped shall be made from non-metallic materials suitable for the chemical application. Pumps selected shall come with a history of installations proven successful and reliable performance for the chemical application.

D. Provide pumps with motors suitable for inverter duty and variable frequency operation. Reference Section 26 20 00, Low Voltage AC Induction Motors for requirements. Motors speed shall be 1750 rpm or less.

E. Combined pump, motor and variable frequency controller system to be capable of 100:1 flow control turndowns and accuracy of plus 5 percent of the full range of the pump package.

2.3 PUMPS' SKID

A. Provide skid mounted chemical feed systems as shown on P&IDs. For a duplex pumps skid, maximum overall dimensions, including pumps local control panels shall be 1.5m (W) x 1.8m (L) x 1.8m (H). For a triplex pumps skid, maximum overall dimensions, including local control panels shall be 2.0m (W) x 2.0m (L) x 2.2m (H).

B. Each pump shall be provided with a local control panel with details as per Section 2.6A and shall be mounted on the pumps skid and be accessible from the front.

C. Pumps skid shall be constructed of carbon steel with epoxy coating. If C-channels, metal clamps or hangers are used for securing equipment on the pumps skid, these must be locked tight and checked prior to shipment. Pump suction line shall sloped immediately prior to pump suction valve with the low point at pump suction valve.

D. Pumps' skids connections: one piece, molded hug type PVC, Schedule 80 flat face flange in accordance with ASTM D2466 and ASTM D2467 for socket weld type, ANSI B16.1 drilling.

E. All piping and fittings shall be Chemflare type. Piping shall be supported in accordance with relevant piping standards and shall not bear weight or horizontal thrust on the pumps.

F. All components mounted on each skid shall be easily accessible from the front of the skid. Metering pumps shall be oriented so that pump heads do not face the back of the skid. Pumps shall be installed at a height of 500mm above grade on pumps skid. Magnetic flow meters shall be installed with transmitter oriented so that it can easily be seen from the access walk way. Transmitters shall not face the back of the skid.

G. All chemical feed system pumps skids shall be provided with 6mm thick minimum translucent front doors (Lexan or approved equal in accordance with B8) with hinges and handles. For sodium hypochlorite pumps skids, translucent doors with hinges and handles shall also be provided for the two sides.

H. Local control panels for pumps shall be mounted on the skid and accessible from the front without the need to open the translucent front doors. Cut outs to the front doors shall be made to suit these local control panels for access.

I. Pump accessories listed below shall be provided by the pumps' manufacturer and mounted on each skid and tested at the factory prior to shipment. Accessories for each pump to include as a minimum:
   1. Isolation valves (suction side)
   2. Strainer (suction side)
   3. Flushing connection with isolation valve (suction side)
   4. Pressure relief valve (discharge side)
   5. Isolation valves (discharge side)
   6. Ball check valve (discharge side)
   7. Flushing connection with isolation valve (discharge side)
   8. Pressure indicating transmitter with suitable diaphragm seal (discharge side upstream of ball check valve)

2.4 VALVES

A. Adjustable external pressure relief (PSV) type installed on pump discharge pipeline. Materials of construction shall be compatible with Service Conditions defined in the Pump Data Sheets. Setting as noted in the Pump Data Sheets attached. Size as recommended by the manufacturer. Pressure relief valves shall be pump manufacturer's standard product.

B. Manual isolation valves shall be PVC ball valve:
   1. Rated 1,035 kPag (150 psig) at 23 degrees C (73 degrees F), with ASTM D1784, Type I, Grade 1 polyvinyl chloride body, ball and stem, end entry, double union design, solvent-weld soket ends, elastomer seat Viton seals to block flow in both directions.
   2. Manufacturers and Products:
      a. Chemline; Type 21
      b. Hayward Z-Ball True Union Valve
      c. Watts: Series TPBV-D

d. Nibco-Chemtrol; PVC Model D

C. PVC Ball Check Valve:
1. ASTM D1784, Type I, Grade 1 polyvinyl chloride body, dual union socket weld ends, rated 1035 kPag at 22 degrees C and Viton seat and seal.
2. Manufacturers and Products:
a. Chemtrol Tru Union; U45BC
b. Hayward TC Series True Union Ball Check
c. Chemline; Series BT-A-OXX-V-S
d. Spears; True Union 2000 Standard Ball Valve

2.5 ELECTRICAL COMPONENTS AND ACCESSORIES

A. Components, wiring methods and standards of acceptance shall meet the requirements of all the other specifications which form part of the overall contract. This includes, but is not limited to Section 26 05 01 and Section 26 20 00.

B. All components and assemblies shall be CSA or cUL rated. IEC rated components are not acceptable.

C. All wiring shall be RW 90, copper and shall be installed in rigid aluminum conduit or liquid tight flexible aluminum conduit. In lien of RW90 in conduit, Teck 90 cables may be installed. Aluminum armored, type Teck 90 cableswith copper conductors may be installed where applicable..Armored cabling shall be properly secured to the skid / frame structure in a neat and professional manner. Cabling shall be run such that it does not interfere with the operation or maintenance of the systems (ie/ shall not block or obstruct maintenance or repair of the system). Cabling shall be secured in accordance with Code requirements.

D. All wiring shall be a type recognized by the CEC permitted for the application.

E. All work shall be in compliance with the CEC.

F. Exposed hardware, fittings and enclosures shall be aluminum, hot-dip galvanized steel or stainless steel. Electroplated steel maybe used when protected inside waterproof enclosures.

G. All enclosures shall be NEMA 4X, corrosion resistant, sealed and gasketted.

H. All components shall be identified with engraved phenolic labels attached with stainless steel screws. All wiring shall be identified at both ends with heat shrink or snap-on labels. Adhesive attached labels or wire markers are not acceptable.

2.6 INSTRUMENTATION AND CONTROL SYSTEM

A. The provision of the VFDs and PLC interface will be by others.

B. Local control panels: One per pump
1. Enclosure:
a. Materials: Type 304 stainless steel.
b. Ingress Protection: NEMA 4X.

c. Location: Skid mounted with pumps
2. Provide the operator controls listed below on the local control station for each chemical feed pump:
   a. HAND/OFF/REMOTE hand switch
   b. Speed adjustment knob (1 to 10 kΩ variable resistor).
   c. EMERGENCY STOP push button
3. Provide an additional EMERGENCY STOP push button mounted at the back of the skid and wired in conduit to the local control panel.

C. Provide wiring and terminals as per the motor schematic and wiring drawings. All signals shall be terminated on clearly marked terminal blocks for connection to external system. Label devices as per the Drawings.

D. Instrumentation:
1. Refer to 40 91 01 Instrumentation and Control Components for requirements.
2. Flow meters shall be magnetic flow meter type.
   a. Provide flow tube suitable for flow rate and chemical
   b. Flow meters shall be Siemens MAG 1100 with MAG6000 transmitter. No alternates will be accepted.
   c. Install magnetic flow meters as per manufacturer's installation requirements.

2.7 APPURTENANCES

A. Provide valves, instrumentation and pipe connections for each pump skid as shown on Contract Drawings.

B. Equipment Identification Plate: 1.5 mm stainless steel with 6 mm die-stamped equipment tag number securely mounted in a readily visible location.

C. Lifting Lugs: Equipment weighing over 45 kg.

D. Anchor Bolts: sized by equipment manufacturer and as specified in Section 05 50 00, Metal Fabrications (Basic). Coat in accordance with Section 09 90 00, Painting and Coating.

E. Gauge Connections: Tapped and plugged suction and discharge gauge connections on piping headers adjacent to pumps.

F. Screens or Guards: Mesh size of less than 13 mm, exposed rotating shafts, rotors, couplings, pulley, wheel, bolts, chains, or similar components. Where guards/screens are over grease fittings, couplings, or other items requiring maintenance, provide a means for ready access.

2.8 FACTORY FINISHING

A. Prepare, prime, and finish coat in accordance with System No. 4:
   1. System No. 4 Exposed Metal – Highly Corrosive:

Surface Preparation	Paint Material	Minimum Coats, Coverage
SP-10, near-white blast cleaning	Epoxy primer, ferrous metal	1 coat, 2.5 MDFT
	Polyamide High Build Epoxy	2 coats, 7 MDFT
	Polyurethane enamel	1 coat, 3 MDFT

B. Equipment Supplier standard coating and linings maybe substituted for the specified coating system if they are of similar quality to the specified system and subject to Contract Administrator approval.

C. Stainless steel and plastic surfaces shall not be coated unless otherwise specified.

2.9 SOURCE QUALITY CONTROL

A. Factory Inspections: Inspect local control stations for required construction, electrical connection, and intended function.

B. Factory Tests and Adjustments: Test all equipment and control stations furnished together in their completed state.

C. Factory Test Report: Include test data sheets.

D. Functional Test: Perform manufacturer's standard test on equipment.

PART 3 EXECUTION

3.1 INSTALLATION

A. All piping, appurtenances, and instruments specified herein as part of the skid mounted systems shall be installed by the Vendor. Systems shall be provided with specific piping connection points at the limits of the skids for connection of facility piping as specified on Contract Drawings. All equipment shall be locked tight to skids.

B. Mount local control stations as shown on the Contract Drawings.

C. Anchor Bolts: Accurately place using equipment templates.

3.2 FIELD FINISHING

A. Equipment as specified in Section 09 90 00, Painting and Coating.

3.3 FIELD QUALITY CONTROL

A. Conduct tests on each pump.

B. Functional Test:
   1. Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.

C. Performance Test:
   1. Perform under actual or approved simulated operating conditions.
   2. Test for a continuous 3-hour period without malfunction.

3.4 CONTRACTOR'S SERVICES

A. Contractor's Representative: Present at Site or classroom designated by the City for minimum person-days listed below, travel time excluded:
   1. Two (2) person-days per chemical system for installation assistance and inspection.
   2. One (1) person-day per chemical system for functional and performance testing and completion of Contractor's Certificate of Proper Installation.
   3. Two (2) person-days per chemical system for facility startup.
   4. One (1) person-day per chemical system for training of the City's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by the City.

B. Allow for a minimum of one trip per chemical system.

C. Startup services shall be at such times as requested by Contractor and as approved by the City.

D. Training of the City's personnel shall be at such times as requested by the City.

E. See Section 01 43 33, Contractor Field Services and Section 01 91 14, Equipment Testing and Facility Startup.

3.5 SUPPLEMENTS

A. Supplement listed below, following "End of Section," are part of this Specification.
   1. Sodium Hydroxide Pump Skid (S-C230) – Data Sheet
   2. Sodium Hypochlorite Pump Skid No. 1 (S-C240) – Data Sheet
   3. Sodium Hypochlorite Pump Skid No. 2 (S-C210) – Data Sheet
   4. Sodium Hypochlorite Pump Skid No. 3 (S-C220) – Data Sheet
   5. Sodium Bisulphite Pump Skid (S-C310) – Data Sheet

END OF SECTION

SODIUM HYDROXIDE PUMP SKID (S-C230) – DATA SHEET

No. of Pumps: 2

Tag Numbers: P-C231, P-C232

Pump Name: Sodium Hydroxide Pump

Manufacturer and Model Number: Pulsafeeder, Oberdorfer, Tuhill

SERVICE CONDITIONS:

Liquid Pumped (Percent): Sodium Hydroxide

Pumping Temperature (Celcius): Normal: 20 deg C Max 35 deg C
Min 15 deg C

Fluid Specific Gravity: 1.53

Fluid Viscosity at min temp: 10

Liquid pH: 13.7

Abrasive (Y/N) N Possible Scale Buildup (Y/N): Y

Min NPSHa (kPa) : _____

Altitude (m): _____ Area Classification: Non-Hazardous

Location (indoor/outdoor): Indoor

Minimum discharge pressure required, gauge (kPag): _____

PERFORMANCE REQUIREMENTS:

Capacity (L/min): 0.02 to 3.2 Rated discharge pressure, gauge (kPag): 345

Maximum pump speed at rated capacity (rpm): 1750

Normal Operating Pressure, gauge (kPag): 345

External Hydraulic Bypass Relief Valve Set Pressure, gauge (kPag): 518

DESIGN AND MATERIALS (Manufacturer to supply missing data):

Foot Mounted (Y/N):_____ Bracket Mounted (Y/N): Y_____
Centerline Case (Y/N): _____Near Centerline Case (Y/N): _____
Pump Shaft Diameter (mm): _____
Suction Orientation:_____ Rotation (view from end of coupling): _____
Internal Gear (Y/N): Y_____ External Gear (Y/N):_____
Casing Materials: _____
Gland Type Material:_____
Gland Plate Taps Required: [Quench] [Draw] [Flush] [Vent]
Shaft Material:_____ Shaft Sleeve Material: _____
Shaft Seals: Packing:_____ Material:__ Size/No. Rings: _____
Mechanical (Y/N) _____ Type: _____
Lubrication: _____Oil___
Bearing Type/No.: Radial:_____ Thrust: _____

ABMA B-10 Bearing Life (hrs):_____100,000_____ Lubrication: _____
Coupling: Falk (Y/N)_____ Fast (Y/N):_____ Spring-Grid (Y/N): ____
Gear Type (Y/N):_____Spacer (Y/N):_____ Manufacturer: ____
Standard (Y/N):_____
Driver Half Coupling Mounted by: Pump Mfr.
Baseplate: Design:_____Material: _____
Pump Control: Constant:_____ Variable: Y____
Vent and Drain Connections Tapped and Plugged (Y/N): Y__
Suction and Discharge Gauge Connections Tapped and Plugged (Y/N): Y_____
Adjustable Speed Drive, see Section 26 29 23, Variable Frequency Drive.

DRIVE MOTOR (Manufacturer to supply missing data):

Max Horsepower (kW): 0.375 Voltage: 575 Phase: 3 Synchronous Speed (rpm) 1750 Service Factor: 1.15

Motor nameplate horsepower shall not be exceeded at any head-capacity point on pump curve.

Enclosure: DIP _____ EXP _____ ODP _____ TEFC _____ CISD-TEFC Y
TENV _____WPI _____ WPII _____ SUBM _____

TESTING:

Pump Tests: Factory Functional (Y/N) Y Factory Performance (Y/N) N

Field Functional (Y/N) Y Field Performance (Y/N) Y

Motor Test: Short Commercial (Y/N) Y Other _____

REMARKS:

_____

SODIUM HYPOCHLORITE PUMP SKID NO. 1 (S-C240) – DATA SHEET

No. of Pumps: 2

Tag Numbers: P-C241, P-C242

Pump Name: Sodium Hypochlorite Pump

Manufacturer and Model Number: Pulsafeeder, Oberdorfer, Tuhill

SERVICE CONDITIONS:

Liquid Pumped (Percent): Sodium Hypochlorite

Pumping Temperature (Celcius): Normal: 10 deg C Max 35 deg C
Min 5 deg C

Fluid Specific Gravity: 1.17

Fluid Viscosity at min temp: 10

Liquid pH: 11-14

Abrasive (Y/N) N Possible Scale Buildup (Y/N): N

Min NPSHa (kPa) : _____

Altitude (m): _____ Area Classification: Non-Hazardous

Location (indoor/outdoor): Indoor

Minimum discharge pressure required, gauge (kPag): _____

PERFORMANCE REQUIREMENTS:

Capacity (L/min): 0.04-0.4 Rated discharge pressure, gauge (kPag): 900

Maximum pump speed at rated capacity (rpm): 1750

Normal Operating Pressure, gauge (kPag): 900

External Hydraulic Bypass Relief Valve Set Pressure, gauge (kPag): 1350

DESIGN AND MATERIALS (Manufacturer to supply missing data):

Foot Mounted (Y/N):_____ Bracket Mounted (Y/N): Y_____
Centerline Case (Y/N): _____Near Centerline Case (Y/N): _____
Pump Shaft Diameter (mm): _____
Suction Orientation:_____ Rotation (view from end of coupling): _____
Internal Gear (Y/N): Y_____ External Gear (Y/N):_____
Casing Materials: _____
Gland Type Material:_____
Gland Plate Taps Required: [Quench] [Draw] [Flush] [Vent]
Shaft Material:_____ Shaft Sleeve Material: _____
Shaft Seals: Packing:_____ Material:__ Size/No. Rings: _____
Mechanical (Y/N) _____ Type: _____
Lubrication: _____Oil___
Bearing Type/No.: Radial:_____ Thrust: _____

ABMA B-10 Bearing Life (hrs):_____100,000_____ Lubrication: _____
Coupling: Falk (Y/N)_____ Fast (Y/N):_____ Spring-Grid (Y/N): ____
Gear Type (Y/N):_____Spacer (Y/N):_____ Manufacturer: ____
Standard (Y/N):_____
Driver Half Coupling Mounted by: Pump Mfr.
Baseplate: Design:_____Material: _____
Pump Control: Constant:_____ Variable: Y____
Vent and Drain Connections Tapped and Plugged (Y/N): Y__
Suction and Discharge Gauge Connections Tapped and Plugged (Y/N): Y_____
Adjustable Speed Drive, see Section 26 29 23, Variable Frequency Drive.

DRIVE MOTOR (Manufacturer to supply missing data):

Max Horsepower (kW): 0.375 Voltage: 575 Phase: 3 Synchronous Speed (rpm) 1750 Service Factor: 1.15

Motor nameplate horsepower shall not be exceeded at any head-capacity point on pump curve.

Enclosure: DIP _____ EXP _____ ODP _____ TEFC _____ CISD-TEFC Y
TENV _____WPI _____ WPII _____ SUBM _____

TESTING:

Pump Tests: Factory Functional (Y/N) Y Factory Performance (Y/N) N

Field Functional (Y/N) Y Field Performance (Y/N) Y

Motor Test: Short Commercial (Y/N) Y Other _____

REMARKS:

_____

SODIUM HYPOCHLORITE PUMP SKID NO. 2 (S-C210) – DATA SHEET

No. of Pumps: 2

Tag Numbers: P-C211, P-C212

Pump Name: Sodium Hypochlorite Pump

Manufacturer and Model Number: Pulsafeeder, Oberdorfer, Tuhill

SERVICE CONDITIONS:

Liquid Pumped (Percent): Sodium Hypochlorite

Pumping Temperature (Celcius): Normal: 10 deg C Max 35 deg C
Min 5 deg C

Fluid Specific Gravity: 1.17

Fluid Viscosity at min temp: 10

Liquid pH: 11-14

Abrasive (Y/N) N Possible Scale Buildup (Y/N): N

Min NPSHa (kPa) : _____

Altitude (m): _____ Area Classification: Non-Hazardous

Location (indoor/outdoor): Indoor

Minimum discharge pressure required, gauge (kPag): _____

PERFORMANCE REQUIREMENTS:

Capacity (L/min): 8.0-11.9 Rated discharge pressure, gauge (kPag): 345

Maximum pump speed at rated capacity (rpm): 1750

Normal Operating Pressure, gauge (kPag): 345

External Hydraulic Bypass Relief Valve Set Pressure, gauge (kPag): 518

DESIGN AND MATERIALS (Manufacturer to supply missing data):

Foot Mounted (Y/N):_____ Bracket Mounted (Y/N): Y_____
Centerline Case (Y/N): _____Near Centerline Case (Y/N): _____
Pump Shaft Diameter (mm): _____
Suction Orientation:_____ Rotation (view from end of coupling): _____
Internal Gear (Y/N): Y_____ External Gear (Y/N):_____
Casing Materials: _____
Gland Type Material:_____
Gland Plate Taps Required: [Quench] [Draw] [Flush] [Vent]
Shaft Material:_____ Shaft Sleeve Material: _____
Shaft Seals: Packing:_____ Material:__ Size/No. Rings: _____
Mechanical (Y/N) _____ Type: _____
Lubrication: _____Oil___
Bearing Type/No.: Radial:_____ Thrust: _____

ABMA B-10 Bearing Life (hrs):_____100,000_____ Lubrication: _____
Coupling: Falk (Y/N)_____ Fast (Y/N):_____ Spring-Grid (Y/N): ____
Gear Type (Y/N):_____Spacer (Y/N):_____ Manufacturer: ____
Standard (Y/N):_____
Driver Half Coupling Mounted by: Pump Mfr.
Baseplate: Design:_____Material: _____
Pump Control: Constant:_____ Variable: Y____
Vent and Drain Connections Tapped and Plugged (Y/N): Y__
Suction and Discharge Gauge Connections Tapped and Plugged (Y/N): Y_____
Adjustable Speed Drive, see Section 26 29 23, Variable Frequency Drive.

DRIVE MOTOR (Manufacturer to supply missing data):

Max Horsepower (kW): 0.75 Voltage: 575 Phase: 3 Synchronous Speed (rpm) 1750 Service Factor: 1.15

Motor nameplate horsepower shall not be exceeded at any head-capacity point on pump curve.

Enclosure: DIP _____ EXP _____ ODP _____ TEFC _____ CISD-TEFC Y
TENV _____WPI _____ WPII _____ SUBM _____

TESTING:

Pump Tests: Factory Functional (Y/N) Y Factory Performance (Y/N) N

Field Functional (Y/N) Y Field Performance (Y/N) Y

Motor Test: Short Commercial (Y/N) Y Other _____

REMARKS:

_____

SODIUM HYPOCHLORITE PUMP SKID NO. 3 (S-C220) – DATA SHEET

No. of Pumps: 3

Tag Numbers: P-C221, P-C222, P-C223

Pump Name: Sodium Hypochlorite Pump

Manufacturer and Model Number: Pulsafeeder, Oberdorfer, Tuhill

SERVICE CONDITIONS:

Liquid Pumped (Percent): Sodium Hypochlorite

Pumping Temperature (Celcius): Normal: 10 deg C Max 35 deg C
Min 5 deg C

Fluid Specific Gravity: 1.17

Fluid Viscosity at min temp: 10

Liquid pH: 11-14

Abrasive (Y/N) N Possible Scale Buildup (Y/N): N

Min NPSHa (kPa) : _____

Altitude (m): _____ Area Classification: Non-Hazardous

Location (indoor/outdoor): Indoor

Minimum discharge pressure required, gauge (kPag): _____

PERFORMANCE REQUIREMENTS:

Capacity (L/min): 1.2-19.6 Rated discharge pressure, gauge (kPag): 345

Maximum pump speed at rated capacity (rpm): 1750

Normal Operating Pressure, gauge (kPag): 345

External Hydraulic Bypass Relief Valve Set Pressure, gauge (kPag): 518

DESIGN AND MATERIALS (Manufacturer to supply missing data):

Foot Mounted (Y/N):_____ Bracket Mounted (Y/N): Y_____
Centerline Case (Y/N): _____Near Centerline Case (Y/N): _____
Pump Shaft Diameter (mm): _____
Suction Orientation:_____ Rotation (view from end of coupling): _____
Internal Gear (Y/N): Y_____ External Gear (Y/N):_____
Casing Materials: _____
Gland Type Material:_____
Gland Plate Taps Required: [Quench] [Draw] [Flush] [Vent]
Shaft Material:_____ Shaft Sleeve Material: _____
Shaft Seals: Packing:_____ Material:__ Size/No. Rings: _____
Mechanical (Y/N) _____ Type: _____
Lubrication: _____Oil___
Bearing Type/No.: Radial:_____ Thrust: _____

ABMA B-10 Bearing Life (hrs):_____100,000_____ Lubrication: _____
Coupling: Falk (Y/N)_____ Fast (Y/N):_____ Spring-Grid (Y/N): ____
Gear Type (Y/N):_____Spacer (Y/N):_____ Manufacturer: ____
Standard (Y/N):_____
Driver Half Coupling Mounted by: Pump Mfr.
Baseplate: Design:_____Material: _____
Pump Control: Constant:_____ Variable: Y____
Vent and Drain Connections Tapped and Plugged (Y/N): Y__
Suction and Discharge Gauge Connections Tapped and Plugged (Y/N): Y_____
Adjustable Speed Drive, see Section 26 29 23, Variable Frequency Drive.

DRIVE MOTOR (Manufacturer to supply missing data):

Max Horsepower (kW): 0.75 Voltage: 575 Phase: 3 Synchronous Speed (rpm) 1750 Service Factor: 1.15

Motor nameplate horsepower shall not be exceeded at any head-capacity point on pump curve.

Enclosure: DIP _____ EXP _____ ODP _____ TEFC _____ CISD-TEFC Y
TENV _____WPI _____ WPII _____ SUBM _____

TESTING:

Pump Tests: Factory Functional (Y/N) Y Factory Performance (Y/N) N

Field Functional (Y/N) Y Field Performance (Y/N) Y

Motor Test: Short Commercial (Y/N) Y Other _____

REMARKS:

_____

SODIUM BISULPHITE PUMP SKID (S-C310) – DATA SHEET

No. of Pumps: 2

Tag Numbers: P-C311, P-C312

Pump Name: Sodium Bisulphite Pump

Manufacturer and Model Number: Pulsafeeder, Oberdorfer, Tuhill

SERVICE CONDITIONS:

Liquid Pumped (Percent): Sodium Hypochlorite

Pumping Temperature (Celcius): Normal: 15 deg C Max 35 deg C
Min 10 deg C

Fluid Specific Gravity: 1.33

Fluid Viscosity at min temp: 10

Liquid pH: 3.8-5.2

Abrasive (Y/N) N Possible Scale Buildup (Y/N): N

Min NPSHa (kPa) : _____

Altitude (m): _____ Area Classification: Non-Hazardous

Location (indoor/outdoor): Indoor

Minimum discharge pressure required, gauge (kPag): _____

PERFORMANCE REQUIREMENTS:

Capacity (L/min): 0.3-6.6 Rated discharge pressure, gauge (kPag): 345

Maximum pump speed at rated capacity (rpm): 1750

Normal Operating Pressure, gauge (kPag): 345

External Hydraulic Bypass Relief Valve Set Pressure, gauge (kPag): 518

DESIGN AND MATERIALS (Manufacturer to supply missing data):

Foot Mounted (Y/N):_____ Bracket Mounted (Y/N): Y_____
Centerline Case (Y/N): _____Near Centerline Case (Y/N): _____
Pump Shaft Diameter (mm): _____
Suction Orientation:_____ Rotation (view from end of coupling): _____
Internal Gear (Y/N): Y_____ External Gear (Y/N):_____
Casing Materials: _____
Gland Type Material:_____
Gland Plate Taps Required: [Quench] [Draw] [Flush] [Vent]
Shaft Material:_____ Shaft Sleeve Material: _____
Shaft Seals: Packing:_____ Material:__ Size/No. Rings: _____
Mechanical (Y/N) _____ Type: _____
Lubrication: _____Oil___
Bearing Type/No.: Radial:_____ Thrust: _____

ABMA B-10 Bearing Life (hrs):_____100,000_____ Lubrication: _____
Coupling: Falk (Y/N)_____ Fast (Y/N):_____ Spring-Grid (Y/N): ____
Gear Type (Y/N):_____Spacer (Y/N):_____ Manufacturer: ____
Standard (Y/N):_____
Driver Half Coupling Mounted by: Pump Mfr.
Baseplate: Design:_____Material: _____
Pump Control: Constant:_____ Variable: Y____
Vent and Drain Connections Tapped and Plugged (Y/N): Y__
Suction and Discharge Gauge Connections Tapped and Plugged (Y/N): Y_____
Adjustable Speed Drive, see Section 26 29 23, Variable Frequency Drive.

DRIVE MOTOR (Manufacturer to supply missing data):

Max Horsepower (kW): 0.75 Voltage: 575 Phase: 3 Synchronous Speed (rpm) 1750 Service Factor: 1.15

Motor nameplate horsepower shall not be exceeded at any head-capacity point on pump curve.

Enclosure: DIP _____ EXP _____ ODP _____ TEFC _____ CISD-TEFC Y
TENV _____WPI _____ WPII _____ SUBM _____

TESTING:

Pump Tests: Factory Functional (Y/N) Y Factory Performance (Y/N) N

Field Functional (Y/N) Y Field Performance (Y/N) Y

Motor Test: Short Commercial (Y/N) Y Other _____

REMARKS:

_____

SECTION 46 41 23

SUBMERSIBLE MIXERS

EQUIPMENT AND COMPONENT NUMBERS

ID No.	Equipment Description
MXR-R151-1	Bioreactor 1 Pre-Anoxic Zone Submersible Mixer
MXR-R151-2	Bioreactor 1 Pre-Anoxic Zone Submersible Mixer
MXR-R152-1	Bioreactor 1 Anaerobic Zone Submersible Mixer
MXR-R152-2	Bioreactor 1 Anaerobic Zone Submersible Mixer
MXR-R152-3	Bioreactor 1 Anaerobic Zone Submersible Mixer
MXR-R152-4	Bioreactor 1 Anaerobic Zone Submersible Mixer
MXR-R153-1	Bioreactor 1 Anoxic Zone Submersible Mixer
MXR-R153-2	Bioreactor 1 Anoxic Zone Submersible Mixer
MXR-R153-3	Bioreactor 1 Anoxic Zone Submersible Mixer
MXR-R153-4	Bioreactor 1 Anoxic Zone Submersible Mixer
MXR-R155-1	Bioreactor 1 Post Aerobic Zone Submersible Mixer
MXR-R155-2	Bioreactor 1 Post Aerobic Zone Submersible Mixer
MXR-R161-1	Bioreactor 2 Pre-Anoxic Zone Submersible Mixer
MXR-R161-2	Bioreactor 2 Pre-Anoxic Zone Submersible Mixer
MXR-R162-1	Bioreactor 2 Anaerobic Zone Submersible Mixer
MXR-R162-2	Bioreactor 2 Anaerobic Zone Submersible Mixer
MXR-R162-3	Bioreactor 2 Anaerobic Zone Submersible Mixer
MXR-R162-4	Bioreactor 2 Anaerobic Zone Submersible Mixer
MXR-R163-1	Bioreactor 2 Anoxic Zone Submersible Mixer
MXR-R163-2	Bioreactor 2 Anoxic Zone Submersible Mixer
MXR-R163-3	Bioreactor 2 Anoxic Zone Submersible Mixer
MXR-R163-4	Bioreactor 2 Anoxic Zone Submersible Mixer
MXR-R165-1	Bioreactor 2 Post Aerobic Zone Submersible Mixer
MXR-R165-2	Bioreactor 2 Post Aerobic Zone Submersible Mixer
MXR-R171-1	Bioreactor 3 Pre-Anoxic Zone Submersible Mixer
MXR-R171-2	Bioreactor 3 Pre-Anoxic Zone Submersible Mixer
MXR-R172-1	Bioreactor 3 Anaerobic Zone Submersible Mixer
MXR-R172-2	Bioreactor 3 Anaerobic Zone Submersible Mixer
MXR-R172-3	Bioreactor 3 Anaerobic Zone Submersible Mixer
MXR-R172-4	Bioreactor 3 Anaerobic Zone Submersible Mixer
MXR-R173-1	Bioreactor 3 Anoxic Zone Submersible Mixer
MXR-R173-2	Bioreactor 3 Anoxic Zone Submersible Mixer
MXR-R173-3	Bioreactor 3 Anoxic Zone Submersible Mixer
MXR-R173-4	Bioreactor 3 Anoxic Zone Submersible Mixer
MXR-R175-1	Bioreactor 3 Post Aerobic Zone Submersible Mixer
MXR-R175-2	Bioreactor 3 Post Aerobic Zone Submersible Mixer

Spare Mixers (quantity=4)

PART 1 GENERAL

1.1 SUMMARY

A. Section includes the supply, delivery, installation, testing and placement into operation of submersible mixers including all appurtenances (mixer base, mast, lifting cables, power and control cables, temperature and leak detection relays, etc.) required to complete an operating system as specified.

B. The power and control cable that is supplied with each submersible mixer and pump will be connected to an electrical junction box under Division 26.

1.2 REFERENCES

A. American National Standards Institute (ANSI).

B. American Water Works Association (AWWA).

C. ASTM International (ASTM).

D. Canadian Government Specification Board (CGSB).

E. Canadian Standards Association (CSA).

F. Electrical and Electronic Manufacturers Association of Canada (EEMAC).

G. Canadian Electrical Code (CEC).

H. National Electrical Manufacturer's Association (NEMA): MG 1, Motors and Generators.

I. 2010 National Building Code of Canada (NBC) with 2011 Manitoba Amendments.

J. Occupational Health and Safety Act (OHSA).

1.3 DEFINITIONS

A. Adequate Mixing: Variation in mixed liquor suspended solids (total residue) of less than 10 percent between the mean value of samples taken at any two depths along any vertical line extending between 300 mm below water surface and 300 mm above tank floor.

1.4 SUBMITTALS

A. Action Submittals:
   1. General layout, mast, complete engineering description, and performance characteristics.
   2. Size, details, and complete list of materials.
   3. Details of wiring schematics.
   4. Submit written certification from Professional Engineer licensed in Province of Manitoba stating that support systems, anchorage, and equipment have been designed for post-

disaster structures according to requirements of NBC with Manitoba Amendments, at time of shop drawing submittals.

B. Quality Control Submittals:
   1. Special shipping, storage and protection, and handling instructions.
   2. Manufacturer's printed installation instructions.
   3. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
   4. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.
   5. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Contractor Field Services.
   6. Field functional test reports.

1.5 PERFORMANCE REQUIREMENTS

A. Achieve adequate mixing in bioreactors tanks at mixed liquor suspended solids concentrations between 3,000 and 8,000 mg/L.

1.6 QUALITY ASSURANCE

A. Provide a written guarantee that the submersible mixers will provide uniform mixing of Mixed Liquor in the pre-anoxic, anaerobic, anoxic and post aerobic zones. If in the opinion of the Contract Administrator, the unit fails to uniformly blend the fluid, replace the unit with a suitable mixer at no additional cost to the City.

PART 2 PRODUCTS

2.1 SUBMERSIBLE MIXERS

A. Design the submersible mixers for continuous full load duty and guarantee the mixers based on the design conditions specified. Design and construct all units to permit economical maintenance. Unspecified details of design and construction of the mixing unit will be manufacturer's standard.

B. Mixers shall be designed and supplied for variable speed operation.

C. Gear driven mixers. Each mixer shall be equipped with a submersible electric motor that is an integral part of the mixing unit. The mixer motor shall be equipped with a power and control cable(s). Each mixer shall be furnished with the accessories necessary for a complete installation. The mixer(s) shall be able to be raised and lowered and easily removed for inspection or service without the need for personnel to enter the mixing tank.

D. Mixers shall be of the integral gear, close-coupled, submersible type design. All components of the mixer, including the motor and gear reducer shall be capable of continuous underwater operation.

E. The propeller shall be constructed of reinforced polyurethane, and shall have 2 blades. The propeller shall be 2.5 m diameter. The blades shall be self-cleaning and have a backward curved design preventing material build-up on the blades which reduces mixer performance and increases vibration. Each propeller shall be dynamically balanced so its imbalance is less than ISO 1940 G6.3 tolerances preventing excessive vibration or other unsatisfactory characteristics when the mixer is operating. The propeller shall be capable of handling solids, fibrous materials, sludge and other matter normally found in wastewater applications.

F. The mixer shall be provided with a double seal system consisting of a mechanical seal on the outer side and two radial shaft seal on the inner side. An oil chamber located between the outer and inner seals shall hold a sufficient quantity of oil to provide lubrication and cooling for the shaft seals.

G. Cell dimensions, flow through, number of mixers and shaft power as indicated below. Refer to project drawings for details.

	Width (m)	Length (m)	Baffle wall in middle of tank	Side water Depth (m)	Min Flow Through zone (ML/d)	Max Flow Through zone (ML/d)	Tank Volume (m^3)	No. of mixers	Mixer Shaft Power (kW)
Pre-anoxic zone	8	27.2	No	7	25	30	1523	2	4.6
Anaerobic zone	8	27.2	Yes	7	37	70	1523	4	2.6 to 3.5
Anoxic Zone	16	27.2	Yes	7	115	175	3046	4	4.6
Post Aeration zone	3.95	27.9	No	7	49	108	771	2	2.6 to 3.5

A. Tank floor elevation is 226 m. Tank roof elevation is 234.4 m. Power/control cable shall be 15 m in length minimum. Refer to drawings for additional details.

2.2 MAST ASSEMBLY FOR SUBMERSIBLE MIXERS

A. Mast: Stainless Steel 316L.

B. Upper Support: Stainless Steel 316L

C. Lower Support: Stainless Steel 316L or engineered concrete.

D. Support grip, cable holder, lifting cable assembly and clamps, in 316 stainless steel.

2.3 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of: Xylem, or Sulzer.

B. No “or equal” will be considered.

PART 3 EXECUTION

3.1 TESTING

A. The final acceptance of the equipment requires a field test for handling the specified fluid under specified conditions.

B. Make available to the City without charge, all test records, whether test witnessing is required or not on the Data Sheet.

C. Performance Test:
   1. Conduct on each tank.
   2. Perform under actual or approved simulated operating conditions.
   3. Test for a continuous 6-hour period without malfunction.
   4. Adjust, rotate, or modify units and retest if necessary.
   5. Test as follows:
      a. Perform at flows approved by the Contract Administrator that are in conformance with Clause 2.1.G.
      b. Select four vertical lines and two depths in each zone of each bioreactor and submit for approval by the Contract Administrator.
      c. Take three samples at each of two depths along each vertical line using Van Dorn sampler.
      d. Independent testing laboratory approved by the Contract Administrator will perform residue test on each sample. Mean value of total residue for three samples at each depth will be used to determine conformance with requirements.
      e. All testing and sampling shall conform to procedures established in latest edition of Standard Methods for Examination of Water and Wastewater.
      f. Mixing test must be completed using mixed liquor.

3.2 INSTALLATION

A. Provide stainless steel mounting bolts, washers, and nuts and install the equipment at locations indicated on the Drawings.

B. Install the equipment in accordance with the manufacturer’s instructions and typical installation detail included in this section.

3.3 START-UP

A. Before operating equipment, provide the services of a qualified manufacturer’s service representative to inspect, operate, test, and adjust the equipment after installation.

B. Submit the manufacturer’s representative’s signed report describing in detail the inspection, tests and adjustments made, quantitative results and suggestions for precautions to be taken to ensure proper maintenance. The report must verity that the equipment conforms to the requirements of the Contract for the service intended and is ready for permanent operation. Provide copies of this report to be included in the installation, operation and maintenance manuals.

C. Included in the Inspection:
   1. Soundness (without cracked or otherwise damaged parts).
   2. Completeness of installation as specified and as recommended by manufacturer.
   3. Correctness of setting, alignment, and relative arrangement of various parts of system.

D. Operate, test, and adjust equipment to prove that it is satisfactorily installed to operate under the intended conditions as specified.

E. Equipment will only be accepted after receipt of the manufacturer's representative's report.

F. Provide notice in writing at least 48 hours before manufacturer's representative is scheduled to perform these activities.

G. Modify or replace equipment or materials failing required tests.

H. Perform additional testing required due to changes of materials required by Supplier or due to failure of materials or construction to meet specifications.

I. Unconditionally guarantee the equipment to meet or exceed the design criteria detailed in this Specification.

3.4 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at Site or classroom designated by the City, for minimum person-days listed below, travel time excluded:
   1. 4 person-days for installation assistance and inspection in two trips.
   2. 5 person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
   3. 2 person-days for prestartup classroom or Site training.
   4. 5 person-days for facility startup.
   5. 2 person-days for post-startup training of the City's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by Contract Administrator.

B. See Section 01 43 33, Contractor Field Services and Section 01 91 14, Equipment Testing and Facility Startup.

3.5 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this Specification.
   1. Pump Data Sheets.
   2. Motor Data Sheets.

END OF SECTION

MIXER DATA SHEET
SUBMERSIBLE MIXERS FOR BIOREACTORS IN PRE-ANOXIC AND ANOXIC ZONES

Project: City of Winnipeg SEWPCC Upgrading/Expansion Project

City: City of Winnipeg

Service: Bioreactors

Mixer Name: Bioreactors Submersible Mixers

Equip. Tag Number(s):

Bioreactor no.1: MXR-R151-1, MXR-R151-2, MXR-R153-1, MXR-R153-2, MXR-R153-3, MXR-R153-4.

Bioreactor no.2: MXR-R161-1, MXR-R161-2, MXR-R163-1, MXR-R163-2, MXR-R163-3, MXR-R163-4.

Bioreactor no.3: MXR-R171-1, MXR-R171-2, MXR-R173-1, MXR-R173-2, MXR-R173-3, MXR-R173-4.

Manufacturer and Model:
(1) Flygt (Xylem) Model 4430
(2) Sulzer Model SB2525-A46/4-EC
(3) _____

No. Mixers Required: 20 (including 2 spares)		
Drive Type: ☐Constant ☒Adjustable		
LIQUID	**OPERATING CONDITIONS**	**SERVICE CONDITIONS**
Name: Mixed Liquor	Shaft power required (kW): 4.6	Area Classification: Unclassified
Liquid Temperature (°C):		
Max 25 Min 10		
Specific Gravity @ 1Kg/L @ 15 °C:		
Viscosity (CP) @ 15 °C: 1.3 centipoise		
Total Suspended Solids (mg/l) 3000 – 8000		
pH: 6 to 8.5		
Corrosion/Erosion/Abrasion Caused by:		
Anaerobic conditions		
	Remarks: _____	Remarks: _____
Remarks: _____	_____	_____

PERFORMANCE REQUIREMENTS (manufacturer to supply missing data)		
Mixer Minimum Speed (rpm): 42		Factory Testing:
Mixer Speed Range (rpm): _____/_____	Rated Power (kw): _____	☒Required ☐Not Required

Equipment Tag Number(s):

Bioreactor no.1: MXR-R151-1, MXR-R151-2, MXR-R153-1, MXR-R153-2, MXR-R153-3, MXR-R153-4.

Bioreactor no.2: MXR-R161-1, MXR-R161-2, MXR-R163-1, MXR-R163-2, MXR-R163-3, MXR-R163-4.

Bioreactor no.3: MXR-R171-1, MXR-R171-2, MXR-R173-1, MXR-R173-2, MXR-R173-3, MXR-R173-4.

MIXER CONSTRUCTION DETAILS (manufacturer to supply missing data)

		Bearings (Type/No.):
		Radial _____ Thrust _____
		ABMA Rating Life (hours): L-10 100,000
		Lubrication Type:
	Mechanical Seal:	☐Grease ☐Oil
Fasteners: Stainless Steel	Manufacturer _____	
Propeller Diameter (m) : 2.5	Model _____	
	Manufacturer Code _____	
Field Testing: ☐Not required		
☒Required, functional and performance		

Remarks: _____

_____

_____

MATERIALS (manufacturer to supply missing data)

Casing: Cast Iron	Propeller: _____	
		Motor Housing: Cast Iron

Shaft: _____

Remarks: _____

_____

_____

_____

ADDITIONAL REQUIREMENTS

INDUCTION MOTOR DATA SHEET

Project: City of Winnipeg SEWPCC Upgrading/Expansion Project

City: City of Winnipeg

Equipment Name: Bioreactors Submersible Mixers

Equipment Tag Number(s):

Bioreactor no.1: MXR-R151-1, MXR-R151-2, MXR-R153-1, MXR-R153-2, MXR-R153-3, MXR-R153-4.

Bioreactor no.2: MXR-R161-1, MXR-R161-2, MXR-R163-1, MXR-R163-2, MXR-R163-3, MXR-R163-4.

Bioreactor no.3: MXR-R171-1, MXR-R171-2, MXR-R173-1, MXR-R173-2, MXR-R173-3, MXR-R173-4.

Type: Squirrel-cage induction meeting requirements of NEMA MG 1

Manufacturer: For multiple units of the same type of equipment, furnish motors and accessories of a single manufacturer

Hazardous Location: ☐ Furnish motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark

Motor kw: 4.6	Guaranteed Minimum Efficiency at Full Load: 75 percent
Voltage: 575 V	Guaranteed Minimum Power Factor at Full Load: 80 percent
Phase: 3	Service Factor (@ rated max. amb. temp.): ☒ 1.0 ☐ 1.15
Frequency: 60 Hz	Enclosure Type:
Synchronous Speed: _____ rpm	Mounting Type: ☒ Horizontal ☐ Vertical
☒ Multispeed, Two-Speed:	☐ Vertical Shaft: ☐ Solid ☐ Hollow
_____ / _____ rpm	☐ Vertical Thrust Capacity (lb): Up _____ Down _____
☐ Constant Power	☒ Adjustable Speed Drive: In accordance with Section 26 29 23, Low Voltage Adjustable Frequency Drive Systems.
☒ Variable Torque	
☐ Constant Torque	Operating Speed Range: _____ to _____% of Rated Speed
Winding: ☐ One ☐ Two	☒ Thermal Protection: _____
	☐ Space Heater: _____ volts, single phase
	☐ Oversize main terminal (conduit) box for motors
	☐ Terminal for connection of equipment grounding wire in each terminal box

Additional Motor Requirements: ☒ In accordance with Section 26 20 00, Low-Voltage AC Induction Motors

Special Features:

leak and temperature relay to be supplied loose for installation by the Contractor

MIXER DATA SHEET
SUBMERSIBLE MIXERS FOR BIOREACTORS IN ANAEROBIC AND POST AERATION ZONES

Project: City of Winnipeg SEWPCC Upgrading/Expansion Project

City: City of Winnipeg

Service: Bioreactors

Mixer Name: Bioreactors Submersible Mixers

Equip. Tag Number(s):

Bioreactor no.1: MXR-R152-1, MXR-R152-2, MXR-R152-3, MXR-R152-4, MXR-R154-1, MXR-R154-2.

Bioreactor no.2: MXR-R162-1, MXR-R162-2, MXR-R162-3, MXR-R162-4, MXR-R164-1, MXR-R164-2.

Bioreactor no.3: MXR-R172-1, MXR-R172-2, MXR-R172-3, MXR-R172-4, MXR-R174-1, MXR-R174-2

Manufacturer and Model:
(1) Flygt (Xylem) Model 4410
(2) Sulzer Model SB2522-A35/4-EC
(3) _____

No. Mixers Required: 20 (including 2 spares)		
Drive Type: ☐Constant ☒Adjustable		
LIQUID	**OPERATING CONDITIONS**	**SERVICE CONDITIONS**
Name: Mixed Liquor	Min. shaft power required (kW): 2.6	Area Classification: Unclassified
Liquid Temperature (°C):		
Max 25 Min 10		
Specific Gravity @ 1Kg/L @ 15 °C:		
Viscosity (CP) @ 15 °C: 1.3 centipoise		
Total Suspended Solids (mg/l) 3000 – 8000		
pH: 6 to 8.5		
Corrosion/Erosion/Abrasion Caused by:		
Anaerobic conditions		
	Remarks: _____	Remarks: _____
Remarks: _____	_____	_____
PERFORMANCE REQUIREMENTS (manufacturer to supply missing data)		
Mixer Minimum Speed (rpm): 32		Factory Testing:
Mixer Speed Range (rpm): _____/_____	Rated Power (kw): _____	☒Required ☐Not Required

Equipment Tag Number(s):

Bioreactor no.1: MXR-R152-1, MXR-R152-2, MXR-R152-3, MXR-R152-4, MXR-R154-1, MXR-R154-2.

Bioreactor no.2: MXR-R162-1, MXR-R162-2, MXR-R162-3, MXR-R162-4, MXR-R164-1, MXR-R164-2.

Bioreactor no.3: MXR-R172-1, MXR-R172-2, MXR-R172-3, MXR-R172-4, MXR-R174-1, MXR-R174-2

MIXER CONSTRUCTION DETAILS (manufacturer to supply missing data)

		Bearings (Type/No.):
		Radial _____ Thrust _____
		ABMA Rating Life (hours): L-10 100,000
		Lubrication Type:
	Mechanical Seal:	☐Grease ☐Oil
Fasteners: Stainless Steel	Manufacturer _____	
Propeller Diameter (m) : 2.5	Model _____	
	Manufacturer Code _____	
Field Testing: ☐Not required		
☒Required, functional and performance		

Remarks: _____

MATERIALS (manufacturer to supply missing data)

Casing: Cast Iron	Propeller: _____	
		Motor Housing: Cast Iron

Shaft: _____

Remarks: _____

ADDITIONAL REQUIREMENTS

Mixers MXR-R154-1, MXR-R154-2, MXR-R164-1 MXR-R164-2, MXR-R174-1 MXR-R174-2, in post aerobic zones shall be installed at 2.5 m from the floor (centerline of the mixer to the floor) since the post aerobic zones are equipped with aeration grids. Refer to drawings for details.

INDUCTION MOTOR DATA SHEET

Project: City of Winnipeg SEWPCC Upgrading/Expansion Project

City: City of Winnipeg

Equipment Name: Bioreactors Submersible Mixers

Equipment Tag Number(s):

Bioreactor no.1: MXR-R152-1, MXR-R152-2, MXR-R152-3, MXR-R152-4, MXR-R154-1, MXR-R154-2.

Bioreactor no.2: MXR-R162-1, MXR-R162-2, MXR-R162-3, MXR-R162-4, MXR-R164-1, MXR-R164-2.

Bioreactor no.3: MXR-R172-1, MXR-R172-2, MXR-R172-3, MXR-R172-4, MXR-R174-1, MXR-R174-2

Type: Squirrel-cage induction meeting requirements of NEMA MG 1

Manufacturer: For multiple units of the same type of equipment, furnish motors and accessories of a single manufacturer

Hazardous Location: ☐ Furnish motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark

Motor kw: Min 2.6 - Max 3.5	Guaranteed Minimum Efficiency at Full Load: 75 percent
Voltage: 575 V	Guaranteed Minimum Power Factor at Full Load: 80 percent
Phase: 3	Service Factor (@ rated max. amb. temp.): ☐ 1.0 ☒ 1.15
Frequency: 60 Hz	Enclosure Type:
Synchronous Speed: _____ rpm	Mounting Type: ☒ Horizontal ☐ Vertical
☒ Multispeed, Two-Speed:	☐ Vertical Shaft: ☐ Solid ☐ Hollow
_____ / _____ rpm	☐ Vertical Thrust Capacity (lb): Up _____ Down _____
☐ Constant Power	☒ Adjustable Speed Drive: In accordance with Section 26 29 23, Low Voltage Adjustable Frequency Drive Systems.
☒ Variable Torque	
☐ Constant Torque	Operating Speed Range: _____ to _____% of Rated Speed
Winding: ☐ One ☐ Two	☒ Thermal Protection: Temperature switch or thermistor
	☐ Space Heater: _____ volts, single phase
	☐ Oversize main terminal (conduit) box for motors
	☐ Terminal for connection of equipment grounding wire in each terminal box

Additional Motor Requirements: ☒ In accordance with Section 26 20 00, Low-Voltage AC Induction Motors

Special Features:

leak and temperature relay to be supplied loose for installation by the Contractor

SECTION 46 41 24

FERMENTER MIXERS

EQUIPMENT AND COMPONENT NUMBERS

ID No.	Equipment Description
MXR-D301	Fermenter Train 1 Cell 1 Mixer
MXR-D302	Fermenter Train 1 Cell 2 Mixer
MXR-D303	Fermenter Train 1 Cell 3 Mixer
MXR-D304	Fermenter Train 1 Cell 4 Mixer
MXR-D311	Fermenter Train 2 Cell 1 Mixer
MXR-D312	Fermenter Train 2 Cell 2 Mixer
MXR-D313	Fermenter Train 2 Cell 3 Mixer
MXR-D314	Fermenter Train 2 Cell 4 Mixer

PART 1 GENERAL

1.1 SUMMARY

A. Section includes the supply, delivery, installation, testing and placement into operation of mixers including all appurtenances required for a complete operating system.

B. A total of 8 top-mounted mixers with drive components above the fermenters roof are required.

C. The power and control cable that is supplied with each mixer will be connected to an electrical junction box under Division 26.

1.2 REFERENCES

A. American National Standards Institute (ANSI).

B. American Water Works Association (AWWA).

C. ASTM International (ASTM).

D. Canadian Government Specification Board (CGSB).

E. Canadian Standards Association (CSA).

F. Electrical and Electronic Manufacturers Association of Canada (EEMAC).

G. Canadian Electrical Code (CEC).

H. National Electrical Manufacturer's Association (NEMA): MG 1, Motors and Generators.

I. 2010 National Building Code of Canada (NBC) with 2011 Manitoba Amendments.

J. Occupational Health and Safety Act (OHSA).

1.3 DEFINITIONS

A. Adequate Mixing: Variation in sludge solids concentration of less than 10 percent between the mean value of samples taken at any two depths along any vertical line extending between 300 mm below sludge surface and 300 mm above tank floor.

1.4 SUBMITTALS

A. Action Submittals:
1. General layout, complete engineering description, and performance characteristics.
2. Size, details, and complete list of materials.
3. Details of wiring schematics.
4. CFD analysis report.
5. Complete details of the mixer including impeller, bearings, seals, shafts, and all monitoring devices. Include illustrated parts diagram and numbered parts list.
6. Plan view drawings showing mixer rotation (i.e., clockwise or counter
7. clockwise) for each fermenter cell.
8. Maximum and minimum sludge levels in the fermenter basin that the mixers can be operated without excessive wear or damage.
9. Details of attachment and support to concrete roof opening above the tanks.
10. Submit written certification from Professional Engineer licensed in Province of Manitoba stating that support systems, anchorage, and equipment have been designed for post-disaster structures according to requirements of NBC with Manitoba Amendments, at time of shop drawing submittals.

B. Quality Control Submittals:
1. Special shipping, storage and protection, and handling instructions.
2. Manufacturer’s printed installation instructions.
3. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
4. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.
5. Manufacturer’s Certificate of Proper Installation, in accordance with Section 01 43 33, Contractor Field Services.
6. Field functional test reports.

1.5 PERFORMANCE REQUIREMENTS

A. Achieve adequate mixing in fermenter tanks at sludge solids concentrations up to 2.25 percent solids.

1.6 QUALITY ASSURANCE

A. Provide a written guarantee that the mixers will provide uniform mixing of sludge. If in the opinion of the Contract Administrator, the unit fails to uniformly blend the fluid, replace the unit with a suitable mixer at no additional cost to the City.

PART 2 PRODUCTS

2.1 GENERAL

A. Mixers shall be of the non-clogging non-ragging, vertical shaft, hyperboloid-body type. The primary purpose of the mixers is to sludge in suspension at uniform concentration throughout, prevent short circuiting, and to prevent solids deposition. Provide a detailed Computational Fluid Dynamics (CFD) analysis demonstrating compliance with the performance requirements.

B. Design the hyperbolic mixers for continuous full load duty and guarantee the mixers based on the design conditions specified. Design and construct all units to permit economical maintenance. Unspecified details of design and construction of the mixing unit will be manufacturer's standard. The mixers shall not overload the motors at any point.

C. Mixer motor shall be rated for Hazardous Location Class 1 Div 2

D. Mixing equipment to consist of speed reducer, electric motor, base plate, mixer shaft, and mixing impeller.

E. The mixer shall be designed with no submerged bearings and with a dry installed motor. The mixer shall produce a steady stationary flow pointed downward parallel to the mixer shaft. During operation the mixer should not generate any upward forces on the mixer support.

F. Cell dimensions, flow through and sludge levels as indicated below. Refer to project drawings for details.

	Width (m)	Length (m)	Floor Elev. (m)	Side water Depth (m)	Min Flow Through zone (m3/d)	Max Flow Through zone (m3/d)	Tank Volume (m^3)
Train 1 Cell 1 and 2	8.54	18.29	228.37	5.30	400	1000	828
Train 1 Cell 3	8.54	9.15	228.32	5.35	400	1000	418
Train 1 Cell 4	8.54	9.15	228.22	1 to 5.45	400	14,000	426
Train 2 Cell 1 and 2	9.14	18.29	228.37	5.30	400	1000	886
Train 2 Cell 3	9.14	9.15	228.32	5.35	400	1000	447
Train 2 Cell 4	9.14	9.15	228.22	1 to 5.45	400	14,000	456

G. Tank opening concrete curb elevation is 235.0 m. Cell 1 and Cell 2 are not separated by a physical wall. Refer to drawings for additional details of fins and benching. Field measure all dimensions before preparation of shop drawings.

H. Sludge level in Cell 4 is variable. The hyperboloid mixer shall be provided with a guide bushing and stainless steel shaft to accommodate the changes in level.

2.2 SPEED REDUCERS

A. Provide heavy duty parallel shaft helical gear configuration.

B. Basic rating shall adhere to AGMA 420.04 or DIN equivalent and bear AGMA or DIN Equivalent nameplate or manufacturer shall certify, in writing, speed reducer designed to AGMA 420.04 or DIN equivalent.

C. Construct housing of cast iron with high-quality acrylic coating.

D. Provide base plate suitable for mounting as shown on Drawings.

E. Gearing:
   1. Internal single helical or combination helical and spiral bevel to ensure highest efficiency, coupled with convenience of mounting, maintenance, and installation. Worm gearing not acceptable.
   2. AGMA quality No. 10 or better, in accordance with AGMA 390.03 or DIN equivalent.

F. Full load operating noise levels of mixer drive shall meet AGMA 297.02 or DIN equivalent, and shall not exceed 82 dBA at 1 m from any part of the drive assembly.

G. Mixer gear drive designed with output shaft system suitable for loadings imposed by specified duty.

H. Provide anti friction type ball or roller drive bearings and output shaft bearings with minimum L10 life of 100,000 hours.

I. Provide integral oil pump or efficient oil splash mechanism for lubrication of speed reducer. Mixer shall be accessible without requiring disassembly. Provide sight glass to observe oil level. Prevent oil leakage down output shaft.

J. Provide high quality lip seal to retain grease if output shaft bearings are grease lubricated. Oil-fill and drain lines and grease fittings shall be easily accessible.

K. Provide necessary accessories, including but not limited to, mixer mounting plate, motor bracket, motor coupling, and coupling guard.

L. Provide rubber vibration dampeners.

2.3 MIXER SHAFT

A. Mixer shaft shall connect to the mixer body (i.e., impeller) with a shaft-hub connection or flange that will not self-loosen. Shaft shall be secured to drive with a feather key connection.

B. Provide hollow FRP impeller shaft. Shaft diameter to be determined by supplier to provide sufficient torsional stiffness.

C. Agitator shaft shall be overhung design; underwater steady bearings are not allowed.

D. Maximum total indicated runout at lower end of shaft shall not exceed 3.1 mm for every 3 m of overhang, as measured when turning over by hand.

E. Maximum stress on mixer shaft shall not exceed 1/4th the yield stress of the mixer shaft material.

F. Maximum angular deflection shall be 1.5-degree or approximately 0.33 inch/ft. of vertical shaft length in dry condition.

2.4 IMPELLERS

A. Provide removable, engineered thermoplastic impellers, streamlined stress-free body without any mounted or fitted parts.

B. Hyperboloid shape (continuous shape) with integral motion fins on the top surface to create the appropriate swirling motion.

C. Mixer body shall have a polished surface.

2.5 ACCESSORIES

A. All hardware shall be 316 SST.

B. Equipment Identification Plates: Provide stainless steel identification plate securely mounted on each drive in a readily visible location. Plate shall bear equipment model and serial number, motor HP and rpm, and power consumption HP to the motor at a minimum.

2.6 PROTECTIVE COATING

A. Coating: Manufacturer is responsible for surface preparation, priming, and factory finish coating of motor and gear reducer with manufacturer’s standard enamel. Coating shall be heavy duty selected by manufacturer for exterior exposure in Winnipeg, Manitoba and shall not peel, crack, or otherwise fail when exposed to sun, rain, snow, ice, temperature variations from minus 40 degrees C to plus 40 degrees C, and exposure to airborne constituents typical of wastewater treatment.

B. Exposed machined or polished ferrous surfaces shall be coated with corrosion prevention compound.

2.7 SPARE PARTS

A. Two shaft clamps

B. 2 set of rubber buffers

2.8 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of Invent Environmental Technologies Inc.

B. No “or equal” will be considered.

PART 3 EXECUTION

3.1 TESTING

A. The final acceptance of the equipment requires a field test for handling the specified fluid under specified conditions.

B. Make available to the City without charge, all test records, whether test witnessing is required or not on the Data Sheet.

C. Performance Test:
   1. Conduct on each tank.
   2. Perform under actual or approved simulated operating conditions.
   3. Test for a continuous 6-hour period without malfunction.
   4. Adjust, rotate, or modify units and retest if necessary.
   5. Test as follows:
      a. Perform at flows approved by the Contract Administrator that are in conformance with this specification.
      b. Select four vertical lines and two depths in each cell of each fermenter train and submit for approval by the Contract Administrator.
      c. Take three samples at each of two depths along each vertical line using Van Dorn sampler.
      d. Independent testing laboratory approved by the Contract Administrator will perform residue test on each sample. Mean value of total residue for three samples at each depth will be used to determine conformance with requirements.
      e. All testing and sampling shall conform to procedures established in latest edition of Standard Methods for Examination of Water and Wastewater.
      f. Mixing test must be completed using primary sludge.

3.2 INSTALLATION

A. Provide stainless steel mounting bolts, washers, and nuts and install the equipment at locations indicated on the Drawings.

B. Install the equipment in accordance with the manufacturer's instructions and typical installation detail included in this section.

3.3 START-UP

A. Before operating equipment, provide the services of a qualified manufacturer's service representative to inspect, operate, test, and adjust the equipment after installation.

B. Submit the manufacturer's representative's signed report describing in detail the inspection, tests and adjustments made, quantitative results and suggestions for precautions to be taken to ensure proper maintenance. The report must verity that the equipment conforms to the requirements of the Contract for the service intended and is ready for permanent operation. Provide copies of this report to be included in the installation, operation and maintenance manuals.

C. Included in the Inspection:
   1. Soundness (without cracked or otherwise damaged parts).
   2. Completeness of installation as specified and as recommended by manufacturer.
   3. Correctness of setting, alignment, and relative arrangement of various parts of system.

D. Operate, test, and adjust equipment to prove that it is satisfactorily installed to operate under the intended conditions as specified.

E. Equipment will only be accepted after receipt of the manufacturer's representative's report.

F. Provide notice in writing at least 48 hours before manufacturer's representative is scheduled to perform these activities.

G. Modify or replace equipment or materials failing required tests.

H. Perform additional testing required due to changes of materials required by Supplier or due to failure of materials or construction to meet specifications.

I. Unconditionally guarantee the equipment to meet or exceed the design criteria detailed in this Specification.

3.4 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at Site or classroom designated by the City, for minimum person-days listed below, travel time excluded:
   1. 4 person-days for installation assistance and inspection in two trips.
   2. 5 person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation, and prestartup classroom or Site training.
   3. 2 person-days for facility startup.
   4. 2 person-days for post-startup training of the City's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by Contract Administrator.

B. See Section 01 43 33, Contractor Field Services and Section 01 91 14, Equipment Testing and Facility Startup.

3.5 SUPPLEMENTS

A. The supplements listed below, following “End of Section,” are a part of this Specification.
   1. Mixer Data Sheets.
   2. Motor Data Sheets.

END OF SECTION

MIXER DATA SHEET
FERMENTER MIXERS

Project: City of Winnipeg SEWPCC Upgrading/Expansion Project

City: City of Winnipeg

Service: Fermenters

Mixer Name: Fermenter Mixers

Equip. Tag Number(s):

Train 1: MXR-D301, MXR-D302. MXR-D303, MXR-D304.

Train 2: MXR-D311, MXR-D312. MXR-D313, MXR-D314

Manufacturer and Model: (1) Invent Environmental Technologies Inc. Model HCM2300

No. Mixers Required: _____		
Drive Type: ☒Constant ☐Adjustable		
LIQUID	**OPERATING CONDITIONS**	**SERVICE CONDITIONS**
Name: _____	Shaft power required (kW): 5.6	Area Classification: Class 1 Div 2
Liquid Temperature (°C):		
Max _____Min _____		
Specific Gravity @ _____°C: _____		
Viscosity (CP) @ _____°C: _____		
Total Suspended Solids (mg/l) 22,500		
pH: _____		
Corrosion/Erosion/Abrasion Caused by:		
_____		
	Remarks: _____	Remarks: _____
Remarks: _____	_____	_____
PERFORMANCE REQUIREMENTS (manufacturer to supply missing data)		
Mixer Minimum Speed (rpm):		Factory Testing:
Mixer Speed Range (rpm): _____/_____	Rated Power (kw): _____	☒Required ☐Not Required

Equipment Tag Number(s): _____		
MIXER CONSTRUCTION DETAILS (manufacturer to supply missing data)		
		Bearings (Type/No.):
		Radial _____ Thrust _____
		ABMA Rating Life (hours): _____
		Lubrication Type:
	Mechanical Seal:	☐Grease ☒Oil
Fasteners: Stainless Steel	Manufacturer _____	Oil shall be synthetic
Propeller Diameter (mm) : 2300	Model _____	
	Manufacturer Code _____	
Field Testing: ☐Not required		
☒Required, functional and performance		
Remarks: _____		
_____		
_____		
MATERIALS (manufacturer to supply missing data)		
	Hyperboloid mixer body and flanged connection: _____	Mounting Base: Carbon Steel with powder coating and rubber buffers
	Shaft and flanged connections: _____	Motor Housing: Cast Iron
Remarks: _____		
_____		
_____		
_____		
ADDITIONAL REQUIREMENTS		
Note that the top mixer opening is 2.13 m square. The impeller will need to be turned on its side, and lowered diagonally through the existing square opening.		

INDUCTION MOTOR DATA SHEET

Project: City of Winnipeg SEWPCC Upgrading/Expansion Project	
City: City of Winnipeg	
Equipment Name: Fermenter Mixers	
Equipment Tag Number(s): Train 1: MXR-D301, MXR-D302. MXR-D303, MXR-D304. Train 2: MXR-D311, MXR-D312. MXR-D313, MXR-D314	
Type: Squirrel-cage induction meeting requirements of NEMA MG 1	
Manufacturer: For multiple units of the same type of equipment, furnish motors and accessories of a single manufacturer	
Hazardous Location: ☒ Furnish motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark	
Motor kw: _____	Guaranteed Minimum Efficiency at Full Load: _____ percent
Voltage: 575 V	Guaranteed Minimum Power Factor at Full Load: _____ percent
Phase: 3	Service Factor (@ rated max. amb. temp.): ☐ 1.0 ☒ 1.15
Frequency: _____	Enclosure Type: TEFC with weather hood (IP 65 per DIN 42950)
Synchronous Speed: _____ rpm	Mounting Type: ☐ Horizontal ☒ Vertical
☐ Multispeed, Two-Speed:	☐ Vertical Shaft: ☐ Solid ☐ Hollow
_____ / _____ rpm	☐ Vertical Thrust Capacity (lb): Up _____ Down _____
☐ Constant Power	☐ Adjustable Speed Drive: In accordance with Section 26 29 23, Low Voltage Adjustable Frequency Drive Systems.
☐ Variable Torque	
☐ Constant Torque	Operating Speed Range: _____ to _____% of Rated Speed
Winding: ☐ One ☐ Two	☒ Thermal Protection: Thermistors (3 in series)
	☐ Space Heater: _____ volts, single phase
	☐ Oversize main terminal (conduit) box for motors
	☐ Terminal for connection of equipment grounding wire in each terminal box
Additional Motor Requirements: ☒ In accordance with Section 26 20 00, Low-Voltage AC Induction Motors	
Special Features:	
Provide two heaters for each motor. One on each end of the winding.	

SECTION 46 41 48

HYDRAULIC MIXING EQUIPMENT

EQUIPMENT AND COMPONENT NUMBERS

ID No.	Equipment Description
P-R304	WAS Mixing Pump

PART 1 GENERAL

1.1 WORK OF THIS SECTION

A. The work of this Section includes furnishing and installation of a hydraulic mixing system for the WAS sump including pump, nozzles assemblies and all appurtenant work indicated in accordance with Contract Documents.

B. Unit Responsibility: Work requires that equipment, complete with all accessories, be end product of one responsible system supplier. Unless otherwise indicated, Contractor shall obtain the system from responsible supplier of equipment. Supplier shall furnish all components and accessories of system to enhance compatibility, ease of operation, and maintenance, and as necessary to place equipment into operation in conformance with specified performance, features, and functions without altering or modifying Contractor's responsibilities under Contract. Contractor is responsible to the City for providing equipment system as specified herein.

1.2 REFERENCES

A. The following is a list of standards that may be referenced in this section:
   1. American Bearing Manufacturers Association (ABMA).
   2. American Iron and Steel Institute (AISI).
   3. American Society for Testing and Materials (ASTM):
      a. A48/A48M, Standard Specification for Gray Iron Castings.
      b. A276/A276M, Standard Specification for Stainless Steel Bars and Shapes.
      c. A436, Standard Specification for Austenitic Gray Iron Castings.
      d. A532/A532M, Standard Specification for Abrasion-Resistant Cast Irons.
      e. A743/A743M, Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
   4. American Society of Mechanical Engineers (ASME):
      a. B16.1, Grey Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250.
      b. B16.5, Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard.
      c. B16.47, Large Diameter Steel Flanges NPS 26 Through NPS 60 Metric/Inch Standard.

5. Hydraulic Institute (ANSI/HI):
   a. 1.1-1.2, Rotodynamic Centrifugal Pumps for Nomenclature and Definitions.
   b. 9.6.4, Rotodynamic Pumps for Vibration Measurements and Allowable Values.
   c. 14.6, Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.
6. Institute of Electrical and Electronics Engineers (IEEE): 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
7. International Organization for Standardization (ISO): 10816-3, Mechanical vibration - Evaluation of machine vibration by measurements on non-rotating parts – Part 3: Industrial machines with nominal power above 15 kW and nominal speeds between 120 r/min and 15000 r/min when measured in situ.
8. National Electrical Manufacturer's Association (NEMA): MG 1, Motors and Generators.
9. 2010 National Building Code of Canada, with 2011 Manitoba Amendments (NBC).

1.3 CONDITIONS OF SERVICE

A. The mixing equipment will be used to mix the contents of municipal Waste Activated Sludge (WAS) sump. The feed sludge (by others) will be a combination of WAS, mixed liquor scum, and secondary clarifiers scum.

B. Design the equipment to meet the specified performance requirements and to be suitable for installation in the WAS sump having the following characteristics:
   - Side Water Depth (maximum): 3.5 m
   - Side Water Depth (minimum): 1.5 m
   - Width : 3.5 m
   - Length : 15 m
   - Sludge solids concentration : 2000 to 5000 mg/L
   - Sludge Temperature: 5 to 25 degrees C

1.4 DESIGN REQUIREMENTS

A. Tailor mixing system design to actual tank geometry and specified performance.

B. Conduct a Computational Fluid Dynamics analysis for the proposed system and submit for review.

C. Provide a mixing system that meet the specified performance requirements at sludge solids concentrations of up to 1 percent dry solids by weight.

D. Provide a mixing system suitable for continuous operation and capable of meeting the specified performance requirements at all liquid depths within the minimum and maximum side water depths specified.

E. Provide a mixing system that creates a mixing pattern that prevents solids deposition on the bottom of the tank and prevents the formation of a scum blanket at the liquid surface.

F. Provide one chopper-type mixing pump equipped with flushless cartridge type mechanical shaft seals as specified. Seals requiring an external source of flushing, lubricating, or cooling fluid are not acceptable.

G. Provide equipment designed to fit within the space allocated on the Drawings and to pass through the available equipment access openings. Provide pumps suitable for the piping and equipment layout shown on the Drawings.

H. The suction piping for the mixing pump will also be used for sludge withdrawal by separate sludge transfer pumps provided by others.

I. The General Contractor will supply and install the following:
   1. Mixing pump suction and discharge piping and pipe supports.
   2. Concrete foundation, electrical power supply, controls, and instrumentation for the mixing pump.

J. Operation of the pumps will normally be controlled automatically by a remote programmable logic controller (PLC) provided by others.

1.5 PERFORMANCE GUARANTEES

A. Guarantee that the equipment will meet the following performance requirement:
   1. The sludge total solids concentration at any point in the WAS sump shall vary not more than plus or minus 25 percent from the mean total solids concentration of the WAS sump.

1.6 DEFINITIONS

A. Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards (HIS).

1.7 SUBMITTALS

A. Shop Drawings:
   1. General arrangement drawings including dimensions, size and location of connections, and equipment weights.
   2. Layout of mixing nozzles, scum control nozzle, and mixing piping.
   3. Make, model, weight, and horsepower of each equipment assembly.
   4. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
   5. Performance data curves showing head, capacity, horsepower demand, and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity. Indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the guarantee point.
   6. CFD analysis.
   7. Detailed structural and mechanical showing the equipment dimensions, size and location of connections and weights of associated equipment.
   8. Power and control wiring diagrams, including terminals and numbers.
   9. Complete motor nameplate data, as defined by NEMA, motor manufacturer, and including any motor modifications.
   10. Factory finish system.
   11. Details of flushless type mechanical seal.
   12. Submit written certification from Professional Engineer licensed in the Province of Manitoba stating that support systems, anchorage, and equipment have been designed

according to requirements of the NBC for post-disaster structures at time of shop drawing submittals.

B. Quality Control Submittals:
   1. Factory Functional and Field Performance Test Reports and Log.
   2. Manufacturer's Certification of Compliance that the factory finish system is identical to the requirements specified herein.
   3. Special shipping, storage and protection, and handling instructions.
   4. Manufacturer's printed installation instructions.
   5. Manufacturer's Certificate of Proper Installation.
   6. Suggested spare parts list to maintain the equipment in service for a period of 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
   7. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
   8. Operation and Maintenance Manual.

1.8 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following extra materials for the mixing pump:
   1. One set of bearings.
   2. One set of gaskets and O-ring seals.
   3. One set of keys, dowels, pins, etc.
   4. One shaft sleeve.
   5. One mechanical seal.
   6. One impeller complete with a cutter.
   7. One impeller shaft.
   8. One complete set of any special tools required to dismantle pump.

PART 2 PRODUCTS

2.1 SYSTEM SUPPLIER

A. WAS sump system supplier:
   1. Vaughan Co. Inc. (Rotamix System)
   2. Fluidyne Corp.

B. No "or-equal" or substitute system suppliers will be considered.

2.2 EQUIPMENT DESCRIPTION

A. The mixing system for the WAS sump shall generally consist of one mixing pump, two mixing nozzles, one scum/foam buster nozzle and appurtenances.

B. Design the mixing nozzles, direction of discharge, and outlet velocity, tailored specifically for this project in order to optimize mixing effectiveness and efficiency.

C. Provide all nozzle assemblies with flanged joint fittings and couplings to permit easy disassembly for cleaning. Design couplings to prevent nozzles from rotating out of position.

D. Provide stainless steel 316 or glass-lined ductile cast iron nozzles.

E. Mixing Nozzle Assemblies:
   1. Single directional discharge nozzles.
   2. Supported by a base elbow anchored to the floor of the tank.
   3. Flanged piping connection

F. Scum Control Nozzle Assemblies:
   1. Supported from wall of tank.
   2. Designed to be an integral part of mixing system
   3. Connected to discharge of mixing pumps and valved separately from mixing nozzles.
   4. Designed to allow periodic manual operation as required to break up scum accumulation at the liquid surface and prevent its reformation.
   5. Flanged piping connection

G. Mixing Pump
   1. The pump should deliver approximately 56.7 L/sec (900 gpm) with the scum nozzle on and approximately 37.85 L/sec (600 gpm) at a reduced speed with the scum nozzle off.
   2. Horizontal, centrifugal, dry pit, chopper type, end suction, vertical discharge, semi-open impeller
   3. Flushless cartridge type mechanical seal, Type 316 stainless steel, silicon carbide or tungsten carbide seal faces, oil lubricated, springs shielded from pumped fluid, requiring no external flush water.
   4. Provide impellers carefully finished to a smooth surface, statically and dynamically balanced, and designed for the specified conditions of service.
   5. Provide stress-relieved pump shafts designed to be rigid type with first critical speed at least 20 percent above the operating speed. Turn, grind, and polish shafts.
   6. Equip oil-lubricated bearings with constant level oiler with visible oil supply.
   7. Size motors for full speed run-out condition of pump performance curve

2.3 ELECTRIC MOTORS

A. See Section 26 20 00, Low Voltage AC Induction Motors.

B. Refer to Data Sheet(s) at end of this Section. The pump will be provided by variable speed driver by others, the pump motor shall be inverter duty.

C. Coordinate motor and VFD parameters to ensure compatibility. See Section 26 19 23, Variable Frequency Drives.

2.4 SUPPLEMENTS

A. Specific requirements are attached to this section as supplements.

2.5 ACCESSORIES

A. Equipment Identification Plate: 1.6 mm stainless steel with 6 mm die-stamped equipment tag number securely mounted in a readily visible location.

B. Lifting Lugs: Equipment weighing over 45 kg.

C. Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer.

2.6 FACTORY FINISHING

A. Prepare, and prime, and finish coat in accordance with Section 09 90 00, Painting and Coating.

2.7 SOURCE QUALITY CONTROL

A. Factory Tests and Adjustments: Test all equipment actually furnished.

B. Factory Test Report: Include test data sheets, curve test results, and performance test logs.

C. Pump Tests:
   1. Factory Functional Tests:
      a. Manufacturer’s standard production tests.
      b. Hydrostatic Pressure Test: Test pump casing at 150 percent of shut-off head. Maintain test pressure for not less than 5 minutes.
      c. Vibration Test: In accordance with ANSI/HI 9.6.4.
   2. Factory Performance Tests:
      a. Conduct on each pump.
      b. In accordance with ANSI/HI 14.6, Acceptance Grade 2B.

D. Motor Tests:
   1. Conduct on each motor.
   2. In accordance with Section 26 20 00, Low Voltage AC Induction Motors.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer’s printed instructions.

B. Supervise installation of furnished Goods by General Contractor to ensure that Goods are installed in accordance with the manufacturer's instructions. Adjust mixing nozzles to proper orientation to ensure that required mixing pattern is achieved.

C. Level base by means of steel wedges (steel plates and steel shims). Wedge taper not greater than 6 mm per 300 mm. Use double wedges to provide level bearing surface for pump and driver base. Accomplish wedging so that there is no change of level or springing of baseplate when anchor bolts are tightened.

D. Adjust pump assemblies such that the driving units are properly aligned, plumb, and level with the driven units and all interconnecting shafts and couplings. Do not compensate for misalignment by use of flexible couplings.

E. After pump and driver have been set in position, aligned, and shimmed to proper elevation, grout space between bottom of baseplate and concrete foundation with poured, non-shrinking grout of proper category, as specified in Section 03 60 00, Grouting. Remove wedges after grout is set and pack void with grout.

F. Connect suction and discharge piping without imposing strain to pump flanges.

G. Anchor Bolts: Accurately place using equipment templates and as specified in Section 05 50 00, Metal Fabrications (Basic).

H. Pipe baseplate drain to hub drain or scupper.

3.2 FIELD FINISHING

A. Equipment as specified in Section 09 90 00, Painting and Coating.

3.3 FIELD QUALITY CONTROL

A. Pump Tests:
   1. Field Functional Tests:
      a. Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.
      b. Operating Temperatures: Monitor bearing areas on pump and motor for abnormally high temperatures.
      c. Vibration Test:
         1) In accordance with ANSI/HI 9.6.4.
         2) Test with unit installed and in normal operation, and discharging to connected piping systems.
         3) If unit exhibits vibration in excess of limits specified, adjust or modify as necessary. Unit that cannot be adjusted or modified to conform as specified shall be replaced.
   2. Field Performance Tests:
      a. Test for continuous 3 hour period.
      b. Test Report Requirements: In accordance with ANSI/HI 14.6.

B. Motor Tests:
   1. Conduct on each motor.
   2. Comply with requirements of Section 26 20 00, Low Voltage AC Induction Motors.

3.4 MANUFACTURER’S SERVICES

A. Manufacturer’s Representative: Present at Site or classroom designated by the City, for minimum person-days listed below, travel time excluded:
   1. One person-day for installation assistance, inspection and functional and performance testing and completion of Manufacturer’s Certificate of Proper Installation.

2. One person-day for facility startup and training of the City's personnel.

B. See Section 01 43 33, Contractor Field Services and Section 01 91 14, Equipment Testing and Facility Startup.

3.5 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this Specification.
   1. Pump Data Sheets.
   2. Motor Data Sheets.

END OF SECTION

PUMP DATA SHEET NO. 1
WAS SUMP MIXING PUMP

Project: City of Winnipeg SEWPCC Upgrading/Expansion Project

Process/Facility: Bioreactors

Service: WAS Mixing

Pump Name: WAS Mixing Pump

Equipment Tag Number(s): P-R304

Manufacturer and Model: (1) Vaughan HE4T6CS-110

(2) Hayward Gordon CHOPX5B

(3) _____

Number of Pumps Required: One	Pump Type: Chopper centrifugal

Drive Type: ☐ Constant Speed ☐ Two Speed ☒ Variable Speed

LIQUID PROPERTIES	OPERATING CONDITIONS	SERVICE CONDITIONS
Name: Waste Activated Sludge	Capacity (L/sec): Rated: 56.7 2nd: 37.8	Ambient Temperature (°C): Min: 5 Max: 40
Fluid Temperature (°C): Min: 5 Normal: 10-20 Max: 25	Total Dynamic Head (m): Rated: 10.5	Relative Humidity (%): Min: 0 Max: 100
Specific Gravity: 1.0-1.02 @ 20 °C		
Vapour Pressure (kPa): 2.5 @ 20 °C		Altitude (m): 228
Viscosity (cp): 1.0-25 @ 20 °C		☒ Indoor ☒ Heated
pH: 6.5-7.5		☐ Outdoor ☐ Unheated
Total Suspended Solids (% by wt.): 0.1-1.0		Area Electrical Classification: Unclassified
Corrosion/Erosion/Abrasion Caused By: _____	NPSH Available (m): Rated: 9	
Remarks: _____	Remarks: _____	Remarks: _____

PERFORMANCE REQUIREMENTS (manufacturer to supply missing data)		
Max. Pump Speed (rpm): 1180		Factory Testing:
Min. Pump Speed (rpm):		☒ Functional ☒ Performance
Speed at Rated Capacity (rpm):	Min. NPSH Margin Ratio: 1.5	Field Testing:
Min. Hyd. Eff. at Rated Capacity (%):		☒ Functional ☒ Performance
Max. Power at Rated Capacity (kW): 11.17		Hydrostatic Test Pressure (kPag):
		150% of pump shut-off head

Remarks: _____

PUMP DATA SHEET NO. 1 (cont'd)
WAS SUMP MIXING PUMP

PUMP CONSTRUCTION DETAILS (manufacturer to supply missing data)

Nozzles						Miscellaneous Connections		
	NPS (mm)	ANSI Class	Facing	Location			Size (mm)	Location
Suction	150 or 200	125	FF	End		Drain		
Discharge	100 or 125	125	FF	Top		Vent		

Impeller:
Type: Semi open
Diameter (in): TBD by mfr

Casing Mount:
☒ Horizontal ☐ Vertical
☐ Centerline ☐ Near Centerline
☒ Foot ☐ Bracket

Motor Coupling:
☒ Direct ☐ Line shaft
☐ V-belt (side) ☐ V-belt (overhead)

Vent and Drain Connections:
☐ Tapped and plugged

Suction and Discharge Gauge Connections:
☐ Tapped and plugged

Packing:
Type: n/a
Manufacturer: n/a
Size/No. of Rings: n/a

Mechanical Seal:
Type: As specified
Manufacturer: Mfr's standard
Model: Mfr's standard
Lubrication: Oil

Bearings:
Radial (type/No.): Mfr's standard
Thrust (type/no.): Mfr's standard
Min. ABMA B-10 Life: 50,000 hrs
Lubrication: ☐ Grease ☒ Oil

Shaft Coupling:
Type: Flexible spacer
Manufacturer: Mfr's standard
Model: Mfr's standard

Remarks: Mechanical seal shall require no external source of flushing water.

MATERIALS OF CONSTRUCTION (manufacturer to supply missing data)

Casing: ASTM A536 ductile cast iron or ASTM A48 cast iron	Shaft: AISI 4140 heat treated steel	
Impeller: ASTM A148 Gr. 90-60 cast alloy steel, heat treated to 625 BHN minimum	Shaft Sleeve: Type 410 or 17-4PH heat treated stainless steel	
Cutter Bar: ASTM A536 ductile cast iron or ASTM A148 Gr. 90-60 cast alloy steel, heat treated to 500 BHN minimum		

Remarks:

ADDITIONAL REQUIREMENTS

MOTOR DATA SHEET NO. 1
WAS SUMP MIXING PUMP

Project: City of Winnipeg SEWPCC Upgrading/Expansion Project

Process/Facility: Bioreactors

Service: WAS Mixing

Pump Name: WAS Mixing Pump

Equipment Tag Number(s): P-R304

Type: Squirrel-cage induction meeting requirements of NEMA MG 1.

Manufacturer: For multiple units of same type of equipment, furnish motors and accessories from single manufacturer.

Hazardous Location: ☐ Furnish motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark.

Motor Size (kW): 11.2 ☐ Min. ☐ Max.	Guaranteed Minimum Efficiency at Full Load (%): 93.0
Voltage: 575	Guaranteed Minimum Power Factor at Full Load (%): Mfr's standard
Phase: 3	Service Factor (at rated max. ambient temperature): ☐ 1.0 ☒ 1.15
Frequency (Hz): 60	Enclosure Type: TEFC
Synchronous Speed (rpm): 1200	Mounting Type: ☒ Horizontal ☐ Vertical
☐ Constant Speed	Vertical Shaft: ☐ Solid ☐ Hollow
☐ Two-speed Speed (rpm): Slow _____ Fast _____	Vertical Thrust Capacity (N): Up _____ Down _____
☒ Multi-speed Speed (rpm): Min. Max. 1200	☒ Adjustable Speed Application (inverter duty rated) In accordance with Section 26 29 23, Variable Frequency Drives. Operating Speed Range: 50 to 100 % of rated speed
Variable Speed Load Classification: ☒ Variable Torque ☐ Constant Torque ☐ Constant Power	☒ Thermal Protection: Thermistors, one per phase ☐ Space Heater: _____ volts, single phase ☐ Oversize main terminal (conduit) box for motors ☐ Terminal for connection of equipment grounding wire in each terminal box
Winding: ☒ One ☐ Two	

ADDITIONAL REQUIREMENTS

☒ In accordance with Section 26 20 00, Low-Voltage AC Induction Motors.

SECTION 46 43 16.13

SECONDARY CLARIFIER MECHANISM (SUCTION HEADER/MANIFOLD TYPE)

MAJOR EQUIPMENT AND COMPONENT NUMBERS

ID No.	Equipment Description
CM-S110	Secondary Clarifier 1
CM-S120	Secondary Clarifier 2
CM-S140	Secondary Clarifier 4
CM-S150	Secondary Clarifier 5

PART 1 GENERAL

1.1 WORK OF THIS SECTION

A. The work of this Section includes furnishing and installation of secondary clarifiers mechanism, control panels, bridge walkway and insulated panel enclosure, windows, and all appurtenant work indicated in accordance with Contract Documents.

B. Unit Responsibility: Work requires that equipment, complete with all accessories, including but not limited to, clarifier mechanism, effluent weir plates, launder covers and Stamford baffles, infrared radiant heaters, control panels, be end product of one responsible system supplier. Unless otherwise indicated, Contractor shall obtain the system from responsible supplier of equipment. Supplier shall furnish all components and accessories of system to enhance compatibility, ease of operation, and maintenance, and as necessary to place equipment into operation in conformance with specified performance, features, and functions without altering or modifying Contractor's responsibilities under Contract. Contractor is responsible to the City for providing equipment system as specified herein.

1.2 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. American Bearing Manufacturers Association (ABMA):
      a. 9, Load Ratings and Fatigue Life for Ball Bearings.
      b. 11, Load Ratings and Fatigue Life for Roller Bearings.
   2. American Gear Manufacturers Association (AGMA):
      a. 2001, Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth.
      b. 2004, Gear Materials, Heat Treatment and Processing Manual.
      c. 6022, Design Manual for Cylindrical Wormgearing.
      d. 6034, Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors.
      e. 9005, Industrial Gear Lubrication.
   3. American Institute of Steel Construction (AISC).
   4. American Iron and Steel Institute (AISI).

5. American Society of Mechanical Engineers (ASME): B29.100, Precision Power Transmission, Double-Pitch Power Transmission, and Double-Pitch Conveyor Roller Chains, Attachments, and Sprockets.
6. American Welding Society (AWS):
   a. D1.1/D1.1M, Structural Welding Code – Steel.
   b. QC 01, Standard for AWS Certification of Welding Inspectors.
7. ASTM International (ASTM):
   a. A36/A36M, Standard Specification for Carbon Structural Steel.
   b. A48/A48M, Standard Specification for Gray Iron Castings.
   c. A148/A148M, Standard Specification for Steel Castings, High Strength, for Structural Purposes.
   d. A283/A283M, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
   e. A285/A285M, Standard Specification for Pressure Vessel Plates, Carbon Steel, Low and Intermediate Tensile Strength.
   f. A536, Standard Specification for Ductile Iron Castings.
8. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
   b. MG 1, Motors and Generators.
9. The Society for Protective Coatings (SSPC): SP 7, Brush-off Blast Cleaning.
10. ASTM A643/A653M, General Requirements for Steel Sheet Zinc Coated (Galvanized) by the Hot Dip Process.
11. ASTM D1187, Bituminous Coating.
12. ASTM E330 Standard Test Method for Structural Performance of Exterior Windows, Door, Skylight and Curtain Walls by Uniform Static Air Pressure Difference.
13. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
14. CAN/CSA A440.4 Window, Door and Skylight Installation.
15. CAN/ULC S701 Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
16. CSA 0121 Douglas Fir Plywood.
17. CSA G40.20/G40.21General Requirements for Rolled or Welded Structural Quality Steel.
18. ASTM B137 Standard Test Method for Measurement of Coating Mass Per Unit Area on Anodically Coated Aluminum.
19. National Building Code of Canada (NBC) with Manitoba Amendments.
20. Canadian Electrical Code (CEC)
21. Canadian Standard Association (CSA).

1.3 DEFINITIONS

A. Alarm Torque: 100 percent of Design Running Torque.

B. Certified Welding Inspector (CWI): As defined in AWS QC 01.

C. Cutout Torque: 125 percent of Design Running Torque.

D. Design Running Torque: Torque used to select size, strength, and type of materials and components for mechanism and drive system and at which or below will provide continuous 24 hour per day clarifier operation for period of not less than 20 years at design torque condition and rotational speed specified herein, without damage, permanent deformation or overload, and equal to 50 percent on overload device scale. Design Running Torque is applied at the output of the low speed final reduction unit.

E. Slenderness Ratio: Ratio of unbraced length to least radius of gyration.

F. Submerged Metal: Metal below gear head drive and a plane 450 mm above weir elevation indicated.

G. Ultimate Torque: 200 percent of Design Running Torque and below which no portion of mechanism will be damaged if operated for only short period of time (a few seconds) and equal to 100 percent on overload device scale. Ultimate Torque is applied at the output of the low speed final reduction unit.

1.4 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings - Secondary Clarifiers Mechanism:
      a. Product Data:
         1) Make, model, weight, and horsepower.
         2) Descriptive literature as necessary to fully describe the equipment to be supplied, specifications, dimensional layout, and identification of materials of construction.
         3) Painting/Coating System(s): Manufacturer's descriptive technical catalog literature and specifications.
      b. Detailed Drawings:
         1) Detailed structural, mechanical, and electrical drawings showing equipment fabrications and interface with other items including dimensions, size, and locations of connections to other work, and weights of associated equipment.
         2) Structural and Mechanical: Details of influent column, sludge return piping, center torque cage, center pier, flocculation well, energy dissipating inlet, walkway bridge, centre platform, retractable access assembly, influent well, sludge suction header and manifold, rotating rake arm trusswork, scum skimmer, scum trough, launder cover, and access platform.
         3) Scum Trough Flushing Actuator Details: Method of operation and flushing water flow adjustment, and flow rate calculations.
         4) Scum trough infrared radiant heaters and mounting details.
      c. Design Details:
         1) Running, Alarm, and Cutout Torque ratings of drive unit assembly.
         2) Ultimate Torque load capabilities of drive unit assembly, torque cage, and rotating rake arm trusswork.
         3) Design calculation for winching system.
      d. Design calculations to confirm mechanism and drive unit torque conditions are met.
      e. Confirmation that field measurement were carried out by supplier.

f. Confirmation that effluent weirs are adjustable as specified.
g. Sludge Withdrawal System: Indicate head loss in sludge suction header and manifold at average, maximum and minimum conditions.
h. Certification of Structural Calculations: Letter of certification for structural design of mechanism, signed and sealed by Professional Engineer licensed in the Province of Manitoba. Copies of detailed structural design calculations shall not be submitted for review. If submitted, calculations will be returned without review.
i. Structural Loads: Static, dynamic, and torque reaction loads to be transferred into structure at center column and Access Bridge support locations.
j. Details of torque sensing and load indication device.
k. Functional description of internal and external instrumentation and controls to be supplied, including list of parameters monitored, controlled, or alarmed.
l. All applicable submittals in 40 99 90 Package Control Systems.
m. Power and control wiring diagrams, including terminal numbers.
n. Shop Drawings – Bridge Walkway Enclosure:Submit shop drawings indicating type of metal wall panels, thicknesses of metal components, size, spacing and location of supports and girts, connections, type and locations of fastenings, sealing, finish and colour.
    1) Indicate design loads and spans, sheet lengths and lap locations.
    2) Indicate provision for structural and thermal movement between metal cladding and adjacent materials.
o. At time of shop drawing submittals, Submit written certification from Professional Engineer licensed in the Province of Manitoba stating that support system, anchorage and equipment have been designed according to requirements of the NBC, Division B, Part 4, article 4.1.8.17 for post-disaster structures.
p. Submit two 300 mm long samples of profiles specified, showing material, thickness, finish and colour.
q. Submit metal finishers certificate that coating system provided meets the specifications.
r. Submit manufacturer's instructions for installation of materials as required

B. Informational Submittals:
1. Designer’s qualifications.
2. Manufacturer’s Certificate of Compliance: Commercial products and factory-applied coating system(s).
3. Special shipping, storage and protection, and handling instructions.
4. Welder/welding operator qualifications.
5. Welding inspector credentials.
6. Welding Inspector’s Report.
7. Test procedures.
8. Test results, reports, and certifications.
9. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
10. Manufacturer’s Certificate of Proper Installation, in accordance with Section 01 43 33, Contractor Field Services.
11. Service records for maintenance performed during construction.

1.5 QUALIFICATIONS

A. Designer: Registered Professional Engineer.

B. Welder/Welding Operator: In accordance with AWS D1.1/D1.1M.

C. Welding Inspector: Certified in accordance with AWS QC 01, and having prior experience with welding codes specified.

1.6 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts and special tools:

Item	Quantity
Gaskets, O-rings, keys, dowels, and pins	One complete set per unit
Shear pins of each different size	Six per unit
Seals used in system	One of each type and size per unit
Scum skimming arm blade pivot bearing	Two of each type and size per unit
Drive chain and/or belts (if used)	One set of each type and size per unit
Special tools required to maintain or dismantle scum collection assemblies, drive unit except for low speed main bearing, but including that required for removal/insertion of main bearing race balls	One complete set
Infra-red heaters	Four bulbs
Lubricants	As required for 1 year of continuous operation per unit
Control Panel components	As per Section 40 99 90.

B. Delivery: In accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:
1. OVIVO
2. WesTech
3. Evoqua

B. No “or-equal” or substitute products will be considered.

2.2 SERVICE CONDITIONS

A. Material Handled: Mixed liquor produced by integrated fixed film activated sludge process and resulting from degritted, primary clarified, municipal wastewater.

B. Influent Liquid Temperature Range: 2 degrees C minimum to 30 degrees C maximum.

C. Influent Mixed Liquor Solids Concentration: 5,000 mg/L maximum, dry weight basis.

D. Influent pH Range: 6.3 minimum to 7.5 maximum.

E. Return Sludge Solids Concentration Range, Dry Weight Basis: 10,000 mg/L minimum, 20,000 mg/L maximum.

F. Site Conditions:
   1. Mechanism and bridge design shall be in accordance with conditions and requirements stated in Section 01 61 00, Common Product Requirements.
   2. Also refer to Secondary Clarifier Mechanism Data Sheet at end of Section
   3. In addition, design shall accommodate the following Site conditions:
      a. Exposure: Ultraviolet radiation of sun. Wind, rain and ice (clarifiers CM-S140 and CM-S150 only).
      b. Ambient Temperature Range: Minus 35 degrees C minimum to 40 degrees C maximum.
      c. Ambient Humidity Range: 10 percent minimum to 98 percent maximum relative humidity.
      d. Flushing Service Water: 4 L/s at 700 kPag.

2.3 MANUFACTURED UNITS

A. Provide four units, two retrofit and two new, each meeting performance and design requirements as specified below and in Data Sheet supplement at the end of this section. See contract drawings for details including mechanical and structural drawings of existing clarifiers' mechanism.

B. The two existing clarifiers CM-S110 and CM-S120 are presently organ pipe mechanisms that have a concentric centre column in which the outgoing RAS flows downward in the middle and the incoming mixed liquor flows upward in the annulus. Design and supply an adapter, located near the bottom of the centre column, to connect the new unit without breaking through the concrete floor.

C. General:
   1. Center pier supported, center drive type.
   2. Furnished complete including drive motor, gearing, bridge, center column, center influent well, flocculation well, bridge, walkways, platforms, skimmer mechanism and scum trough and other necessary parts, including anchor bolts.
   3. Direction of mechanism rotation shinf all be clockwise.
   4. Scum baffles and effluent weirs shall be provided by clarifier mechanism manufacturer in accordance with Section 46 43 79, Weirs and Baffle Plates.

D. Performance Requirements:
   1. Provide clarifier mechanisms capable of continuous operation.
   2. Remove balanced proportional volume of settled sludge uniformly from and across entire tank bottom.
   3. Mixed liquor enters through a pipe installed below the tank floor and flows up the centre column through inlet ports into the centre energy dissipating compartment. Ports in this compartment direct mixed liquor to the outer flocculating well. Settled solids are collected hydraulically through double rotating suction arms with properly sized orifices.
   4. Collect and convey settled sludge to center-located rotating manifold and discharge into and through sludge return pipe.
   5. Clarified effluent overflows the V-notch weir plates, located along the perimeter of the clarifier, and discharges into the effluent launder. The weir plates shall be adjustable within plus or minus 100 mm from the specified elevation. Note that the existing effluent concrete launders for Clarifiers 1 and 2 are in poor conditions. Anchoring of new weirs shall be with stainless steel 316 bolts that shall sandwich the existing concrete walls from both sides.
   6. Floating Scum: Collect, convey, and discharge from surface of clarifier to a central point at outside perimeter of unit.
   7. Return Sludge: Remove through suction manifold header.
      a. Maximum Head Loss: 300 mm water column maximum headloss in sludge withdrawal header, as measured from tank water surface to hydraulic gradient at discharge point into rotating center sludge collection box.
   8. Sludge Suction Header Velocity: Minimum 0.15 m/s at any point in header at minimum RAS flow.
   9. The complete package shall be of sufficient strength to sweep in the 50mm grout on the tank bottom under its own power. Method of grouting of the tank floor to be in accordance with the Supplier recommendations.
   10. Operate satisfactorily under the conditions indicated in the Data Sheet supplement.

E. Design Requirements:
   1. Gears, Bearings, Chains and Sprockets: Above clarifier water surface.
   2. Mechanism Construction: Welded, except at locations requiring periodic field adjustment and as approved. Welded joints shall be seal welded in shop. Welding shall conform to AWS D1.1/D1.1M requirements. Impacts of seal welding on structural design of mechanism, if any, shall be incorporated into design.
   3. Stresses: Maximum 90 percent of material yield strength at Ultimate Torque load in members.
   4. Maximum Slenderness Ratio: 200 for compression member and 240 for tension member.
   5. Design Running Torque:
      a. Clarifiers CM-S110 and CM-S120, 32,540 N-m (24,000 ft-lb) minimum.
      b. Clarifiers CM-S140 and CM-S150, 61,010 N-m (45,000 ft-lb) minimum.
   6. Sludge collection arm tip speed between 1.82 and 2.43 m/min (6 and 8 fpm)
   7. Capable of withstanding, without failure or permanent deformation of any part, Ultimate Torque Rating as defined herein.

F. Dimensional Verifications:
   1. Conduct a minimum of two Site visits to the plant and take field measurement of existing structures and required connections prior to submitting shop drawings for review.

2.4 MATERIALS

A. Conform to ASTM specifications where possible. State all deviations.

B. All elements 2 m below clarifier liquid level shall be in stainless steel 316L.

C. Unless otherwise noted, minimum thickness of all stainless steel plates and structural members designated for submerged or partially submerged service is 5 mm.

D. Fabricate all walkway trusses, walkway and extended platform grating and staircase of 6063T6 aluminum alloy for bearing bars and 6063T5 aluminum alloy for crossbars. Take protective measures to avoid galvanic corrosion between beams and grating.

E. Fabricate guardrails of anodized 6063 T52 or 6063 T832 Aluminum alloy. Bolt the guardrails together in the field. Finish Aluminum railings with clear anodized finish, to Architectural Class 1 Anodic Colour Coating in accordance with Aluminum Association Specification AA-M12C22A42/44 after fabrication.

F. The centre cage and submerged rotating trusses for the support of scrapers, sludge collection devices, skimmers, etc., shall be all-welded stainless steel construction designed for assembly by bolting in the field.

G. Construct the centre cage and submerged rotating trusses for the support of scrapers, sludge collection devices, skimmers, etc., of Type 316Lstainless steel.

H. Provide sludge suction header of hollow, Type 316L stainless steel construction.

I. Provide sludge removal arms of Type 316L stainless steel truss construction. Fabricate any raking blades of Type 316L stainless steel with spring stainless steel squeegees. Secure squeegees with Type 316 stainless steel bolts and nuts.

J. Fabricate the scum removal system (ducking skimmer, skimmer blades, rotating weir, scum box etc.) of Type 304L or 316L stainless steel.

K. Fabricate other bolts and nuts of Type 316 stainless steel dipped in anti-seize compound to prevent galling.

L. Fabricate energy dissipating compartment and scum skimming system of Type 304L or 316 L stainless steel.

M. Fabricate flocculating well Type 316L stainless steel structural members. Use Type 316L stainless steel plate with a minimum thickness of 4.5 mm for panels between framing members.

N. Welding of stainless steel to conform to AWS D1.6 and specific welding requirements included in this specification.

O. Enclose gear reduction and turntable units in ductile iron or fabricated steel housings.

P. Provide Type 304L or 316L stainless steel scum baffles.

2.5 CENTRE COLUMN

A. For new clarifiers, mount stainless steel pipe over mixed liquor inlet as centre column, which also acts as influent pipe. Influent column diameter shall be 1050 mm (42”). Coordinate influent column with influent pipe as shown on the contract drawings. For existing clarifiers, connect the center column to a sludge manifold adapter.

B. For new clarifiers, flange base of column for bolting to clarifier floor and top of column for bolting to base of drive. For existing clarifiers, flange base of column for connecting to the sludge manifold adapter and top of column for bolting to base of drive.

C. Design column to withstand torque and vertical loads as well as any unbalanced loads.

D. Provide a minimum of 4 ports that remove no more than 50 percent of column material, to allow mixed liquor to exit. Design for exit velocity no greater than 1.5 m/s at peak flow. Extend openings a minimum of 150 mm above average water level to allow floatables and scum to escape.

2.6 ROTATING COLLECTION CHAMBER OR SLUDGE MANIFOLD

A. Fabricate rotating collection chamber of Type 316L stainless steel plate. Provide flanged connection to sludge suction header and connect to centre cage.

B. The return secondary sludge enters from the suction header and exits through a hole in the floor within the chamber (new clarifiers) or through a collection device that is mounted at the bottom of the centre column to transmit the flow to a RAS pipe in the centre of the column (existing clarifiers).

C. Design to preclude leakage when subjected to 1.0 m head. Make seal between centre column and collection chamber using neoprene.

D. Provide a Type 316L stainless steel ring bolted to the floor. Provide a seal between the floor and the bottom of the collection chamber.

2.7 SLUDGE MANIFOLD ADAPTER

A. Provide sludge manifold adapter made of Type 316L stainless steel for the secondary mechanisms to be installed in the existing clarifiers. The sludge manifold adapter is to allow mixed liquor to flow upwards through the annulus of the adapter to the centre column and allow the collected sludge to be withdrawn downwards through the centre of the adapter.

Coordinate influent column with influent pipe as shown on the contract drawings and field verified by the supplier.

B. Provide flange connection at the top end of the sludge manifold adapter for connecting to the flange base of the centre column for the existing clarifiers.

C. Flange base of the adapter for bolting to clarifier floor.

D. Design the adapter to withstand torque and vertical loads as well as any unbalanced loads.

2.8 CENTRE CAGE

A. Suspend the centre cage from the turntable, adequately braced and sufficiently strong and stiff to support and rotate the rake arms, suction headers and skimming arms.

B. Design with sufficient strength and rigidity such that with 60/40 percent load imbalance at Ultimate Torque Load; no member will be stressed to level beyond maximums allowed by AISC Specifications.

C. Fasten the cage to main ring gear with machine screws or bolted connections.

D. Include connections for the sludge rake arms, suction headers and skimming arms.

E. Connections to rake arm: adjustable and bolted.

2.9 ENERGY DISSIPATING INLET (EDI) COMPARTMENT

A. Function: Create a colliding flow configuration that impinges flow, dissipates energy and promotes enhanced flocculation.

B. Provide Multi-Layer Energy Dissipating Inlet Column (MEDIC):
   1. Size and dimensional design details: Provided by Hydrosims.
   2. Licensing Fees: Provide to US Patent Holder (Licensor) and licensed to the City (Licensee). Licensing fees shall be paid by Supplier to Hydrosims, 9330 S 222ad ST BLDG B KENT WA 98031 (Licensor).
   3. Material: Type 304L stainless steel.

C. Support EDI from the center column.

2.10 FLOCCULATION WELL

A. Size flocculation well to provide 20 minute retention time at average clarifier influent flows (including RAS flow) within the area described by the well, including the full clarifier depth.

B. Make the flocculation well structure extend from the water surface to 50 percent depth.

C. Support from truss arms and/or centre cage.

D. Fabricate flocculation well as a circle or as a polygon with a minimum of 8 equal sides.

E. Fabricate circular well of structural stainless steel members.

F. For polygonal well, use Type 316L stainless steel plates bolted to a Type 316L stainless steel frame. Connect adjacent pieces and the frame with neoprene gaskets between to minimize leakage.

G. Mount the well level with the top edge of the frame 10 mm below the average water surface, plus or minus 3 mm. Mounting at this elevation allows the passage of scum and foam without compromising the flow pattern.

H. Provide the mounting with the necessary features to handle a vertical plus or minus 25 mm adjustment.

2.11 TRUSS ARMS

A. Provide two (2) truss arms per clarifier.

B. Support rotating truss arms from centre cage.

C. Fabricate truss arms using Type 316L structural stainless steel, without the use of rods, sections, turn buckles, clevises, and locknuts.

D. Design to hold the sludge and scum collection devices in a horizontal and vertical plane when subjected to momentary peak torque.

E. Sludge Suction Header Connections: Adjustable and bolted with two Type 316 stainless steel bolts at each location. Do not seal weld connections

2.12 SLUDGE SUCTION HEADERS

A. Include a full diameter double suction header of a minimum of 6 mm stainless steel plate construction flanged from a central rotating collection chamber.

B. Taper the header with rectangular cross section, decreasing from the centre of the tank to the outer tip to impart a maximum uniform sludge withdrawal velocity that is less than 1.2 m/s within the header to reduce the system headloss. Additionally, a minimum header velocity greater than 0.15 m/s is required to ensure no sludge build-up in the header or orifice clogging.

C. Provide orifices in the header to collect the sludge. Space and size the orifices based on the amount of sludge each must remove to achieve proportional rate of sludge withdrawal across the entire diameter of the tank. Space the orifices at a maximum distance of 750 mm apart.

D. Mount the header parallel to clarifier bottom, with the face on which the orifices have been placed on an angle of forty-five degrees to physically and hydraulically trap the sludge.

E. Provide a bottom vane to fluidize the sludge into the area of influence of the orifices.

F. Provide a neoprene squeegee with a Type 316L stainless steel backing plate attached to this vane. On the squeegee, provide slotted holes allowing for 25 mm vertical adjustment.

G. Design suction header for a maximum headloss of 0.3 metres between the farthest orifice from the centre column and the connection to the sludge collection manifold.

H. Inner End of Header: Flanged for field bolting to collection chamber with Type 316 stainless steel fasteners and an elastomeric gasket at least 3 mm thick.

2.13 BRIDGE/WALKWAY

A. For existing clarifiers, provide a full diameter bridge/walkway and a centre platform around the drive mechanism. Provide a walkway spanning the entire length of the rotating scum trough.

B. For the new clarifiers, provide a full diameter bridge/walkway and a centre platform around the drive mechanism. The bridge/walkway shall be completely covered from its southern end to and including the centre platform around the drive mechanism. Provide one access door from the centre platform to the other side of the bridge/walkway.

C. Arrange so that all areas or equipment items requiring maintenance can be accessed from the bridge platform. Provide inspection openings where necessary.

D. Support the bridge/walkway rigidly on centre column and by the clarifier wall.

E. Diagonally cross brace and space beams as necessary to carry loads and produce required clear walkway width. Extend full radius.

F. Coordinate walkway fabrication with access platform, stairwell and scum box access platform/walkway fabrication.

G. Open walkways shall have a minimum clear width of 900 mm and a minimum working space around the drive mechanism of 1200 mm (on four sides).

H. Design the bridge/walkway for a live load of 4.8 kN/m2. At the design loads, ensure that the deflection is no more than 1/360 of the span. Design the centre platform to accommodate a davit base rated at 150 kg and provide suitable openings for human access.

I. Provide structural support, off from the walkway, for 9 heating lamps for each new clarifier to be positioned across the entire length of the rotating scum trough and the scum box for heating. The heating lamps shall be positioned below the walkway grating at an adequate distance from the clarifier liquid level and provided with suitable removable mechanism for service.

J. Provide an extended platform, off the bridge/walkway access platform (as shown on the contract drawings), supported by the clarifier wall for the installation of a retractable access assembly.

2.14 BRIDGE/WALKWAY ENCLOSURE

A. Enclosed walkways for the new clarifiers shall have a minimum clear width of 1300 mm and a minimum working space around the drive mechanism of 1200 mm (on four sides).

B. Design Requirements:
   1. Design metal panel system using concealed fastening details
   2. Design metal panels, anchors, fastenings and secondary support system to withstand applicable loads established by the National Building Code of Canada and applicable local regulations for the locality for post disaster structures. Deflection of profile sheets: Maximum 1/180th of span at this loading. Reference velocity pressure: Based on hourly wind pressures for the locality.
   3. Design work of this Section, which will support other items or will be required to support structural loads of any nature, by a Professional Engineer licensed in the Province of Manitoba. Affix professional seal and signature to shop drawings for such items.
   4. Design components for deflection, including bridge deflection.
   5. Design system to comply with CAN/CSA S16.1.

C. Fabricate walkway enclosure of 75 mm thick insulated metal panels:
   1. Exterior Walls and Roof: Commercial quality 0.76 mm, minimum, zinc coated (galvanized) to ASTM A653/A653M coating class Z275.
   2. Models and Manufacturers:
      a. Vicwest, DM 40 – MESA Insulated Panels.
      b. Kingspan metal and wall systems: Roofs; 900 High Rib. Walls 200 Inverted Rib or similar roof profile.
      c. Garland:, Insulated Wall panels- R-MER Wall-Pan
      d. Or approved equal in accordance with B8.
   3. Miscellaneous Shapes: CAN/CSA-G40.21 M; galvanized steel, galvanized to CAN/CSA A164 M, hot-dip galvanizing of 610 g/m² zinc coating.
   4. Coping counterflashing, flashing closures of same material and finish as metal panels: 0.61 mm galvanized steel sheet.
   5. Concealed Fasteners: Stainless steel for aluminum wall panels, galvanized carbon steel for steel wall panels.
   6. Isolation Coating: ASTM D1187 Bituminous Coating.
   7. Touch up Primer: Sealtight Galvafroid Zinc Rich Coating by W.R. Meadows of Canada Ltd.
   8. Flexible Seals: 1.0 mm thick EPDM or Neoprene sheet and adhesive.
   9. Sealant:
      a. Shop Applied Sealant: One part elastomer, TRS 600 by Tremco (Canada) Ltd
      b. Sealant for On Site Sealing: Dymeric 240 by Tremco (Canada) Ltd. Primer: As recommended by sealant manufacturer. Colour of sealant: Of colour similar to predominant material to which sealant is applied and subject to review by the Contract Administrator.

2.15 FLOORS -BRIDGE/WALKWAY ENCLOSURE

A. General: Comply with design requirements of Section 2.14 above.

B. Fabricate floors of checkered plate on air barrier and insulation over structural deck:
   1. Fabricate floor of 6 mm thick 6061 T6 aluminum checker plate formed to profiles to suit enclosure floors.
   2. Polystyrene Insulation (Type 1): CAN/ULC S701, Type 4, rigid, expanded, extruded polystyrene board insulation, RSI=0.87 per 25 mm thickness and a minimum compressive strength of 240 kPa at 10 percent deformation or yield; shiplapped edges. Thickness 100mm.
   3. Air and Vapour Barrier: 0.51 mm thick reinforced vinyl sheet, FR40 by Lexsuco Canada Ltd. Mechanical fastening strip for vinyl sheet: 25 by 3 mm thick securement strip by Hydrotech Membrane Corp.

C. Insulated Access hatches:
   1. Fabricate insulated hatches with safety grating, in floor assembly, Type BD-Bolt down, size: 457 mm by 457 mm.
   2. Manufacturers: MSU Mississauga, Bilco Canada, or Lexsuco Canada.

D. Sealant: Dymeric 240 by Tremco (Canada) Ltd. Primer: As recommended by sealant manufacturer. Colour of sealant: Of colour similar to predominant material to which sealant is applied and subject to review by the Contract Administrator.

2.16 WINDOWS -BRIDGE/WALKWAY ENCLOSURE

A. Design Requirements:
   1. Design members and their connections to withstand within acceptable deflection limitations their own weight, the weight of their glass, loads imposed by the motion of operable elements and the minimum design loads, and combinations of loads, due to the pressure and suction of wind as calculated in accordance with the National Building Code of Canada for the locality for post disaster structures.
   2. Limit deflection to L/175 of clear span tested to ASTM E330 under wind loads for building locality as per National Building Code of Canada Division B, Appendix C, Climatic and Seismic Information for Building Design in Canada.

B. Manufacturers:
   1. Acceptable manufacturers: Kawneer, Sherwood Windows Ltd., Alumicor Ltd.
   2. Sections are based on Kawneer's sizes and thickness of extrusions and location of thermal break. Other sections will be permitted if they meet the design requirements of the specifications.

C. Aluminum Sections: ASTM B221, alloy AA6063 T5, accurately formed and extruded aluminum free from defects impairing appearance, strength and durability. Aluminum Sheet: ASTM B209, Alloy 1100-H14 anodizing quality.

D. Casements:
   1. Kawneer 526 Isoport Series, heavy duty side hinged, open out.
   2. Hardware for Casements: Extruded aluminum hinges with stainless steel pin, double weatherstripping, solid white bronze cam handles with concealed keeper.
   3. Insect Screens: Aluminum framed 14/18 aluminum mesh.

E. Miscellaneous Steel: CSA G40.20 hot dip galvanized after fabrication.

F. Screws, Bolts and Fasteners: ASTM A167, #300 Series stainless steel.

G. Insulation: Polystyrene Insulation: CAN/ULC S701 Type 4, compressive strength 210 kPa, thickness as shown, or Mineral Fiber Insulation: CW225 by Owens Corning Canada Inc., or RXL40 by Roxul Inc. Thickness as indicated.

H. Sealant for Glazing: Vision strip by Tremco (Canada) Ltd. Primer: As recommended by sealant manufacturer.

I. Finish: Fluoropolymer Enamel: PPG Duranar two coat system 30 plus/minus 5 microns dry film thickness. Colour to later selection. Glass:

J. Glass:
   1. Manufacturers:
      a. PPG Canada Inc./Industrial Control Development Inc. (ICD).
      b. Guardian Industries, Corp.
      c. Solutia Inc.
      d. AFG Glass Inc.
   2. Tempered Insulating Glass (TIG): Insulating glass units with 12 mm air space, clear tempered glass outboard and clear glass tempered inboard, each sheet 6 mm minimum thickness, Class C, warranted by manufacturer against failure of edge sealing for minimum 5 years from date of manufacture. Provide low emissivity coating on the No. 3 surface. Fill air space with Argon gas.
   3. Shims, spacers and setting blocks: 45, 50 and 70 Durometer A hardness plus/minus 5 respectively, neoprene rubber by Goodyear Industrial Products. Resistance to oxidation and permanent deformation under load shall be the prime essentials of shims, spacers and setting blocks. Sized to suit glass weight.
   4. One part glazing gaskets: Extruded neoprene of accepted profile. Gaskets properties: Tensile strength, 7300 kPa; Durometer A hardness, 50 plus/minus 5; resistance to permanent set, ASTM D395, Method D, 25 percent maximum set; minimum elongation at break, 300 percent; resistance to ozone, ASTM D1149, showing no cracks. Colour: Black.
   5. Sealant for heel bead air tight/gas tight and bedding exterior glazing: Vision strip by Tremco Canada Ltd.
   6. Glazing tape: Polyshim II by Tremco (Canada) Ltd.

2.17 DOORS - BRIDGE/WALKWAY ENCLOSURE

A. Manufacturers:
   1. S.W. Fleming Ltd.
   2. Baron Metal Industries Inc.
   3. Metal Door Ltd.

B. Materials:
   1. Steel sheet: ASTM A653, CS, Type B, Coating Designation ZF75 (A25) minimum.
   2. Galvanized steel: CSA G164 unless otherwise specified hot-dip zinc coating.
   3. Stainless steel: ASTM A167 Type 316 stainless steel.
   4. Thermal Insulation: Glass fibre insulation minimum density 24 kg/m³.
   5. Primer: CGSB 1.181, zinc rich primer.

C. Fabrication – Doors:
   1. Doors: Hollow, welded stiffener construction.
   2. Assemble components of door by means of spot welding with vertical stiffeners spaced 150 mm maximum o.c. and welded at 150 mm o.c.
   3. Continuously weld door edge seams, body fill, and grind smooth. Face seams in finished product are not acceptable.
   4. Fabricate steel flush closed ends on edges, top and bottom of doors.
   5. Door Thickness: 45 mm.
   6. Thermal Insulation: Full thickness of door. Fill all voids in door including stiffeners.

D. Fabrication - Frames
   1. Mitre frame accurately and weld continuously on inside of frame profile.
   2. Prepare frame for rubber silencers. Use three silencers per standard height door. Use a minimum of two welded channel or angle spreaders per frame to ensure alignment.
   3. Terminate frame at top of Weld floor plates to frame for anchorage to slab. Verify depth of extension of finished floor to concrete slab.
   4. .Form continuous drip to exterior frame head.

E. Door hardware:
   1. Hinges: Butt hinges, Satin stainless steel No. 630 finish, Extra heavy-weight, four ball races, full mortise, stainless steel model FBB199-32D by Stanley, or T4A3386-32D by McKinney.
   2. Lockset: Mortise utility room lock with lever handle, Model 35H7EW3H by Best, Model 8204 LNJ by Sargent, Model L9080 03 by Schlage.
   3. Keying: Lock Cylinders: Operate by a master key system, Furnish lock manufacturer's removable core maximum security keying system.
   4. Closers: Painted finish, Regular arm with hold-open, model 4010H Series by LCN, 350H series by Sargent or 7500IT by Norton.
   5. Raindrip: Zero 11 aluminum mill finish, for exterior side of frame head door by Zero International Inc.
   6. Weather stripping (head and jambs): W 16S heavy duty surface mounted anodized extruded aluminum with black solid neoprene seal for each leaf by K.N. Crowder Mfg. Inc.
   7. Thresholds: One-piece full width of opening, with stainless steel self tapping screws in threaded expansion anchors, clear anodized aluminum finish. Thermal break saddle (155 mm x 12 mm), model 253X3AFG by Pemko, S473A by Reese, or CT-45 by K.N. Crowder.
   8. Automatic Door Bottom and gas tight seal: CT 50 by K.N. Crowder Mfg. Ltd. Heavy duty anodized extruded aluminum with closed cell sponge neoprene seal.

2.18 GUARDRAILS

A. Fabricate and install guardrails to meet all Manitoba Building Code and Manitoba Workplace Safety and Health Act requirements. Use handrails that are free standing and are attached to the bridge structure or use handrails that are attached to the inside of the upper truss member if that truss member is at the correct height. Do not use trusses for handrailing.

B. Provide suitable insulation at the connection points between dissimilar metals to prevent galvanic corrosion.

C. Provide double row horizontal pipe guardrails, with top member 1070 mm above the base and a horizontal intermediate members spaced midway between the top and the base, and vertical members at both ends of the horizontal members with intermediate vertical supports that are not more than 3 m apart at their centers.

D. Design minimum horizontal load applied inward or outward at the top of every guardrail is concentrated load of 1.0 kN applied at any point for access walkways to equipment platforms, contiguous stairs and similar areas where the gathering of many people is improbable.

E. Design individual elements within the guardrails, including solid panels and pickets, for concentrated load of 0.5 kN at any point in the element.

F. Design minimum load applied vertically at the top of every required guardrail to be 1.5 kN/m.

G. Provide a toe board not less than 140 mm high above the surface of the walkway at the outer edge of the walkway. The space between the bottom of the toe board and the surface of the walkway to be not more than 6 mm.

2.19 RETRACTABLE ACCESS ASSEMBLY AND EXTENDED PLATFORM

A. Provide as set of retractable, 900 mm wide, aluminum, access assembly for each clarifier mechanism. Hinge the retractable access assembly to the extended platform.

B. Provide a portable winching system to lift the access assembly to a horizontal position during normal operation and to lower the access assembly to the bottom of the secondary clarifier when needed for access.

C. Design the extended platform to withstand the dead and live load of the retractable access assembly, portable winching system and the applied live load from traffic.

D. Design the retractable access assembly to withstand the live load from traffic to be specified by the supplier.

E. Provide swinging, lockable aluminum gate at the top of the retractable assembly.

2.20 STAIRS

A. Provide 2 access stairs in aluminum for each of clarifiers CM-S140 and CM-S150 from the walkway platforms to grade.

B. Provide steps in aluminum for clarifiers CM-S110 and CM-S120 from the walkway platforms to concrete floors as necessary.

2.21 SCUM REMOVAL SYSTEM

A. General:
   1. Mechanically collect and discharge surface scum from annular space between center influent stilling well and outer perimeter scum baffle.
   2. Consists of skimmer assembly, rotating weir assembly (scum trough), and additional devices specified and required for proper operation.
   3. Skimming equipment shall operate within circumferential scum baffle.
   4. Design the skimming system such that its operation will not conflict with the installation of the Stamford baffles.
   5. The maximum volume per flush shall be 1600 Litres for clarifiers CM-S140/S150 and 1100 Litres for clarifiers CM-S110/S120.

B. Ducking Skimmer Assembly:
   1. Quantity: One per clarifier
   2. Collect floating scum full distance between the outer diameter of the flocculation well and the inner diameter of the peripheral scum baffles, located just inside the V-notch weir plate.
   3. Supported by collector arms. Designs that rely on scum baffle for support are not acceptable.
   4. Furnish with pivot support that allows skimmer to pass under rotating weir without interfering with operation of rotating skimmer.
   5. Furnish with polyurethane wear shoes that contact skimmer guides allowing smooth submergence and return to vertical position.
   6. Provided with additional supports or stops as required to prevent damage to equipment when basin is dewatered or when collector assembly is operated in dry basin.
   7. Provide with replaceable, adjustable, Type 304L stainless steel or UHMW wearing surfaces at contact points between skimmer assembly and weir assembly to make contact as skimmer passes under weir assembly.
   8. Fabricate with skimmer blade sections, blade supports, support pivot bearings, wiper, and return mechanism.
   9. Skimmer Blade Sections:
      a. 6 mm thick fiberglass reinforced plastic or 16 gauge Type 304L.
      b. Design to not exceed 3 m in length, approximately 300 mm high, with top of blade 125 mm above clarifier weir crest.
      c. Sealed between sections and have adequate supports attached to collector arms.
   10. Support Pivot Bearings:
      a. Suitable for underwater service.
      b. Water-lubricated or self-lubricating type not requiring additional lubrication.

11. Positive Return Mechanism:
    a. Rotates skimmer blade assembly to vertical position after it passes under weir.
    b. Actuated by counter weight or float. Spring or cable and weight mechanisms are not acceptable.

C. Rotating Weir Assembly:
1. Discharge scum by gravity flow into scum tank located on side of clarifier as shown on the drawings.
2. Align so skimmer blades make simultaneous contact at wearing surfaces along entire length of rotating weir assembly.
3. Support from walkway.
4. Stainless steel pipe with weir openings, support bearings, and actuating system to control dipping cycle. Design to begin weir dipping cycle as skimmer approaches weir, by rotating weir to receive scum and flushing water from basin, and by returning weir to closed position as skimmer passes.
    a. Size: Nominal diameter not less than 400 mm and wall thickness of not less than 6 mm.
    b. Pipe material: Type 304L stainless steel
    c. Weir openings cut in top. Grind smooth the cut edges of openings so that they are straight and parallel to rotating axis of pipe.
5. Weir Plates:
    a. Install at weir openings to allow fine adjustment of weir crest elevations.
    b. AISI Type 304L stainless steel construction, 1.7 mm thick.
    c. Attached to rotating weir using AISI Type 316 stainless steel fasteners. Plates shall include slotted holes to allow for adjustment range of 12 mm.
6. Deflection:
    a. Design so that the level can be maintained within a tolerance of 3 mm so that deflection does not exceed 3 mm.
    b. Deflection limitations shall apply to two conditions:
        1) Empty pipe with basin water level at scum weir crest.
        2) Full pipe in empty basin.
7. Close at one end by 6 mm Type 304L stainless steel plate that fits into pipe collar at feedwell wall. Design the pipe collar at open end of rotating weir shall to provide watertight seal.
8. Seal:
    a. Suitable for submerged service in sewage.
    b. Effective in operating positions of rotating weir.
    c. Replaceable without removing weir.
    d. Shall not bind or impede smooth action of weir.
9. Support Bearings:
    a. Attach to walkway.
    b. Spacing: Maximum 3 m apart.
    c. Suitable for continuous service partially submerged in sewage.
    d. Adequately lubricated when equipment is operated with basin dry.
    e. Adjustable to provide alignment and leveling of rotating weir.
    f. Resists movement of steel pipe including, but not limited to, hydrostatic uplift forces or weight of pipe.

g. Provide means of preventing movement in steel pipe weir parallel to axis of pipe.

D. Rotating Weir Motorized Actuator:
1. Materials suitable for use in sewage environment by either use of corrosion-resistant materials or totally weatherproof sealed housings.
2. Heavy-duty, reversing, electric motor, valve-type operator driving worm gear activator.
3. Motor: 600 volts, three-phase, 60 Hz power
4. Floor-mounted support, bottom exit output shaft, integrated motor, gearing, adjustable torque protection each direction, torque capacity as required to operate weir, operating handwheel interlocked with motor, and self-locking.
5. Limit Switches:
   a. Control limits of weir rotation by four position limit switches in electrical operator.
   b. Adjustable from weir closed to weir crest 25 mm below bottom of basin V notch weirs.
   c. Include three isolated, reversible or double throw contacts rated 6 amperes at 120 volts, single-phase. Connect switch outputs to wiring strip mounted in separate weather proof enclosure.
6. Position Indicator:
   a. Operator position indicator shall indicate weir elevation relative to elevation of bottom of V notch weir.
   b. Scale shall be graduated in mm in both directions from zero and marked from bottom of V notch.
   c. The Limits marked on scale will indicate closed position and maximum lower elevation below V notch.
7. Actuator system Manufacturer:
   a. Rotork

E. Rotating Weir Controls:
1. Skimmer Location Limit Switches:
   a. Quantity: Two per clarifier
      1) One switch shall cause weir operator to rotate weir to open position and shall be infinitely adjustable over 1 m range measured as peripheral distance between skimmer and rotating weir at outer end of weir.
      2) Second switch shall cause weir operator to close weir as skimming arm passes under weir and shall be adjustable over plus or minus 300 mm range measured from weir.
   b. Heavy-duty, weatherproof.
   c. To sense skimming arm location for automatic operation of rotating weir.
   d. Continuous adjustments to set switch positions.
2. Support and Adjustment Mechanism: Type 304L stainless steel.

F. Infrared Radiant Heaters:
1. The heaters are only required on secondary clarifiers CM-S140 and CM-S150
2. Quantity: 9 per clarifier over scum trough and scum box
3. For use in outdoor installations and areas subject to periodic washdown
4. Anodized and chemically brightened extruded aluminum reflector
5. 3.6 kW, 600 V, 3 phase.

6. Overall length 1149 mm, heated length 1041 mm
7. Wire guard
8. Clarifier supplier mechanism to design and supply mounting frame to facilitate maintenance. The heaters separation distance from the clarifier normal operating liquid level shall not exceed 1200 mm. Provide one access hatch above each infrared radiant heater.
9. Manufacturers and Products:
   a. CCI Thermal Technologies, OKA Series, Model OKA413H6R with wire guard

2.22 EFFLUENT SCUM BAFFLE

A. Provide a plate scum baffle, 900 mm deep for 3 meter long on both sides of the rotating weir and 450 mm deep for the remaining length.

B. Locate the scum baffle 200 mm from the inboard side of the effluent weir.

C. Provide mounting hardware to attach the scum baffles to the peripheral effluent launder of the clarifier.

D. Type 304L or 316L stainless steel plate in accordance with Section Section 46 43 79, Weirs and Baffle Plates.

E. Minimum 6 mm thickness.

2.23 WEIR PLATES

A. Type 304L or 316L stainless steel plate in accordance with Section 46 43 79, Weir and Baffle Plates.

B. Minimum 6 mm thickness

2.24 STAMFORD BAFFLE

A. Located at perimeter of clarifier to prevent density currents from traveling across clarifier floor and up perimeter wall to effluent weirs. Size determined by manufacturer with a minimum of 1900 mm width.

B. Slope upper surface 45 degrees to discourage sludge accumulation. Beneath the effluent v-notch weirs. Baffles must be attached to the knee of the effluent trough wall, with at least 50 mm diameter half-round vent holes per 1200 mm section.

C. Material: Fiberglass or 304 Stainless steel.

D. Stamford Baffle Manufacturers:
   1. NEFCO, Inc., Palm Beach Gardens, FL.
   2. MFG Water Treatment Products Company, Union City, PA.
   3. Warminster Fiberglass, Southampton, PA.
   4. No “or equal” or substitute products will be acceptable.

2.25 LAUNDER COVER

A. The launder covers are only required on secondary clarifiers CM-S140 and CM-S150.

B. Intent of launder cover is to inhibit the growth of algae on the launder troughs and weirs of the clarifier tank by minimizing incident sunlight on these surfaces. In addition, the cover is intended to keep leaves and other airborne debris from entering the launder.

C. Provide the launder cover consisting of a system of molded fiber glass panels that are attached together to form a continuous cover over the launder trough, weir and scum baffle within the secondary clarifier.

D. Design and manufacture the cover to inhibit incident sunlight from striking the surfaces of the launder and weir. Mold each cover section of UV protected fiberglass and shall be opaque to sunlight.

E. Provide individual sections that are a minimum of 1.2m in length to follow the shape of the tank. Extend the cover over the trough and weir as far as possible. The cover may extend to a point immediately inside the scum baffle.

F. Design the cover such that adjacent panels fit together properly and the completed cover, when installed, forms a rigid structure and has a well-engineered and professional appearance.

G. Provide each cover segment consisting of two sections, a fixed mounting section and a hinged cover section. The fixed section shall provide a rigid mount for the cover and is fastened above the weir wall on stainless steel brackets. The hinged cover section extends outward toward the tank wall and rests on an FRP support flange attached to the inner wall of the tank. The cover section is designed to swing open to provide access to the trough and weir for inspection and maintenance. Fasten the two sections together by a stainless steel continuous hinge.

H. Design the hinged cover sections such that alternating sections have integral tabs at each side which rest on the adjacent section, insuring that the seams between panels are covered and enabling the alternate panels to open independent of every other panel. Make provision to secure the cover to the support flange with an easily opened latch mechanism. Handles are required for all panels.

I. Make provision to support the cover in such a manner that the panels are held securely in place, with the panels hinged to provide access to the launder and weir for inspection and maintenance.

J. Covers with inspection hatches or cleanout doors are unacceptable.

K. Neither the cover nor the means used to support it shall interfere with effluent flow over the weir or within the trough.

L. Where the circumference of the trough is interrupted by the bridge support or other obstacle, a fixed panel(s) shall be installed over the trough beneath the support such that the surface of the

cover is continuous around the entire tank. Alternatively, vertical panels maybe installed on both sides of the bridge supports to block out sunlight.

M. Design the cover system to withstand wind load of 0.54 kPa and snow load of 1.3 kPa. The covers are not intended to be a "walk-on" covers. Provide adequate stiffeners as an integral part of each panel. Panels reinforced with balsa or foam cores are not acceptable.

N. Mold each cover panel of fiberglass reinforced plastics. Provide the resins and fiberglass reinforcing materials that are consistent with the environmental conditions and structural requirements of the application.

O. Use the resin of an industrial quality general purpose resin with UV suppression additives. Pigment the resin to ensure that the resulting part is opaque.

P. Launder cover colour to be gray with reflectivity of no more than 35 percent.

Q. Use chopped strand roving, 357-211 PLN CTC with a minimum 12.5mm strand length.

R. When necessary, add supplemental reinforcement in the form of stiffening ribs. Use the glass content of the finished laminate of not less than 30% by weight. Use the nominal thickness of each panel of 6.35mm.

S. Provide the laminate consisting of a 500 μ outer layer of marine quality white gel coat, followed by chopped strand roving. Use laminations that are dense and free of voids, dry spots, cracks or crazes. Sand and seal all factory trimmed edges. The finished laminate shall have a smooth, even appearance.

T. Manufacturer to provide all of the 316 stainless steel fasteners, handles, hinges and latches and brackets required for the installation. Brackets may be 316 stainless steel or FRP. The support flange and weir wall brackets are installed using 9.5 by 95 mm expansion anchors with flat washers, lock washers and hex nuts.

U. Coordinate with other Divisions to ensure there are no conflicts in the work.

V. Coordinate the launder cover design and installation requirements with the clarifier mechanism, scum box, (see contract drawings) and launder effluent channel configurations.

W. Submit certified test reports of the physical and mechanical properties of the product. Provide test reports that prove that each panel has the following minimum physical properties:

Property	**Minimum Value**	**Test**
Tensile Strength	69,000 kPa	ASTM D-638
Flexural Strength	110,000 kPa	ASTM D-790
Flexural Modulus	1 x 730 kPa	ASTM D-790

Property	**Minimum Value**	**Test**
Barcol Hardness	60	ASTM D-2583
Notched Izod Impact	71 m.kg/m	ASTM D-256
Water Absorption	0.2%	ASTM D-570

X. Install the covers in accordance with the contract drawings, manufacturing drawings and manufacturer's recommendations. Field cutting of panels is allowed to complete the structure and accommodate in-tank obstructions. All cut ends shall be dressed as per the manufacturer's recommendations.

Y. Launder Cover Manufacturers:
   1. NEFCO, Inc., Palm Beach Gardens, FL.
   2. MFG Water Treatment Products Company, Union City, PA.
   3. Warminster Fiberglass, Southampton, PA.
   4. No "or equal" or substitute products will be acceptable.

2.26 DRIVE MECHANISM

A. Provide a primary gear reduction unit, an intermediate gear reduction unit (if required), and a final reduction unit enclosed in a turntable base.

B. Provide the drive unit consisting of a solid internal main spur gear, bearing turntable, pinion, secondary speed reducer, support base and drive unit bearing.

C. Mount the drive on the center column and support the entire load of the mechanism.

D. Fabricate the pinion of heat treated alloy steel.

E. Fully enclose all speed reducers in running oil.

F. Fabricate support base for the drive of stainless steel 304L or 316L.

G. Provide lubricant and dust shields.

H. If drive bearing includes forged steel precision gear/bearing, provide fully contoured raceways hardened to a minimum 58-60 Rockwell C and protected by a neoprene seal, and provide the main internal gear of forged alloy hardened steel.

I. If strip liners are used, provide liners that are renewable and hardened to a minimum of 38-42 Rockwell C.

J. Design the drive so that the major wear components of the main drive can be replaced without removing the access walkway.

K. Run the main gear and pinion in an oil bath. Provide oil sight glass, fill pipe and drain line for the reservoir.

L. Undertake non-destructive testing of the drive using liquid penetration methods or magnetic particle testing, as appropriate to illustrate that the metal porosity is low.

M. Design gears to meet AGMA Standards for standard duty.

N. Base the design running torque rating of the drive gearing on the smaller of the strength and durability values determined from AGMA standard.

O. Provide oil lubricated main drive unit. Run all main gears and bearings in an oil bath. Provide readily accessible lubricant fill and drain pipes with necessary fittings and oil indicators.

P. Design the mechanism and drive unit for a continuous operating load per design requirements of this section. Supply calculations to show that these torque conditions are met:
   1. Alarm Torque: 100% of design running torque
   2. Cut-out Torque: 125% of design running torque
   3. Minimum Main Drive Overload: 200% of design running torque
   4. Design all structural components not to yield below 300% of design running torque

Q. Provide an overload device enclosed in a stainless steel or aluminum, weatherproof enclosure that is actuated by torque generated from the main drive or worm gear.

R. Provide two independently adjustable switches operated by the overload device

S. Adjust these two switches in the factory to accurately calibrate the alarm torque value and the overload position. Provide a visual torque indicator and orient so that it may be read from the walkway. Calibrate from 0 to 160 percent of design running torque.

T. As a backup mechanical disconnect, provide additional limit switch or shear pin that fails and disconnects the motor at 140% of the design running torque.

U. Design the drive main bearing for the total rotating weight with a minimum ABMA L10 bearing life of 200,000 hours, suitable for 24 hour continuous operation.

V. Design all main drive components to provide a minimum wear life of twenty (20) years under 24 hr continuous operation

W. Design all bearings other than the drive main bearing for a minimum ABMA L10 bearing life of 100,000 hours, suitable for 24 hour continuous operation.

X. Design the main bearing to be capable of withstanding the calculated overturning moment without the aid of any underwater guides or bearings to ensure correct tooth contact for AGMA rating of the main gear.

2.27 DRIVE MOTOR

A. Provide a motor adequately sized to continuously carry all loads that may be imposed. Refer to Section 26 20 00, Low Voltage AC Induction Motors for motor requirements.

B. Mount the motor on top of the drive mechanism unit

C. Provide motor with capacity sufficient to operate the driven load under all conditions of operation without overloading

D. Make the motor weather proof, type TEFC.

E. Provide a ground connection and lifting eyes or lugs.

2.28 SLUDGE JUDGE

A. Provide one sludge judge for each clarifier including mounting brackets in stainless steel 316 attached to the walkway bridge. The proposed location is a third of the way from the edge of the clarifier walls on the unenclosed portion of the walkway. Exact location to be approved by the Contract Administrator. The sludge judge shall be long enough to measure the sludge level through the entire depth of the clarifier. The sludge blanket level transmitter shall be located near the sludge judge.

2.29 INSTRUMENTATION AND CONTROLS

A. The following are minimum requirements. The Supplier shall supply all necessary components and accessories for operating the systems per the supplier's standards.

B. Control Panel:
   1. In accordance with general control requirements and component qualities specified in Section 40 99 90, Package Control Systems.
   2. Provide a single control panel for each clarifier for both Rotating Weir and Clarifier Drive controls. The panel shall be factory assembled and wired.
      Enclosure Circuit Breaker Engage/Disengage Handle

C. Rotating Weir (Scum Trough):

   1. Control Equipment:
      a. Control Panel Buttons/Readout
         1) LOCAL/OFF/AUTO selector switch.
         2) CLOSE/STOP/OPEN momentary pushbuttons of heavy-duty, weatherproof type.
         3) Close and Open position indicating lights
      b. Process Control System (PCS) Interface
         a) Provide clearly labeled terminals for interface to the PCS, including but not limited to the following:
            (1) Dry contact with less than 2 mA minimum switching current at 24 VDC for Plant Control System discrete intput signals:

(a) Scum Trough Auto Mode
(b) Scum Trough Opened
(c) Scum Trough Closed
(d) Scum Trough System Fault
(2) 24 VDC relay coil for PCS discrete output signals:
(a) Enable Command

2. In LOCAL control selection, the actuator shall respond to CLOSE, STOP and OPEN pushbuttons. In AUTO control selection, the actuator shall respond to control signals generated by the position of the scum skimmer.
3. The actuator shall seal in upon receipt of either CLOSE or OPEN discrete signal and shall move to corresponding limit switch position before stopping.
4. The scum trough system shall only operate while the Enable Command from the PCS is active.
5. Provide the capability for remote setting of the frequency for scum trough activation from 0.5 to 99 revolutions via Modbus TCP or an alternate method approved by the Contract Administrator.

D. Clarifier Drive:

1. Equip the drive mechanism with a mechanical torque indicator, electro-mechanical overload contacts and load cell for continuous torque measurement.
2. Provide an indicating controller that connects to the load cell and provides a continuous torque reading, complete with two adjustable process alarm relay contacts, and analog output signal. Mount components in a heated NEMA 4X enclosure, with viewing window suitable for remote mounting on the handrail. Pre-wire the load cell and mechanical torque switches to a numbered terminal strip mounted in the enclosure. Identify enclosures as ADP-S110, ADP-S120, ADP-S140, and ADP-S150.
3. Provide mechanically activated micro-switches that activate when torque overload starts to develop and to stop the motor when the torque becomes excessive.
   a. Micro switch contacts shall be form C and rated for 10A, 125 VAC.
4. Motor Starter:
   a. Combination full voltage reversing.
   b. Thermal-magnetic circuit breaker.
   c. NEMA Size 1, minimum.
   d. Externally reset overloads.
5. Control Equipment
   a. Process Control System (PCS) Interface
      a) Provide clearly labeled terminals for interface to the PCS, including but not limited to the following:
         (1) Dry contact with less than 2 mA minimum switching current at 24 VDC for Plant Control System discrete intput signals:
            (a) Run Status
            (b) Hi Torque Alarm
            (c) Hi-Hi Torque Alarm
            (d) System Fault (includes Motor Overload and Fail Safe Torque Cutout)

b. Control Panel Buttons/Readout:
   1) Start momentary pushbutton
   2) Stop momentary pushbutton
   3) Run Light
   4) Alarm Horn
   5) Alarm Beacon
   6) Alarm Horn Silence pushbutton
   7) Alarm/Overload Reset pushbutton
   8) Hi-Torque Alarm Light
   9) Hi-Hi Torque Alarm Light
   10) Motor Overload Alarm Light

E. Sludge Blanket Analyzer:
   1. To be provided by the General Contractor as specified in 40 91 01 Instrumentation and Control Components.
   2. Provide adequate location for installation of sludge blanket analyzer sensor and indicate location on shop drawings.
   3. Coordinate installation requirements with the General Contractor prior to shop drawings submittal.

2.30 DISSIMILAR METALS

A. Isolate dissimilar metals or connectors to prevent direct contact and electrical conductivity.
   1. Use 3 mm thick continuous neoprene gasket to insulate aluminum grating, checker plate, and handrail post bases from access walkway support bridge and other components.
   2. Use insulating washer and Teflon sleeves at bolted connections.

2.31 ACCESSORIES

A. Anchor Bolts: Provide coated Type 316 stainless steel bolts, sized by equipment manufacturer and at least 12 mm diameter or as shown, in accordance with Section 05 50 00, Metal Fabrications. Coating shall be as specified in Section 09 90 00, Painting and Coating.

B. Equipment Identification Plates: 16-gauge, Type 304 stainless steel, securely mounted on drive unit and control panel in readily visible location. Plate shall bear 9.5 mm high engraved equipment identification number.

2.32 FABRICATION

A. Fabricate bridge beam or stringer sections in continuous unbroken pieces.

B. Shop fabricate and assemble mechanism components in largest sections practicable and permitted by transportation carrier regulations.

C. Divide large assemblies such as center torque cage, rake arms, influent well, sludge collection header, access walkway bridge, into flanged sections. Bolt together with Type 316 stainless steel fasteners. Field assembly shall use bolted connections. No field welded connections are

allowed. Bolted connections shall not be assembled until the final coating system has been applied to mating surfaces and cured.

D. Welded Construction:
   1. Mechanism component interfaces that are not field bolted connections shall be seal welded in shop.
   2. Welding: As specified in Section 05 05 23, Welding-Quality Assurance.
   3. Welding: Comply with AWS D1.1/D1.1M for procedures, appearance, and quality of welds, and methods used in correcting welding.

E. Shop/Factory Finishing:
   1. Shop prime ferrous metal in accordance with and as specified in Section 09 90 00, Painting and Coating, for submerged surfaces and for nonsubmerged, nongalvanized surfaces. If coating system is self-priming, first coat of system may be applied as shop prime coat provided recoat time will not be exceeded prior to field finish coating. Alternatively, compatible primer by same coating manufacturer may be shop-applied to avoid recoat time limits.
   2. Exposed metal surfaces of motors, gear reducers and assemblies, shall be factory prepared and primed and field finish coated in accordance with Section 09 90 00, Painting and Coating.
   3. Surfaces inaccessible subsequent to erection, shall be prepared, primed, and finish coated prior to erection.
   4. Shop-applied and field-applied coatings shall be by same manufacturer to ensure compatibility.

2.33 SOURCE QUALITY CONTROL

A. Factory Inspections: Inspect control panels for required construction, electrical connection, and intended function.

B. Factory Adjustments: Calibrate torque controls.

C. CWI shall:
   1. Monitor conformance with approved welding procedure specifications.
   2. Monitor conformance of welder/welding operator qualifications.
   3. Inspect weld joint fit-up and provide in-process inspection.
   4. Provide 100 percent visual inspection of welds in accordance with AWS D1.1/D1.1M, Paragraph 6.9.
   5. Maintain records and prepare report confirming results of inspection.

PART 3 EXECUTION

3.1 INSTALLATION

A. In accordance with manufacturer's written instructions.

B. Rotating Weir Installation:
   1. Support bearings for rotating weir pipe shall be adjusted following installation to provide level alignment of pipe. Maximum allowable variation of pipe centerline shall be 3 mm over its length.
   2. Stainless steel weir plates on rotating weir pipe shall be adjusted in field to provide maximum variation in level of 1.6 mm with clarifier full of water to effluent weir crest.

C. Field assembly of mechanism shall not require field welding. If field welding is required to correct deficiencies, it shall comply with applicable requirements of AWS D1.1/D1.1M. Coated areas shall be cleaned and repaired following field welding in accordance with coating system manufacturer's recommendations.

D. Anchor Bolts for Center Column: Locate using steel templates furnished by manufacturer and as specified in Section 05 50 00, Metal Fabrications (Basic).

3.2 FIELD FINISHING

A. Paint ferrous metal in accordance with and as specified in Section 09 90 00, Painting and Coating, for exposed, nongalvanized mild steel. Stainless Steel do not require painting. Shop-applied and field-applied coatings shall be by same manufacturer to ensure compatibility.

B. Shop primed mechanism shall be prepared for field finish coating by brush-off blasting in accordance with SSPC SP 7. Exposed metal following brush-off blasting shall be primed using same material as was factory applied prior to finish coating.

C. Touch up damaged coatings on metal surfaces of motors, gear reducers and assemblies using same coating as was factory applied in accordance with Section 09 90 00, Painting and Coating.

3.3 FIELD QUALITY CONTROL

A. Functional Tests:
   1. Conduct on each mechanism.
   2. Test for continuous 3-hour period without malfunction.

B. Performance Test:
   1. Conduct on each completed assembly in accordance with accepted test procedures.
   2. Perform under actual or approved simulated operating conditions.
   3. Perform to confirm mechanical and structural compliance with specified torque requirements.
      a. Load each mechanism to 120 percent of Design Running Torque to demonstrate mechanism's structural capability to withstand resulting loads.
         1) Apply loads to mechanism's rake arms through cables or other means anchored to basin floor or wall. Utilize hydraulic cylinder, springs, or other means that allows machine to rotate for peripheral distance of at least 900 mm under load.
         2) Accomplish testing with machine in operation.

b. Conduct static torque test on mechanism. Anchor both collector arms, start collector drive, and load drive to 120 percent of Design Running Torque to demonstrate mechanism's structural capability to withstand resulting loads.
c. Demonstrate mechanism overload devices; verify actual torques at which alarm and cutout (shutdown) contacts and load limiting device are actuated.
d. Correlate with scale indications.

4. Replace shear pins after torque testing is completed.

3.4 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at Site or classroom designated by Contract Administrator for minimum person-days listed below, travel time excluded:
   1. 4 person-days in two trips for field measurements prior to shop drawings preparation.
   2. 12 person-days in four trips for installation assistance and inspection.
   3. 12 person-days in four trips for functional and performance testing, completion of Manufacturer's Certificate of Proper Installation, pre-startup classroom or field training, and startup.
   4. 2 person-days in one trip for post-startup training. Training shall not commence until accepted detailed lesson plan for each training activity has been reviewed by Contract Administrator.

B. See Section 01 43 33, Contractor Field Services and Section 01 91 14, Equipment Testing and Facility Startup.

3.5 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this Specification:
   1. Secondary Clarifier Mechanism Data Sheet
   2. Induction Motor Data Sheet.

END OF SECTION

SECONDARY CLARIFIER MECHANISM DATA SHEET

Project: City of Winnipeg SEWPCC Upgrading/Expansion Project

Process/Facility: Secondary Clarifiers

Service: Mixed Liquor Clarification

System Name: Secondary Clarifier Mechanisms

Equipment Tag Number(s)	CM-S110, CM-S120	CM-S140, CM-S150
Number of Mechanisms to Supply	Two	Two
Installation Type	Retrofit	New
Clarifier Diameter (m)	33.5	45.7
Side Water Depth (m)	4.6	6.0
Floor Slope	2% - refer to existing drawings for details	2% - refer to drawings for details
Weir on Launder Configuration	Double (On both sides of launder)	Single
Launder Width (m)	0.6 m	0.85 m
Design Flows, All Clarifiers In Operation (ML/d), each Average Peak Instantaneous	 12.5 29.7	 23.8 56.3
RAS Flow (ML/d), each	9.4	18.8
Min RAS Flow (ML/d), each	70% of RAS Flow	70% of RAS Flow
Range of MLSS Concentration (mg/L)	2,000 to 5,000	2,000 to 5,000
Surface Overflow Rates, All Clarifiers In Operation ($m^3/m^2/d$) At Average Flow At Peak Flow	 14.2 33.7	 14.5 34.3
Solids Loading Rates, All Clarifiers In Operation ($kg/m^2/d$) At Average Flow At Peak Flow	 120 288	 127 300
Minimum EDI Retention Time at Average Design Flow including RAS Flow (s)	10	10
Flocculating Centre Well Retention Time at Average Design Flow including RAS Flow (min)	20	20

Remarks:

INDUCTION MOTOR DATA SHEET

Project: City of Winnipeg SEWPCC Upgrading/Expansion Project

City: Winnipeg

Equipment Name: Secondary Clarifier Mechanisms

Equipment Tag Number(s): CM-S110, CM-S120, CM-S140, CM-S150

Type: Squirrel-cage induction meeting requirements of NEMA MG 1

Manufacturer: For multiple units of the same type of equipment, furnish motors and accessories of a single manufacturer.

Hazardous Location: ☐ Furnish motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark.

Motor Horsepower: _____

Voltage: 575 V

Phase: 3

Frequency: 60

Synchronous Speed: _____ rpm

☐ Thermal Protection: _____

☐ Space Heater: ____ volts, single-phase

Guaranteed Minimum Efficiency at Full Load: 90 percent

Guaranteed Minimum Power Factor at Full Load: Mnftr. Standard

Service Factor (@ rated max. amb. temp.): ☐ 1.0 ☒ 1.15

Enclosure Type: TEFC

☐ Multispeed, Two-Speed: ____ / ____ rpm

Winding: ☐ One ☐ Two

Mounting Type: ☐ Horizontal ☒ Vertical

☐ Vertical Shaft: ☐ Solid ☐ Hollow

☐ Vertical Thrust Capacity (lb): Up ____ Down ____

☐ Adjustable Speed Drive: See Section 26 29 23, Low-Voltage Adjustable Frequency Drive Systems.

Operating Speed Range: ____ to ____% of Rated Speed

☐ Variable Torque

☐ Constant Torque

Additional Motor Requirements: ☒ See Section 26 20 00, Low-Voltage AC Induction Motors.

Special Features: _____

Breathers and drains for moisture removal.

SECTION 46 43 79

WEIR AND BAFFLE PLATES

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. American Water Works Association (AWWA): F102, Matched-Die-Molded, Fiberglass-Reinforced Plastic Weir Plates, Scum Baffles, and Mounting Brackets.
   2. ASTM International (ASTM):
      a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
      b. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
      c. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
      d. A276, Standard Specification for Stainless Steel Bars and Shapes.
      e. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
      f. B308/B308M, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
      g. C581, Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass-Fiber-Reinforced Structures Intended for Liquid Service.
      h. C920, Standard Specification for Elastomeric Joint Sealants.
      i. D256, Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
      j. D570, Standard Test Method for Water Absorption of Plastics.
      k. D638, Standard Test Method for Tensile Properties of Plastics.
      l. D790, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
      m. D2583, Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.

1.2 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings:
      a. Detailed description of laminate and type of reinforcing to be used.
      b. Manufacturer’s drawings showing dimensions of the items and accessories being provided.
      c. Complete information regarding the specific resin to be used.
   2. Sample: Manufacturer’s 150 mm square sample of fiberglass reinforced plastic laminate of same construction, nominal thickness, and color as materials specified.

B. Informational Submittals:
   1. Manufacturer's Certificate of Compliance, in accordance with Section 01 33 00, Submittal Procedures, and stating the following:
      a. Reinforcing material used will provide suitable chemical resistance.
      b. Resin is suitable for the environmental conditions intended and the fabrication technique proposed.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Site properly packaged for ease of handling and to minimize damage during shipping.

B. Handling and storage of the items provided hereunder shall be in strict accordance with the manufacturer's printed instructions. Care shall be taken not to damage the components and accessories.

PART 2 PRODUCTS

2.1 GENERAL

A. Like items of equipment specified herein shall be the end products of one manufacturer in order to achieve standardization of appearance, operation, maintenance, and manufacturers' services.

B. Coordinate scum baffle configuration with equipment, such as a scum skimmer, that will physically interface with baffle to ensure proper functioning of system.

2.2 MATERIALS

A. Fiberglass:
   1. Match-die molded fiberglass, 6 mm minimum thickness, in accordance with AWWA F102.
   2. Resin: Except as modified by this Specification, conform to ASTM C581:
      a. Type I: Isophthalic polyester only.
      b. Type II: Suitable for intended service; premium grade and corrosion-resistant such as chlorendic polyester, vinyl ester, or bisphenol A fumarate polyester.
      c. Shall not contain fillers or thixotropic agents, except as may be required, and shall conform to resin manufacturer's recommendations.
      d. Glass Content: 20 percent to 30 percent.
      e. Inorganic Fillers: No less than 40 percent of resin mixture.
      f. Coloring: Pigmented gel-coat containing ultra-violet blocking agent; manufacturer's standard color.
      g. Sufficient thixotropic agents to form a paste to seal machined or cut edges.
      h. Reinforcement:
         1) Commercial grade glass, made specifically for use in fiberglass reinforced plastic, and having a coupling agent providing a compatible bond between the glass reinforcement and the resin.

2) Weight and density may be varied to obtain necessary resin-glass ratio and structural strength for the specified service.

i. Mold Surfaces: Reinforced with surfacing mat, followed by minimum of 3 ounces of chopped strand mat, in a minimum of two layers, with no other product introduced between layers.

j. Exposed Surfaces:
1) Resin-rich, 10 mils to 20-mils thick with Type C surfacing mat, silane finish, and styrene-soluble binder.
2) Glass fibers shall not be exposed.
3) Chopped strand and chopped strand mat shall be Type E glass with silane finish and styrene-soluble binder.
4) Minimum Glass Content: 30 percent by weight.

k. Laminates:

Property (20 Degrees C)	**ASTM Standard**	**Value**
Ultimate Tensile Strength, psi	D638	7,500 minimum
Flexural Strength, psi	D790	16,000 minimum
Flexural Modulus, psi	D790	800,000 minimum
Water Absorption	D570	0.2% in 24 hours
Impact, foot-pounds	D256	10

l. Barcoal Hardness: ASTM D2538; minimum 90 percent of resin manufacturer's minimum specified hardness for cured, nonreinforced resin.

m. Allowable cosmetic defects: As defined in AWWA F102.

n. Final Laminate:
1) Thickness: Within plus or minus 10 percent of nominal laminate thickness.
2) Tolerance: Plus 1.5 mm; minus 0 mm of minimum specified thickness.
3) Void Content (Completed Laminate): Maximum 2-1/2 percent of laminate by volume.

3. Manufacturers:
a. MFG Water Treatment Products Company, Union City, PA.
b. Warminster Fiberglass, Southampton, PA.
c. NEFCO, Inc., Palm Beach Gardens, FL.

B. Stainless Steel:
1. Plate, Baffles, and Supports: Type 316L, minimum 6 mm thick.
2. Fasteners: ASTM A193/A193M and ASTM A194/A194M, Type 316.

2.3 APPURTENANCES

A. Gasket: Closed-cell neoprene, 50 durometer, 6 mm thick.

B. Sealant:
1. Polyurethane base, single-component, moisture curing, ASTM C920, Type S, Grade NS or P, Class 25.
2. Capable of being continuously immersed in water.

3. Manufacturers and products:
   a. Sika Chemical Corp.; Sikaflex-1a.
   b. Mameco International; Vulkem 45.

C. Anchoring: Type 316 stainless steel adhesive anchors as specified in Section 05 50 00, Metal Fabrications (Basic).

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in strict accordance with the manufacturer's written instructions.

B. FRP Plates: Sand all cut edges or drilled holes greater than 10 mm in diameter, and seal with a nonair-inhibited resin solution, as recommended by resin manufacturer.

C. Install weir plates such that weir crest is level with a maximum variation of 1.5 mm throughout its entire length.

D. Gasket:
   1. Install between weir plate and concrete wall, extending from bottom of weir plate to the top of the wall.
   2. Gasket shall be continuous along entire length of weir plate, except at scum trough where a joint is allowed.
   3. Joints: Butt type, using adhesive recommended by gasket manufacturer for submerged service.

E. Sealant:
   1. Clean and prepare concrete and weir plate surfaces in accordance with sealant manufacturer's recommendations.
   2. Application:
      a. In accordance with manufacturer's instructions.
      b. Completely cover the interface between the weir plate and mounting surface over the full height of the weir plate.
      c. Apply sufficiently to completely fill any gaps between the weir plate and the supporting wall surface.
      d. Clean excess sealant that is forced from between the weir plate and supporting wall as the plate is tightened against the wall surface to provide a neat installation.
      e. Clean all adjacent surfaces of smears or soiling.

3.2 TESTS AND INSPECTION

A. In accordance with Section 01 91 14, Equipment Testing and Facility Startup.

B. Functional Test: Demonstrate proper installation of weir plate for both water tightness and level, prior to placing unit into service, by filling unit with water to the weir crest elevation. Make adjustments as necessary to meet specification.

END OF SECTION

SECTION 46 51 21.13

COARSE BUBBLE AIR DIFFUSERS FOR CHANNELS

PART 1 GENERAL

1.1 WORK OF THIS SECTION

A. The work of this Section includes furnishing and installation of coarse bubble air diffusers and all appurtenant work indicated in accordance with Contract Documents.

B. Unit Responsibility: Work requires that equipment, complete with all accessories, be end product of one responsible system supplier. Unless otherwise indicated, Contractor shall obtain each system from responsible supplier of equipment. Supplier shall furnish all components and accessories of system to enhance compatibility, ease of operation, and maintenance, and as necessary to place equipment into operation in conformance with specified performance, features, and functions without altering or modifying Contractor's responsibilities under Contract. Contractor is responsible to the City for providing equipment system as specified herein.

1.2 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. American Society of Mechanical Engineers (ASME):
      a. B16.5, Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard.
      b. B16.9, Factory-Made Wrought Buttwelding Fittings.
      c. B36.19M, Stainless Steel Pipe.
   2. American Society for Testing and Materials (ASTM):
      a. A182/A182M, Standard Specification for Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
      b. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
      c. A312/A312M, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
      d. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
      e. A403/A403M, Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.

1.3 DEFINITIONS

A. Basin: Structure within which aeration occurs.

B. Drop Leg: Vertical piping connection from air source to manifold.

C. Manifold: Single horizontal run of piping that connects drop leg with diffusers.

D. sm^3/h: Volume of air in cubic meters per hour at standard conditions.

E. Standard Conditions: 20 degrees C, 101.3 kPa (absolute), and 36 percent relative humidity.

1.4 SUBMITTALS

A. Shop Drawings:
1. Make, model, and weight of each equipment assembly.
2. Manufacturer's catalog information, descriptive literature, specifications, and identification of materials of construction.
3. Detailed drawings showing equipment fabrications and interface with other items. Include dimensions, size, and locations of connections to other work, and weights of associated equipment.
4. Diffuser system design basis for each separate channel including velocity gradient, air flow per unit length of channel, number of diffusers, air flow per diffuser, and total air flow.
5. Detailed drawing of aeration equipment layout for each channel showing air line sizes and lengths, location and orientation of diffusers, and locations of supports.
6. Details of diffusers, drop legs, manifolds, pipe couplings, and supports.

B. Quality Control Submittals:
1. Special shipping, storage and protection, and handling instructions.
2. Manufacturer's installation instructions.
3. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Contractor Field Services.
4. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.

1.5 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts and special tools:

Item	Quantity
Pre-assembled diffuser assemblies including reducer bushing and nipple	20
Orifice plugs	20
Special tools required to maintain or dismantle equipment	One complete set

B. Delivery: In accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:
   1. Tideflex Technologies.
   2. Or approved equal in accordance with B8.

2.2 DESIGN REQUIREMENTS

A. Furnish coarse bubble diffused air aeration equipment including, but not necessarily limited to, drop legs, manifolds, diffusers, supports, accessories, and miscellaneous appurtenances.

B. Furnish complete engineered systems. Drawings indicate general drop leg and manifold locations and orientations only. Details such as air manifold sizes, diffuser spacing and orientation, and support locations shall be defined by and be responsibility of manufacturer and shall be consistent with requirements of this specification.

C. Design for minimum velocity gradient (G value) of 130 s^{-1}. Adjust design velocity gradient as required for each specific aeration application to account for solids content, density, and viscosity of wastewater.

D. Diffuser manifolds may be identified on Drawings with following designations:
   1. Type 1: Four (4) diffusers per manifold.
   2. Type 2: Six (6) diffusers per manifold.
   3. Type 3: Eight (8) diffusers per manifold.
   4. Type 4: Ten (10) diffusers per manifold.
   5. Type 5: Twelve (12) diffusers per manifold.

2.3 CONDITIONS OF SERVICE

A. The air diffusers will be used to provide mixing in the following wastewater channels:
   1. Raw sewage influent channel.
   2. Screen channels, both upstream and downstream of screens.
   3. Grit tanks influent channels.
   4. Grit tanks effluent channels.
   5. Primary effluent channel.
   6. Return activated sludge channel.
   7. Mixed liquor channel.

B. Refer to drawings for channel geometry, dimensions, and water depths.

C. Design for the following wastewater characteristics:
   1. Raw sewage containing rags, stringy material, fibrous material, pieces of wood, metal objects, garbage, paper, rocks, sand, grit, glass, plastics, coarse waste solids, organic waste solids, oils, fats, and grease.
   2. Grit Content Upstream of Grit Removal: Up to 70 mL grit /m^3 of wastewater.
   3. Grit Particle Specific Gravity: 2.65.

4. Mixed Liquor Suspended Solids Concentration: 1,000-5,000 mg/L.

2.4 PERFORMANCE REQUIREMENTS

A. Diffusers shall provide free-flow air discharge when submerged and shall prevent backflow of process liquid into diffusers, manifold, and drop leg through diffuser air emittance opening when air supply is turned off.

B. Airflow Rate Output: Shall not differ by more than 10 percent, at minimum and maximum airflows, for any two diffusers connected to same manifold (based on diffuser with lower flow rate).

C. Air Distribution and Balancing: Control by use of proper manifold, diffuser, and orifice size selection. Do not use flow distribution control devices requiring automatic or manual adjustment.

D. Provide adequate mixing to maintain grit, screenings, and suspended solids in suspension at all plant flow rates.

E. Diffuser Air Flow: Not to exceed 12 sm^3/h per diffuser.

2.5 GENERAL

A. Shop fabricate welded metal parts and assemblies from Type 316L stainless steel with a 2D finish conforming to ASTM A240.

B. Shop fabricate non-welded parts and pieces from sheets and plates of Type 316 stainless steel conforming to ASTM A240, unless specified otherwise.

C. After fabrication, pickle and passivate stainless steel assemblies and parts by immersion in pickling solution of 6 percent nitric acid and 3 percent hydrofluoric acid at 60 degrees C for 15 minutes. Neutralize by immersing in a trisodium phosphate solution.

D. Support System: Allow for expansion and contraction over a temperature range of 70 degrees C when installed.

E. Diffuser Spacing: Not to exceed 500 mm, center to center.

F. Point of air emittance not to exceed 100 mm above floor of channel.

2.6 DROPLEG AND MANIFOLD

A. Fabricated from stainless steel pipe and fittings in configuration as generally shown on Drawings.

B. Pipe: ASTM A312/A312M, Type 316L, Schedule 10 minimum, conforming to ASME B36.19M, annealed, pickled, and passivated per ASTM A380.

C. Fittings: ASTM A403/A403M, Type 316L, Schedule 10 minimum, conforming to ASME B16.9, annealed, pickled, and passivated per ASTM A380.

D. Grooved End Couplings: Rigid, Type 316 stainless steel, EPDM gasket, Victaulic Style 489 or approved equal in accordance with B8.

E. Provide grooved end couplings at top and bottom of drop leg for easy disassembly and removal of drop leg and manifold.

F. Provide galvanized loose follower (Van Stone) flange, drilled to ASME B16.5 dimensions, at top of drop leg.

G. Provide grooved end coupling complete with stainless steel cap at each end of manifold.

H. Provide stainless steel lifting lug at top of drop leg.

I. Provide manifold with 19 mm NPT stainless steel threaded couplings for connection of diffuser assemblies.

J. Each dropleg shall be equipped with a butterfly valve Type V510 for isolation, and a 32 mm ball valve Type V307 and a quick connect to facilitate the use of a portable flowmeter. Note that the butterfly valves are not shown on the Piping and Instrumentations Drawings for all facilities. They also are not all shown on the valve schedule. They shall be supplied by the coarse bubble air diffusers supplier as part of the package. Also provide a 13mm capped threaded weldolet on every dropleg supply pipe for installation of a portable pressure gauge. Coordinate with piping supplier the location of valves, quick connects and weldolets to provide adequate access from outside the channels. Provide detailed shop drawings for review.

2.7 DIFFUSER ASSEMBLIES

A. Diffuser body fabricated from EPDM synthetic elastomer with leachable oils content of 10 percent or less.

B. Diffuser body clamped to PVC reducer bushing or stainless steel pipe nipple with heavy duty stainless steel hose clamp to ensure diffuser will not separate from connection during operation.

C. Provide orifice plug between threaded coupling and diffuser nipple to provide equal air flow distribution between diffusers.

2.8 SUPPORTS

A. Fabricated from Type 304 stainless steel plate, ASTM A240. Use Type 304L stainless steel for welded parts, ASTM A240.

B. Provide drop legs with wall support brackets equipped with bolted riser clamp type closure and anchored to concrete wall.

C. Provide manifolds with wall or floor mounted cradle type support brackets anchored to concrete wall or floor of channel. Brackets to allow for vertical adjustment.

2.9 APPURTENANCES

A. Miscellaneous: Nuts, bolts, washers, and other non-welded parts to be Type 316 stainless steel, ASTM A240. Threaded assemblies shall be chemically treated or lubricated prior to assembling to prevent galling.

B. Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer, and as specified in Section 05 50 00, Metal Fabrications (Basic).

2.10 SOURCE QUALITY CONTROL

A. Functional Tests: Conduct manufacturer's standard quality control tests.

PART 3 EXECUTION

3.1 INSTALLATION

A. In accordance with manufacturer's written instructions.

B. Accurately place anchor bolts using templates furnished by manufacturer and in accordance with Section 05 50 00, Metal Fabrications (Basic).

3.2 FIELD QUALITY CONTROL

A. Functional Tests: Conduct on each aeration system.

B. Performance Test:
1. Conduct on each aeration system.
2. Perform under actual or approved simulated operating conditions. Airflow shall be as measured by plant instrumentation. Calibrate airflow instrumentation as part of testing procedure.
3. Test for a continuous 3-hour period without malfunction.
4. Adjust, realign, or modify units and retest if necessary.

3.3 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at Site or classroom designated by the City for minimum person-days listed below, travel time excluded:
1. Two person-days for installation assistance and inspection.
2. Two person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
3. Two person-days for pre-startup classroom or Site training.
4. Two person-days for facility startup.

B. See Section 01 43 33, Contractor Field Services, and Section 01 91 14, Equipment Testing and Facility Startup.

END OF SECTION

SECTION 46 51 21.16

COARSE BUBBLE AIR DIFFUSER SYSTEM FOR TANKS

PART 1 GENERAL

1.1 WORK OF THIS SECTION

A. The work of this Section includes furnishing and installation of coarse bubble air diffusers and all appurtenant work indicated in accordance with Contract Documents.

B. Unit Responsibility: Work requires that equipment, complete with all accessories, be end product of one responsible system supplier. Unless otherwise indicated, Contractor shall obtain each system from responsible supplier of equipment. Supplier shall furnish all components and accessories of system to enhance compatibility, ease of operation, and maintenance, and as necessary to place equipment into operation in conformance with specified performance, features, and functions without altering or modifying Contractor's responsibilities under Contract. Contractor is responsible to the City for providing equipment system as specified herein.

1.2 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. American Society of Mechanical Engineers (ASME):
      a. B16.5, Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard.
      b. B16.9, Factory-Made Wrought Buttwelding Fittings.
      c. B36.19M, Stainless Steel Pipe.
   2. American Society for Testing and Materials (ASTM):
      a. A182/A182M, Standard Specification for Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
      b. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
      c. A312/A312M, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
      d. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
      e. A403/A403M, Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.

1.3 DEFINITIONS

A. Adequate Mixing: Variation in mixed liquor suspended solids (total residue) of less than 10 percent between the mean value of samples taken at any two depths along any vertical line extending between water surface and elevation of the top of diffusers.

B. Basin: Structure within which aeration occurs.

C. Distribution Header: Piping between manifold and diffuser assembly.

D. Dropleg: Connection from air source to manifold.

E. Grid: Configuration of diffuser system in a zone.

F. Manifold: Single run of piping that connects dropleg with distribution header(s).

G. Standard Cubic Metres per hour (sm^3/h): Air at 20 degrees C, 101.3 kPa absolute, and 36 percent relative humidity.

H. Zone: Area within an aeration basin used to provide a particular type or level of treatment. One or more cells may be included in a zone.

1.4 CONDITIONS OF SERVICE

A. The air diffusers will be used to provide mixing in the following basins (refer to drawings):
   1. IFAS distribution channel for bioreactors 1, 2 and 3 (Length: 33 m, Width: 1.0 m, Side Water Depth: 5.3 m (plus or minus 0.1 m))
   2. Post aerobic zone pass 1 for bioreactors 1, 2 and 3. (Length: 33 m, Width: 3.95 m, Side Water Depth: 7.03 m (plus or minus 0.1 m)). Zone includes a benched strip 2 m in length (refer to drawings).
   3. Post aerobic zone pass 2 for bioreactors 1, 2 and 3. (Length: 29.5 m, Width: 3.95 m, Side Water Depth: 7.03 m (plus or minus 0.1 m))

B. Air supply pressure: 70.2 kPag at top of drop leg. Pressure needed by the aeration system shall not exceed the air supply pressure in any condition. Refer to drawings for size of stainless steel drop leg piping. Configuration of aeration grid and manifold shall be per the aeration system supplier.

C. The IFAS distribution channel may be partially filled with media that migrate from the IFAS basins.

1.5 PERFORMANCE REQUIREMENTS

A. Airflow Rate Output: Not differ by more than 10 percent for any two system diffusers.

B. Air Distribution and Balancing:
   1. Control by use of orifices and proper header size selection only.
   2. Do not use flow distribution control devices requiring automatic or manual operation.
   3. Sufficient to maintain mixed liquor suspended solids in a state of suspension over entire depth of basin at stated airflow requirements.

C. Mixing:
   1. Adequate throughout each zone of aeration basins at stated airflow requirements.
   2. Achieve adequate mixing in aeration basins at mixed liquor suspended solids concentrations between 1,000 and 5,000 mg/L.

D. Material being aerated is a mixture of primary effluent, return activated sludge, and fermented sludge filtrate.

E. Post aerobic zone pass 2 zone will have the ability to change between mechanical submersible mixing and aeration as chosen by the City's operations staff.

F. System Aeration Requirements:
   1. Allowable Diffuser Mounting Distance Above Basin Floor:
      a. Minimum (Floor to Diffuser Element): 250 mm.
      b. Maximum (Floor to Diffuser Element): 350 mm.

G. System Zoned Aeration Requirements:
   1. Airflow shall be between the minimum and maximum noted below:

Zone (typical for three bioreactors)	**Airflow (sm^3/h)**	
	Minimum	**Maximum**
IFAS Distribution Channel	460	552
Post Aerobic Zone Pass 1	654	719
Post Aerobic Zone Pass 2	585	644

1.6 DESIGN REQUIREMENTS

A. Furnish fixed header, coarse bubble aeration equipment system as a complete package including, but not necessarily limited to; air manifold; distribution headers; diffusers; supports; header joints; accessories; and miscellaneous appurtenances.

B. Furnish complete, engineered systems. Refer to location of stainless steel droplegs shown on drawings and coordinate the system accordingly. Drawings indicate one possible configuration for air manifold, header, and diffusers. The aeration system supplier shall design the system to suit their specific system. Details such as air manifold sizes, air header sizes and spacing, air manifold and header supports and spacing, diffuser spacing, etc., shall be defined by and be the responsibility of system supplier and Contractor, and shall be consistent with the requirements in this section.

C. The total piping head loss from the top of drop leg to the diffusers shall be less than 3.150 kPag (0.456 psig).

D. Design aeration equipment so that upon completion of installation, diffusers are level to within plus or minus 10 mm of a common horizontal plane. Note that the post aerobic zone pass 1 includes a 2 m long benched area that requires a coarse bubble air diffuser mounted at a higher elevation. Refer to drawings for details. Supply pressure control orifices or other equipment

to control air pressure as necessary. Note also that the post aerobic zone pass 2 includes two propeller mixers that are located along the central axis of the zone. Refer to drawings for details. Coordinate with mixer supplier and design the air header to avoid the mixers and their base. The mixers will not be in operation when the diffusers are turned on.

1.7 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings:
      a. Make, model, and weight of each equipment assembly.
      b. Manufacturer's catalog information, descriptive literature, specifications, and identification of materials of construction.
      c. Detailed mechanical drawings showing equipment fabrications and interface with other items. Include dimensions, size, and locations of connections to other work, and weights of associated equipment.
      d. A detailed drawing of proposed aeration equipment layout for each basin showing air line sizes and lengths, distances between air distribution headers, and location of diffusers, supports, and expansion joints.
      e. Diffuser, diffuser connector, balancing orifices, and system head loss information.
      f. Calculations showing distribution and balancing of air within each basin for airflow rates.
      g. Calculations by a registered engineer in the province of Manitoba to demonstrate that support design complies with requirements of this section.
      h. Submit written certification from Professional Engineer licensed in Province of Manitoba stating that support systems, anchorage, and equipment have been designed for post-disaster structures according to requirements of NBC with Manitoba Amendments, at time of shop drawing submittals.

B. Information Submittals:
   1. Factory test results, reports, and certifications.
      1. Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.
   2. Manufacturer's Certificate of Conformance: Manufactured/commercial products.
   3. Special shipping, storage and protection, and handling instructions.
   4. Manufacturer's Certificate of Proper Installation in accordance with Section 01 43 33, Contractor Field Services.
   5. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data. Include manufacturer's written/printed installation instructions with erection drawings indicating, by piece marking, how entire assembly (for each basin service) is to be shipped and field assembled.
   6. Manufacturer's special guarantee.
   7. Service records for maintenance performed during construction.

1.8 SPECIAL GUARANTEE

A. Furnish manufacturer's extended guarantee or warranty, which shall be in addition to the Contractor's 1-year correction period, with the City named as beneficiary, in writing, as

special guarantee. Special guarantee shall provide for correction, or at option of the City, replacement of diffuser connectors and assemblies found defective during period of 5 years after date of Substantial Completion. Manufacturer shall be responsible for material replacement of parts or materials that fail during warranty period. Down time, labor, or associated costs shall not be included in the extended warranty period beyond the Contractor's 1-year correction period.

1.9 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts and special tools:

Item	Quantity
Sealing gaskets	Two percent of total
Completely assembled diffusers	One of each type
Air distribution pipe support assemblies	5 of each type
Air distribution pipe expansion joints	One of each type
Tool sets, if required, for removal and replacement of diffuser assemblies.	One set

B. Delivery: In accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Coarse bubble diffuser system materials, equipment, and accessories specified in this section shall be products of:
   1. Veolia VWTC.
   2. Aquarius Technologies.
   3. Stamford Scientific.
   4. Sanitaire (Xylem).
   5. Gummi-Jaeger.

B. No "or-equal" or substitute products will be considered.

2.2 SERVICE CONDITIONS

A. System:
   1. Temperature of Mixed Liquor:
      a. Minimum: 10 degrees C.
      b. Maximum: 25 degrees C.
   2. pH of Mixed Liquor: 6 to 8.
   3. Mixed Liquor Suspended Solids Concentration:
      a. Average: 3,500 mg/L.

b. Maximum: 5,000 mg/L.

4. Air supply temperature can vary between 40 degrees C and 120 degrees C.

2.3 GENERAL

A. Shop fabricate welded metal parts and assemblies from Type 304L or 316 L stainless steel with a 2D finish conforming to ASTM A240.

B. Shop fabricate non-welded parts and pieces from sheets and plates of Type 304 or 316 stainless steel conforming to ASTM A240, unless specified otherwise.

C. After fabrication, pickle and passivate stainless steel assemblies and parts by immersion in a pickling solution of 6 percent nitric acid and 3 percent hydrofluoric acid at 60 degrees C for 15 minutes. Neutralize by immersing in a trisodium phosphate solution.

D. Header and Header Support System: Allow for expansion and contraction over a temperature range of 70 degrees C when installed.

2.4 AERATION EQUIPMENT

A. The aeration equipment shall allow control of the aeration and mixing energy to meet process air and mixing requirements. The aeration equipment shall include, but not be limited to:
1. Drop leg(s),
2. Connection to the air manifold
3. Air manifold
4. Distribution header
5. Air balancing orifices as required
6. Diffusers
7. Supports
8. Fixed or flanged joints Droplegs
9. Air manifold and header joints including expansion joints as necessary
10. Gaskets
11. Fasteners (Anchor Bolts and Anchor Bolt Sleeves, bolts, nuts, and washers).

B. Air Piping, Droplegs, Air Manifold, and Distribution Headers:
1. Furnish all piping beginning with Class 150 flanged drop legs and ending with the diffuser.
2. Provide a flexible joint in the drop leg to allow for expansion and contraction.
3. Air piping, drop pipe, air manifolds shall be constructed of stainless steel in accordance with Section 40 27 00.08A, Stainless Steel Pipe and Fittings – Process Air Service Data Sheet. Headers shall be fabricated in sections to allow easy assembly. Sections shall be joined with fixed joints, flanged joints, or expansion fittings as required.

C. Diffusers:
1. Nonclogging type.
2. Diffuser bodies, hardware, and components shall be all Type 304/304L stainless steel.

3. Diffusers shall produce a uniform discharge of air and prevent entrance of sludge and liquid into the header during airflow interruptions, or be designed to purge sludge and liquid upon reintroduction of air.
4. Coarse bubble aeration diffusers.
5. Passivate all completed assemblies by mechanical or chemical cleaning in accordance with ASTM A380 06 Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
6. Furnish the aerated zones in each tank with the required number of diffusers as determined by the system supplier to meet process air and mixing requirements.

D. Supports:
1. Supports shall be fabricated from Type 304L stainless steel, except for embedded items which will be Type 316. The supports shall be designed to provide lateral and vertical adjustment of the header after accounting for any slope of the tank floor. Adjustment shall be continuous and possible without removing the air piping from the support. Support height shall be sufficient to provide the diffuser elevation specified previously.
2. Air manifold and header piping shall have a maximum spacing between supports so that that maximum deflection is 6 millimeters under the media load in the IFAS distribution channel and each section of pipe shall have a minimum of two supports between joints. Supports shall include holddown, guide straps, anchor bolts and supporting structure.
3. Manifold and header supports shall prevent stress build-up due to, and accommodate, thermal expansion and contraction of the air piping.
4. Fixed support shall consist of a hold-down mechanism and self-limiting clamp device.

E. Header Joints:
1. The air distribution header shall include an expansion/contraction system consisting of fixed joints, slip joints, flanged joints, fixed supports, and intermediate supports. Fixed supports shall be designed to anchor against longitudinal movement at the support. Intermediate supports shall allow for longitudinal movement.
2. Connections between sections of the air distribution header shall be special flanged joints or slip joints. These joints shall be designed so that individual header sections can be rotated independently of adjacent header sections for alignment purposes. Flanged joints shall be structurally designed to transmit the longitudinal forces caused by expansion and contraction in the air distribution header. Slip joints shall be designed to allow for expansion and contraction of the air distribution header.

F. Gaskets: Fixed joints and flanges shall be provided with gaskets forming an airtight connection at 138 kPa minimum. Gaskets shall be neoprene, 45 to 55 durometer.

2.5 APPURTENANCES

A. Miscellaneous: Nuts, bolts, washers, and other nonwelded parts: Type 304 or 316 stainless steel, ASTM A240. Threaded assemblies shall be chemically treated or lubricated prior to assembling to prevent galling.

PART 3 EXECUTION

3.1 INSTALLATION

A. In accordance with manufacturer's written instructions.

B. Accurately place anchor bolts using templates furnished by manufacturer and in accordance with Section 05 50 00, Metal Fabrications (Basic).

3.2 FIELD QUALITY CONTROL

A. Functional Tests: Conduct on each aeration system.

B. Performance Test:
1. Conduct on each aeration system.
2. Perform under actual or approved simulated operating conditions. Airflow shall be as measured by plant instrumentation.
3. Test for a continuous 3-hour period without malfunction.
4. Adjust, realign, or modify units and retest if necessary.
5. Test as follows:
   a. Pressure Test: Measure air pressure immediately upstream of elbow located at top of each dropleg, and at airflows and submergences stated under Articles Conditions of Service and Performance Requirements.
   b. Mixing Test:
      1) Perform at airflows stated in Article Performance Requirements.
      2) Select three vertical lines and two depths in each basin and submit for approval by the Contract Administrator.
      3) Take three Samples at each of two depths along each vertical line using Van Dorn sampler.
      4) Independent testing laboratory approved by Contract Administrator will perform residue test on each Sample. Mean value of total residue for three Samples at each depth will be used to determine conformance with requirements.
      5) All testing and sampling shall conform to procedures established in latest edition of Standard Methods for Examination of Water and Wastewater.

3.3 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at Site or classroom designated by the City, for minimum person-days listed below, travel time excluded:
1. 2 person-days for installation assistance and inspection.
2. 2 person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
3. 2 person-days for prestartup classroom or Site training.
4. 2 person-days for facility startup.
5. 2 person-days for post-startup training of the City's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by Contract Administrator.

B. See Section 01 43 33, Contractor Field Services and Section 01 91 14, Equipment Testing and Facility Startup.

END OF SECTION

SECTION 46 66 20

UV DISINFECTION SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. Comply with the following:
   1. Division 1 – General Requirements
   2. Section 40 99 91, Package Control Systems

B. This section covers the work necessary to supply, program, deliver, supervise installation and commission the UV disinfection system, complete with UV lamps, UV lamp sleeves, lamp holders, UV banks, level control system, UV intensity monitoring, power distribution center, ballasts, control and instrumentation system, automatic cleaning system, lifting equipment, safety equipment, and spare parts.

C. UV disinfection technologies acceptable are vertically or incline mounted low pressure high intensity lamp systems in open channel.

D. Design and provide a completely functional UV disinfection system including all aspects such as design, supply, test and start-up of hardware and software.

1.2 DEFINITIONS

A. Bank: An assembly consisting of a number of lamp modules. Synonym for “reactor”.

B. Disinfection Channel: A concrete channel in which UV lamps are placed for disinfection of wastewater effluent.

C. Module: An assembly containing a number of lamps designed to be lifted from the disinfection channel as a unit for inspection and maintenance.

D. NWRI Guidelines: “Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse – 2nd Edition” May 2003, Published by the National Water Research Institute (NWRI) in collaboration with American Water Works Research Foundation.

E. Design Bioassay Dose: The ultraviolet dose as validated in accordance with NWRI Guidelines using the Bioassay Procedure.

1.3 SHOP DRAWINGS

A. Shop drawings shall be provided in accordance with Section 01 33 00, Submittal Procedures.

B. The following shop drawings shall be submitted:
   1. Dimensions and installation requirements.
   2. Descriptive information including catalogue cuts and supplier's specifications for all components.
   3. Hydraulic profile and headloss calculations indicating losses across each component, including but not limited to inlet gate, baffle plate if applicable, each UV bank, controlled level at end of channel, outlet weir gate, and any free discharge allowance.
   4. Electrical schematics, wiring diagrams, connection diagrams, layout drawings.
   5. Electrical power supply / breaker requirements.
   6. Control schematics with plant PCS interconnect details. Interconnection diagrams shall show all electrical and network connections between equipment, panel, terminal junction boxes and field mounted components.
   7. All requirements from specification section 40 99 91, Custom Package Control Systems must be met.
   8. Product data for all instrumentation.
   9. Tables showing data maps for communications with Plant PLC.
   10. Tables showing data map for communications with Plant HMI.
   11. Network architecture showing all components of the network supplied by the UV Equipment Supplier.
   12. Third-party certification of lamp age factor determined per NWRI guidelines.
   13. Third-party certification of quartz sleeve transmittance factor determined per NWRI guidelines.
   14. Detailed validation testing report completed and signed off by third party. At a minimum, the report shall include details of the validated UV reactor and intensity sensor, test set-up and detailed methodology, reactor performance data, validation curves, and derivation of dose algorithm. UV equipment validation shall be in accordance with the NWRI guidelines.
   15. Warranty details on all components including, but not limited to:
      a. UV lamps
      b. Ballasts
      c. Sleeves
      d. Sensors
      e. Wiper rings
   16. Submittals conforming to the requirements of Section 40 99 91, Custom Package Control Systems.
   17. Panel construction and layout drawings with Bills of Materials. Show the location of all panels mounted devices, doors, louvers and outline the space designated for equipment required. Drawings shall be to scale and include a panel legend identifying all devices, networking equipment, equipment supplier, type number, tag number and all nameplate inscriptions.
   18. Provide a detailed Control Narrative and an operator interface layout. Written description shall include instrumentation and control system including list of functions monitored, controlled, and alarmed by Equipment Supplier. The Control Narrative shall include all failure conditions including individual PLC failures, instrumentation failures, network connection failures, and master control failures and responses to each situation. Equipment shall be controlled in REMOTE-MANUAL (operator controlled through selection of equipment to start/stop) and REMOTE-AUTO (equipment operates automatically based on process feedback) modes of operation through the PCS system.

Listing shall clearly indicate information to be provided by the City through the existing PCS network, or as hardwired inputs to the UV system controller. The narrative is to be written so that the text conforms to the following headings: Process Description, Equipment, Control Modes, I/O Points, Normal Operation, Fault Response and Interlocks, Program Variables, Virtual Points, Alarms, PLC Data Exchange (Memory Map) and Hardwired Control Logic.

19. Provide a register map for data exchange with plant PLC and plant HMI PCS via Ethernet. Identify all register locations in UV system controller software to be accessed for monitoring purposes by the PCS system, and those registers from which the UV PLC will read control settings required for the operation of the system. This document shall be approved by the Contract Administrator prior to commencement of programming.

1.4 SOFTWARE COORDINATION AND DESIGN REVIEW

A. Meet with the City's PCS programming team to discuss aspects of the machine and process control strategies, network functions and OI graphics, and the Section 40 99 91, Custom Package Control Systems to discuss the City's standards and levels of control (LOCAL, PLT-MAN, PLT-AUTO, etc.). Propose, discuss, and explain alternative methods, styles, hierarchy, modules and other considerations.
   1. Meet for one-day each at approximately 0 percent and again at 50 percent complete of software development.
   2. Meet at the Project Site for two sessions, five hours each.

1.5 SITE LAYOUT

A. The UV equipment shall be installed in the existing Effluent Disinfection Facility and shall replace the existing UV equipment. The UV system will receive effluent from the High Rate Clarifiers prior to discharge to the outfall. A minimum of one UV channel shall be in service at all times. Installation of UV equipment shall be coordinated with the Contractor, Contract Administrator, and the City.

B. The channel layout for the existing UV disinfection system consists of two (2) parallel channel configuration as described in Section 2.3 Design Criteria.

C. The existing channel width and depth can be reduced as required and specified by the equipment supplier, subject to the Contract Administrator's approval. The Contractor shall be responsible for modifying the channels as specified by the equipment supplier and agreed upon by the Contract Administrator. Modifications may include 316 SST or FRP inserts or grouting the concrete walls and floors. Inserts shall not obstruct existing or new equipment and shall not allow flow to bypass the UV disinfection equipment. Grout and/or concrete modifications shall conform to the structural details provided in the contract drawings or as agreed upon by the Contract Administrator. The equipment supplier shall ensure the UV channel width is within the required tolerance of the equipment supplied.

1.6 EQUIPMENT SUPPLIER'S FIELD SERVICES

A. Qualified representative(s) for the equipment selected shall be present at the Jobsite for the minimum person-days listed for the services herein under, travel time excluded:
   1. Four person-days for installation assistance, inspection, certificate of shipment unloading, and certification of the installation. Provide certificates.
   2. Five person-days for functional and guaranteed performance requirements testing certification.
   3. Two person-days for classroom and/or Jobsite training for operations staff.
   4. Two person-days for classroom and/or Jobsite training for maintenance staff (two sessions, one person-day each).
   5. Software coordination as indicated above in Clause 1.4.A.

B. Training of the City's personnel shall be at such times and at such locations as requested by the City. Furnish complete training materials, to include operation and maintenance data, to be retained by each trainee.

1.7 GUARANTEES

A. Guarantee all materials and workmanship furnished to be free from defects for the warranty period of two years after final acceptance and make good all defective material and workmanship without cost to the City. The two-year warranty commences after substantial performance has been awarded.

B. In addition, guarantee performance as specified herein and as demonstrated during the field tests throughout the warranty period. The guarantee shall be provided by the UV system equipment supplier directly to the City.

1.8 OPERATION AND MAINTENANCE MANUALS

A. Content, format and schedule for providing as specified in Section 01 78 23, Operation and Maintenance Data.

B. The O&M manuals shall include software documentation, instructions on equipment storage, installation, startup, and operation and maintenance, together with a thorough troubleshooting guide and recommended spare parts list. Include procedures required for operator to setup and run the UV system, including all aspects of the Power Distribution Center (PDC), graphic displays, and UV PLC panel.

C. Preliminary manuals shall be provided a minimum of two weeks prior to the functional test and an "as built" set after successful completion of the performance test.

PART 2 OVERALL PRODUCT REQUIREMENTS

2.1 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:
   1. Trojan Technologies (London, ON);

2. ITT Wedeco UV Technologies (Charlotte, NC);

2.2 GENERAL

A. All components of the UV disinfection system shall be supplied by one responsible equipment supplier.

B. The scope of supply will include a UV disinfection system for installation in two Disinfection Channels. Each channel has existing inlet stop logs and an existing outlet modulating weir gate. A summary of the scope of supply is provided in the table below as further described herein:

Component	Quantity
Total No. of Channels	2
No. of Existing Inlet Stop Logs	2
No. of Outlet Modulating Weir Gates	2
No. of UV Banks	determined by vendor
Control & Power Panels	1 per bank
UV PLC Panels	2, 1 per channel
Online UVT Monitor	2, 1 per channel

C. The system shall be able to provide continuous disinfection during flows equal to or less than 100 percent of peak day flow with both disinfection channels in service. The system shall also be able to provide continuous disinfection during flows equal to or less than 130 percent of average day flow (assuming two channels in service) while one bank is out-of-service to replace UV lamps, quartz sleeves, ballasts, and while cleaning the UV lamp sleeves.

D. Each component shall be sized to hydraulically accommodate 112,500 m^3/d per channel with the headlosses less than or equal to those specified in Clause 2.3.C.

2.3 MATERIALS OF CONSTRUCTION

A. All wetted metal components shall be Type 316L stainless steel.

B. All other stainless steel components shall be Type 304L or 316L stainless steel.

C. All wiring exposed to UV light shall be Teflon coated, or otherwise protected from UV radiation effects.

D. Any other materials used which are exposed to UV radiation (254 nm) must be unaffected by prolonged exposure over the component’s life.

E. All manufacturing welds must be passivated.

2.4 DESIGN CRITERIA

A. The UV disinfection system shall operate in an open channel, be of modular design, use low pressure, high output UV lamps, and be provided with an automatic cleaning system and variable output electronic ballast.

B. Contract drawings show one potential equipment layout. Vendor may propose a different layout to suit the size of the proposed equipment. It is the responsibility of the Contractor to provide all electrical and controls requirements for a full and working system. Adjustments to the electrical requirements and design are subject to approval by the Contract Administrator and Contract Administrator of Record prior to any changes being performed. Equipment arrangement shall not interfere with other system, equipment, operator access, etc.

C. The control system shall be designed based on a two (2) channel UV disinfection system, with two channels providing the firm capacity required to meet the disinfection parameters.

D. Provide a system to disinfect received filter effluent flows at the South End Water Pollution Control Centre (SEWPCC) under the following design conditions:

Parameters	**Design Condition**
Treatment Design Flows: • Minimum Day Flow • Average Day Flow (ADF) • Peak Day Flow (PDF) • Flow per Channel @ PDF	 20,000 m^3/d 95,000 m^3/d 225,000 m^3/d 112,500 m^3/d
Design Disinfection Influent Quality: • TSS • Effluent $cBOD_5$ • Design UVT	 Less than or equal to 30 mg/L Less than or equal to 10 mg/L 55 %
Design Effluent Disinfection Limits: • PDF (225,000 m^3/d) • Compliance	 200 E.coli/100 ml Monthly geometric mean of 1 grab sample collected at equal time intervals on each of a minimum of 3 consecutive days per week.
Design Channel Dimensions: • Width • Length • Depth	 1,420 mm 10,520 mm 3,300 mm
UV Equipment Factors: • Lamp Age Factor • Fouling Factor • Quartz Sleeve Transmission Factor	 0.80 0.90 0.92
Design Disinfection Season	Year round

Parameters	Design Condition
Lamp Efficiency (Electricity into UV-C out of the lamp)	40%
Minimum Design Bioassay UV Dosage Delivered at Peak Day Flow, at End of Lamp Lifetime, including Fouling Factor	24 mJ/cm^2
Maximum Allowable Headloss	300 mm at Peak Instantaneous Flow in two channels. Headloss is calculated over the entire length of the UV disinfection banks and channel (excluding the upstream inlet stop logs, and downstream control gate). If applicable in the vendor's equipment, separately state the headloss across any baffle plate.
Power Supply	480 V, 3 phase, 4 wire + ground, 60 Hz

E. The proposed UV system shall be validated in accordance with the NWRI Guidelines using the bioassay procedure. The validation testing shall clearly indicate the system's ability to deliver the design bioassay dose over a range of UVT and flows, which shall include the design UVT as well as the minimum, average and peak day flows. The validation testing shall be conducted by a third party.

F. Alternate Lamp Age Factor and/or Fouling Factor may be used only if third-party certification of the alternate factor determined according to NWRI Guidelines is provided by the UV Equipment Supplier.

2.5 GUARANTEED PERFORMANCE REQUIREMENTS

A. Design UV disinfection performance shall be less than or equal to 200 count/100 mL *E.Coli* using the MPN index determined by the monthly geometric mean of 1 grab sample collected at equal time intervals on each of a minimum of 3 consecutive days per week. Grab sample means an individual sample of at least 1,000 millilitres collected in the appropriate container at a randomly selected time in a calendar month over a period of time not exceeding 15 minutes. The sampling and analyses required shall be performed as described in "Standard Methods for Examination of Water and Wastewater", 19th Edition, 1995, as amended from time to time by more recently published editions.

B. Lamp Operating Life and Lamp Output:
   1. After 12,000 hours of operation the lamp's output must be no less than 80 percent of a new lamp (after 100 hour burn in). This requirement is based on an average of 4 cycles per 24 hours, maximum, both outputs before adjustment for sleeve absorption and fouling.
   2. The lamp life of the low pressure lamps shall be rated for a life of at least 12,000 hours of system operation, pro-rated after 8,760 hours of system operation.
   3. If a lamp fails under normal operation before reaching 8,760 hours of system operation, the Equipment supplier shall replace the lamp at no cost to the City. If the lamp fails

under normal operation before the specified operating life after 8,760 hours of system operation, the Equipment supplier shall replace the lamp on a pro-rated basis.

4. If the average intensity of the UV lamps measured for a channel is less than the minimum output at the end-of-lamp life, the UV intensity will be tested (in factory) on a random selection of 5 percent of the installed lamps. Failure of the tested lamps to meet the required average UV intensity will require the Equipment Supplier to replace all the lamps in the channel with new lamps at no cost to the City or factory test all lamps and replace the failed lamps at no cost to the City.

C. The power consumption per lamp (including ballast losses) and total system power consumption shall not exceed the guaranteed power consumption for the required UV dosage under design conditions. Design conditions are as defined in Clause 2.3.C at average day flow, maximum TSS, and maximum $cBOD_5$.

D. The design life of the ballasts shall be not less than 10 years. Equipment Suppliers shall provide an extended warranty for all ballasts that conforms to the following requirement: Ballasts shall have a separate, three-year pro-rated warranty commencing upon successful completion of field tests identified in Clause 3.3. If 30 percent of the ballasts have failed at least once during the warranty period, the Equipment Supplier agrees to immediately replace all ballasts within three months of the end of the warranty period.

E. The power factor of the UV system shall not be less than 0.95 throughout the life of the UV system.

F. Provide the following guarantees as part of the submittals, complete with a notarized statement accepting the responsibilities outlined below.

1. Warrant that at the end of lamp design life, the supplied UV system will deliver a bioassay UV dose of 24 mJ/cm^2 at peak design flow and design effluent characteristics.
   a. This assumes that the input power per lamp is maintained within the optimal range of 60 – 80 percent input power.
   b. The end of lamp design life is as stated in the Equipment Supplier's lamp life guarantee.
   c. The validated bioassay UV dose will be verified through collimated beam studies performed on Site during the Guaranteed Performance Test (GPT) using native E. coli as the challenge organism.
   d. Compliance with this guarantee will be verified according to the GPT procedure outlined in Part 3.
   e. Failure to comply with the GPT, as interpreted by the Contract Administrator, may yield the UV equipment deficient.

2.6 FLOW CONTROL

A. Flow control shall be maintained by an automatic control system, consisting of motorized downward-opening actuated weir gates at the discharge end of each of the UV channels. The existing weir gate will be replaced. The existing gate actuators shall be replaced with new actuators provided by the UV system supplier in accordance with Section 35 20 16.25 Fabricated Slide Gates and Stop Logs. Vendor shall modulate gate elevation to ensure that the

UV lamps are submerged irrespective of the flow rate. Vendor shall provide level transmitters and use gate position for calculating flow through each channel.

2.7 METAL RACKS

A. Metal racks (Type 316L stainless steel) shall be provided for supporting the lamp modules in each channel (i.e. one rack for each lamp module).

B. Rack shall support all associated lamps and UV equipment in the UV channel as specified hereinbefore.

C. If racks are removable, guide brackets shall be installed on the channel walls to provide smooth removal and replacement of each rack. Guide brackets shall protrude into the channel not more than 5.1 cm on each side of channel. Guide brackets shall be Type 316L stainless steel.

2.8 CLEANING SYSTEM

A. Automatic Cleaning System:
1. The UV system shall have either automatic mechanical and chemical cleaning abilities or automatic mechanical wiping abilities complete with an automatically initiated and controlled cleaning cycle.
2. The automatic wiping system shall be fully operational without requiring either lamps or modules be placed out of service.
3. Cleaning cycle intervals to be field adjustable within the range required by the equipment supplier. Remote manual and remote auto cleaning control shall be provided through the operator interface.
4. The system shall be provided with the required cleaning reagents and solutions necessary for initial equipment testing and for equipment startup.
5. The cleaning system wipers in contact with the quartz sleeve shall not damage or scratch the quartz sleeve. Wiper materials shall be resistant to high-intensity radiation, high temperatures, chlorine at concentrations up to 10.0 mg/L, and strong acids.

B. Cleaning System Accessories:
1. Provide a Type 304L or 316L stainless steel cleaning rack capable of holding one lamp module or rack. The rack shall make lamps accessible by plant operators for hand wiping of the module frame and quartz sleeves. Mount the rack on lockable rubber wheels or casters.

2.9 SAFETY EQUIPMENT

A. Provide five face shields that block UV light wavelengths between 200 and 400 nm.

2.10 Lifting Mechanism

A. Supplier shall provide a lifting mechanism for removal of modules from the channel for servicing. Individual modules shall be removable while remaining modules continue to operate.

B. Lifting mechanism shall be integrated into module design or shall be a vendor supplied external hoist. Lifting device shall be designed to fit within the existing building and shall not interfere with the equipment layout and operation/maintenance access.

C. Where lifting mechanism is an external hoist provide one separate lifting frame with a minimum of two (2) hooks for removing the modules from the channel. Hoist design and installation shall be acceptable to the Contract Administrator.

D. Lifting mechanism shall be electrically or hydraulically powered.

2.11 MODULE LIFTING LUGS

A. Supply the lifting lugs to assist the operator to transport the lamp modules from the UV bank to a working platform. One module shall be transported at one time.

B. Lifting Lugs:
1. Equipment weighing over 45 kilograms pounds shall be provided with lifting lugs.
2. Provide each module with two side-mounted lifting lugs.

2.12 CHANNEL COVERS

A. Vendor equipment shall prevent the emission of UV light into the UV equipment room when lamps are inserted in channel.

B. Equipment installed flush with the concrete floor and not otherwise covered with an independent load bearing surface shall be suitable for supporting traffic loads. Vendor equipment shall not leave a gap between the equipment and existing UV channel walls that may act as a tripping hazard.

C. Equipment installed below the concrete floor shall be covered with flush mounted removable grating or checker plate supported from the channel walls.

D. Railings and/or guards around the UV channels are not acceptable.

2.13 SPARE PARTS

A. Provide the following spare parts. Percentages are based on the total equipment supplied.
1. Ten (10) percent of ultraviolet lamps.
2. Ten (10) percent of ballasts.
3. Ten (10) percent of quartz sleeves.
4. Ten (10) percent of lamp control modules.
5. Ten (10) percent of lamp cleaning wiper seals and housings.
6. As applicable to the UV system supplied, one (1) year’s worth of other spare parts for the cleaning system.
7. As applicable to the UV system supplied, fifteen (15) sets of gland nuts, associated washers, O-rings for quartz sleeves, O-rings for UV lamp Teflon plugs and lamp socket connections.
8. Two (2) UV intensity sensors.
9. One (1) photocell.

10. One (1) UVT intensity printed circuit board.
11. One (1) handheld UVT monitor.
12. Any additional spare parts as recommended by the Equipment supplier.
13. One (1) complete module.

B. All spare parts are to be separately packaged. All packages are to have bill of materials with quantity, item description and part number.

C. If dependent upon chemicals the supplier shall also provide six (6) months' supply of cleaning chemicals based on a flow of 112,500 m^3/d.

2.14 LOW PRESSURE-HIGH INTENSITY LAMP UV SYSTEM

A. The low-pressure-high intensity lamp UV System shall consist of low-pressure mercury amalgam or mercury vapour, high intensity UV lamps, oriented vertically or inclined, arranged in a modular design inside open channels.
   1. Lamp Array Configuration:
      a. The lamp array configuration shall be the uniform array with all lamps parallel to each other. The lamps shall be evenly spaced in horizontal rows with centreline spacings equal in both directions.
      b. The single array pattern shall be continuous and symmetrical throughout the bank.
      c. The system shall be designed for complete immersion of the UV lamps including both electrodes and the full length of the lamp tube in the effluent. Both lamp electrodes shall operate at the same temperature and be cooled by the effluent.
      d. Systems designed whereby the lamps are inserted through a metallic bulkhead or which otherwise prevent continuous cooling of the lamp electrodes by the effluent shall not be permitted.

B. Design of the low pressure-high intensity lamp UV System shall meet the following requirements:
   1. System to be installed in open channels.
   2. Number of channels: as required to meet design criteria in Clause 2.3.
   3. Specify channel dimensions subject to site layout restrictions as required to meet design criteria in Clause 1.5.D.
   4. Number of UV modules per bank: as required to meet design criteria in Clause 2.3.

C. System Design Parameters:
   1. The flow characteristics through the system shall closely simulate ideal plug flow conditions under the full operating flow range.
   2. Full use shall be made of the system volume throughout the flow range. The actual retention time of the effluent within the system determined by hydraulic analysis shall not be less than 0.9 times the theoretical retention time, i.e. $\theta/T > 0.9$.

D. The effluent depth at any point in the channels shall be automatically maintained. This variation in depth shall include variations due to head losses through the modules and variations in the depth controlled by the downward opening actuated gates. Control of the existing downward opening actuated gates shall provide free discharge over the top of the gate.

2.15 UV LAMPS AND CONTROLLERS

A. UV lamps shall be low-pressure mercury amalgam or mercury vapour, high intensity lamps of the hot cathode instant start design in which the coiled cathodes are heated by the arc current. Each UV lamp shall emit ultraviolet light with at least 90 percent of the emissions at wavelengths of 233.7 to 273.7 nanometers (average 254 nm).

B. The UV lamps shall be capable of full intensity variability between 60 and 100 percent.

C. The filament of the lamps shall be significantly rugged to withstand shock and vibration.

D. Maximum UV lamp arc length of 1.5 m.

E. Rated to produce zero levels of ozone.

F. The lamp’s design shall prevent direct arcing in moist or submerged conditions.

G. The controllers shall be of electronic design and specifically designed for the lamp. Ballast shall supply lamp output recommended by the lamp equipment supplier, plus or minus 10 percent. The design mean time between failure shall be at least 10 years.

2.16 UV MODULE

A. Each UV module shall consist of lamps integrated into a Type 316L stainless steel frame.

B. Each lamp shall be enclosed in its individual quartz sleeve, each end sealed by a lamp end seal and O-ring, or in lamp sleeves open at one end and encased with the module enclosure. Lamps enclosures shall ensure:
   1. The lamp is isolated from the module frame and all other lamps in the module.
   2. The moisture is prevented from entering the lamp module frame and the electrical connections to the other lamps in the module in the event of a quartz sleeve fracture.

C. The quartz sleeve shall not come in contact with any steel in the frame.

D. The ends of the lamp sleeve shall not protrude beyond the stainless steel frame of the UV Module.

E. All wires connecting the lamps to the ballasts shall be enclosed inside the frame of the UV Module and not exposed to the effluent or rated for exposure to the effluent and UV light.

F. The UV Modules shall be connected to a receptacle or power distribution centre by means of a multi-conductor cable with a moulded connector, or cable fitted with a multi-pin connector.

G. At the point of exit from the UV Module frame the multi-conductor cable shall pass through a waterproof strain relief or be fitted with a water resistant ULC rated multi-pin connectors.

H. The UV Modules shall be designed such that operating personnel at the plant can change the lamps and quartz sleeves. Each module shall be capable of being serviced in the channel by being lifted and held into position with a mechanical lifting device.

I. UV Lamp Sleeves:
   1. UV lamp sleeves shall be provided around each UV lamp to prevent the UV lamps and electrical connections from coming in contact with the wastewater.
   2. The UV lamp sleeves shall be Type 214 clear fused quartz circular tubing as manufactured by General Electric or approved equal in accordance with B8.
   3. Lamp sleeves shall be rated for a minimum UV transmission of 90 percent and shall not be subject to solarization over the length of their life.
   4. The nominal wall thickness of the sleeves shall be 1.25 mm minimum.

J. Each UV module shall be uniquely identified either by the on-board control system electronics or by the operator interface.

K. The control system for each module shall have a non-volatile memory capable of retaining stored data relative to all conditions including UV intensities, alarm conditions, elapsed operating hours and power settings, and number of on-off cycles for each lamp.

L. Each UV lamp module shall be protected by a Class B Ground Fault Circuit Interrupter (GFCI) or other approved system as per CEC Code or the ballast shall incorporate a galvanic separation of the two circuits. In case of the secondary circuit operating in abnormal conditions regarding voltage and/or amperage, the ballast shall shut off the lamp concerned.

2.17 CHANNEL MODIFICATION

A. UV equipment shall be installed in the existing UV building and the UV modules shall be installed in the existing UV disinfection channels.

B. Where the channel dimensions exceed the UV module dimensions, the Supplier shall provide details for the modification of the channel dimensions. Supplier shall not require the enlargement of the channels. Channel modifications shall be approved by the Contract Administrator. Contractor shall modify the channels as specified by the Supplier and approved by the Contract Administrator.

2.18 ELECTRICAL

A. The UV disinfection system consists of modules of UV lamps, and a system Power Distribution Centre (PDC) and a vendor PLC panel. The PDC shall contain all components for power distribution, protection, control and monitoring.

B. The electrical system shall be designed based on a two (2) channel UV disinfection system suitable for operation without modification.

C. Electrical supply available to the system is 480 volts, 3 phase, 3 wire, 60 hertz.
   1. A single connection to each Control and Power Panel (PDC) shall supply all components of a PDC, its UV bank and related components.
   2. The maximum power consumption of each of the units shall be as shown on the electrical drawings, and shall not exceed this value. The electrical power distribution systems have been sized based on the loads shown on the drawings.

D. Supplier shall provide all cabling between lamps and drivers.

E. Cables between PDCs and UV modules shall be in overhead cable trays. Conduits shall not be required in the existing floor. Cable routing from cable trays to UV channels shall not interfere with equipment access or removal of channel covers.

F. Supplier shall incur any costs resulting from harmonics limits not being in accordance with IEEE 519 as amended from time to time by more recently published editions.

G. Control Components: Operate at 24 VDC. The input power to the control systems shall be at 120 VAC UPS and normal power. Redundant power supplies shall be internal to the unit.

H. All components shall be factory installed and prewired to junction boxes or control panel.

I. The components shall be arranged in the enclosure such that failure of any component requires the removal of the failed component only. Systems where groups of components are enclosed and serviced as a sub-system will not be permitted.

J. Chain or hinge-connected waterproof caps shall be provided for all multi-pin connectors.

2.19 TRANSFORMER

A. The General Contractor shall provide one transformer per channel as shown on the contract drawings and specifications. If the vendor supplied system has a larger electrical load than supported by the WWTP power distribution system indicated on the contract drawings and specifications, the General Contractor shall increase the electrical supply to suit the UV system at no additional cost to the City.

2.20 INSTRUMENTATION AND CONTROL

A. Control panels shall be in accordance with the requirements of Section 40 99 91, Custom Package Control Systems. Provide all items, including items not specifically called out, that are required to implement the specified performance and functions and the functions required for proper system operation.

B. Provide completely operational UV Disinfection System.

C. Furnish Panels and Controls as follows:

Panel No.	**Name**	**NEMA 250 Rating**	**Material**
PDC-U211	UV Channel 1 Bank 1 Power Distribution Centre	4X	Stainless steel 304/316
PDC-U212	UV Channel 1 Bank 2 Power Distribution Centre	4X	Stainless steel 304/316
PDC-U213	UV Channel 1 Bank 3 Power Distribution Centre	4X	Stainless steel 304/316
PDC-U214	UV Channel 1 Bank 4 Power Distribution Centre	4X	Stainless steel 304/316

Panel No.	Name	NEMA 250 Rating	Material
PDC-U215	UV Channel 1 Bank 5 Power Distribution Centre	4X	Stainless steel 304/316
PDC-U221	UV Channel 2 Bank 1 Power Distribution Centre	4X	Stainless steel 304/316
PDC-U222	UV Channel 2 Bank 2 Power Distribution Centre	4X	Stainless steel 304/316
PDC-U223	UV Channel 2 Bank 3 Power Distribution Centre	4X	Stainless steel 304/316
PDC-U224	UV Channel 2 Bank 4 Power Distribution Centre	4X	Stainless steel 304/316
PDC-U225	UV Channel 2 Bank 5 Power Distribution Centre	4X	Stainless steel 304/316
CP-U210	UV PLC panel Channel 1	4X	Stainless steel 304/316
CP-U220	UV PLC panel Channel 2	4X	Stainless steel 304/316
LCP-U216	UV Cleaning System PLC panel Channel 1	4X	Stainless steel 304/316
LCP-U226	UV Cleaning System PLC panel Channel 2	4X	Stainless steel 304/316

D. The PDC shall provide electrical power and control signals for components supplied under this section. A single power feed will be supplied to each PDC and PLC panel.

E. The UV PDCs shall be capable of operating under the direction of the UV PLC panel. The UV PDCs shall also operate, manually as a minimum, while the UV PLC panel is not in service.

F. Control panels are intended to be located near the UV equipment.

G. PLC panel and PDC access shall only be via front door of each panel.

H. UV Power Distribution Centre (PDC):
   1. Provide one independent PDC for manual and automatic operation of each bank. PDC to contain all control devices, circuit breakers, contactors and power transformers. PDC to include a main disconnect switch which is lockable, flange mounted and interlocked with UV control.
   2. Panels to be free standing. 304 SST, 316 SST. PDC may be split into several enclosures to limit enclosure length to 1500 mm per section.
   3. Provide each PDC with independent sensors, relays, and interlocks in order to operate with full protection in 100 percent output in all modes.
   4. May be started and stopped locally via manual selector.
   5. Each PDC to include:
      a. Print pocket.
   6. Each UV auxiliary equipment shall provide automatic control of UV light banks and lamp cleaning mechanism, generate alarms, and communicate with the UV PLC panel.

7. The PDCs shall be coordinated via communications link with the UV PLC panel while operating in PLT-AUTO mode.
8. PDCs shall be capable of standalone LOCAL-MANUAL operation while operating in LOCAL mode.
9. Each PDC shall be equipped with a suitable air conditioning system supplied by the UV manufacturer. Forced air ventilation will not be allowed.
10. PDCs shall be sealed from the environment.
11. PDCs shall be UL approved or equivalent.
12. There is a maximum wall length of 7500mm available for the installation of the PDC cabinets for each UV reactor train. PDC cabinets for each reactor train including distance required to open cabinet doors and remove equipment shall not exceed width of 7500mm.

I. UV PLC Panels:
1. Provide an industrial grade PLC for the System Control Centre controller.
2. There is a maximum wall length of 1200mm available for the installation of the system control centre cabinets for each UV reactor train. Cabinet for each reactor train including distance required to open cabinet doors and remove equipment shall not exceed width of 1200mm.
3. Include the following as a minimum, on the PLC panel for automatic control of sequencing and modulation of banks and channels:
   a. Programmable logic controller (PLC), power supplies, I/O modules, and network components to establish communication between the plant control system and PDC, and ancillary equipment.
   b. Application software for the PLC with full read/write access.
   c. UV Operator Interface Terminal (OIT): Industrial grade HMI, Colour touch screen, Ethernet/IP communications interface and 128 MB RAM.
   d. Print packet.
   e. Internal light and switch
4. Each UV PLC shall interface between the plant control system and the UV PDCs. The UV PLC shall include the features of a master PLC such as interface with devices such as UV channel modulating weir gates, level sensors for each UV channel, level sensors for the UV facility effluent chamber, and plant flow signal. It shall provide overall co-ordination and sequencing of UV banks and channels. Operator may adjust the duty sequence of banks and channels.
5. The UV system shall not be based on a Master PLC and separate PLC for each UV channel. The design shall be based a separate PLC for each UV channel and the each PLC interfacing with the plant control system.
6. The UV PLC shall include necessary flow calculation algorithm based on UV channel level and outlet weir gate position transmitter signal. This flow signal shall be available for use for UV system control.
7. Accept the plant flow signal from the plant control system via a 4-20 mA signal.
8. Accept set points and duty commands from plant PCS and performs overall control and sequencing of all UV banks and channels including but not limited to:
   a. Bank 1A PLT-MAN/PLT-AUTO:
      1) PLT-MAN: entry of ON/OFF and manual lamp intensity setting;
      2) PLT-AUTO: the lamp intensity varies based on signals from the plant effluent flow, the current transmissivity, and the manual DOSE Target Setpoint;
      3) repeated for each channel/bank.

b. UV transmissivity PLT-MAN/PLT-AUTO:
   1) PLT-MAN: entry of manual transmissivity value;
   2) PLT-AUTO: the transmissivity monitor is engaged.
c. Channel 1 UV IN/OUT of service; repeated for each channel/bank.
d. DUTY SEQUENCE selection of the channels and banks of UV lamps.

9. Utilizes UV transmissivity monitor signal, which is hardwired to PLC in this panel.
10. Controls and monitors channel effluent weir gates. The weir gates are hardwired to the PLC in this panel. Provides remote (Remote-Manual and Remote-Auto) control and monitoring of gates via communication link with plant PCS. Monitors weir gate closed limit switch, Hand-Off-Remote selector switch and 4-20 mA position. Controls outlet gate position via 4-20 mA setpoint.
11. Response time to any UV operator screen and to the plant computer operator screen should not exceed a maximum of five seconds.
12. Monitor channel level and modulate outlet gates to control level. Accept 4-20 mA signal from level transmitter provided by UV system supplier.
13. Accept manual commands from plant HMI while outlet gate(s) are in Remote-Manual mode.
14. Provide communications between UV PLC panel and plant control network via Ethernet/IP for monitoring.

J. The vendor shall provide a list of all available signals readable by the Plant HMI via the Ethernet/IP communications links to enable a replication of the local HMI. Alarm signals shall include suggested alarm priority. The signals shall include, but not be limited to the following signals:

Readable by the Plant HMI **Signal Description**
Bank alarm, Minor (DI)
Bank alarm, Major (DI)
Incomplete sequence, alarm (DI)
UV channel fail (DI)
Communications fail between UV PLC & PDC (DI)
UV bank failure to energize (DI)
UV cleaning system failure to complete (DI)
Channel level high, alarm (DI)
Channel level low, alarm (DI)
UV lamps intensity low, alarm (DI)
Cooling System Fail (DI)
Effluent water transmittance low, alarm (DI)
UV System Power Fail (DI)
Bank status (ON/OFF) (DI)

Readable by the Plant HMI
Signal Description
Cleaning system status (ON/OFF) (DI)
Average lamp intensity (AI)
Effluent transmittance (AI)
Run time (AI)
Other alarms as specified.
Other alarms as deemed necessary by the supplier.
Bank ON/OFF status and intensity
Statuses of outlet gates
Bank Life Hours (AO)
Bank Runtime (AO)
Runtime on each individual bulb (AO)

K. Provide a means on the local HMI to choose between either the local HMI or Plant HMI as the operator interface.

L. The UV system shall accept as a minimum, the following command signals:
   1. Channel 1 Weir Gate Remote-Auto/Remote-Manual (typical for each unit)
   2. Channel 1 Weir Gate OPEN/CLOSE or POSITION % (typical for each unit)
   3. For each Bank
      a. UV Bank Remote-Auto/Remote-Manual
      b. UV Bank OFF/ON command
      c. UV Bank MANUAL SETPOINT
   4. Common UV system Dose Target Setpoint
   5. Common UV System BANK DUTY SEQUENCE

M. Flow Pacing
   1. Provide a system, which automatically turns on and off, up and down appropriate banks of UV lamps in relation to variations in water flow, lamp wear, lamp grime, and transmissivity so that the required dosage is maintained and minimum electrical power is consumed.
   2. The UV banks shall be controlled by a flow signal.
      a. Under normal conditions flow shall be calculated by the UV PLC based on the channel level sensors and weir gate position.
      b. On loss of flow signal above in service lamps shall automatically operate at 100 percent power until plant operator manually enters a flow value. Alarm shall issue on loss of flow signal. Alarm shall issue on return of flow signal in (a) above.
      c. Operator may select one of the two signals for the UV system to use for control.
      d. Logic and time delays shall be provided to regulate the starting and stopping of channels and the UV bank ON/OFF cycle.

3. The UV control system must also be able to accept a signal from the UV online transmissivity monitor and directly from UV intensity sensor.
4. The system shall allow the operator the option to operate individual banks in either manual or automatic mode, in any combination.
5. The system shall not cycle the lamps on and off more frequently than four (4) times per 24 hour time period.
6. The UV lamps shall operate only when they are submerged.

N. UV Bank/Channel Sequencing
   1. Provide a staged duty sequence in order to operate the optimal quantity of banks and channels.

O. Graphics Operator Interface Terminals (OIT):
   1. On the UV PLC panel provide a menu driven operator interface using touch panel screen, controller and all required software and programming.
   2. Provide EtherNet/IP link between OIT and PLC.
   3. Provide password protected adjustment of system settings, for use by the City's maintenance personnel, for diagnostics, calibration, and maintenance of all system functions.
   4. Allow all routine and non-routine displays to be viewable without the entry of password.
   5. Programming shall be consistent with follow the City's HMI Layout and Animation Plan document.

P. The OIT display at UV PLC panel shall include the following PDC data:
   1. Display bank status, cleaning system status, UV intensity, channel flow, UV transmittance, channel level, gate statuses, temperature alarms and level alarms.
   2. Provide a minimum of 10 screens as follows:
      a. UV dose, Alarm Status, System Settings, Coolant Control, Bank Control, Pacing, Alarm History, Bank System Overview, Wiper control and Help screen.
   3. An alarm graphic showing the time, and date of occurrence with the facility for operator to acknowledge alarm at the graphic. At a minimum, the following alarms shall be included.
      a. Minor Alarms, indicating maintenance required.
         1) Individual lamp failure: Location of lamp to be indicated by module and lamp sequence number. Alarm when number of nonadjacent, failed lamps in a bank does not exceed 5 percent of the total.
         2) Low UV intensity: When the UV intensity of the bank drops below preset intensity. Setpoint to be adjustable at the UV operator screen.
      b. Major Alarms, indicating UV disinfection performance is being affected.
         1) Adjacent lamp failure: Two or more adjacent lamps failed.
         2) Multiple lamp failure: Alarm when more than 5 percent of the lamps in a bank have failed.
         3) Low UV transmittance: Alarm when the UV transmittance drops below a preset UV operator screen adjustable low level.
         4) Ground fault interruption or module failure alarms.
         5) Breaker trip alarms.
   4. LOCAL-REMOTE selector switch.
      a. While REMOTE is selected, control passes up to the UV PLC panel.

Q. The OIT display at the UV PLC panel shall include the following:
   1. A system overview graphic representing the number of channels, UV lamp banks and associated power distribution centres. Display all commands received from the PCS
   2. Provide a low UV transmittance alarm: Alarm when the UV transmittance drops below a preset field adjustable low level.
   3. All setpoints, control mode selections, commands, etc. available on the local OIT shall also be accessible and adjustable from the PCS HMI. The PLC program shall be developed to accept commands from both the local OIT and the PCS system simultaneously. Operator input parameters shall be updated on both the OIT and the PCS to reflect any adjustments made from either location.

R. Functional Requirements: Provide the following control functions:
   1. Provide the facility for the Operator to control the light banks in LOCAL mode.
      a. LOCAL: When selected the bank lights are to be turned on or off at the particular PDC. Local operation to remain effective in the event of UV PLC failure or failure of the communications between the UV PLC and PDC.

S. PLC OIT & HMI Programming:
   1. Provide all PLC application software programming necessary for a fully functional and operable PLC system in accordance with the specifications.
   2. Conform to the City of Winnipeg's PLC & PCS programming standards as outlined in Section 40 99 90, Package Control Systems and Appendix C – RMOH PCS Standards. Standards cover aspects such as colours, screen format, pop-ups, standards bits/words for process equipment data exchange, and so on. All analog signals require the City's standard PLC code and HMI graphics.
   3. PLC programming shall include as minimum:
      a. I/O and register addressing assignments.
      b. PLC application software development and installation. PLC equipment configuration.
      c. PLC interface to the UV Control System and vendor-furnished control panels.
      d. System testing
      e. PLC application software debugging and trouble shooting.
      f. System hardware and software documentation.
      g. PLC system commissioning.
   4. HMI:
      a. In addition to the UV Equipment Supplier's OIT located on the UV PLC panel, provide program development for complete sets of display screens, and related databases, for loading on the City's PCSS workstations in the plant. The UV vendor shall use the latest version of PLC software for development. Include all data screens such as monitored and controlled points, alarms, alarm history, setup screens, maintenance screens, factory screens, and other screens.
      b. The Equipment Supplier shall provide any software development licenses as required for their own use. the City will not provide any software licenses for the development of the HMI.

T. Level Switches: Provide HIGH and LOW level switches for each reactor channel. Provide one grounding electrode for each bank. Provide relay for level element in the UV PDC. The set points to be provided during installation. System power shall turn off in the event of low

water level. System shall generate a warning in the event of high water level. Level interlocks and warnings operate in all modes of operation. Monitor, indicate and control the water depth of each channel.

U. Level Indicator Transmitters:
   1. For each UV channel provide a level transmitter:
      a. This product was standardized by the City via a separate RFP.
      b. No alternates or substitutes will be accepted.
      c. Manufacturer and Model:
         1) Siemens Milltronics Multiranger 100 with XPS 15 sensor
   2. For common outlet channel provide one level transmitter :
      a. Capable of two 4-20 mA output signals, each connecting to a separate UV system.
      b. Power shall be 24 VDC from external power supply provided by others.
      c. Sensor mounting shall be on a 150 mm (6 inch) 150# ANSI flange imbedded in concrete above the channel.
      d. This product was standardized by the City via a separate RFP.
      e. No alternates or substitutes will be accepted.
      f. Manufacturer and Model:
         1) Siemens Milltronics Multiranger 100 with XPS 15 sensor

V. Online Transmissivity Monitor
   1. Provide the UV system with one on-line ultra-violet transmissivity (UVT) monitoring device for each reactor channel. Monitoring device shall be designed for continuous monitoring of the UV transmittance. The UVT monitor shall have built-in self cleaning feature.
   2. The online UVT monitor shall incorporate a display screen for virtual display of transmittance.
   3. A 4-20 mA analog output shall be available for interfacing the online UVT monitor with the UV system master control panel or a 4-20 mA signal directly from the UV sensor shall interface with the UV master control panel and to create an effluent UV demand feedback loop.
   4. The online UVT monitoring device shall be a spectrophotometer suitable for measurement of the transmittance of the influent at a wavelength of 254 nm plus or minus 3 nm. Unit shall be suitable for continuous on-line measurement.
   5. Provide local indication of the transmittance (0 to 100 percent) and an isolated 4-20 mA output proportional to the measured transmittance. The 4-20 mA analog output shall be hardwired to the UV system PLC panel.
   6. The unit shall consist of a UV light source, filter, 10-mm sample cell, and a detector. Transmittance shall be measured with a minimum accuracy of 5 percent of actual value and have a two-second maximum response time.
   7. The unit shall be housed in a NEMA 4X 304/316 stainless steel cabinet suitable for wall mounting and shall be designed to be run from a 120-volt, 60-Hz AC supply.

W. UV Intensity Sensors
   1. Each ultraviolet lamp bank shall have a minimum of one (1) ultraviolet intensity sensor.
   2. The UV intensity sensor shall be submersible if installed outside the lamp module.
   3. The UV intensity sensor shall not degrade after prolonged exposure to UV light.

4. The UV intensity sensor shall continuously measure only the germicidal portion of the light generated (253.7 nm plus or minus 20 nm). The sensor must have a minimum sensitivity of 90 percent of the germicidal light.
5. The UV intensity shall be continuously displayed on the monitor, to a maximum of 99.9 milliwatts/square centimeter.
6. The UV intensity sensor shall be factory calibrated.
7. The 4-20 mA analog output from the UV Intensity Sensor shall be hardwired to the UV system PLC panel

PART 3 EXECUTION

3.1 FABRICATION

A. The UV disinfection system specified herein shall be factory assembled, to the largest extent possible, complete with all components specified. Provide an opportunity for the Contract Administrator and the City to inspect the system prior to packing/packaging for shipment.

3.2 iNSTALLATION OF EQUIPMENT

A. Installation of equipment to be done by the General Contractor.

B. Equipment Supplier's representative through the General Contractor shall provide the services detailed in Part 1 and the testing required herein.

3.3 FIELD TESTS

A. General Testing Requirements:
1. High Purity Oxygen (HPO) effluent will be discharged to the UV facility until the Biological Nutrient Removal (BNR) system is operating. The Contractor shall perform the demonstration testing and startup of the new UV system when construction of the UV system is complete. The new UV facility will operate on HPO effluent prior to the BNR commissioning. Performance testing of the new UV equipment will take place after the BNR is in operation and design flow conditions are met. Refer to 01 91 14 Equipment Testing and Facility Startup, and 01 52 10 Construction Sequencing for additional information on startup, testing and construction sequencing.
2. The Equipment Supplier is responsible for the planning, development, and coordination of all testing. The General Contractor will be required to assist the Equipment Supplier with the testing. The Equipment Supplier will be responsible for coordinating the testing with the General Contractor.
3. The UV equipment shall be installed in existing channels and one channel must be in service at all times. UV equipment shall be installed, tested, and commissioned in one channel prior to installing, testing, and commissioning UV equipment in second UV channel.

B. Functional Testing: Prior to start-up, the installed UV disinfection system shall be inspected for proper alignment, correct operation, proper connection, and satisfactory function of all components. The installation shall be approved and provided with a certification that the system components have been installed correctly and are ready for operation.
   1. With the assistance of the General Contractor, develop a functional testing procedure for review by the Contract Administrator, before scheduling and performing the functional test.
   2. Functional testing shall include proving of the serial interface between the UV controller and the plant control system. The UV Equipment Supplier's Representative shall coordinate with the plant control system equipment supplier/supplier during the interface test.
   3. Functional testing will be witnessed by the Contract Administrator and shall demonstrate that the system and related control system operate in accordance with the specifications, including all operating, monitoring, and shutdown functions.
   4. If, in the opinion of the Contract Administrator, the system meets the requirements specified herein, the system will advance to performance testing. If, in the opinion of the Contract Administrator, the functional test results do not meet the requirements specified herein, the system will be classed as non-conforming.
   5. In the case of a nonconforming system, advancement to performance testing will not commence, at no additional cost to the City, until such adjustments, changes, and/or additions as are necessary to correct the system are completed, and have been demonstrated by a satisfactory functional test as specified above.

C. Guaranteed Performance Testing (GPT):
   1. The intent of the GPT is to prove compliance with the design bioassay UV dosage requirement listed in the specification.
   2. With assistance of the General Contractor, plan, co-ordinate and conduct the GPT.
   3. Unless otherwise specified, the City will bear the cost for the water and the power used during the GPT.
   4. GPT testing requirements are as follows:
      a. Provide all test equipment, including instruments, analyzers, sample containers, and collimated beam apparatus necessary to conduct the necessary tests.
      b. At the City's discretion, split all samples for duplicate analysis by the City.
      c. Bear all costs for sampling and analysis required to fulfill the requirements of the GPT.
      d. the City will bear the cost of independent analysis of split samples. The analysis of split samples will be done for the purpose of verifying the findings of the UV Equipment Supplier.
      e. All analyses to be performed by a certified independent laboratory.
      f. Provide a GPT protocol for review and acceptance by the Contract Administrator.
   5. GPT will consist of one Site visit planned after the system has been operated for a period that approaches the end of lamp life. It is anticipated that this period will coincide with the time when the lamps have operated for more than 80 percent of their design life.
   6. The procedure for GPT is as follows:
      a. Plant staff will ensure that the flow is approximately equal the peak design flow through at least one channel.
      b. In the channel, ensure that all lamps are operational and that the UV system has been recently cleaned.

c. Measure and/or record the power drawn by the UV system(s) in operation.
d. Obtain representative samples of the UV influent (undisinfected) for collimated beam analysis.
e. Split sample to undertake at least four (4) replicates with two replicates of each sample sent to two laboratories for E. coli concentrations, TSS, and UVT.
f. Collimated beam analysis may be done off-site. Preserve and ship the samples in accordance with the requirements of Standard Methods (APHA, AWWA, WEF), latest version.
g. Conduct collimated beam analysis using a low pressure lamp, shielded through its length other than at the collimated beam discharge point.
    1) The light emitted from the discharge point will travel along a reflective collimating tube, of the same or larger diameter as the sample Petri dish mounted at the bottom of the collimating tube.
    2) Make the collimating tube length sufficient to ensure that the light intensity across the tube cross section is consistent.
    3) Control entry of light into the tube by the use of a precision aperture.
    4) At the Petri dish liquid surface elevation, measure UV intensity in mJ/cm^2, using an approved, laboratory quality radiometer/photometer.
    5) Place a sample in a Petri dish, on a mixing plate, at the same elevation. Expose it to UV light for a controlled period and then measure the residual E. coli density in the sample.
    6) Repeat this procedure for at least six UV dosages in the range 5 to 80 mJ/cm^2.
    7) In addition, measure the E. coli density of a sample with no exposure to UV light.
    8) Measure the UV transmissivity of the sample. Calculate the average UV intensity through the exposed samples in accordance with the Beer-Lambert equation.
    9) Using the results from these analyses, construct a dose-response graph for the effluent. The dose (mJ/cm^2) should be shown on the x-axis and the ratio between the measured number of E. coli in the exposed samples to the measured number of E. coli in the untreated sample should be shown on the y-axis (logarithmic scale, dimensionless).
    10) On two additional, separate days, collect samples for the collimated beam analysis and prepare two separate dose-response curves, as in 4) to 9) above. Show all three curves on one graph.
h. At approximately the same time (on three separate days) as the three samples are taken for collimated beam analysis, obtain three series of at least five independent samples of the UV system effluent. (On each of three days, one sample for the collimated beam analysis and one series of five effluent samples.) Take the samples from a downstream location in a manner that ensures that the average and mean would be representative of the average and mean for the flow during that period. Use 100 percent input power to the lamps.
i. Immediately after obtaining the samples, manually turn off one bank of the UV lamps in the channel and 10 minutes later, obtain a series of at least five upstream and downstream samples of the influent and disinfected effluent, respectively. Take samples from downstream locations in a manner that ensures that the average and mean would be representative of the average and mean for the flow during that period. Use 100 percent input power to the lamps.

j. Repeat a run with two banks with lamps at 75 percent input power and take five (5) replicates of influent and the corresponding disinfected effluent.
k. Analyze all samples from the system for E. coli densities.
l. Within ten (10) working days of conducting the GPT, provide a report summarizing the findings of the GPT testing and analyses. Include a complete listing of test results and describe the mathematical methods used in the analyses.

7. The Contract Administrator will assess the results of the GPT to determine whether the installed UV system is capable of delivering the specified UV dosage. Should the GPT results fail, the GPT will be repeated at no cost to the City.
8. Should the subsequent GPT prove unacceptable, the system will be deemed deficient.

END OF SECTION

SECTION 46 70 01

RDT WASH WATER BOOSTING SYSTEM

EQUIPMENT AND COMPONENT NUMBERS

ID No.	Equipment Description
P-D431	RDT Wash Water Booster Pump
P-D432	RDT Wash Water Booster Pump
TK-D430	Hydro-pneumatic Tank

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this Section:
   1. American Bearing Manufacturers Association (ABMA).
   2. American Iron and Steel Institute (AISI).
   3. American Society of Mechanical Engineers (ASME):
      a. B16.1, Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250.
      b. B16.5, Pipe Flanges and Flanged Fittings.
   4. American Society for Testing and Materials (ASTM):
      a. A48, Standard Specification for Gray Iron Castings.
      b. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
      c. A276, Standard Specification for Stainless Steel Bars and Shapes.
      d. A576, Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
      e. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
      f. B148, Standard Specification for Aluminum-Bronze Sand Castings.
      g. B584, Standard Specification for Copper Alloy Sand Castings for General Applications.
   5. Canadian Electrical Code (CEC).
   6. Hydraulic Institute Standards (ANSI/HI).
   7. Institute of Electrical and Electronics Engineers (IEEE): 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
   8. National Electrical Manufacturer’s Association (NEMA): MG 1, Motors and Generators.
   9. National Building Code of Canada (NBC) with Manitoba Amendments.

1.2 DEFINITIONS

A. Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards.

1.3 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings:
      a. Make, model, weight, and horsepower of each equipment assembly.
      b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
      c. Performance data curves showing:
         1) Capacity vs. head, shaft power, NPSH required, and pump efficiency at 50, 60, 70, 80, 90, and 100 percent of rated speed, over entire operating range of pump from shutoff to runout capacity. Indicate separately head, shaft power, NPSH required, and efficiency at rated capacity.
         2) System curves based on specified operating conditions.
         3) Manufacturer's preferred operating region and allowable operating region in accordance with ANSI/HI 9.6.3 recommendations.
         4) Manufacturer's recommended minimum continuous flow.
      d. Detailed general arrangement drawings including principal dimensions, weights, direction of rotation, casing position, suction and discharge connection sizes, motor, anchor bolt size and locations, and other information required for the installation of the equipment and accessories as a complete system.
      e. Complete motor nameplate data, as required by NEMA and CSA, motor manufacturer, and including any motor modifications.
      f. All applicable submittals in 40 99 90 Package Control Systems.
      g. Process control narrative.
      h. Factory finish system data sheets.
      i. Submit written certification from Professional Engineer licensed in Province of Manitoba stating that support systems, anchorage, and equipment have been designed for post-disaster structures according to requirements of NBC with Manitoba amendments, at time of shop drawing submittals.

B. Information Submittals:
   1. Factory test results, reports, and certifications.
   2. Manufacturer's Certificate of Conformance: Manufactured/commercial products.
   3. Special shipping, storage and protection, and handling instructions.
   4. Manufacturer's Certificate of Proper Installation in accordance with Section 01 43 33, Contractor Field Services.
   5. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
   6. Service records for maintenance performed during construction.

1.4 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts and special tools:

Item	Quantity
Bearings	One complete set
Gaskets and O-ring seals	One complete set

Item	Quantity
Shaft sleeve	One complete set
Keys, dowels, pins, etc.	One complete set
Mechanical seal	One
Impeller	One
Impeller shaft	One
Wear rings	One complete set
Lubricants	One year supply
Special tools required to maintain or dismantle equipment	One complete set

B. Delivery: In accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Equipment and accessories specified in this section shall be product of:
   1. Xylem/Goulds.
   2. Armstrong.
   3. Grundfos.

B. No “or-equal” or substitute products will be considered.

2.2 GENERAL

A. Provide packaged, skid-mounted, factory-assembled wash water boosting system complete with two variable speed multistage centrifugal pumps, suction and discharge piping manifolds complete with isolation and check valves, hydro-pneumatic tank, instrumentation, and controls.

B. Provide automatic recirculation system, if required, to recirculate portion of pumped flow from discharge manifold to suction manifold to maintain flow rate through pump above manufacturer’s recommended minimum continuous flow and to not exceed allowable number of pump starts per hour, while meeting system demand.

C. Provide overall coordination of the complete wash water boosting system.

D. Coordinate hydro-pneumatic tank sizing requirements with pump requirements.

E. Provide all items not specifically called out which are required to implement specified functions and functions required for proper system operation.

F. Design equipment, anchorage, and support systems for vertical and lateral loading in accordance with NBC.

2.3 CONDITIONS OF SERVICE

A. Pumps will be used to supply wash water at constant discharge pressure to rotary drum thickeners (RDTs). Flow demand will be intermittent or continuous and flow rate will vary depending on number of RDTs in operation at any given time. Design system such that pump manufacturer's recommended maximum number of pumps starts per hour is not exceeded under all operating conditions.

B. Fluid Handled: Strained plant effluent water having maximum solids size of 150 microns.

C. Environmental Conditions:
   1. Location: Indoors.
   2. Ambient Air Temperature: 5 to 40 degrees C.
   3. Relative Humidity: 0 to 100 percent.
   4. Electrical Area Classification: Unclassified.

D. Design Criteria:
   1. Flow Rate: 0 to 40 m^3/h.
   2. Suction Pressure: 690 to 750 kPag.
   3. Discharge Pressure: 965 kPag.

2.4 PUMP DESIGN

A. Type: Vertical multi-stage centrifugal.

B. Casing: Cast iron with integrally cast ASME B16.1 Class 125 flat face flanges.

C. Impellers and Diffusers: Type 316 stainless steel.

D. Bearings: Heavy-duty grease-lubricated ball bearings conforming to standards of ABMA with L-10 bearing life of minimum 50,000 hours.

E. Shaft Coupling: Flexible spacer type to permit disassembly and inspection without disturbing the pump, motor, or connected piping. Coupling guards shall be provided.

F. Shaft Seal: Self-flushed single mechanical seal.

G. Refer to Pump Data Sheets at end of section for additional requirements.

2.5 PIPING MANIFOLDS

A. Provide Type 316 stainless steel pump suction and discharge piping manifolds. Piping shall conform to Section 40 27 00.08, Stainless Steel Pipe and Fittings – General Service. Provide ANSI Class 150 flanges at ends of manifolds for connection of external piping.

B. Provide suction butterfly valve and discharge ball valve and check valve for each pump.

C. Provide suction and discharge pressure gauges complete with isolation valve for each pump.

2.6 HYDRO-PNEUMATIC TANK

A. Type: ASME bladder type, carbon steel shell, factory coated, factory pre-charged with air, vertical orientation, suitable for controlling system shock and water hammer and providing pump protection by reducing surge and minimizing pump starts and stops. Rated for minimum 1207 kPag working pressure.

B. Design Criteria:
   1. Total Tank Volume: As recommended by manufacturer for application.
   2. Drawdown Volume: As recommended by manufacturer for application.

C. Bladder: Replaceable heavy duty butyl rubber. Water is contained in the bladder.

D. Connections:
   1. System Connection: 50 mm NPT.
   2. Charging Valve: 25 mm NPT.

E. Other:
   1. Pressure relief valve directly mounted on top of tank.
   2. Pressure gauge directly mounted on air side of tank.

F. Pressure Switches:
   1. Acceptable Manufacturers:
      a. Ashcroft.
      b. Barkesdale.
      c. United Electric Controls.

2.7 ELECTRIC MOTORS

A. In accordance with Section 26 20 00, Low Voltage AC Induction Motors.

B. Motor Control: Manufacturer’s standard motor starters shall be provided in control panel. Provide all interfaces indicated and as required for a complete and functional system. Provide motors with thermal overload and short circuit protection.

C. All electrical components shall comply with or be approved by EEMAC, IEEE and CSA as applicable.

D. Refer to Motor Data Sheet at end of Section for additional requirements.

2.8 ELECTRICAL COMPONENTS AND ACCESSORIES

A. General: Provide all necessary electrical components and wiring for a complete, functional system. Electrical components shall be provided in accordance with requirements of Division 26, Electrical.

B. Wiring: All wiring shall meet requirements of Section 26 05 21, Wires and Cables (0-1000V) - Electrical, and CEC. All insulation shall be rated 600V, minimum. Twisted shielded pair cable shall be used for all low-voltage (24V dc) signals.

C. Electrical Raceways: All electrical wiring shall be installed in conduit meeting requirements of Section 26 05 34, Conduits, Conduit Fasteners, and Conduit Fittings. All raceways shall be installed in accordance with Section 26 05 34, Conduits, Conduit Fasteners, and Conduit Fittings, and CEC.

D. Motors: Provide squirrel-cage AC induction motors meeting requirements of Section 26 20 00, Low-Voltage AC Induction Motors, and as specified herein.

E. Electrical Responsibilities: Manufacturer/supplier shall be responsible for all electrical conduits, wiring, and electrical appurtenances located on equipment, including terminal junction boxes for power and control circuits.

F. Variable Frequency Drives: In accordance with Section 26 29 23, Variable Frequency Drives, supplied by equipment manufacturer and factory installed, connected, configured, and tested inside package control panels.

2.9 INSTRUMENTATION AND CONTROLS

A. General:
1. All controls and instrumentation shall be in accordance with requirements of Section 40 99 90, Packaged Control Systems.
2. Provide complete and functional system, including interfaces with plant Process Control System (PCS).
3. Provide variable frequency drives and full-voltage starters in package control panels for package system components. Each motor starter shall be equipped with thermal overloads in all three phases. Overloads shall be resettable without opening panel.
4. Segregate analog wiring in dedicated raceways.
5. Control components shall operate on 24 VDC or 120V ac power.
6. Provide instruments in accordance with Section 40 91 01, Instrumentation and Control Components, unless specified otherwise. Provide industrial grade instruments suitable for intended service and environment.
7. Instrumentation and controls specified herein are minimum requirements. Equipment manufacturer shall provide additional components and features necessary to achieve intended function and provide safe and reliable operation of equipment supplied.

B. Control Panels:

Panel No.	Name	NEMA 250 Rating	Enclosure Material	Mounting
LCP-D430	RDT Wash Water Booster Pumps Local Control Panel	4X	Type 316 stainless steel	Skid

1. Main disconnect switch for 600V power supply, with lockable handle and interlocked with panel door.
2. Control power transformer.
3. Variable frequency drives.
4. Overload and over-current protection for motor drives.

5. Power Supply to Panel: Single 600V, 3-phase, 60 Hz supply. Power supply to all skid-mounted motors and instruments shall be obtained from panel.
6. Panel shall be sized to properly dissipate heat from variable frequency drives. Provide cooling fans or fins as required. Power for cooling fans shall be obtained from same 600V feed to panel. Provide transformer as required. To maintain integrity of panel enclosure, louver penetrations will not be permitted.
7. Operator Controls and Indicators:
    a. HAND/OFF/AUTO selector switch for each pump.
    b. PUMP 1/PUMP 2 duty selector switch.
    c. Pump SPEED control and indication, available from VFD display/keypad, for each pump.
    d. EMERGENCY STOP pushbutton.
    e. System RESET pushbutton.
    f. Pump ON indicating light for each pump.
    g. FAULT indicating light for each pump.
    h. Suction pressure LOW indicating light.
8. External Interfaces:
    a. Provide all required inputs and outputs for interfacing with all skid-mounted devices.
    b. Plant PCS Interface:
        1) Provide clearly labeled terminals for interface to plant PCS, including but not limited to:
            a) Dry contact rated 5A at 120 VAC for plant PCS discrete input signals:
                (1) “Pump Running” status for each pump.
                (2) “System Fault”.
                (3) “Suction Pressure Low” alarm.
            b) Isolated analog output signals to plant PCS:
                (1) “Discharge Pressure”.
9. Functional Requirements:
    a. When either HAND/OFF/AUTO selector switch is in HAND position, associated pump shall run continuously and speed shall be manually controlled using VFD keypad (HAND mode is intended for maintenance and testing purposes only). In AUTO position, pump shall be controlled automatically by LCP depending on position of PUMP 1/PUMP 2 duty selector switch.
    b. In AUTO mode, LCP shall start, stop, and vary speed of duty pump to maintain discharge pressure set-point.
    c. Low suction pressure condition shall stop pump(s) and generate low suction pressure alarm.
    d. When EMERGENCY STOP pushbutton is pressed, pumps shall stop, in both HAND and AUTO modes. Operation of pumps shall be disabled until system RESET pushbutton is pressed.
    e. Upon overload of motor, pump shall stop and alarm shall be activated at LCP, in both HAND and AUTO operating modes.
    f. In event of system FAULT, operation of pumps shall be disabled until cause of fault is corrected and system RESET pushbutton at LCP is pressed.
    g. In event of power supply failure while pump is operating, pump shall automatically resume operation upon restoration of power supply. In event of power supply failure

during system FAULT, pump shall remain in fault condition upon restoration of power supply.

C. Instrumentation:
1. Pressure Gauges:
a. Pressure Gauges:
1) Provide pressure gauge on hydro-pneumatic tank and on suction and discharge of each pump.
2) Acceptable Manufacturers:
a) Ashcroft.
b) Trerice.
b. Pressure Switches:
1) Provide suction low pressure switch, discharge low pressure switch, and discharge high pressure switch.
2) Acceptable Manufacturers:
a) Ashcroft.
b) United Electric.
c. Pressure Transmitter:
1) Provide discharge pressure transmitter.
2) Acceptable Manufacturers:
a) Siemens.
b) Rosemount.

2.10 ACCESSORIES

A. Lifting Lugs: Provide suitably attached for all equipment assemblies and components weighing over 45 kg.

B. Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer, and as specified in Section 05 50 00, Metal Fabrications (Basic).

C. Equipment Identification Plates: In accordance with Section 40 05 53, Identification Labels for Equipment, Fabricated Tanks, Valves and Piping Systems.

2.11 FACTORY FINISHING

A. Manufacturer’s standard coating and finish for corrosive and wet environment.

2.12 SOURCE QUALITY CONTROL

A. Factory Inspections: Inspect control panels for required construction, electrical connection, and intended function.

B. Factory Tests and Adjustments: Test all pumps, control panels, and hydro-pneumatic tank actually furnished.

C. Factory Test Report: Include test data sheets, curve test results, performance test logs, certified correct by a Professional Engineer.

D. Pump Functional Test: Perform pump balance and vibration test per Hydraulic Institute Standards.

E. Pump Performance Test:
   1. Conduct on each pump.
   2. Perform under simulated operating conditions.
   3. Test for a continuous 3-hour period without malfunction.
   4. Provide completed Hydraulic Institute Standards data sheets.
   5. Adjust, realign, or modify units and retest in accordance with the Hydraulic Institute Standards, if necessary.

F. Motor Test: In accordance with Section 26 20 00, Low Voltage AC Induction Motors.

G. Hydrostatic Test: Test pump casing at 150 percent of shutoff head. Maintain test pressure for not less than 5 minutes.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's printed instructions.

B. Connect suction and discharge piping without imposing strain to pump flanges.

C. Anchor Bolts: Accurately place using equipment templates and as specified in Section 05 50 00, Metal Fabrications (Basic).

3.2 FIELD FINISHING

A. As specified in Section 09 90 00, Painting and Coating.

3.3 FIELD QUALITY CONTROL

A. Functional Tests:
   1. Pumps:
      a. Conduct on each pump.
      b. Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.
      c. Vibration Test:
         1) Test with unit installed and in normal operation, and discharging to the connected piping systems at rates between low discharge head and high discharge head conditions specified, and with actual building structures and foundations provided shall not develop at any frequency or in any plane, RMS vibration displacement exceeding the limits specified in ISO 10816-3.
         2) If units exhibit vibration in excess of the limits specified adjust or modify as necessary. Units which cannot be adjusted or modified to conform as specified shall be replaced
         3) Flow Output: Measured by plant instrumentation.

2. Hydro-pneumatic Tank: Perform according to manufacturer's instructions.

B. Operating Temperatures: Monitor bearing areas on pump and motor for abnormally high temperatures.

C. Performance Test: In accordance with Hydraulic Institute Standards.

3.4 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at site or classroom designated by Contract Administrator for minimum person-days listed below, travel time excluded:
   1. One person-day for installation assistance and inspection.
   2. One person-day for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
   3. Two person-days for pre-startup classroom and field training.
   4. One person-day for facility startup.
   5. One person-day for post-startup training. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by Contract Administrator.

B. See Section 01 43 33, Contractor Field Services and Section 01 91 14, Equipment Testing and Facility Startup.

3.5 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this Specification.
   1. Pump Data Sheet.
   2. Induction Motor Data Sheet.

END OF SECTION

PUMP DATA SHEET NO. 1
RDT FLUSHING WATER BOOSTER PUMPS P-D431, P-D432

Project: City of Winnipeg SEWPCC Upgrading/Expansion Project

Process/Facility: Sludge Thickening

Service: Flushing Water

Pump Name: RDT Flushing Water Booster Pumps

Equipment Tag Number(s): P-D431, P-D432

Manufacturer and Model: (1) Xylem/Goulds; Series e-SV
(2) Armstrong
(3) Grundfos

Number of Pumps Required: Two	Pump Type: Vertical multi-stage

Drive Type: ☐ Constant Speed ☐ Two Speed ☒ Variable Speed

LIQUID PROPERTIES	OPERATING CONDITIONS	SERVICE CONDITIONS
Name: Flushing water	Capacity (m^3/h):	Ambient Temperature (°C):
Fluid Temperature (°C):	Rated: 40 2nd: 6.5 3rd: _____	Min: 5 Max: 40
Min: 5 Normal: 10-20 Max: 25	Total Dynamic Head (m):	Relative Humidity (%):
Specific Gravity: 1.0 @ 20 °C	Rated: 27 2nd: 27 3rd: _____	Min: 0 Max: 100
Vapour Pressure (kPa): 2.5 @ 20 °C	Suction Pressure (kPa):	Altitude (m): _____
Viscosity (cp): 1.0 @ 20 °C	Rated: 690 2nd: 750 3rd: _____	☒ Indoor ☒ Heated
pH: 6.5-7.5	NPSH Available (m):	☐ Outdoor ☐ Unheated
Max. Solids Size (microns): 150	Rated: _____ 2nd: _____ 3rd: _____	Area Electrical Classification:
Corrosion/Erosion/Abrasion Caused By:		Unclassified
_____		
Remarks: _____	Remarks: _____	Remarks: _____

PERFORMANCE REQUIREMENTS		
Max. Pump Speed (rpm): 3500	Min. Shut-off Head (m): _____	Factory Testing:
Min. Pump Speed (rpm): _____	Min. Solids Passage (mm): _____	☒ Functional ☒ Performance
Speed at Rated Capacity (rpm): _____	Min. NPSH Margin Ratio: 1.5	Field Testing:
Min. Hyd. Eff. at Rated Capacity (%): 75	Min. Continuous Flow (m^3/h): 6.5 max.	☒ Functional ☒ Performance
Max. Power at Rated Capacity (kW): 5.0		Hydrostatic Test Pressure (kPag):
		150% of pump shut-off head

Remarks: _____

PUMP DATA SHEET NO. 1 (cont'd)
RDT WASH WATER BOOSTER PUMPS P-D431, P-D432

PUMP CONSTRUCTION DETAILS

Nozzles						Miscellaneous Connections		
	NPS (mm)	ANSI Class	Facing	Location			Size (mm)	Location
Suction	65	125	FF			Drain		
Discharge	65	125	FF			Vent		

Impeller:
Type: Radial
Diameter (in): TBD by mfr.

Casing Mount:
☐ Horizontal ☒ Vertical
☐ Centerline ☐ Near Centerline
☐ Foot ☐ Bracket

Motor Coupling:
☒ Direct ☐ Line shaft
☐ V-belt (side) ☐ V-belt (overhead)

Vent and Drain Connections:
☐ Tapped and plugged

Suction and Discharge Gauge Connections:
☐ Tapped and plugged

Packing:
Type: n/a
Manufacturer: n/a
Size/No. of Rings: n/a

Mechanical Seal:
Type: As specified
Manufacturer: Mfr's standard
Model: Mfr's standard
Lubrication: _____

Bearings:
Radial (type/no.): Mfr's standard
Thrust (type/no.): Mfr's standard
Min. ABMA B-10 Life: 100,000 hrs
Lubrication: ☒ Grease ☐ Oil

Shaft Coupling:
Type: Mfr's standard
Manufacturer: Mfr's standard
Model: Mfr's standard

Remarks: _____

MATERIALS OF CONSTRUCTION

Pump Casing: Cast iron, ASTM A48	Casing Wear Ring: _____	Shaft: Type 316 stainless steel
Impellers: Type 316 stainless steel	Impeller Wear Ring: _____	Shaft Sleeve: _____

Remarks: _____

ADDITIONAL REQUIREMENTS

_____

MOTOR DATA SHEET NO. 1
RDT WASH WATER BOOSTER PUMPS P-D431, P-D432

Project: City of Winnipeg SEWPCC Upgrading/Expansion Project

Process/Facility: Sludge Thickening

Service: Flushing Water

Pump Name: RDT Wash Water Booster Pumps

Equipment Tag Number(s): P-D431, P-D432

Type: Squirrel-cage induction meeting requirements of NEMA MG 1.

Manufacturer: For multiple units of same type of equipment, furnish motors and accessories from single manufacturer.

Hazardous Location: ☐ Furnish motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark.

Motor Size (kW): 5.6 ☒ Min. ☐ Max.	Guaranteed Minimum Efficiency at Full Load (%): Per CAN/CSA-C390 Table 3
Voltage: 575	Guaranteed Minimum Power Factor at Full Load (%): Mfr.'s std.
Phase: 3	Service Factor (at rated max. ambient temperature): ☐ 1.0 ☒ 1.15
Frequency (Hz): 60	Enclosure Type: TEFC
Synchronous Speed (rpm): 3600 max.	Mounting Type: ☐ Horizontal ☒ Vertical
☐ Constant Speed	Vertical Shaft: ☒ Solid ☐ Hollow
☐ Two-speed Speed (rpm): Slow _____ Fast _____	Vertical Thrust Capacity (N): Up _____ Down _____
☒ Multi-speed Speed (rpm): Min. 1800 Max. 3600	☒ Adjustable Speed Application (inverter duty rated) In accordance with Section 26 29 23, Variable Frequency Drives. Operating Speed Range: 50 to 100 % of rated speed
Variable Speed Load Classification: ☒ Variable Torque ☐ Constant Torque ☐ Constant Power	☐ Thermal Protection: _____ ☐ Space Heater: _____ volts, single phase ☒ Oversize main terminal (conduit) box for motors ☒ Terminal for connection of equipment grounding wire in each terminal box
Winding: ☒ One ☐ Two	

ADDITIONAL REQUIREMENTS

☒ In accordance with Section 26 20 00, Low Voltage AC Induction Motors.

SECTION 46 71 33

ROTARY DRUM THICKENERS

EQUIPMENT AND COMPONENT NUMBERS

ID No.	Equipment Description
RDT-D403	WAS Rotary Drum Thickener
RDT-D404	WAS Rotary Drum Thickener
RDT-D415	FSL Rotary Drum Thickener
RDT-D416	FSL Rotary Drum Thickener
RDT-D417	FSL Rotary Drum Thickener

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. American Gear Manufacturers Association (AGMA).
   2. American National Standards Institute (ANSI).
   3. American Society of Mechanical Engineers (ASME):
      a. B16.5, Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard.
   4. American Society for Testing and Materials (ASTM).
   5. American Water Works Association (AWWA):
      a. Standard Methods for the Examination of Water and Wastewater.
   6. Canadian Electrical Code (CEC).
   7. Canadian Standards Association (CSA).
      a. C390, Test Methods, Marking Requirements, and Energy Efficiency Levels for Three-Phase Induction Motors.
   8. Electrical and Electronics Manufacturers Association of Canada (EEMAC).
   9. Institute of Electrical and Electronics Engineers (IEEE).
   10. National Building Code of Canada (NBC) with Manitoba Amendments.
   11. National Fire Protection Association (NFPA):
      a. 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
   12. National Electrical Manufacturers Association (NEMA).
   13. Occupational Health and Safety Act (OHSA).

1.2 DEFINITIONS

A. Percent Solids Capture: Percentage of feed solids contained in dewatered end product, on weight basis. For purposes of this Specification, percent solids capture is defined as:

Percent Solids Capture = (C / F) x [(F - E) / (C - E)] x 100%

where: C = Thickened sludge total solids (%)
F = Feed sludge total solids (%), excluding any dilution from polymer solution flow
E = Filtrate total solids (%), excluding any dilution from polymer solution and wash water flows

B. Polymer Consumption: Equivalent dosage of active polymer in kilogram per dry tonne of feed solids (kg/tonne DS) required by supplied equipment to meet specified performance requirements.

C. RDT: Rotary drum thickener.

1.3 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00, Submittal Procedures.

B. Action Submittals:
1. Shop Drawings:
a. Make, model, weight, layout and horsepower of each equipment assembly.
b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
c. Detailed drawings showing equipment dimensions, size and locations of connections, and weights of associated equipment.
d. Power and control wiring diagrams, including terminal numbers.
e. Process and instrumentation diagrams (P&IDs) with appropriate tag numbers and PLC I/O points. P&IDs included in Contract Documents are based on first-named manufacturer and information obtained from similar projects. Manufacturer shall revise P&IDs as required to suit equipment supplied and include in first shop drawing submission.
f. Process control narrative including, but not limited to, control strategy for system start-up, unit sequencing, operation of auxiliary systems to provide complete system operation, system shut-down, default parameter settings, and alarms.
g. Complete motor nameplate data, as defined by NEMA, including any motor modifications.
h. Details of sludge/polymer mixing assembly, including graph of pressure drop vs. sludge feed flow rate.
i. All applicable submittals in 40 99 90 Package Control Systems.
j. Control panel heat dissipation calculations. Demonstrate that panel internal temperature does not exceed drive operating requirements.
k. Information, including technical catalog, literature, and specifications on factory prime and finish coating systems in accordance with Section 09 90 00, Painting and Coating. Where manufacturer proposes paint system different from that specified,

submit complete technical literature showing that proposed paint system is equal or better than paint system specified for intended environmental conditions. Submit request for approved equal paint system in accordance with B8.

l. Submit written certification from Professional Engineer licensed in Province of Manitoba stating that support systems, anchorage, and equipment have been designed for post-disaster structures in accordance with requirements of NBC with Manitoba Amendments, at time of shop drawing submittals.

C. Informational Submittals:
1. Factory test results, reports, and certifications.
2. Special shipping, storage and protection, and handling instructions.
3. Manufacturer's printed installation instructions.
4. Manufacturer's Certificate of Proper Installation in accordance with Section 01 43 33, Contractor Field Services.
5. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
6. Suggested spare parts list to maintain the equipment in service for a period of 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
7. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.

1.4 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts and special tools, as applicable, for each set of equipment of same make and model:

Item	Quantity
Filter cloths	One complete set
Drum main bearings	One complete set
Trunnion wheels	One complete set
Drive chain and sprockets	One complete set
Spray nozzles	One complete set
Solenoid valves	One complete set
Lubricants	One year supply
Drum lifting tool	One
Special tools required to maintain or dismantle equipment	One complete set

B. Delivery: In accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

2.1 GENERAL

A. Each RDT system shall generally consist of in-line sludge/polymer mixing device, flocculation tank with mixer, rotary drum thickener, sludge hopper, control panels, and appurtenances.

B. System components shall be skid-mounted and factory pre-assembled and pre-piped to maximum extent possible. Installation of equipment may require partial disassembly and reassembly of equipment on site. Manufacturer shall provide representative to inspect reassembled equipment where disassembly is required.

C. Where possible, provide end products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, replacement, and manufacturer's service.

D. Design equipment with due regard to safety of operation, accessibility, and durability of parts, and compliance with applicable OHSA, provincial, and local safety regulations.

E. Design equipment, anchorage, and support systems for vertical and lateral loading in accordance with NBC.

F. A single manufacturer who, as a Subcontractor to the Contractor shall have sole-source responsibility for the design, testing, delivery and performance verification of the system and shall provide all components of the Rotary Drum Thickener (RDT) system included in this section. Such manufacturer shall be referred to herein as the RDT Manufacturer.

2.2 MANUFACTURERS

A. Equipment and accessories specified in this section shall be products of:
   1. Alfa Laval Inc.; Aldrum.
   2. Parkson Corporation; Hycor Thicktech.
   3. Andritz; PowerDrum.
   4. IPEC Consultants; Model IFT.

B. Design shown on Drawings is based on first-named manufacturer above. Use of equipment from manufacturer other than first-named manufacturer may require substantial changes to design shown on Drawings including, but not limited to, equipment and piping layouts, pipe sizes, sludge pump capacities and motor sizes, access platform layouts, gantry cranes, odour control ducting sizes and layout, electrical power supply and distribution, and instrumentation and controls. All changes to design shown on Drawings that are necessitated by Contractor's selection of other than first-named manufacturer shall be Contractor's responsibility, subject to review and acceptance by Contract Administrator, and all costs associated with such changes shall be included in Contractor's tender price. No claims from Contractor after contract award for additional costs associated with such changes will be considered by the City. All costs incurred by Contract Administrator after contract award to review and, if necessary, revise Contractor's proposed changes to design shown on Drawings shall be at Contractor's expense. Contract Administrator's acceptance of Contractor's proposed changes to design shown on Drawings shall in no way relieve Contractor of responsibility for

compliance with specified functional, performance, and contractual requirements. Contract Administrator will not review any proposed changes to design shown on Drawings prior to contract award.

2.3 CONDITIONS OF SERVICE

A. Materials Handled: Waste activated sludge and fermented sludge.

B. Operating Environment:
1. Equipment Location: Indoors.
2. Ambient Air Temperature: 5 to 40 degrees C.
3. Relative Humidity: Up to 100 percent.
4. Electrical Hazardous Area Classification: As shown on Drawings.

C. Feed Sludge Quantities and Characteristics (prior to polymer addition):

	Waste Activated Sludge (WAS)	**Fermented Sludge (FSL)**
Description	Blend of waste activated sludge and secondary scum	Blend of primary sludge, fermented primary sludge, and high-rate clarifier sludge
Solids Loading to RDTs (total) [1]:		
- Minimum (kg/h)	130	95
- Average (kg/h)	330	310
- Peak week (kg/h)	415	1,270
- Peak day (kg/h)	430	2,270
Hydraulic Loading to RDTs (total) [1]:		
- Minimum (m^3/h)	25	17
- Average (m^3/h)	45 – 95	20 – 40
- Peak week (m^3/h)	50 – 115	90 – 115
- Peak day (m^3/h)	55 – 120	160 – 220
Total Solids Concentration (%)	0.4 – 1.5	0.7 – 2.5
pH	6 – 8	5 – 7
Temperature (degrees C)	5 – 25	5 – 25
[1] Based on continuous feeding.		

D. Feed sludge shall be conditioned with polymer prior to thickening. Post-diluted polymer solution having a concentration of approximately 0.02% active polymer will be supplied to each RDT system.

2.4 PERFORMANCE REQUIREMENTS

A. Equipment shall receive, condition, flocculate, and thicken feed sludge specified herein, and neatly discharge thickened sludge to sludge hopper and filtrate to collection piping system, as shown on Drawings. Equipment shall be suitable for continuous operation, 24 hours per day, 7 days per week, and shall operate either continuously or intermittently on demand.

B. Equipment shall meet following performance requirements while operating either continuously or intermittently:

	RDT-D403, RDT-D404	**RDT-D415, RDT-D416, RDT-D417**
Feed Sludge	WAS	FSL
Minimum Hydraulic Loading Rate per RDT at Maximum Capacity (m^3/h) [1]	80	80
Hydraulic Loading Rate per RDT at Minimum Capacity (m^3/h) [1]	40	40
Minimum Percent Solids Capture (%)	95	95
Thickened Sludge Total Solids Concentration (%)	4 – 6	4 – 6
Maximum Polymer Consumption (kg/tonne DS)	5	5
Maximum Wash Water Consumption per RDT (m^3/h)	8	8
[1] Excluding polymer solution.		

2.5 MATERIALS OF CONSTRUCTION

A. Materials specified are considered minimum acceptable for purposes of durability, strength, and resistance to erosion and corrosion. Manufacturer may propose alternative materials for purpose of providing greater strength or to meet required stress limitations. However, alternative materials must provide at least equivalent qualities to those specified. Submit requests for approved equals in accordance with B8.

B. Stainless Steel:
   1. Plate, Sheets, and Strips: ASTM A240/A240M, Type 316L, 2D finish.
   2. Bars and Shapes: ASTM A276/A276M, Type 316L.

3. Tubing: ASTM A269/A269M, Type 316.
4. Bolts: ASTM A193/A193M, Type 316.
5. Nuts: ASTM A194/A194M, Type 316.

C. All components fabricated from stainless steel shall be pickled and passivated in accordance with ASTM A380.

2.6 GENERAL COMPONENT REQUIREMENTS

A. Equipment Supports: Design equipment, anchorage, and support systems for vertical and lateral loading in accordance with NBC and Manitoba Amendments. Design shall be stamped and signed by Professional Engineer registered in province of Manitoba.

B. Service Factors: Service factors shall be applied in selection and design of components where so indicated. Where not indicated, minimum service factor shall be 1.25, except for gears and gear drives as specified herein.

C. Safety Devices: Provide all necessary permanent safety devices, such as machinery guards, emergency stops, and similar items required by OHSA and other federal, provincial, and local health and safety regulations.

D. Materials: All metallic items routinely wetted during operation shall be Type 316 stainless steel (Type 316L for all welded items) unless specified otherwise, and hardened as required to limit abrasive wear. Where this Section requires stainless steel, it shall be Type 316/316L, unless specified otherwise.

E. Welding:
1. Except where specified otherwise, welding shall comply with AWS D1.1, D1.2, D1.3, and D1.6, as applicable.
2. Welding shall be performed using process allowed by applicable AWS code for material being welded. Qualification of weld procedures, welders, and welding operators shall conform to AWS standards.
3. Composite fabricated steel assemblies which are to be erected or installed inside a hydraulic structure, including any fixed or movable structural components of mechanical equipment, shall have continuous seal welds and shall prevent entrance of air or moisture.
4. Welding shall be performed by a method as described in AWS “Welding Handbook”, as supplemented by other AWS standards.
5. During assembly and welding, component parts shall be clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall comply with AWS code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance with uniform weld contours and dimensions. Sharp corners of material which is to be painted or coated shall be ground to a minimum of 0.8 mm on the flat.
6. All welds on stainless steel shall be pickled and passivated in accordance with ASTM A380.

F. Bearings: Bearings shall conform to ABMA standards. Except where otherwise indicated, bearings for process equipment shall have minimum L-10 life expectancy of 100,000 hours.

G. Gears and Gear Drives:
   1. Except where specified otherwise, gears shall be of helical or spiral-bevel type, designed and manufactured in accordance with AGMA standards, with anti-friction bearings, minimum service factor (thermal and mechanical) of 1.7, minimum L-10 bearing life of 100,000 hours, and minimum efficiency of 94 percent.
   2. Gear reducers shall be designed for continuous 24-hour operation in accordance with AGMA recommendations for Class II service.
   3. Gear reducers or increasers shall be enclosed type, oil- or grease-lubricated and fully sealed, with breather to allow air to escape but keep dust and dirt out. Casing shall be cast iron or heavy-duty steel construction with lifting lugs and inspection cover for each gear train. For oil-lubricated drives, provide oil level sight glass and oil flow indicator for easy reading.
   4. Gears and gear drives as part of an equipment assembly shall be shipped fully assembled for field installation.
   5. Material selections shall comply with AGMA values and manufacturer's recommendations. Input and output shafts shall be properly designed for service and load requirements. Gears shall be computer-matched for minimum tolerance variation. Output shall have two positive seals to prevent oil leakage.
   6. Oil level and drain locations shall be readily accessible. When oil drain is not at low point of gear box, provide suitable oil pump for draining and changing oil. Oil coolers or heat exchangers with all required appurtenances shall be included where indicated.
   7. Where gear drive output shafts connect to couplings or sprockets, gear drive manufacturer shall supply matching key.
   8. Each motor shall be sized based on requirements of driven load with consideration given to all drive train components. Comply with requirements of Section 26 20 00, Low-Voltage AC Induction Motors.
   9. Motors shall be premium efficiency and sufficiently sized such that there will be no overload on motor above rated nameplate horsepower under any condition of operation. Torque and heat dissipation shall be sufficient for continuous operation.
   10. Motors shall be capable of starting under full operational loading conditions.
   11. Gear reducers shall be SEW Eurodrive or approved equal in accordance with B8.

2.7 EQUIPMENT DESCRIPTION

A. General:
   1. Each RDT shall generally consist of rotating cylindrical screen that removes free water from sludge by dynamic gravity drainage. Each manufacturer's specific details of equipment design, configuration, and operation may differ slightly from that described herein.
   2. Feed sludge shall be mixed with polymer solution and shall enter flocculation tank where floc development shall be completed. Flocculated sludge shall flow by gravity from flocculation tank into RDT where liquid portion separates from flocculated solids through perforated plate, wedge wire, or woven wire mesh screen, is collected in filtrate tank, and exits through drain in bottom. Separated solids shall continue along dewatering stages of drum before being discharged from end of unit. Self-cleaning wash water spray header mounted above drum screen shall keep screen openings clear of solids.
   3. Unless specified otherwise, all components of equipment in contact with process liquids or solids shall be fabricated from Type 316L stainless steel. Skids shall be constructed of

epoxy-coated carbon steel. Principal elements of RDT systems shall be fully factory-assembled for ease of shipping, handling, and installation.

B. Sludge/Polymer Mixing Device:
   1. Type: Inline, non-clogging, mechanically-operated with variable area orifice plate connected to externally mounted lever and adjustable counterweight to vary mixing energy.
   2. Fabricated from Type 316L stainless steel with removable cover for inspection and cleaning.
   3. End Connections: ASME B16.5 Class 150 flat-face flanges.
   4. Pressure Loss: Maximum 200 kPa at design flow.
   5. Polymer Injection Assembly:
      a. Consisting of polymer solution flow splitting manifold, clear flexible tubing with stainless steel hose fittings, and polymer injection ring.
      b. Capable of injecting polymer solution at minimum of four locations equally spaced around ring circumference.
      c. Inside diameter of ring shall not be less than sludge feed pipe inside diameter.

C. Flocculation Tank:
   1. Sized by manufacturer to provide sufficient retention time for complete floc development of sludge/polymer mixture at maximum rated hydraulic capacity of RDT.
   2. Fabricated from Type 316L stainless steel with baseplate for anchoring to concrete equipment pad, mixer mounting bracket, and cover plate with hinged inspection hatch.
   3. Connections for External Piping:
      a. Sludge Inlet: 150 mm diameter, flanged.
      b. Sludge Outlet: Minimum 150 mm diameter.
      c. Odourous Air: 75 mm diameter, flanged.
      d. Drain: 50 mm diameter NPT.
      e. Flanges shall be ASME B16.5 Class 150, flat faced.
   4. Mixer:
      a. Electric motor driven, top-entering type with stainless steel shaft and impeller, and variable frequency drive.
      b. Drive:
         1) AC gear motor, rated for severe duty, sized by RDT manufacturer according to specific unit requirements.
         2) Inverter duty rated, suitable for 575V, 3-phase, 60 Hz power supply.

D. Rotary Drum Thickener:
   1. Rotary Drum:
      a. Single- or multi-stage drum fabricated from Type 316L stainless steel.
      b. Filtration Media: Type 316L stainless steel perforated sheet, wedge wire, or woven wire mesh, or polyester filter cloth.
      c. Designed to induce rolling of sludge and minimize slippage. Internal baffles, if utilized, shall direct flow from inlet to point of discharge.
      d. Multi-stage designs shall function in distinct progression of dewatering process. Porosity or percent openness of each stage shall be selected to maximize filtrate flow and solids capture. Each stage shall be equipped with roll bars, split augers, ports, closures, and/or deflectors to influence shear, water release, and drainage rate

independent of flow. Delivery of output solids shall be by gravity resulting from series of detention rings separating each stage, progressively lower in direction of delivery and influenced by split augers.

e. Drums constructed of wedge wire shall consist of V-shaped wire continuously welded together with teardrop wire support structure. V-shaped wire shall form inside of cylinder and shall have smooth surface running full horizontal length of drum.

f. Drums constructed from woven wire mesh or filter cloth shall be easily changed with simple tools. Woven meshes shall be fastened as outer covering of each stage and shall be flanged to outer surface of perforated metal housing surrounding each stage.

g. Drive:

1) AC gear motor, rated for severe duty, sized by RDT manufacturer according to specific unit requirements.

2) Inverter duty rated, suitable for 575V, 3-phase, 60 Hz power supply.

3) Drum Rotational Speed: 10 rpm maximum.

2. Washing System:

a. Single or double self-cleaning washing header oriented in horizontal position and spanning full length of drum to maintain positive cleaning with each revolution of drum, forcing washed-off solids to return to mass of solids tumbling inside drum.

b. Provide wash water supply piping to each RDT equipped with type V306 manually operated ball valve, type V308 ball valve with electric motor actuator, and type V711 pressure reducing valve, in accordance with Section 40 27 02, Process Valves and Operators.

c. Wash water (strained plant effluent) will be supplied to each RDT at pressure of approximately 700-800 kPag.

d. Nozzles of washing header shall be capable of passing plant flushing water containing suspended solids of up to 150 microns in size without plugging or fouling.

e. Nozzles shall be easily accessible from RDT service platform and removable for cleaning.

3. Housing, Covers, and Support Frame:

a. Fabricated from Type 316L stainless steel.

b. Provide covers completely enclosing rotating drum and mounted to frame. Covers shall be sealed to contain all water and mist. Covers shall be completely removable to permit removal of drum assembly.

c. Provide covers with hinged panels to provide access to drum for routine checks and maintenance.

4. Return Water Collection:

a. All elements of rotary system shall be contained and mounted above return water collection tank fabricated from Type 316L stainless steel.

b. Discharge of collected return water shall be by gravity through one 200 mm diameter tank drain at low point of tank.

5. Solids Discharge Chute:

a. Fabricated from Type 316L stainless steel to direct thickened solids from outlet of RDT to thickened sludge hopper as shown on Drawings.

b. Provide hinged panels for access to interior of chute.

6. Sample Ports:

a. Provide sample ports for manual collection of feed sludge, thickened sludge, and filtrate samples.
b. Provide each sample port with stainless steel ball valve.

E. Thickened Sludge Hopper:
1. Designed to receive and hold thickened sludge discharged from RDT for subsequent withdrawal by pump, as shown on Drawings.
2. Fabricated from Type 316L stainless steel with sloped bottom, cover with hinged inspection hatch, and support legs with baseplates suitable for anchoring to concrete equipment pads.
3. Connections for External Piping:
a. Sludge Outlet: 100 mm diameter, flanged.
b. Drain: 150 mm diameter, flanged.
c. Overflow: 150 mm diameter, flanged.
d. Flanges to be ASME B16.5 Class 150, flat faced.
4. Working Volume (between high and low level switches): 1.4 m^3 minimum.

2.8 ELECTRICAL COMPONENTS AND ACCESSORIES

A. General: Provide all necessary electrical components and wiring for a complete, functional system. Electrical components shall be provided in accordance with requirements of Division 26, Electrical. All electrical components shall be suitable for hazardous area classification, as shown on Drawings, within which component will be located.

B. Wiring: All wiring shall meet requirements of Section 26 05 21, Wires and Cables (0-1000V) - Electrical, and CEC. All insulation shall be rated 600V, minimum. Twisted shielded pair cable shall be used for all low-voltage (24V dc) signals.

C. Electrical Raceways: All electrical wiring shall be installed in conduit meeting requirements of Section 26 05 34, Conduits, Conduit Fasteners, and Conduit Fittings. All raceways shall be installed in accordance with Section 26 05 34, Conduits, Conduit Fasteners, and Conduit Fittings, and CEC.

D. Motors: Provide squirrel-cage AC induction motors meeting requirements of Section 26 20 00, Low-Voltage AC Induction Motors, and as specified herein.

E. Electrical Responsibilities: Manufacturer/supplier shall be responsible for all electrical conduits, wiring, and electrical appurtenances located on equipment, including terminal junction boxes for power and control circuits.

F. Variable Frequency Drives: In accordance with Section 40 99 90, Package Control Systems and Section 26 29 23, Variable Frequency Drives, supplied by equipment manufacturer and factory installed, connected, configured, and tested inside package control panels.

2.9 INSTRUMENTATION AND CONTROLS

A. General:
1. All controls and control panels shall be in accordance with requirements of Section 40 99 90, Package Control Systems.

2. Provide complete and functional system, including interfaces with plant PCS.
3. Provide variable frequency drives and full-voltage starters in package control panels for package system components. Each motor starter shall be equipped with electronic overloads in all three phases. Overloads shall be resettable without opening panel.
4. Segregate analog wiring in dedicated raceways.
5. Control components shall operate on 24VDC or 120V ac power.
6. Provide instruments in accordance with Section 40 99 90, Package Control Systems, and Section 40 91 01, Instrumentation and Control Components, unless specified otherwise. Provide industrial grade instruments suitable for intended service and environment.
7. Instrumentation and controls specified herein are minimum requirements. Equipment manufacturer shall provide additional components and features necessary to achieve intended function and provide safe and reliable operation of equipment supplied.
8. Provide a separate local control panel (LCP) for each RDT. Provide one common system control panel (CP) for monitoring and controlling the two WAS RDTs, and one common system CP for monitoring and controlling the three FSL RDTs. Each system control panel shall perform all required coordination with local control panels and plant PCS.

B. Control Panels:

Panel No.	**Name**	**NEMA 250 Rating**	**Enclosure Material**	**Mounting**
LCP-D403	WAS Rotary Drum Thickener RDT-D403 Local Control Panel	4X	Type 316 stainless steel	Stanchion
LCP-D404	WAS Rotary Drum Thickener RDT-D404 Local Control Panel	4X	Type 316 stainless steel	Stanchion
LCP-D415	FSL Rotary Drum Thickener RDT-D415 Local Control Panel	4X	Type 316 stainless steel	Stanchion
LCP-D416	FSL Rotary Drum Thickener RDT-D416 Local Control Panel	4X	Type 316 stainless steel	Stanchion
LCP-D417	FSL Rotary Drum Thickener RDT-D417 Local Control Panel	4X	Type 316 stainless steel	Stanchion
CP-D400	WAS RDTs System Control Panel	4X	Type 316 stainless steel	Floor
CP-D410	FSL RDTs System Control Panel	4X	Type 316 stainless steel	Floor

1. Local Control Panels (LCP) Requirements:

a. Main disconnect switch for 600V power supply, with lockable handle and interlocked with panel door.
b. Control power transformer.
c. Variable frequency drives for flocculation tank mixer and rotary drum thickener motors.
d. Overload and over-current protection for motor drives.
e. Power Supply to Panel: Single 600V, 3-phase, 60 Hz supply to each panel. Power supply to all associated motors shall be obtained from associated panel.
f. Panel shall be sized to properly dissipate heat from variable frequency drives. Provide cooling fans or fins as required. Power for cooling fans shall be obtained from same 600V feed to panel. Provide transformer as required. To maintain integrity of panel enclosure, louver penetrations will not be permitted.
g. Operator Controls and Indicators (including but not limited to):
    1) Flocculation Tank Mixer HAND/OFF/REMOTE selector switch.
    2) Flocculation Tank Mixer SPEED control and indication, available from VFD display/keypad.
    3) Flocculation Tank Mixer EMERGENCY STOP pushbutton.
    4) Flocculation Tank Mixer RUNNING indicating light.
    5) Flocculation Tank Mixer FAIL indicating light.
    6) Rotary Drum Thickener HAND/OFF/REMOTE selector switch.
    7) Rotary Drum Thickener SPEED control and indication, available from VFD display/keypad.
    8) Rotary Drum Thickener EMERGENCY STOP pushbutton.
    9) Rotary Drum Thickener RUNNING indicating light.
    10) Rotary Drum Thickener FAIL indicating light.
h. External Interfaces: Provide all required inputs and outputs for interfacing with associated CP.
i. Functional Requirements:
    1) When each HAND/OFF/REMOTE selector switch is in HAND position, associated drive shall run continuously and speed shall be manually controlled using VFD keypad (HAND mode is intended for maintenance and testing purposes only). In REMOTE position, drive shall be controlled by associated CP.
    2) When EMERGENCY STOP pushbutton is pressed, associated drive shall stop, in both HAND and REMOTE positions. Operation of drive shall be disabled until system RESET pushbutton at associated CP is pressed.

2. System Control Panels (CP) Requirements:
    a. Provide a separate Programmable Logic Controller (PLC) for each RDT, with an Ethernet port for Modbus TCP communication.
    b. Power Supply to Panel: Dual 120V, single-phase, 60 Hz supplies to each panel, one UPS supply and one non-essential supply. Provide redundant 24 VDC power supplies for control system equipment with alarms to the control system for power supply failure. Power supply to all instruments shall be obtained from the associated control panel.
    c. Operator Controls and Indicators:
        1) Touchscreen operator interface terminal (OIT).
        2) System RESET pushbutton.
    d. External Interfaces:

1) Provide all required inputs and outputs for interfacing with associated LCPs and instruments.
2) Plant Process Control System (PCS) Interface:
   a) Provide clearly labeled terminals for interfacing with Plant PCS, for each RDT, including but not limited to:
      (1) Dry contact with less than 2 mA minimum switching current at 24 VDC for Plant PCS discrete input signals:
         (a) RDT Running.
         (b) RDT Fault.
         (c) RDT in Remote Mode
         (d) RDT Ready to Receive.
         (e) Sludge Hopper Low Level
      (2) 24 VDC relay coil for Plant PCS discrete output signals:
         (a) RDT Run Command.
      (3) Isolated analog output signals to Plant PCS:
         (a) Sludge Hopper Level.
      (4) Analog input signals from Plant PCS:
         (a) Feed Sludge Flow Rate.
   b) Provide a Modbus TCP interface for each PLC for monitoring of all statuses and alarms, including but not limited to:
      (1) Flocculation Mixer Speed.
      (2) RDT Drum Speed.
      (3) Flocculation Tank Level High Alarm.
      (4) Sludge Hopper Level High Alarm.
      (5) Sludge Hopper Level Low Alarm.

e. Control System Requirements:
   1) PLCs to be Schneider M580 PLCs, no exceptions.
   2) OIT to be Schneider XBT or GTO with size of 12 inches or greater, no exceptions. OIT graphics to be consistent with City document 612620-0015-40ER-0001 “HMI Layout and Animation Plan”.
   3) Panel-mounted OIT will be fully replicated in Plant HMI. Coordinate with Systems Integrator to provide full replication of OIT on Plant HMI. Provide means for operators to select either local OIT or Plant HMI as the active system.
   4) PLC and OIT programs shall have full read/write functionality when turned over to the City.

f. Functional Requirements:
   1) Control system shall allow both manual and automatic control of equipment from CP. In AUTO mode, each RDT system shall be automatically controlled by CP as follows:
      a) Plant PCS will determine number of RDT systems required in operation at any given time depending on rate of sludge production.
      b) When an RDT system is required to operate, plant PCS will issue “Run Command” to CP. RDT system shall not operate unless “Run Command” is received from plant PCS.
      c) CP shall start RDT and flocculation mixer and prepare RDT system to receive feed sludge. Provide “Ready to Receive” indication to plant PCS when RDT system is ready to receive feed sludge.

d) Plant PCS will start feed sludge and polymer solution pumps. Feed sludge flow rate will vary depending on rate of sludge production. Polymer solution flow rate will vary in proportion to sludge feed flow rate. Plant PCS will also start thickened sludge pump. Thickened sludge flow rate will vary depending on level in thickened sludge hopper.
e) CP shall automatically adjust speed of RDT and flocculation mixer and operate wash water valve to clean screen, as required, to optimize thickening of sludge and maintain thickened sludge concentration within 4 to 6 percent solids.
f) When plant PCS removes “Run Command” from CP, CP shall initiate RDT cleaning cycle. Upon completion of cleaning cycle, CP shall stop RDT and flocculation mixer.

2) Upon overload of RDT or flocculation mixer motor, RDT system shall stop and alarm shall be activated at CP, in both manual and automatic operating modes.
3) In event of system FAULT (any abnormal condition that stops operation of RDT system), operation of RDT system shall be disabled until cause of fault is corrected and system RESET pushbutton at CP is pressed.
4) In event of power supply failure while RDT system is operating, RDT system shall automatically resume operation upon restoration of power supply. In event of power supply failure during system FAULT, RDT system shall remain in fault condition upon restoration of power supply.

C. Instrumentation:
1. Flocculation Tank Level Switches:
a. Provide level switch for each flocculation tank to detect HIGH sludge level in tank.
b. Suitable for Class I, Zone 2, Group IIA hazardous area.
2. Thickened Sludge Hopper Level Switches:
a. Provide level switches for each thickened sludge hopper to detect LOW and HIGH sludge levels in hopper.
b. Suitable for Class I, Zone 2, Group IIA hazardous area.
c. Set LOW level switch to actuate 200 mm above bottom of hopper.
d. Set HIGH level switch to actuate just below invert of hopper overflow connection.
3. Thickened Sludge Hopper Level Sensors:
a. Provide level sensor for each thickened sludge hopper to monitor sludge level in hopper.
b. Suitable for Class I, Zone 2, Group D hazardous area.
c. Provide 4-20 mA analog output wired to package system PLC.

2.10 ACCESSORIES

A. Lifting Lugs: Provide suitably attached for all equipment assemblies and components weighing over 45 kg.

B. Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer, and as specified in Section 05 50 00, Metal Fabrications (Basic).

C. Equipment Identification Plates: In accordance with Section 40 05 53, Identification Labels for Equipment, Fabricated Tanks, Valves and Piping Systems.

2.11 FACTORY FINISHING

A. Prepare, prime, and finish coat in accordance with Section 09 90 00, Painting and Coating.

2.12 SOURCE QUALITY CONTROL

A. Factory Inspections: Inspect all equipment supplied for required construction, electrical connection, and intended function.

B. Factory Tests and Adjustments:
   1. Test all equipment actually furnished.
   2. Functional Tests: Perform manufacturer's standard production tests.
   3. Motor Tests: In accordance with Section 26 20 00, Low-Voltage AC Induction Motors.

PART 3 EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. In accordance with Section 01 61 00, Common Product Requirements.

3.2 INSTALLATION

A. Install in accordance with the manufacturer's printed instructions.

B. Base shall be installed level.

C. All assemblies shall be adjusted such that the driving units are properly aligned, plumb, and level with the driven units and all interconnections.

D. Piping shall be connected without imposing strain.

E. Anchor Bolts: Accurately place using equipment templates and as specified in Section 05 50 00, Metal Fabrications (Basic).

3.3 FIELD QUALITY CONTROL

A. General:
   1. In accordance with Section 01 91 14, Equipment Testing and Facility Startup.
   2. Manufacturer's Functional Test procedures shall be submitted to Contract Administrator for review minimum 30 days prior to start of testing.
   3. Functional and Performance Testing shall be conducted by qualified representative of Manufacturer with assistance from Contractor.

B. Functional Tests:
   1. Conduct on each RDT system.
   2. Prior to system startup, inspect components for proper alignment, connection, and satisfactory operation.

3. Manufacturer's Representative shall inspect installation, check lubrication and minor adjustments, and provide certification that all system components have been installed correctly and are ready for operation.

C. Performance Test:
1. Conduct on each RDT system.
2. Performance testing shall demonstrate that each RDT system can consistently meet specified performance requirements.
3. All auxiliary systems required for RDT performance testing shall be functionally tested and ready prior to performance testing, including but not limited to:
   a. Feed sludge pumping system.
   b. Polymer solution preparation and pumping system.
   c. Wash water supply system.
   d. Thickened sludge pumping system.
   e. Odour control system.
4. Contractor shall coordinate with City if assistance is required from City's operations personnel during performance testing. Performance testing shall be witnessed by Contract Administrator.
5. City will provide feed sludge, wash water, electrical power, and sludge disposal necessary to conduct performance tests. Contractor is responsible for providing polymer solution for performance tests.
6. Initial System Optimization: Perform preliminary testing to optimize system operation, including but not limited to, drum angle, drum speed, wash water frequency and duration, mixing valve position, flocculation mixer speed, and jar testing for polymer selection and dose.
7. Conduct performance testing as follows:
   a. Perform one test at maximum hydraulic capacity for eight hours continuous duration, and one test at 50 percent capacity for eight hours continuous duration.
   b. Manufacturer shall not make any adjustments during each test run unless authorized by Contract Administrator. If unauthorized adjustments are made, test shall be re-started.
   c. Obtain following samples and measurements at approximately one-hour intervals:
      1) Feed sludge flow rate.
      2) Feed sludge total solids concentration (prior to polymer addition).
      3) Polymer solution flow rate.
      4) Polymer solution active concentration.
      5) Thickened sludge total solids concentration.
      6) Filtrate total solids concentration.
      7) Wash water flow rate, frequency, and duration.
   d. Perform following calculations based on samples and measurements obtained during test:
      1) Percent solids capture.
      2) Polymer consumption (kg active polymer per tonne dry solids).
   e. All testing and sampling shall conform to procedures established in latest edition of AWWA Standard Methods for the Examination of Water and Wastewater.
   f. Sample analysis shall be performed by independent testing laboratory acceptable to the Contract Administrator and cost shall be paid by manufacturer.

g. Mean value of all samples will be used to determine conformance with performance requirements.
h. Should equipment not meet specified performance requirements during performance test, manufacturer shall take such remedial measures as are necessary to correct any deficiencies revealed by performance test, and shall repeat specified performance test until it is demonstrated that such deficiencies have been corrected to satisfaction of Contract Administrator and equipment meets specified performance requirements.
i. All repeated performance tests shall be at no additional cost to City.

8. Submit written report within ten days following completion of performance test, presenting results of successful testing. Report shall include but not be limited to:
   a. All operating parameters and characteristics, such as drum angle, drum speed, flushing water frequency and duration, mixing valve position and polymer dose, etc.
   b. Description of polymer (manufacturer, identification, characteristics, etc.).
   c. Summary of data and results demonstrating that performance test consistently achieved specified performance requirements.
   d. Other operating characteristics, such as hydraulic throughput, solids throughput, etc.
   e. Solids balance during the performance test.
   f. Attach copies of all sample reports from testing laboratory.
9. Variation in Sludge Characteristics:
   a. If sludge characteristics are not within ranges specified herein, Manufacturer shall make compensating calculations for effects, if any, of changed conditions. Support data shall be provided by Manufacturer. These calculations and data will be considered by Contract Administrator in determining conformance with specified design conditions. Contract Administrator shall be sole judge of conformance with performance testing requirements.
   b. If retesting to document compliance is required due solely to sludge characteristics outside of specified range, City may consider waiving retest and may compensate Manufacturer for reasonable costs to witness retesting at City's option.

3.4 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at site or classroom designated by City for minimum person-days listed below, travel time excluded:
   1. Four person-days for installation assistance and inspection.
   2. Two person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
   3. Four person-days for pre-startup classroom and field training.
   4. Four person-days for facility startup.
   5. Two person-days for post-startup training. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by City.

B. See Section 01 43 33, Contractor Field Services and Section 01 91 14, Equipment Testing and Facility Startup.

3.5 SUPPLEMENTS

A. The supplements listed below, following “End of Section,” are part of this Specification:
   1. Motor Data Sheets.

END OF SECTION

MOTOR DATA SHEET NO. 1
ROTARY DRUM THICKENERS RDT-D403/D404/D415/D416/D417

Project: City of Winnipeg SEWPCC Upgrading/Expansion Project

Process/Facility: Sludge Thickening

Service: Waste Activated Sludge and Fermented Sludge

Equipment Name: Rotary Drum Thickeners

Equipment Tag Number(s): RDT-D403, RDT-D404, RDT-D415, RDT-D416, RDT-D417

Type: Squirrel-cage induction meeting requirements of NEMA MG 1.

Manufacturer: For multiple units of same type of equipment, furnish motors and accessories from single manufacturer.

Hazardous Location: ☒ Furnish motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark.

Motor Size (kW): TBD by mfr.	Guaranteed Minimum Efficiency at Full Load (%): Per CAN/CSA C390, Table 3
Voltage: 575	Guaranteed Minimum Power Factor at Full Load (%): Mfr.'s std.
Phase: 3	Service Factor (at rated max. ambient temperature): ☐ 1.0 ☒ 1.15
Frequency (Hz): 60	Enclosure Type: TEFC
Synchronous Speed (rpm): TBD by mfr.	Mounting Type: ☒ Horizontal ☐ Vertical
☐ Constant Speed	Vertical Shaft: ☐ Solid ☐ Hollow
☐ Two-speed Speed (rpm): Slow _____ Fast _____	Vertical Thrust Capacity (N): Up _____ Down _____
☒ Multi-speed Speed (rpm): Min. _____ Max. _____	☒ Adjustable Speed Application (inverter duty rated) In accordance with Section 26 29 23, Variable Frequency Drives. Operating Speed Range: 50 to 100 % of rated speed
Variable Speed Load Classification: ☐ Variable Torque ☐ Constant Torque ☐ Constant Power	☒ Thermal Protection: Thermistors ☐ Space Heater: _____ volts, single phase ☒ Oversize main terminal (conduit) box for motors ☒ Terminal for connection of equipment grounding wire in each terminal box
Winding: ☒ One ☐ Two	

ADDITIONAL REQUIREMENTS

☒ In accordance with Section 26 20 00, Low-Voltage AC Induction Motors.

MOTOR DATA SHEET NO. 2
FLOCCULATION TANK MIXERS MXR-D403/D404/D415/D416/D417

Project: City of Winnipeg SEWPCC Upgrading/Expansion Project

Process/Facility: Sludge Thickening

Service: Waste Activated Sludge and Fermented Sludge

Equipment Name: Flocculation Tank Mixers

Equipment Tag Number(s): MXR-D403, MXR-D404, MXR-D415, MXR-D416, MXR-D417

Type: Squirrel-cage induction meeting requirements of NEMA MG 1.

Manufacturer: For multiple units of same type of equipment, furnish motors and accessories from single manufacturer.

Hazardous Location: ☒ Furnish motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark.

Motor Size (kW): TBD by mfr.	Guaranteed Minimum Efficiency at Full Load (%): Per CAN/CSA C390, Table 3
Voltage: 575	Guaranteed Minimum Power Factor at Full Load (%): Mfr.'s std.
Phase: 3	Service Factor (at rated max. ambient temperature): ☐ 1.0 ☒ 1.15
Frequency (Hz): 60	Enclosure Type: TEFC
Synchronous Speed (rpm): TBD by mfr.	Mounting Type: ☐ Horizontal ☒ Vertical
☐ Constant Speed	Vertical Shaft: ☒ Solid ☐ Hollow
☐ Two-speed Speed (rpm): Slow _____ Fast _____	Vertical Thrust Capacity (N): Up _____ Down _____
☒ Multi-speed Speed (rpm): Min. _____ Max. _____	☒ Adjustable Speed Application (inverter duty rated) In accordance with Section 26 29 23, Variable Frequency Drives. Operating Speed Range: 50 to 100 % of rated speed
Variable Speed Load Classification: ☐ Variable Torque ☐ Constant Torque ☐ Constant Power	☒ Thermal Protection: Thermistors ☐ Space Heater: _____ volts, single phase ☒ Oversize main terminal (conduit) box for motors ☒ Terminal for connection of equipment grounding wire in each terminal box
Winding: ☒ One ☐ Two	

ADDITIONAL REQUIREMENTS

☒ In accordance with Section 26 20 00, Low-Voltage AC Induction Motors.