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DIVISION 01

Reviewed and Approved

Date

SCOPE OF WORK

1. GENERAL

.1 The scope of the Contract includes the design, supply, delivery, installation assistance and commissioning of all equipment and appurtenances required for the Vertical Axial Flow Propeller Ultraviolet (UV) Influent Pumps, Variable Frequency Drives (VFDs) and associated fabrications, piping and fittings.

.2 Scope of Supply consists of the following major items:

.1 Provide equipment information to the Contract Administrator during design to facilitate progress of the Installation Contract;

.2 Fabricate and factory test the equipment. This includes, but not limited to the following:

.1 Six (6) Axial flow pumps, five (5) installed with one (1) on the shelf spare complete with lifting chains, power and control cables.

.2 Five fabricated draft tube, pump, pipe, and coupling assemblies generally as shown on Drawing No. 66303D CP 1.05C3.

.3 Five (5) VFDs, Contractor is responsible for the selection of suitable VFDs to ensure the pumps performance.

.3 Supply and deliver equipment to Site;

.4 Off-load and inspect delivered equipment;

.5 Provide installation training;

.6 Supervise the installation of the equipment;

.7 Supervise equipment performance testing and commissioning;

.8 Supervise operations and maintenance training in conformance with International Organization for Standardization (ISO) 14001;

.9 Provide operating and maintenance manuals in conformance with ISO 14001;

.10 Provide As-Built Drawings;

.11 Provide technical support and remedy defects during the Warranty Period as detailed in GC 10.

.3 The supplied equipment shall include all accessories required to ensure the supplied equipment safely and satisfactorily operates as an integral system as required by the Contract Documents.

.4 Provide any appurtenances or services not specifically mentioned or included in the Contract Documents but which are necessary as part of the Work to ensure that the equipment is fully operational when installed.

.5 The Contractor shall note that this Contract is intended to be a supply-only Contract. All installation Work is to be undertaken by the Installation Contractor, unless specified otherwise in the Contract Documents.

2. COORDINATION

.1 The Contractor is advised that other contractors (e.g. the Installation Contractor) or the City's own forces may be working on the Site during the execution of this Contract. It will be the Contractor's responsibility to cooperate to the fullest extent with other personnel working in the area and such cooperation is an obligation of the Contractor under the terms of this Contract.

.2 The Contractor shall cooperate and liaise with the Installation Contractor in order to make appropriate working arrangements to ensure satisfactory execution and timely completion of the Work.

.3 The Contractor shall attend coordination meetings, as directed by the Contract Administrator, when the Contract Administrator considers that they are necessary for ensuring the sufficiency of the liaison and cooperation with the Installation Contractor and other contractors. The Contractor shall be deemed to have allowed in his Total Bid Price for any interference to his operations which may result for any of the above. He must also take all precautions necessary to ensure that he does not hinder or delay in any way the progress of these other parties or cause damage to their completed Work.

3. SCHEDULE AND STATUS REPORTS

.1 The critical milestones to be met are:

(a) Award of Equipment Supply Contract to successful Contractor ..... May 25,2005

(b) Submission of Shop Drawings ..... July 6, 2005

(c) Start of Construction ..... July 20,2005

(d) Delivery of Draft Tube, Interconnecting Pipe, and Couplings. ..... September 30, 2005

(e) Delivery of Pumps and Variable Frequency Drives (VFDs) ..... November 30, 2005

(f) Start of equipment performance tests ..... April 21, 2006

(g) Substantial Performance ..... Refer to D12.1

(h) Total Performance ..... Refer to D13.1

.2 The Contractor shall prepare and submit to the Contract Administrator, a signed typed report at the end of each month stating the status and rate of progress of design, fabrication, shipping and delivery of the equipment and their effect, if any, on the delivery schedule.

4. INDEPENDENT INSPECTION/TESTING AGENCIES

.1 Independent Inspection/Testing Agencies will be retained by the City for the purpose of inspecting and/or testing portions of the Work. All costs of such services will be borne by the City unless otherwise noted.

.2 Employment of Inspection/Testing Agencies in no way relieves the Contractor of responsibility to perform the Work in accordance with the Contract Documents.

.3 Allow the Inspection/Testing Agencies access to all portions of the Work on-site and in manufacturing or fabrication plants, as may be necessary. Provide facilities for such access.

END OF SECTION

SUBMITTALS

1. SHOP DRAWINGS

.1 Refer to GC 4.04 - General Conditions and Supplemental Conditions D21.

2. OPERATING AND MAINTENANCE MANUALS

.1 Not less than eight (8) weeks prior to the time of Equipment Performance Testing, submit to the Contract Administrator for review three (3) draft copies of Operating and Maintenance (O&M) manuals containing information required by the Specifications. All instructions in these manuals shall be in simple language to guide the City in the proper operation and maintenance of the installation.

.2 Submit O & M manuals in electronic format. Organize contents into applicable Sections of Work, parallel to Specifications breakdown.

.3 Furnish complete operations manuals and maintenance information as specified in this Section for installation check-out, operation, maintenance, and lubrication requirements for each unit of mechanical, electrical, and instrumentation equipment or system and each instrument.

.4 Customize the O&M manuals to describe the equipment actually furnished. Do not include extraneous data for models, options, or sizes not furnished. When more than one (1) model or size of equipment type is furnished, show the information pertaining to each model, option or size.

.5 In addition to information called for in the Specifications, include the following:

.1 Title sheet, labelled "Operating and Maintenance Instructions", and containing project name and date.

.2 List of contents.

.3 Record Drawings of all mechanical and electrical installations.

.4 Full description of entire mechanical and electrical system and operation.

.5 Address and telephone number of the Contractor and the nearest Contractor's Representative, including distributors for parts, servicing, and repairs.

.6 Detailed Specification and O&M instructions for all items of equipment provided including a preventative maintenance program.

.7 Signed copies of certificates included at the end of Division 16.

.8 Process control/operating instructions for each component and the entire system as a whole. This shall include, but not necessarily be limited to:

.1 The Contractor's recommended step-by-step procedures for starting and stopping under normal and emergency operation. Include all specified modes of operation

including recommended operation after the assembly or equipment has been in long-term storage.

.2 Control diagrams with data and information to explain operation and control of systems and specific equipment.

.3 Technical information on all alarms and monitoring devices provided with the equipment.

.4 Routine maintenance requirements including procedures and specific description of consumable items such as lubricants, filter, seals, etc. and listing Canadian sources of supply.

.5 Complete disassembly, inspection, repair and re-assembly instructions including required tolerances, fastener pre-loads, specialty tools and any other information necessary to restore equipment to correct operation.

.9 List of spare and replacement parts and consumables.

.10 List of special tools.

.11 Nameplate information including equipment number, make, size, capacity, model number, serial number and equipment tag number.

.6 The Contractor shall modify and supplement the manual as required by the Contract Administrator. When accepted, a total of five (5) electronic copies shall be provided by the Contractor for distribution purposes at least four (4) weeks before the start of Equipment Performance Testing. Three (3) electronic copies will be required by the City.

.7 Submit separately originals of all warranties and guarantees. Arrange to conform to same sequence as project Specifications. Provide two (2) additional copies of warranties and guarantees.

.8 The City conforms to the requirements of the International Organization for Standardization (ISO) 14001 environmental management system. The Contractor shall be mindful of this fact when preparing O&M manuals.

END OF SECTION

MATERIAL AND EQUIPMENT

1. PRODUCTS

1.1 Quality of Materials

.1 Provide new materials, equipment, and articles incorporated in the Work, not damaged or defective and of the best quality (compatible with Specifications) for the purpose intended. If requested furnish evidence as to type, source, and quality of Products provided.

.2 Defective materials, equipment and articles whenever found may be rejected regardless of previous inspection. Inspection by the Contract Administrator or an inspector does not relieve the Contractor of his responsibility but is merely a precaution against oversight or error. Remove and replace defective materials at own expense and be responsible for all delays and expenses caused by rejection.

.3 Should any dispute arise as to the quality or fitness of materials, equipment or articles, the decision rests strictly with the Contract Administrator based upon the requirements of the Contract Documents.

.4 Unless otherwise indicated in the Specifications, maintain uniformity of Manufacturer for any particular or like item throughout the Work.

.5 Permanent labels, trademarks, and nameplates on materials, equipment, and articles are not acceptable in prominent locations except where required for operating instructions and when located in mechanical or electrical rooms.

1.2 Availability of Materials

.1 Immediately upon signing the Contract, review Product requirements and anticipate foreseeable delivery delays in any items. If delays in deliveries of materials, equipment or articles are foreseeable, propose substitutions or other remedial action in ample time to prevent delay in performance of the Work.

.2 If such proposal is not given to the Contract Administrator, the Contract Administrator reserves the right to substitute more readily available Products later in order to prevent delays at no additional cost to the City.

.3 No substitution of any item will be permitted unless the item cannot be delivered to the job Site in time to comply with the Schedule.

.4 To receive approval, proposed substitutes must equal or exceed the quality, finish and performance of those specified and/or shown, and must not exceed the space requirements allotted on the Drawings.

.5 Provide documentary proof of equality, difference in price (if any) and delivery dates in the form of certified quotations from suppliers of both specified items and proposed substitutions.

1.3 Storage, Handling and Protection of Materials

.1 Handle and store materials in a manner to prevent damage, contamination, deterioration, and soiling and in accordance with Manufacturer's recommendations when applicable.

.2 Store packaged or bundled Products in original and undamaged condition with Manufacturers' seals and labels intact. Do not remove packaging or bundling until required in the Work.

.3 Materials subject to damage from weather are to be stored in weatherproof enclosures.

.4 Store cementitious materials clear of earth or concrete floors and away from walls.

.5 When used for grout or mortar materials, keep sand clean and dry. Store on polyethylene and cover with waterproof tarpaulins during inclement weather.

.6 Store sheet material, lumber, etc. on flat, solid supports and keep clear of ground.

.7 Store and mix paints in a room assigned for this purpose. Keep room under lock and key at all times. Remove oily rags and any other combustible debris from Site daily. Take every precaution necessary to prevent spontaneous combustion.

.8 Remove and replace damaged Products at own expense.

1.4 Manufacturers' Directions

.1 Unless otherwise specified, install or erect all Products in accordance with Manufacturers' recommendations. Do not rely on labels or enclosures provided with Products. Obtain instructions directly from Manufacturers.

.2 Notify the Contract Administrator, in writing, of any conflicts between the Specifications and Manufacturers' instructions so that the Contract Administrator may establish the course of action.

.3 Improper installation or erection of Products due to failure in complying with these requirements authorizes the Contract Administrator to require any removal and re-installation that may be considered necessary, at no increase in Contract Price.

1.5 Transportation Costs of Materials

.1 Pay all costs for transportation of materials required for the Work.

2. WORKMANSHIP

2.1 General Requirements

.1 Workmanship is to be of the best quality executed by workers fully experienced and skilled in their respective trades.

.2 At all times enforce discipline and good order among workers. Do not employ any unfit person or anyone unskilled in the duties assigned to him. The Contract Administrator reserves the right to require the removal from Site of workers deemed incompetent, careless, insubordinate or otherwise objectionable.

.3 Decisions as to the quality or fitness of workmanship in cases of any dispute rests solely with the Contract Administrator whose decision is final.

2.2 Coordination

.1 Coordinate the Work of all Subcontractors.

.2 Ensure that all Subcontractors examine the Drawings and Specifications for other parts of the Work which may affect the performance of their Work.

.3 Ensure that sleeves, openings, and miscellaneous equipment bases are provided as required for the Work.

.4 Ensure that items to be built in are supplied when required with all necessary templates, measurements, and Shop Drawings.

2.3 Concealment

.1 In finished areas conceal all pipes, ducts and wiring except where indicated otherwise on Drawings or in Specifications.

.2 Before installation inform the Contract Administrator of any conflicts. Install as directed.

2.4 Location of Fixtures

.1 Consider the location of fixtures, outlets, and other mechanical, and electrical items indicated on Drawings as approximate. The actual location of these items is to be as required or directed to Site conditions at the time of installation and as is reasonable.

.2 Before installation inform the Contract Administrator of any conflicts. Install as directed.

2.5 Cutting and Remedial Work

.1 Perform all cutting and remedial Work that may be required to make the several parts of the Work come together properly. Coordinate and schedule the Work to ensure that cutting and remedial Work are kept to a minimum.

.2 Employ specialists familiar with the materials affected in performing cutting and remedial Work. Perform in a manner to neither damage nor endanger any portion of the Work.

.3 Do not cut, drill or sleeve any load-bearing members without written approval of the Contract Administrator.

.4 The Contractor is to perform Work so that no dust is generated.

2.6 Fastenings

.1 Provide metal fastenings and accessories in same texture, colour, and finish as adjacent material unless otherwise specified.

.2 Prevent electrolytic action between dissimilar metals and materials.

.3 Use non-corrosive, non-staining fasteners and anchors for securing exterior Work unless otherwise specified.

.4 Space anchors within their load limit or shear capacity and ensure that they provide positive permanent anchorage. Wood plugs are not acceptable.

.5 Keep exposed fastenings to a minimum, space evenly and lay out neatly.

.6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

2.7 Protection of Work In Progress

.1 Adequately protect all Work completed and in progress. Repair or replace all damaged Work.

.2 Prevent overloading of any part of the Work.

2.8 Cleaning

.1 Remove waste materials and debris from the Site at regular intervals. Do not burn waste materials and debris on-site.

3. MEASUREMENT

3.1 Metric Project

.1 Unless otherwise noted, this Project has been designed in accordance with, and is to be constructed in, the S.I. metric system of measurements.

.2 During construction, when specified metric elements are unattainable at the time they are required to meet the Construction Schedule, the Contractor shall notify the Contract Administrator in writing and suggest alternative substitutions. Costs due to these substitutions shall be borne by the Contractor.

END OF SECTION

EQUIPMENT INSTALLATION

1. INTENT

.1 This Section describes general requirements for all equipment supplied under the Contract relating to factory inspections, equipment delivery, equipment installation training, equipment installation, equipment performance testing, and process performance testing.

2. DEFINITIONS

.1 Contractor's Representative: A Contractor's Representative is a trained serviceman empowered by the Contractor to provide:

.1 Witnessing of delivery

.2 Installation training

.3 Witnessing of equipment installation

.4 Assistance in equipment commissioning

.5 Confirmation of satisfactory equipment operation

.6 Participation in the performance testing

3. EXPERTISE AND RESPONSIBILITY

.1 The Contract Administrator recognizes the expertise of the Contractor.

.2 Should the Contract Administrator issue an Addendum, Notice of Proposed Change, Field Order or Change Order to change the Work which would, in the opinion of the Contractor, compromise the success or safety of the Work, then it shall be incumbent on the Contractor to notify in writing the Contract Administrator to this effect within two (2) days upon receipt.

4. INSPECTION AT FACTORY

.1 The Contract Administrator may, before or after selection of equipment has been made, inspect or have an authorized representative inspect the manufacturing, assembling and testing facilities at the Contractor's or Subcontractor's equipment factory, to satisfy themselves of the capability of the Contractor or Subcontractor to supply the specified equipment.

.2 The Contract Administrator may inspect or have an authorized inspector inspect the equipment factory or the process of manufacture or testing of the equipment at the Contractor's or Subcontractor's equipment factory at any reasonable time. The Contract

Administrator or the inspector may notify the Contractor or Subcontractor at any time of unsatisfactory materials, workmanship, or processes.

.3 The Contractor or Subcontractor, as the case may be, shall provide every reasonable facility, access and cooperation to assist the Contract Administrator or an authorized inspector in carrying out inspection or testing at the equipment factory or plant.

.4 Inspection or testing carried out by the Contract Administrator or an authorized inspector shall not relieve the Contractor of the responsibility for supplying equipment in accordance with the Bid Opportunity Documents and good engineering practice.

5. EQUIPMENT DELIVERY

.1 All equipment shall be delivered in its entirety in one (1) shipment, unless otherwise specified.

.2 The Contractor shall deliver all equipment required under this Contract to the City of Winnipeg, North End Water Pollution Control Centre, 2230 Main Street, Winnipeg, Manitoba.

.3 The Contractor shall deliver the equipment on or before the specified delivery date(s). The Contractor shall submit a delivery schedule within fifteen (15) calendar days after notification of acceptance of Shop Drawings.

.4 The schedule shall allow for a two (2) week period for the Installation Contractor to review and comment on the Contractor's Shop Drawings for the equipment to be supplied.

.5 The Contractor will be entitled to an extension of the quoted delivery period on account of delay(s) attributable to Acts of God or other matters, which were not the fault of the Contractor and over which it had no control, provided that the Contractor took all possible action to reduce delays and notified the City promptly of the occurrence of such delays.

.6 Delivery of parts or materials, which are required in advance of the delivery of the equipment, shall be made when required by the City.

.7 Written acceptance of receipt, at delivery, by the Installation Contractor shall constitute "Delivery to Site" under this Contract. A representative from each of the following groups will be in attendance at the time of delivery: The Contractor, Installation Contractor, and the Contract Administrator. A duly executed "Certificate of Equipment Delivery" (**Form 200**) shall be completed. A sample of this certificate is included at the end of Division 16. Any damage identified during the inspection shall be repaired as per the Manufacturer's recommendations by the Contractor at no cost to the City.

.8 The Contractor shall, ten (10) days before delivery, give notice to the Contract Administrator so that arrangements for receipt and for inspection can be made. The shipping lists of materials will be carefully checked by the Contractor in the presence of the Contract

Administrator and the City. The Contractor shall arrange for delivery during normal working hours.

.9 The Contractor shall off-load and place into storage all equipment at the Site at the location agreed with the Contract Administrator. The Contractor shall provide off-loading requirements and procedures to the Contract Administrator well in advance of the arrival of the equipment.

.10 Shipments shall be Free on Board (F.O.B.) destination, freight prepaid. Cost of shipping to the Site shall be included and shall be paid for under the items, Part A - Form B: Prices.

.11 Refer to Part D – Supplemental Conditions, Clause D8 for insurance requirements.

.12 No delivery to the Site of the Work shall occur until Reviewed Shop Drawings are received by the Contractor.

.13 The City will be responsible for storing the equipment, appurtenances, and materials and for protection against weather, loss, damage or theft. The Contractor shall be responsible for providing the Contract Administrator full instructions in writing of all precautions to be observed in connection with the storing and protection of the equipment.

.14 The Contractor shall clearly mark each item to be shipped and identify and reference it to the packing lists and to bills of materials on the Shop Drawings. The lists will be used by the Contractor, the Installation Contractor, and the Contract Administrator to check the contents of each delivery. No shipments will be off-loaded until itemized packing lists have been received by the parties mentioned herein.

.15 The Contractor shall adequately pack and crate each component to provide protection during transport, handling, and storage. Equipment suitable for outside storage will be stored to the satisfaction of the Contractor and the Contract Administrator. The Contractor shall identify each component with durable labels or tags securely attached to each piece of equipment, crate or container.

.16 No item shall be shipped loose or in such a way as to be adversely affected by weather conditions, pilferage, normal transit hazards, or other reasonably anticipated shipping hazards.

.17 Where the equipment is to be stored on-site for any period of time exceeding one (1) week, the Contractor shall instruct the Installation Contractor Site staff of the specific storage requirements to ensure there is no uneven wear or distortion of equipment component parts.

.18 The Contractor shall protect polished and machined metal surfaces from corrosion and damage during shipment and storage and shall carefully pack and crate the equipment for shipment. The Contractor shall protect threaded connections with threaded plugs or caps and shall protect open plain end pipes with caps. He shall especially pack electrical equipment and control panels to prevent scratching, access by dirt, moisture, or dust or damage to insulation, and shall cover equipment having exposed bearings and glands to

exclude foreign matter. All openings in the equipment shall be covered before shipment. Sufficient lifting hooks shall be supplied for handling all crates or boxes and heavy pieces

.19 The Contractor's Representative shall be at the delivery Site to check the delivery and to examine the equipment for damage or loss, and to inspect the Installation Contractor's storage facilities for the equipment supplied for compliance with the Contractor's recommendations. The Contractor shall maintain an inventory of all equipment supplied and delivered to the Installation Contractor.

.20 The equipment may have to be stored on the Site for an extended period of time before installation and equipment performance testing. Accordingly, the Contractor shall provide any special packaging and protective coatings, lubricants, etc. which the Contractor deems necessary to protect the equipment during the protracted storage and prior to equipment performance testing. The Installation Contractor will be responsible for removing any protective coatings prior to installation and equipment performance testing in accordance with the Contractor's written instructions.

6. INSTALLATION ASSISTANCE

.1 Unless otherwise specifically stated in the Specifications, the Contractor shall provide, and shall allow for in his proposal, a factory-trained representative who, in conjunction with the Contract Administrator or his agent, shall give instructions regarding the installation of the equipment.

.2 Before commencing installation of equipment, the Installation Contractor will arrange for the attendance of the Contractor's Representative to provide instructions to the Installation Contractor in the methods, techniques, precautions, and any other information relevant to the successful installation of the equipment.

.3 The Installation Contractor will inform the Contract Administrator, in writing, of the attendance at the Site of the Contractor's Representative for installation training at least fourteen (14) days prior to arrival.

.4 The Contractor shall instruct the Installation Contractor in the proper installation of the equipment and shall provide all necessary installation instructions to the Installation Contractor in writing.

.5 The Contractor shall provide advice and instructions to the Installation Contractor on the installation of the equipment but shall not be responsible for the detailed supervision of the installation of the equipment or of the workers installing it. The Contractor shall notify the Contract Administrator in writing immediately in the event of any disputes with the Installation Contractor concerning installation of the equipment.

.6 The Contractor's Representative shall complete **Form 201**, attached at the end of Division 16 , when satisfied that the Installation Contractor has received adequate instruction in the installation of the Contractor's equipment. The completed **Form 201** must be submitted to the Contract Administrator prior to the commencement of equipment installation. Such

certification shall be provided to the Contract Administrator before the Contractor's Representative leaves the Site.

.7 Installation of the equipment will not commence until the Contract Administrator has advised that completed **Form 201** has been accepted.

7. INSTALLATION

.1 The Contractor's Representative shall visit the Site as frequently as required to ensure that the installation Work is being performed in a proper and workmanlike manner.

.2 If necessary, or if so directed by the Contract Administrator during the course of installation, the Installation Contractor will contact the Contractor to receive clarification of installation procedures, direction, or any other additional information necessary to continue or complete the installation in an appropriate manner.

.3 If it is found necessary, or if so directed by the Contract Administrator, the Installation Contractor will arrange for the Contractor's Representative to visit the Site to provide assistance to the Installation Contractor during installation, all at no cost to the City.

.4 Prior to completing installation, the Installation Contractor will inform the Contractor and arrange for the attendance at the Site of the Contractor's Representative to verify successful installation.

.5 The Contractor's Representative shall conduct a detailed inspection of the installation including alignment, attached pipework, wiring and motor starters, electrical connections, controls and instrumentation, rotation direction, running clearances, lubrication, workmanship, satisfactory noise, and vibration requirements and all other items as required to ensure successful operation of the equipment.

.6 The Contractor's Representative shall identify any outstanding deficiencies in the installation and shall provide a written report to the Contract Administrator and Installation Contractor describing such deficiencies.

.7 The deficiencies shall be rectified by the Installation Contractor and the Contractor's Representative will be required to re-inspect the installation, at no cost to the City.

.8 The Contractor's Representative shall complete **Form 202**, attached at the end of Division 16, following installation of the equipment. The completed **Form 202** must be submitted to the Contract Administrator prior to the commencement of functional testing.

.9 Deliver the completed **Form 202** to the Contract Administrator prior to departure of the Contractor's Representative from the Site.

.10 Tag the equipment with a 100 mm by 200 mm card stating "Equipment Checked. Do Not Run." stencilled in large black letters. Sign and date each card.

8. EQUIPMENT AND PERFORMANCE VERIFICATION

.1 Equipment will be subjected to a demonstration test, running test, and equipment performance tests (EPT) after the installation has been verified and any identified deficiencies have been remedied.

.2 The Installation Contractor will inform the Contract Administrator at least fourteen (14) days in advance of conducting the tests and arrange for the attendance of the Contractor's Representative. The tests may be concurrent with the inspection of satisfactory installation if mutually agreed by the Installation Contractor and the Contract Administrator.

.3 The Contractor's Representative shall conduct all necessary checks to the equipment and if necessary, advise the Installation Contractor of any further Work needed prior to confirming the equipment is ready to run.

.4 Demonstration Test: The Installation Contractor will then operate the equipment for at least one (1) hour to demonstrate to himself the operation of the equipment and any required ancillary services. Any remedial measures required to ensure satisfactory operation will be promptly undertaken.

.5 The Installation Contractor will then notify the Contract Administrator of his readiness to demonstrate the operation of the equipment. The Contract Administrator will attend, as expeditiously as possible.

.6 With the assistance of the Contractor's Representative, the Installation Contractor will demonstrate that the equipment is properly installed. Alignment, piping connections, electrical connections, etc. will be checked and if appropriate, code certifications provided.

.7 Running Test: The equipment will then be run for one (1) hour. Local controls will be satisfactorily verified by cycling the equipment through several start-stop operations, modulating its output, or some combination. Operating parameters such as temperature, pressure, voltage, vibration, etc., will be checked to ensure that they are within the specified or Contractor's recommended limits, whichever is more stringent.

.8 On satisfactory completion of the one (1) hour demonstration test, the equipment will be stopped and the Contractor shall recheck all critical parameters.

.9 Equipment Performance Test: The equipment will be restarted and run continuously for three (3) days. During this period, as practicable, conditions will be simulated which represent maximum or most severe, average, and minimum or least severe conditions. These conditions will be mutually agreed by the Contractor, the Installation Contractor and the Contract Administrator on the basis of the information contained in the Contract Documents, as well as the methods utilized to create the simulated conditions and the time periods allotted to each. During these tests the plant will be operated by the Installation Contractor under the supervision of the Contractor.

.10 Performance tests will be conducted either concurrent with or subsequent to the running test, as practicable and agreed between the Contract Administrator, the Contractor and the Installation Contractor.

.11 Performance tests will be as dictated in the technical Specifications for each item of equipment or as reasonably required by the Contract Administrator to prove adherence to the requirements listed in the Specification.

.12 The Installation Contractor will submit the results of the performance tests to the Contract Administrator, documented and summarized in a format acceptable to the Contract Administrator. The Contract Administrator reserves the right to request additional testing. No equipment will be accepted and handed over to the City prior to the satisfactory completion of the EPT(s) and acceptance of the test reports by the Contract Administrator.

.13 All water, chemicals, temporary power, heating, or any other ancillary services required to complete the initial demonstration, running test, and EPTs are the responsibility of the Installation Contractor.

.14 Should the initial demonstration, running test or EPTs reveal any defects, then those defects shall be promptly rectified and the demonstration, running tests, and / or performance tests will be repeated to the satisfaction of the Contract Administrator. Additional costs incurred by the Installation Contractor, the Contract Administrator, or the City, due to repeat demonstration, running tests, and/or performance tests shall be the responsibility of the Contractor.

.15 On successful completion of the demonstration, running test, and performance tests, the **"Certificate of Satisfactory Equipment Performance" (Form 203)** attached to this Specification will be signed by the Contractor's Representative, the Installation Contractor, the Contract Administrator and the City.

END OF SECTION

TRAINING

1. DESCRIPTION

.1 This Section contains requirements for training the City's staff, by persons retained by the Contractor specifically for the purpose, in the proper operation and maintenance (O&M) of the equipment and systems installed under this Contract.

.2 Training sessions are required during the equipment performance testing (EPT).

.3 As a minimum, the Contractor is to allow at least four (4) hours of training per shift (maximum of four (4) shifts), as required for each item of equipment or system. Refer to the equipment Specifications for specific time periods.

.4 The intent is that the City should receive sufficient training on the equipment system that they are going to operate and maintain. The Contract Administrator shall have the authority to determine the duration and content of each training session required.

.5 Training sessions should include a test with a pass fail in terms of continuing education units in the Province of Manitoba

2. QUALITY ASSURANCE

.1 Where required by the equipment Specifications, provide on-the-job training of the City staff. Training sessions will be conducted by qualified, experienced (two (2) years minimum), factory-trained representatives of the various equipment suppliers. Training includes instruction of City staff in equipment operation and preventive maintenance and instruction on mechanics, electricians, instrumentation, and communications technicians in normal maintenance up to major repair.

.2 The trainer(s) proposed by the Contractor shall be experienced in training plant operators and shall have relevant experience in similar Work.

3. SUBMITTALS

.1 Submit the following information in accordance with Section 01300. For phased testing and start-up activities, separate submittals can be prepared for equipment items or systems. The material must receive a "REVIEWED" or "REVIEWED AS MODIFIED" status by the Contract Administrator no later than four (4) weeks prior to delivery of the training:

.1 Lesson plans and training manuals, handouts, visual aids, and other reference materials for each training session to be conducted by the Contractor's trainer(s).

.2 Date, time, and subject of each training session.

.3 Training schedule. Concurrent classes will not be allowed.

4. LOCATION

.1 Where specified, conduct training sessions for the City staff, O&M personnel, on the operation, care, and maintenance of the equipment and systems installed under this Contract. Training will take place at the Site of the Work and under the conditions specified in the following paragraphs.

.2 Field training sessions will take place at the Site of the equipment. Classroom training to take place in the boardroom in the Administration Building. The Contract Administrator may direct the classroom training to take place at another suitable location.

5. LESSON PLANS

.1 Prepare formal written lesson plans for each training session and coordinate with the Contract Administrator. Lesson plans to contain an outline of the material to be presented along with a description of visual aids to be utilized during the session. Each plan will contain a time allocation for each subject. Furnish ten (10) copies of necessary training manuals, handouts, visual aids, and reference materials at least two (2) weeks prior to each training session.

6. FORMAT AND CONTENT

.1 Include time in the classroom and at the location of the equipment or system for each training session. As a minimum, cover the following topics for each item of equipment or system:

.1 Familiarization

.2 Safety

.3 Operation

.4 Troubleshooting

.5 Preventive maintenance

.6 Corrective maintenance

.7 Parts

.8 Local representatives

7. VIDEO RECORDING

.1 The City may record each training session. After taping, the material may be edited and supplemented with professionally produced graphics to provide a permanent record for the City's use. Advise all Suppliers providing training sessions that the training material may be videotaped.

8. TRAINING

8.1 General Requirements

.1 Conduct training in conjunction with the EPT period (see 01650). Schedule classes such that classroom sessions are interspersed with field instruction in logical sequence. Arrange to have the training conducted on consecutive days, with no more than four (4) hours of classes scheduled for any one (1) shift.

.2 Provide final O&M manuals, as defined in Section 01300, for the specific equipment to the City at least four (4) weeks prior to the start of any training. Videotaping may take place concurrently with all training sessions.

8.2 Operator Classroom Training

.1 As a minimum, classroom equipment training for operations personnel will include:

.1 The equipment's specific location in the plant and an operational overview. Use slides and drawings to aid discussion.

.2 Purpose and plant function of the equipment.

.3 The operating theory of the equipment.

.4 Start-up, shutdown, normal operation, and emergency operating procedures, including system integration and electrical interlocks, if any.

.5 Safety items and procedures.

.6 Routine preventive maintenance.

.7 Operator detection, without test instruments, of specific equipment trouble symptoms.

.8 Required equipment exercise procedures and intervals.

.9 Routine disassembly and assembly of equipment if applicable for purposes such as operator inspection of equipment.

.10 Exam

8.3 Operator Hands-On Training

.1 As a minimum, hands-on equipment training for operations personnel will include:

.1 Identifying instrumentation: location of primary element; location of instrument readout; discuss purpose, basic operation, and information interpretation.

.2 Discussing, demonstrating, and performing standard operating procedures and daily visual inspection of system operation.

.3 Discussing and performing the preventive maintenance activities.

.4 Discussing and performing start-up and shutdown procedures.

.5 Performing the required equipment exercise procedures.

.6 Performing routine disassembly and assembly of equipment if applicable.

.7 Identifying and reviewing safety items and performing safety procedures, if feasible.

8.4 Maintenance Classroom Training

.1 Classroom equipment training for the maintenance and repair personnel will include:

.1 Basic theory of operation.

.2 Description and function of equipment.

.3 Routine start-up and shutdown procedures.

.4 Normal and major repair procedures.

.5 Equipment inspection and troubleshooting procedures including the use of applicable test instruments and the "pass" and "no pass" test instrument readings.

.6 Routine and long-term calibration procedures.

.7 Safety procedures.

.8 Preventive maintenance and up to and including major repairs such as replacement of major equipment part(s) with the use of special tools.

.9 Exam

8.5 Maintenance Hands-On Training

.1 Hands-on equipment training for maintenance and repair personnel will include:

.1 Locating and identifying equipment components.

.2 Reviewing the equipment function and theory of operation.

.3 Reviewing normal repair procedures.

.4 Performing routine start-up and shutdown procedures.

.5 Reviewing and performing the safety procedures.

.6 Performing City-approved practice maintenance and repair job(s), including mechanical and electrical adjustments and calibration and troubleshooting equipment problems.

.7 Reviewing and using Contractor's manuals in the hands-on training.

8.6 Equipment and Systems for Training

.1 Provide training during the EPT period for the following equipment and systems:

.1 The Vertical Axial Flow Pumps O&M.

.2 The Variable Frequency Drive (VFD) O&M.

.2 Coordinate and finalize with the Contract Administrator on training schedules and duration of each training session.

8.7 Training Completion Forms and Payment

.1 Training for the equipment shall be conducted before the operation period as described in **Form 203**. Complete **Form 203**, at the end of Division 16..

.2 The Contract shall not be considered complete, for the purpose of issuing a Certificate of Substantial Performance, until the training has been provided and **Form 203** has been signed.

8.8 Training Exams

.1 Provide and mark an exam for each group of City staff that attend the training sessions. Pass mark shall be 70%. The exam can be an open-book exam, if required.

END OF SECTION

TABLE OF CONTENTS

DIVISION 11

Reviewed and Approved

Date

SUBMERSIBLE MOTORS

1. GENERAL

1.1 Work Included

.1 The submersible motor is an integral part of the Axial Flow Pump, this Section details the requirements pertinent to the submersible motor.

1.2 Submittals

.1 Shop Drawings: Submit with the related item of process equipment in accordance with Section 01300. In addition, submit the following details:

.1 Submit efficiency and power factor information at 100% and 75% load for each motor size and type required.

.2 Operating and Maintenance (O&M) Data: Provide with the related item of process equipment for incorporation in an O&M manual as specified in Section 01300.

1.3 Service Conditions

.1 Unless specified otherwise, provide motors suitable for continuous operation at an elevation of 220 m above sea level.

.2 Provide motors suitable for continuous operation in a 40°C ambient temperature.

1.4 Coordination

.1 For motors fed via variable frequency drives (VFDs), communicate motor requirements to and comply with drive requirements of the Manufacturer of the VFD in accordance with Division 16.

1.5 Quality Assurance

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

1.6 Shipment, Protection and Storage

.1 Ship, protect, and store equipment in a manner that prevents damage or premature aging.

.2 Handle motors with suitable lifting equipment.

.3 Store motors in heated, dry, weather-protected enclosure.

2. PRODUCTS

2.1 Acceptable Manufacturers

.1 Flygt

.2 KSB

.3 ABS

.4 Ebara

2.2 Exposure Classification

.1 The exposure classification for each motor is specified with the related equipment.

.2 Motors installed in areas where dangerous gases may occur or which are to be immersed in flammable liquids, shall be Totally Enclosed Explosion Proof (TEXP), minimum.

.3 All other motors shall be totally enclosed, waterproof.

2.3 Motors - Sewage Application

.1 Heavy duty service.

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

.3 For starting and torque characteristics, conform to Electrical and Electronic Manufacturers Association of Canada (EEMAC) Design B.

.4 316, 416 or 417L stainless steel motor shafts.

.5 For services 0.37 kW and greater provide motors nameplate rated for 600 V, 60 Hz, 3-phase service unless otherwise noted.

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

.7 Provide motors capable of ten (10) evenly spaced starts per hour on a continuous basis without temperature rises which would harm insulation and windings.

.8 Design motors for semi-continuous immersion in liquid with an ambient temperature of 40°C unless higher temperatures are noted. Design casing for adequate heat rejection. Designs utilizing the circulation of the pumping liquid are not permitted.

.9 Where motors are designated intermittent immersion, provide cooling fins, sealed fan units, or other devices suitable for the function.

.10 Provide thermal protection. Incorporate two (2) bimetallic sensors that sense when the motor temperature rises above 140°C. The motor shall automatically restart after cool-down. For TEXP motors, calibrate the two (2) bimetallic sensors to shut down the motor at 120°C. Include three (3) additional thermistors which shut down the motor if a temperature of 140°C is sensed. On sensing this condition, the motor will be shut down and held until reset. Use the thermal switches in conjunction with and supplemental to external thermal motor overload protection.

.11 For motors greater than 20 kW, provide a moisture sensing device in the stator housing to sense the presence of moisture.

.12 Attach an oil-filled reservoir to the bottom of the motor. Prohibit the ingress of moisture with inner and outer single mechanical seals. Mechanical seals to be tungsten carbide or sintered silicon carbide, both faces.

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

.14 Provide sealed ball bearing type bearings with an Anti-Friction Bearings Manufacturers Association (AFBMA) B10 life of 100,000 hours.

.15 Provide 304 or 316 stainless steel hardware.

.16 Ensure motors used with VFDs have adequate cooling capacity when operating through the entire speed range capacity of the drive.

2.4 Cable

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

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

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

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

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

2.5 Finishes

.1 Factory prime and paint submersible motors as specified in Section 11901.

2.6 Mounting

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

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

3. EXECUTION

3.1 Manufacturer's Representative

.1 All motors are to be supplied as an integral component of some other item of equipment. The Manufacturer's Representative for that equipment is responsible for the supervision of installation, Site testing, and commissioning of the motor as part of the equipment as specified in other Sections. The Manufacturer's Representative for the motor shall inform both the representative for the equipment and the installer of requirements for the motor, installation, testing, and commissioning.

3.2 Installation

.1 Ensure the motor is properly installed to provide satisfactory service.

3.3 Testing and Commissioning

.1 Ensure the motor operates as intended during testing of the individual equipment and during process commissioning.

END OF SECTION

PROCESS PUMPS – GENERAL REQUIREMENTS

1. GENERAL

1.1 Description

.1 This Section defines the general requirements for the supply and supervision of installation and commissioning of all pumps required for this project.

1.2 Definitions

.1 The terms in the Specification generally comply with the definitions of the Hydraulic Institute.

.2 Definitions:

.1 Efficiency: Pump efficiency shall be calculated as the delivered hydraulic power divided by the electrical power at the inlet box of the pump. It shall take full account of mechanical and electrical losses.

.2 Performance Curve: The performance curve is a graph of the flow delivered (L/s, x-axis) in relation to the discharge head (metres, y-axis). It generally denotes efficiencies as isopleths and may include net positive suction head (NPSH) requirements as a function of the flow.

.3 BEP: The BEP (Best Efficiency Point) is the point in the pump performance curve where the pump operates at its highest efficiency.

.4 Rating Point: The pump rating point is the combination of discharge head and flow which the pump must satisfy. It typically is determined on the basis of all duty pumps (one (1) or more, depending on the service) operating simultaneously against the worst system conditions (typically maximum headloss, minimum suction head, maximum discharge head, etc.). This condition is listed in the detailed pump Specification and must be satisfied by the pump supplied.

.5 Low Head Point: The low head point is the combination of head and flow which corresponds to the least head the pump might operate against. It is determined on the basis of only one (1) duty pump operating against the system conditions which would produce the least discharge pressure (typically minimum headloss, maximum suction head, minimum discharge head, etc.). The minimum system head is shown or described for each pump. The Manufacturer must ensure that the pump can operate satisfactorily, without cavitation in the pump casing or over-stressing of the motor, at the intersection of the pump curve and the minimum head curve, or low head point.

.6 Low Speed Point: The minimum flow and head conditions against which a variable speed pump is expected to operate.

.7 NPSH: The total pressure (atmospheric) at the pump suction. The available NPSH is the pressure available at the pump suction and is a function of site atmospheric pressure and suction piping losses. Required NPSH (NPSHR) is the pressure required at the pump suction to ensure cavitation due to water column separation does not occur.

NPSHR shall be defined by the pump supplier at the pump inlet connection whether that be at the casing or at the face of a suction reducer/elbow supplied as an integral part of the pump.

.8 Minimum Diameter Passing: Solids handling pumps have listed a minimum diameter passing. A sphere of this size must be capable of passing from the pump intake to the discharge.

1.3 Submissions

.1 Shop Drawings: Submit in accordance with Section 01300

.2 Performance curve for the pumping unit(s) superimposed on the system curve for the particular pumping application. Where the system curve is not included in the Specifications, request this information from the Contract Administrator when required. With the performance curve, include efficiency isopleths and NPSHR variation with flow. Where required in the specific pump sections, the performance curve should be certified in accordance with Hydraulic Standards.

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

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

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

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

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

.8 Operation and Maintenance (O&M) Data: Provide for incorporation in O&M manual as specified in Section 01300. Include the following:

.1 Complete description of operation

.2 General arrangement and detailed Drawings

.3 Wiring diagrams for power and control schematics

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

.5 Number of weeks prior to shipment that Contract Administrator will be required to supply final conditions of flow and head for trimming the impeller. Manufacture casings to the conditions given on the system head curves, but complete final trim of the

impellers according to the flow and head supplied for this pump on or before a date agreed on between Contractor and the Contract Administrator.

1.4 Delivery and Storage

.1 Ship pre-assembled to the degree that is possible. Inform installer of any Site assembly requirements.

.2 Securely fasten heavy wood blanks to the pump flanges. Use blanks that are larger diameter than the flange. Protect machined surfaces against rusting. Protect threaded connections with threaded plugs or caps. Protect open, plain pipe ends with caps.

.3 Where pumps are to be stored on-site for any period of time exceeding on week, instruct Site staff of specific requirements to ensure there is no uneven wear or distortion of pump component parts.

.4 Identify any special storage requirements.

1.5 Coordination

.1 Coordinate with other Divisions to ensure there are no conflicts in the Work.

2. PRODUCTS

2.1 Pump Performance Requirements

.1 Provide pumps that are suitable for continuous duty.

.2 Select impellers for fixed speed pumps that permit operation at an efficiency within 5% of the efficiency at the BEP.

.3 For variable speed pumps, select pump speed and impeller diameter which allow operation from the Rating Point to the Low Speed Point at efficiencies with 10% of efficiency at the BEP.

.4 Ensure that motors are sufficiency sized to drive pumps at a maximum speed when the head is as defined for the low head point.

.5 Provide pumps capable of operating at 50% of the flow at the rated capacity with good efficiency without exceeding the motor horsepower, and capable of operating at any point on its characteristic curve, to where that curve intersects the low head point, without exceeding motor power rating.

2.2 Pressure Sensing

.1 Supply a means of measuring inlet and outlet pressure with each pump, except as noted.

.1 For centrifugal pumps handling clean water, provide gauges for the inlet and outlet of each pump.

.2 For submersible pumps, provide only one gauge for mounting on the discharge of the pump on a weldolet installed outside, but within 2 m of the wet well.

.3 For centrifugal pumps handling sewage, sludge, grit, or effluent water, provide one pressure sensor and one gauge for each pump. Refer to standard details for mounting requirements.

.4 For positive displacement pumps (diaphragm, piston, etc.), provide full pipe diameter annular ring pressure sensor for both the suction and discharge, complete with gauges and connections for instrumentation devices.

.5 For axial flow propeller pumps, no pressure gauges are required

.2 Gauges:

.1 Supply gauges that are 75 mm diameter, 6.35 mm bottom connection, complete with shut off cock with stainless steel movement and Bourdon tube.

.2 Use metric units of measurement (kPa or Pa), clearly indicated on the face of the gauge.

.3 Calibrate the gauges to read pressure ranges approximately as follows:

	Actual Pressure	**Gauge Pressure Range**
Suction	-50 kPa to 50 kPa	-50 kPa to 350 kPa
	50 kPa to 200 kPa	0 kPa to 350 kPa
	200 kPa to 700 kPa	0 kPa to 1000 kPa
Discharge	50 kPa to 350 kPa	0 kPa to 700 kPa
	350 kPa to 700 kPa	0 kPa to 1000 kPa
	700 kPa to 1500 kPa	0 kPa to 2000 kPa

.4 Acceptable Manufacturers: Ashcroft, H.O. Trerice.

.3 Pressure Sensors

.1 Provide annular ring, flow through type pressure sensors, with stainless steel body, a sensing element compatible with the corrosive and abrasive nature of the fluid being measured, 25 mm diameter.

.2 Acceptable Products: Red Valve Series 42 or Robbins and Myers RKL Series W.

.3 Provide stainless steel nipples extending to a tee from the pressure sensor. Mount the gauge on one (1) leg of the tee. If a pressure indicator/transmitter/switch is shown on the Drawings, mount on the other side of the tee. Otherwise, plug the tee.

.4 Supply annular type pressure sensors with their initial fill of fluid.

2.3 Pump Seals

.1 Provide cartridge type, single mechanical seals, externally mounted.

.2 Provide non-destructive, self-aligning seals of the stationary design with require no wearing sleeve for the shaft.

.3 Material of construction:

Type of Service	Metal Parts	Spring(s)	O-Rings	Faces
Potable water	316 or 317L Stainless Steel	316 or Hastelloy C	Buna-N or Viton	Silicon Carbide on Carbon
Sewage	316 or 317L Stainless Steel	316 or Hastelloy C	Viton	Sintered Silicon Carbide on Carbon
Secondary Sludge and Scum	316 or 317L Stainless Steel	316 or Hastelloy C	Viton	Tungsten Carbide on Sintered Silicon Carbide
Primary Sludge, Digested Sludge, and Grit	316 or 317L Stainless Steel	316 or Hastelloy C	Viton	Tungsten Carbide on Sintered Silicon Carbide

.4 Approved Manufacturers are:

.1 Durametalic

.2 John Crane

.3 Chesterton

2.4 Bearings

.1 For all pumps other than submersible and where otherwise noted in the detailed Specifications, provide a bearing shield, complete with labyrinth seals, to prevent the ingress of water.

2.5 Protective Guards

.1 Provide a protective guard for all couplings and keys, drive belts, or other exposed rotating devices.

2.6 Couplings

.1 For all pumps other than submersible and where noted otherwise in the detailed Specifications, provide flexible, double disc, spacer type couplings.

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

.3 Acceptable Products: Wood Sureflex, Rex Omega

2.7 Shafts

.1 Design shafts to absorb 1.15 times the rated power of the motors required to drive the pumps when the pump is fitted with maximum size impellers.

.2 Use stainless steel shafts, without any allowance for shaft sleeves.

2.8 Spare Parts

.1 For each pump type and size, provide a single impeller or propeller, wear plate, suction ring (if replaceable), one (1) pump shaft, and nut.

.2 For each pump type and size, provide one (1) spare mechanical seal, O ring set, and one (1) set of pump bearings.

2.9 Factory Performance Testing

.1 Conduct factory performance testing in compliance with the Hydraulic Institute Standards.

.2 Inform Contract Administrator at least three (3) weeks prior to the factory testing to allow for his attendance.

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

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

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

2.10 Finishes

.1 Factory prime and paint all pumps in accordance with Section 11901.

3. EXECUTION

3.1 General

.1 Comply with the requirements of the specific sections for the pumps to be provided, in particular Section 11313.

3.2 Installation

.1 Comply with the requirements of the specific sections for the pumps to be provided, in particular Section 11313.

3.3 Testing

.1 Field test all pumps greater than or equal to 3.7 kW, and smaller units where noted, to verify performance.

.2 In this application field-testing will be carried out as part of the performance testing to ensure the pumps operate as expected. Flow and head calculations will not be possible due to the volumes being pumped. It will suffice, based on satisfactory factory test certification to verify correct operation only.

.3 For variable speed pumps, conduct the tests at two (2) speeds, typically 100% of the design speed and 30% of the design speed.

.4 Field Test Report

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

.2 Describe test set-up.

.3 For each pump, list the specified operation requirements and field test results.

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

END OF SECTION

VERTICAL AXIAL FLOW PROPELLER PUMPS

1. WORK INCLUDED

1.1 Work Included

.1 Supply and supervision of the installation, testing, and commissioning of submersible, axial flow propeller pumps, with motors, vertical discharge columns, pump cans, intake piping, alarm monitoring panel, and power and signal cables.

.2 The Contractor shall coordinate with the Variable Frequency Drive (VFD) subcontractor and be responsible for matching the submersible axial flow pump motors with the VFDs.

2. PRODUCTS

2.1 Description

.1 Pumps for pumping large volumes of secondary effluent against low head into the ultraviolet (UV) disinfection system.

.2 Provide submersible, single stage, axial flow, propeller pumps.

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

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

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

.6 For each pump (except shelf spares), include the vertical discharge column complete with seats and support flanges, pump can (wet pit), and intake lateral piping.

.7 Include a spring-loaded hooking device and lifting chains with a working load 50% greater than the pump/motor unit weight.

2.2 Acceptable Manufacturers

.1 ABS

.2 Ebara

.3 Flygt

.4 KSB

2.3 Capacities and Performance

.1 Six (6) pumps shall be provided. Five (5) pumps will be installed to lift effluent into the UV disinfection building. The pumps shall be capable of pumping between 42 and 412 ML/d

over a continuous range without any gaps, by varying both the number of pumps running and the speed at which they run.

Number of Installed Pumps:	5
Number of Spare Pumps:	1
Drive:	Variable Speed
Capacity at minimum speed:	42 ML/d
Capacity at maximum speed:	86 ML/d
Maximum static head:	6.0 m
Minimum static head:	5.5 m
Maximum discharge tube diameter:	1000 mm (maximum)

2.4 Materials

.1 Fabricate propeller of cast aluminum bronze conforming to American Society for Testing and Materials (ASTM) B 584.

.2 Fabricate major pump components of grey cast iron, Class 35, to ASTM A48 with smooth surfaces devoid of blow holes and other irregularities.

.3 Fabricate all exposed nuts and bolts of 304 stainless steel.

.4 Fabricate wear ring between bowl assembly and propeller of ASTM A320 stainless steel.

.5 Fabricate motor/propeller shaft ASTM B54, grade 50 carbon steel.

.6 Fabricate pump column of mild steel pipe, ASTM A53 Type B, epoxy coated.

2.5 Propeller

.1 Make propeller a four (4) bladed, fixed pitch design.

.2 Curve blades backward to minimize any tendency to clog.

.3 Fit the propeller assembly onto the shaft with a sliding fit with one (1) key.

.4 Dynamically balance the assembly.

2.6 Guide Vanes

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

2.7 Pump Shaft

.1 Use single piece shaft.

.2 Completely isolate the shaft from the pumped liquid.

2.8 Bearings

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

.2 Provide cylindrical roller upper motor bearing.

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

.4 Provide bearings with a minimum Anti-Friction Bearings Manufacturers Association (AFBMA) B10 bearing life of 100,000 hours minimum.

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

2.9 Mechanical Seals

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

.2 Design seals to run in an oil reservoir.

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

.4 For the lower seal unit between the pump and the oil chamber, make one stationary ring and one (1) positively driven rotating ring of tungsten carbide. For the upper seal unit between the oil reservoir and motor, make one (1) stationary ring of tungsten carbide and one (1) positively driven rotating ring of carbide.

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

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

2.10 Pump Discharge Column

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

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

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

2.11 Pump Can/Draft Tube and Intake Piping

.1 Provide intake piping and pump cans as shown in the Drawings.

2.12 Motor

.1 Motor types, voltages, service conditions, and power ratings are indicated in the detailed pump Specification sheets.

.2 Use submersible motor in accordance with the requirements of Section 11207.

2.13 Anti Rotation Device

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

2.14 Cooling System

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

2.15 Power Cable

.1 Provide adequate length of cable to reach the junction box without splices, situated outside the pump chamber.

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

.3 Use cable rated for 750V and 90°C.

2.16 Cable Entry

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

2.17 Junction Box

.1 Design the junction box with two (2) separate terminal boards, one for connecting the signal wires and signal cable, and one (1) for connecting the stator leads and power cables.

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

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

2.18 Controls

.1 Provide a pump control status monitoring system for each pump. The motor starters, disconnect switches, control panel, and other power ancillaries will be provided by the installation contractor as detailed in Division 16.

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

.3 For each pump control/monitoring system provide 25 m of control wiring and a junction box to connect between the pump and the control enclosure.

2.19 Finishes

.1 Shop prime and paint the pumps and discharge columns, internally and externally, in accordance with Section 11901.

2.20 Spare Parts

.1 Provide the following spare parts for each pump:

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

.2 Mechanical seal assembly

.3 O ring for discharge column sealing

.4 Propeller

.5 Casing wear ring (2)

.6 Bearing, motor side

.7 Bearing, pump side

.2 If within the first six (6) months of pump start-up the design or duty conditions change, provide a one-time exchange propeller having a different blade pitch as determined by the Contract Administrator, at no cost to the City.

2.21 Factory Tests & Factory Performance Testing

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

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

.2 Test motor and cable insulation for defects.

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

.4 Submerge the pump and run for thirty (30) minutes.

.5 Simulate the flow and head conditions in the Table O-3 and record the absorbed power and efficiency. The absorbed power shall be obtained when Power factor has been corrected to 0.95.

.6 Develop a certified test curve (per Hydraulic Institute Class A standards) showing the performance of the pump.

.7 Repeat the insulation tests after the operational test.

.8 Document the tests and submit the results.

Table O-3: Pump Efficiency & Absorbed Power

Flow ML/d	Head (m)	Overall Efficiency	Absorbed Power Usage (kW)*
42	**6**		
53	**6**		
64	**6**		
75	**6**		
86	**6**		

The information supplied within this table will be used to determine compliance with the Performance Guarantee provided in the Bid Submission.

* Absorbed Power is the power drawn by the motor at the specified duty point and shall be derived when the power factor is corrected to 0.95.

3. EXECUTION

3.1 Manufacturer's Representative

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

3.2 Installation

.1 Ensure that each pump is installed in accordance with these Specifications as required to provide satisfactory service.

.2 Instruct Installation Contractor in the methods and precautions to be followed in the installation of the equipment. Certify the Installation Contractor understanding by completing Form 201.

.3 Cooperate with the Installation Contractor to fulfill the requirements for a successful installation as documented by Form 202.

3.3 Testing

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

.2 Cooperate with the Installation Contractor to fulfill the requirements for successful testing of the equipment as documented by Form 203.

.3 Refer to Section 11300 for testing requirements.

3.4 Training

.1 Allow for a minimum of two (2) days of operation and maintenance training as outlined in Section 01664.

3.5 Commissioning

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

Cooperate with the Installation Contractor, Contract Administrator, and the City to fulfill the requirements for successful commissioning of the system as documented by Form 203.

END OF SECTION

DRAFT TUBES, PIPING AND COUPLINGS

1. GENERAL

1.1 Description

.1 This Section describes the requirements for the fabrication of the draft tubes, interconnecting pipework and couplings required to construct the pumping system as presented in Drawing No. 66303D CP1.05C3

.2 The overall dimensions must be retained to ensure that the draft tube and interconnecting pipework will fit between the concrete fixtures which make up the complete pumping station. The dimensions to be determined by the Contractor are the draft tube diameter, which can be adjusted to suit the pump characteristics, and respective material thicknesses necessary for structural integrity.

.3 Material shall be Carbon Steel, grade of steel being selected by the Contractor to suit their design.

1.2 Submittals

.1 With the submittals required in Division 1 the Contractor shall submit detailed fabrication Drawings, welding procedures, and coating details for review prior to manufacture.

1.3 Reference Standards

.1 Conform to the following reference standards:

.1 AWWA M11, Steel Pipe - A Guide for Design and Installation

.2 ASTM A570/A570M, Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality.

.3 AWWA C200, Steel Water Pipe, 6 Inches and Larger.

.4 AWWA C203, Coal Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied.

.5 AWWA C206, Field Welding of Steel Water Pipe.

.6 AWWA C209, Cold-Applied Tape Coating for Special Sections, Connections, and Fittings for Steel Water Pipelines.

.7 AWWA C210, Coal-Tar Epoxy Coating System for the Interior and Exterior of Steel Water Pipe.

.8 AWWA C214, Tape Coating Systems for the Exterior of Steel Water Pipelines.

1.4 Design Requirements

.1 The design has been completed to the degree necessary for the Contractor to Tender the project. It is not fully detailed and will require the Contractor to undertake design of several aspects for the draft tube system, interconnecting pipework and couplings.

.2 Contractor shall note that the draft tube is shown as a complete assembly, this may not be practical from a manufacturing perspective and the Contractor shall detail how the section will be assembled. Site welding will not be allowed, therefore, any assembly will have to be bolted.

.3 Design documentation will be submitted to the Contract Administrator as necessary to indicate compliance with the requirements of pumping systems.

1.5 Fabrication & Welding Requirements

.1 Welding: Prior to commencing any welding of carbon steel fabrication, prepare and submit to the Contract Administrator a written description of welding techniques including but not limited to materials, methods, and quality control to be utilized.

.2 Prior to the commencement of welding, submit current and complete documentation of the welder's qualifications prior to the commencement of welding.

.3 Use welding materials conforming to CSA W48.1.

.4 Welding procedures shall conform to CSA Z183.

.5 Carbon Steel Welding

.1 Use manual shielded metallic arc, submerged arc, or inert gas shield arc welding.

.2 Bevel all ends prior to welding.

.3 Clean and dry welding surfaces thoroughly prior to welding.

.4 Do not proceed with welding when metal temperatures fall below minus 18°C. Apply supplemental heat when metal temperatures are below 0°C, to heat the metal to 20°C.

.5 Maintain flanges, pipes, fittings, etc. in alignment during welding. Ensure that no part of the weld is offset by more than 20% of the wall thickness.

.6 Make tack welds of material equal to the root pass. Tack welds which have not cracked may be incorporated in the root pass.

.7 Ensure the first bead obtains full root penetration with a minimum of weld material projecting within the pipe.

.8 For butt welds use three passes - minimum.

.9 For lap joints, weld joint in two passes minimum.

.10 Between passes, visually inspect bead for pinholes or other defects. Repair any defects prior to the placement of the next pass.

.11 Clean all flux, slag and other foreign material from the weld prior to applying a successive bead, and on completion of the weld.

.12 Do not start successive passes at the same point.

.13 Completely fill the joint with weld, and have a reinforcement greater than 1.5 mm and less than 3.0 mm, with no undercutting at the weld edges.

1.6 Quality Assurance

.1 Welding Certification. As a minimum, welders will hold a Level B Journeyman Welder's Certificate.

1.7 Flexible Couplings - Type I

.1 Unless specifically shown otherwise use Type I flexible couplings where a flexible coupling is shown or required, Contractor will determine the which class, A, B or C as described below.

.2 Type I General Requirements:

.1 Centre ring: Steel, shop coated for corrosion protection.

.2 Gaskets: Fabricated of material suitable to the service conditions.

.3 For submerged, buried or below structure applications, use stainless steel bolts, nuts and washers.

.4 Provide the necessary amount and appropriate size of restraining rods and gussets as recommended by the Manufacturer.

.5 Type 1 – Restrained: use a flexible sleeve-type coupling with restraining rods, and gussets welded to the pipe. Provide sufficient restraint to resist pressure equal to twice the system test pressure.

.3 Flexible Couplings - Type IA

.1 Flexible sleeve type couplings: Cylindrical centre ring, two follower rings, two resilient gaskets, and connecting bolts.

.2 Acceptable Products are:

.1 Dresser Style 38

.2 Ford Meter Box FC1

.3 Robar 1408

.4 Rockwell Type 411

.5 Viking Johnson Quick-Fit

.4 Flexible Couplings - Type IB

.1 Flanged flexible sleeve type couplings: Flanged cylindrical centre ring, a companion flange, one follower ring, one resilient gasket, and connecting bolts.

.2 Acceptable Products are:

.1 Dresser Style 128

.2 Ford Meter Box FCA

.3 Robar 7808

.4 Rockwell Type 913

.5 Viking Johnson Quickfit Flange Adapter

.5 Flexible Couplings - Type IC

.1 Transition flexible sleeve type couplings: Cylindrical centre ring, two follower rings two resilient gaskets, and connecting bolts.

.2 Acceptable Products are:

.1 Dresser Style 62

.2 Robar 1408

1.8 Conflicts

.1 Review the Drawings prior to installation, identify any conflicts and cooperate with the Contract Administrator to determine the adjustments necessary to resolve these conflicts.

1.9 Shipment, Protection and Storage

.1 Deliver draft tubes, pipe and couplings to Site using loading methods which do not damage pipe or coatings.

1.10 Gaskets

.1 Use gasket materials Neoprene (black) 70 durometer 3.2 mm thick for flanged connections if required.

1.11 Bolts and Nuts

.1 Provide hex head bolts and nuts. Threads to be ANSI B1.20.1, standard coarse thread series.

.2 For general service, use bolts and nuts conforming to ASTM A307, Grade A; nuts conforming to ASTM A563, Gr.A.

.3 Provide stainless steel bolts, nuts and washers for submerged, buried, and concrete encased service; bolts conforming to ASTM A193, Gr.B8, C1.1; nuts conforming to ASTM A194, Gr.8.

.4 Provide hex nuts equal to or less than 25 mm. Greater than 25 mm, provide heavy hex.

1.12 Interior Finishes

.1 Draft tube, pipe and couplings to have factory applied coatings and finishes unless otherwise noted.

.2 As a minimum, apply coal tar epoxy to the internal surface of draft tube and piping in accordance with AWWA C210, to a minimum dry film thickness of 350 microns.

1.13 Exterior Finishes - Shop Applied

.1 Draft tube, pipe and couplings to have factory applied coatings and finishes unless otherwise noted.

.2 As a minimum apply coal tar epoxy to the exterior of draft tube, pipes and couplings in accordance with AWWA C210.

1.14 Exterior Finishes - Field Applied

.1 The field work shall be carried out by the Installation Contractor under the supervision of the Contractor. Contractor shall supply the materials necessary to carry out the following:

.1 Coal Tar Epoxy: Touch up coal tar epoxy coatings in accordance with AWWA C210.

.2 Tape wrap all pipe joints, completely covering the entire coupling Polyken, Tec-Tape or Denso tape, consisting of primer and tape applied to minimum thickness of 0.90 mm in accordance with AWWA C209.

END OF SECTION

FACTORY APPLIED CORROSION PROTECTIVE AND MAINTENANCE COATINGS

1. GENERAL

1.1 Work Included

.1 Supply and application of all factory applied prime coats or factory applied finish coats.

1.2 Submissions

.1 With the equipment Shop Drawings, submit details of the coating systems to be applied.

1.3 Quality Assurance

.1 This Specification is intended to be a minimum reference standard. Alternative coating systems may be submitted for review, for specific items of equipment, which provide equal or better corrosion protection and maintenance service than those specified herein.

2. PRODUCTS

2.1 Surface Preparation

.1 Immersion Service: For ferrous components, degrease and dry blast to a white metal finish in accordance with Steel Structures Painting Council (SSPC)-SP5 to a degree of cleanliness in accordance with National Association of Corrosion Engineers (NACE) #1. Obtain a 50 micron blast profile.

.2 Non-Immersion Service: After degreasing, as a minimum, hand tool clean all surfaces in accordance with SSPC-SS2 or power tool clean in accordance with SSPC-SS3.

2.2 Prime Coating

.1 Coat all ferrous surfaces before the blasted surfaces deteriorate.

.2 To ferrous surfaces apply inorganic zinc primer, containing a minimum of 50% solids by volume, to a minimum dry film thickness of 75 micron.

2.3 Finish Coats

.1 Apply finish coats in conformance with Section 11900 for service, coating types and application rates.

2.4 Assembly

.1 Before the parts are assembled, clean and coat surfaces of items that are to be bolted together before shipment.

.2 Make all welded connections continuous weld, sealing the mating surface completely. On completion of the welding and fettling, treat all weld seams with phosphoric acid solution, then rinse and thoroughly dry before the primer is supplied.

.3 Where dissimilar metals are mated, insulate the surfaces from one another to provide protection against galvanic or other corrosion.

.4 For immersion service, use 316 stainless steel nuts, bolts, washers, and similar fittings. For non-immersion service use 304 stainless nuts, bolts, washers, and similar fittings. Clean and coat the inner face of bolt holes, not threaded, as required for other surfaces.

3. EXECUTION

3.1 Inspection

.1 Notify the Contract Administrator two (2) weeks before commencing the protective coating in order to facilitate the inspection by the Contract Administrator of the surface preparation and protective coating application.

3.2 Protection

.1 Adequately protect all coated equipment against damage, dust, moisture, and scratching during shipment, off-loading, and storage on-site. If, in the opinion of the Contract Administrator, the coating is damaged during shipment to the extent that touch up would not be satisfactory, return the equipment and recoat at no cost to the City.

END OF SECTION

UV INFLUENT PUMPING DESIGN AND OPERATING DESCRIPTION

1. INTRODUCTION

.1 Pumps and related electrical systems are City supplied. The Contractor shall be responsible for supplying, installing, and Commissioning of the pump control systems.

.2 Secondary Effluent (SE) leaves the clarifiers via a pair of rectangular conduits. Up to 400 ML/d of the flow is diverted to one conduit only at the Primary Effluent Bypass Junction structure. The flow is conveyed in this single conduit for approximately 150 m to the existing Effluent Gate Chamber (EGC).

.3 SE enters a new channel connected to the future outfall connection of the EGC. The new channel terminates in a deep section which serves as a pump intake sump. Five (5) laterals convey flow to five (5) vertically mounted axial flow propeller pumps mounted in individual "cans". The pumps discharge into individual boxes set higher than the receiving channel water level, providing a passive backflow protection, with no need for valves or flapgates.

.4 The SE flows down a channel and is distributed into the three (3) UV Reactor Channels.

2. DESIGN

2.1 Description

.1 SE flows through a channel to a structure where five (5) submersible axial flow propeller pumps are installed in vertical draft tubes. The pumps are removable with an overhead crane for repair, maintenance, and replacement.

.2 Because flows vary throughout the day, the pumps are equipped with variable frequency drives (VFDs). The pump(s) speed modulates to maintain a relatively constant level in the intake sump between the minimum submergence and overflow levels.

.3 There are five (5) pumps, each sized to pump approximately one-fifth (1/5) of the maximum flow. No standby pump is installed; a sixth unit will be available on the shelf. Because the pumps are relatively easy to remove and install, this reduces the size of the pump intake and discharge structure by approximately 20%.

.4 Each pump will pump between 42 ML/d and 86 ML/d at a static head of 6 to 6.5 m

.5 The pumps will be restricted to a maximum combined flow of approximately 410 ML/d. Flow in excess of this amount will be allowed to back up into the Primary Effluent (PE) Channel and spill over the PE bypass weirs directly into the outfall conduit.

2.2 Design Criteria

.1 Five (5) pumps will be installed at this stage, each sized to accommodate 100% of the minimum flow to 20% of the maximum flow (approximately). Each pump will be variable speed. The level in the wetwell (SE channel) will control the speed of the pumps between their minimum and maximum pumping rates. Signals from level sensor(s) in the intake control the pump speed to maintain the set level.

.2 The water depth will be maintained at between 226.12 m ASL (above sea level) (4.3 m above plant datum) to provide at least 1,800 mm above the centre line of the pump intake lateral, and a maximum water level of 226.62 m ASL (4.8 m above plant datum).

.1 Main Inlet Channel Invert: 225.478 m ASL / 3.658 m APD (above plant datum)

.2 Pump Intake Channel and Pipe Invert: 223.72 m ASL / 1.900 m APD

.3 Pump Intake Pipe Centre Line: 224.32 m ASL / 2.5 m APD

.4 Normal LWL (low water level): 226.12 m ASL / 4.3 m APD

.5 Normal Operating Water Level: 226.37 / 4.55 m APD

.6 Normal HWL (high water level): 226.62 ASL / 4.8 m APD

.7 Pump Shut-off Level: 225.82 / 4.0 m APD

.8 Overflow Level: 227.12 m ASL / 5.3 m APD

.3 As the influent flow increases and the water level in the channel rises, the pumps' speeds will increase to prevent SE from rising above HWL (26.62 m), and spilling over the UV bypass weir (227.12 m). At flows less than or equal to 430 ML/d, the pumps turn on and off or speed up and slow down to maintain the water level between the minimum submergence level and the maximum water level.

.4 Flow into the secondary treatment system will be restricted to 380 ML/d at the inlet to the existing High Purity Oxygen (HPO) reactors. Excess flow will overflow at the PE bypass structure. The influent control at the HPO reactors is not precise, and allowance is made for the pumps and UV structure to hydraulically accommodate up to 430 ML/d. Under normal circumstances, the flow into the pump intake will not exceed 380 ML/d.

.5 Each pump is mounted in a 1,000 mm diameter vertical tube, which discharges vertically into individual discharge boxes set approximately 500 mm above HWL in the receiving channel, preventing backflow when a pump is not operating.

2.3 Design Data

Description	Units	Design Value
Duty		5
Standby		1 (on shelf)
Capacity (maximum, each)	L/s	995
Capacity (minimum, each)	L/s	486
Discharge tube diameter	mm	1,000 maximum
TDH	m	6-0 - 6.5
Power, each	kW	127 maximum
Firm capacity total	ML/d	410 – 430 (APPROX)
Minimum Submergence	m	1.800
Wetwell (SE channel) floor invert	m	223.42

Description	Units	Design Value
Pump Intake Pipe Centre Line	m	224.32
Minimum water level at pump intake	m	226.12
Bypass weir elevation	m	227.12
Maximum water level	m	226.62
High High alarm level (bypass occurring)	m	227.12
High alarm (bypass imminent)	m	226.82
Minimum water level (pump stop)	m	225.82

2.4 Arrangement

.1 The pump inlet channel abuts the eastern side of the EGC structure. The PE enters a deeper section of channel, and is withdrawn to the pumps by five (5) 1,200 mm diameter laterals (one (1) per pump).

.2 The five (5) pumps are mounted in individual "cans" and discharge tubes which discharge to a channel upstream of the UV reactors.

.3 The UV system is sized for a peak flow of 380 ML/d (disinfection capacity) and approximately 430 ML/d (hydraulic capacity). The pumps installed at this stage will be sized to convey approximately 410 to 430 ML/d.

2.5 Other Disciplines

.1 Structural/Building Services

.1 The floor of the pump intake area is at an elevation to provide an overall minimum submergences.

.2 The length and width of the pump intake area meets the minimum requirements to optimize flow conditions through each pump.

.3 The enclosure over the pump structure provides adequate access to allow the pumps to be removed by crane or hoist.

.4 Each pump weighs approximately 1,700 kg; the can and discharge tube assembly is estimated to weigh 11,000 kg.

.2 Mechanical

.1 The pump structure is an enclosed underground structure and does not require general ventilation.

.3 Electrical

.1 The electrical room and electrical service is sized for the major items of equipment installed summarized in the following table.

Description	Tag	Full Load (kW)*
UV Influent Pump 1	U010-P1	100 – 130
UV Influent Pump 2	U020-P1	100 – 130
UV Influent Pump 3	U030-P1	100 – 130
UV Influent Pump 4	U040-P1	100 – 130
UV Influent Pump 5	U050-P1	100 – 130
TOTAL PUMP LOAD		
* Load dependent on manufacturer/pump model		

3. OPERATING DESCRIPTIONS

3.1 Control Devices

Description	Location	Number	Function
U010-VFD1	Central	1	Match pump 1 output to inflow, up to 995 L/s
U020-VFD2	Central	1	Match pump 2 output to inflow, up to 995 L/s
U030-VFD3	Central	1	Match pump 3 output to inflow, up to 995 L/s
U040-VFD4	Central	1	Match pump 4 output to inflow, up to 995 L/s
U050-VFD5	Central	1	Match pump 5 output to inflow, up to 995 L/s
U005-LE U005-LIT UA005-LT	Local DCS	1	Controls pump VFDs to maintain wetwell water level
U060-FT U060-FIT U060-FT	Local PLC	1	Measure flow by depth over inlet weirs
U170-LE U170-LIT U170-LT	Local PLC	1	Water Depth at UV Channel 1 outlet
U270-LE U270-LIT U270-LT	Local PLC	1	Water Depth at UV Channel 2 outlet
U370-LE U370-LIT U370-LT	Local PLC	1	Water Depth at UV Channel 3 outlet
U102-ZSB	Local		UV outlet weir gate closed
U102-ZSD	Local		UV outlet weir gate open
U102-ZIT	Local		UV outlet weir gate position
U102-HS1/HS2/HS3	Local		UV outlet weir gate Local/Remote Open/Close
U202-ZSB	Local		UV outlet weir gate closed
U202-ZSD	Local		UV outlet weir gate open
U202-ZIT	Local		UV outlet weir gate position
U202-HS1/HS2/HS3	Local		UV outlet weir gate Local/Remote Open/Close
U302-ZSB	Local		UV outlet weir gate closed
U302-ZSD	Local		UV outlet weir gate open

Description	Location	Number	Function
U302-ZIT	Local		UV outlet weir gate position
U302-HS1/HS2/HS3	Local		UV outlet weir gate Local/Remote Open/Close
Off/On Switch	Central	5	Turn pumps on and off from central control
HOA Switch	Local	5	Turn pumps control from central (AUTO) to OFF to local (HAND)
Start/Stop	Local	5	Start and stop pumps in local control mode

3.2 Normal

.1 Automatic (local HOA selector switch in AUTO)

.1 The pumps maintain a relatively constant liquid level in the wetwell and generally pump the SE at the same rate as it arrives from the secondary clarifiers.

.2 During normal operation all five (5) pumps will be available for operation, and will run, depending on the flow. The lead and lag pump roles will alternate.

.3 All five (5) pumps are placed in AUTO mode at the local panel and ON at the central control system.

.4 The speed of the pumps and the number of pumps in operation is controlled by the level in the inlet. One (1) to five (5) pumps normally run continuously, unless the water level falls below the minimum operating level and approaches the level corresponding to the minimum submergence requirement. If this occurs while the pump(s) is/are running at minimum speed, it/they will shut down.

.1 Water levels used for pump control are as follows:

.1 225.82 m (4.0 m): Minimum Pump Submergence Level; operating pumps begin to shut off as this level is reached

.2 226.12 m (4.3 m): Minimum Recommended Intake Water Level, or Normal Low Water Level (NLWL): approximate normal operating level with operating pump(s) running at minimum speed (operating pumps will adjust speed to maintain this level)

.3 226.37 m (4.5 m): Average Water Level: Pumps will operate to maintain this water level.

.4 226.62 m (4.8 m): Normal High Water Level (NHWL): Operating pump(s) will speed up if they are running at less than maximum speed if this level cannot be maintained

.5 226.82 m (5.0 m): High Level Alarm: Information alarm which indicates operating pumps are running at full capacity with net positive inflow into the inlet channel. Next pump, if available will start. If all pumps are running at

maximum speed (> 380 ML/d combined) the water level will be allowed to rise to overflow 227.12 m (5.3 m).

.6 227.02 m (5.2 m): Overflow Imminent Alarm. If all pumps are operating at maximum speed (> 380 ML/d combined) the water level will be allowed to rise to overflow 227.12 m (5.3 m).

.7 227.12 m (5.3 m): Overflow weir level

.2 At effluent flows between 85 and 170 ML/d, two (2) pumps will run; water level should be maintained at or below 226.37 m (4.55). If influent flow drops below the minimum pumping rate of 42 ML/d per pump while the two (2) pumps are at minimum speed, the water level will drop. One (1) pump will shut off in this event. If the inflow is less than 42 ML/d, the last operating pump will shut off when the water level drops to the shutoff level.

.3 As flows increase, the increase in water level will cause additional pumps to start. All operating pumps will be controlled to run at the same speed.

.5 High Level Alarm is 226.82 m. There are three (3) possible responses to this condition:

.1 If five (5) pumps are running at maximum speed: Normally, as it is permissible to bypass the UV process when flows exceed 380 ML/d, this high level alarm is an "information alarm" only, indicating that bypass of the UV influent pumps is about to occur; the pumps will not speed up past their combined imposed limit of 410 to 430 ML/d. The flow into the pump intakes should not exceed this under normal conditions, as the flow is restricted to 380 ML/d at a remote point upstream.

.2 All running pumps should be running at maximum speed if the water rises to this level. If, however, the pumps are not running at maximum speed, the pumps will speed up, and the next duty pump (if four (4) or fewer pumps are operating) will start to prevent overflow into the bypass, up to their combined imposed limit of 410 ML/d.

.3 If High Level Alarm occurs in conjunction with another alarm that indicates failure or malfunction of a pump, another pump will be started if available.

.6 High High alarm 227.02 m (bypass to outfall is imminent). There are three (3) possible responses to this condition:

.1 If five (5) pumps are running at maximum speed: Normally, as it is permissible to bypass the UV process when flows exceed 380 ML/d, this alarm is an "information alarm" only, indicating that bypass of the UV is occurring; the pumps will not speed up past their combined imposed limit of 410 ML/d.

.2 All running pumps should be running at maximum speed if the water rises to this level. If, however, the pumps are not running at maximum speed, the pumps will speed up, and the next duty pump (if four (4) or fewer pumps are operating) will start in an attempt to prevent overflow into the bypass, up to their combined imposed limit of 410 to 430 ML/d.

.3 If High level alarm occurs in conjunction with another alarm that indicates failure or malfunction of a pump (at flows less than 330 ML/d), another pump will be started if available.

.7 Low level alarm is 225.82 m (approximately minimum required pump submergence, indicating pump shutdown is imminent). The pumps will continue to run, but will slow down to try to maintain the water level at this elevation. If the water level drops with all running pumps at minimum speed, they will shut down one by one, until no pumps are in operation.

.8 The lead pump will restart first when the influent level to rises above 226.12 m after all pumps have been shut down. The lead pump duty will be cycled among all five pumps.

.9 The number of pumps running, and the speed at which they are running, is controlled to maintain a relatively constant level in the wetwell (SE channel) at about 226.37 m.

.10 The level transmitter (U-005) measures the water level in the wetwell. The signal is sent to the control system, which uses the setpoints for start, stop, speed control, and alarms for the pumps.

.11 Motor status and HOA status of each pump are output to the Computer Control System.

.2 Manual (Local HOA selector switch in HAND, and start/stop button on START)

.1 Each pump that is in MANUAL will run continuously, regardless of the level in the wetwell (PE channel) or signal from the flow meter, until it is shut off (start/stop button on STOP or HOA placed in OFF or AUTO).

.2 The pump will run at the speed set manually at the VFD keypad.

.3 Automatic Startup

.1 To start the pumps, place the HOA on AUTO. The DCS will confirm that all control inputs (wetwell levels, flow signals, speed controllers etc) are functional. Ensure the suction and discharge structures are unobstructed. The pumps will start and vary their speed automatically in response to the level in the wetwell.

.2 Normally, two (2) pumps will operate in tandem until flow exceeds 170 ML/d. When this occurs, levels in the influent well increase, causing a third pump to start. The lead pumps will slow down, and all operating pumps will run at the same speed. Above 250 ML/d, water level increases again, and a fourth pump starts. All running pumps ramp down and match speed to pump the incoming wastewater. If the inflow exceeds 330 ML/d, the water level increases again and the fifth pump starts. Again, all operating pumps ramp down to match each other's speed. All pumps then ramp up to match inflow if it increases beyond this point. At 410 ML/d, all five (5) pumps should be running at maximum speed. Higher flows should not occur, as the flow into the upstream process is limited to 380 ML/d. In the event higher flows do enter the influent channel, overflow to the bypass will occur

.3 The pumps alternate lead/lag/standby roles.

.4 Automatic Shutdown

.1 From the central control system, any pump can be stopped by the operator by placing it in an OFF status.

.2 From the local panel, placing any pump local HOA selector switch in OFF stops the pump from operating regardless of other conditions.

.3 In AUTO, the pumps automatically shut down in sequence; the LEAD pump continues to run while the LAG pumps shut down in sequence. When inflow falls below 100 ML/d, only the lead pump should remain in operation.

3.3 Adverse Conditions

.1 Low Flows: When the minimum capacity of a single pump exceeds the SE flow, water level in the intake structure will fall. The pump will stop if the interval of low flow is sufficient to decrease the water level to the shut off level of 225.82 m (4.0 m). The pump will restart when the water level rises to 226.37 m (4.55 m).

.2 High flows: When flow exceeds the capacity of each individual pump, water level in the intake structure will rise, and the pumps will start/stop or speed up/slow down in response, as described above in 3.2.3.2.

.3 Extreme flows: When the influent to the Works exceeds the design capacity of the five (5) duty pumps (410 to 430 ML/d), the five (5) pumps will run continuously at the speed required to convey their maximum capacity, and excess flows will be allowed to spill over the PE bypass weir (approximately 150 m upstream of the EGC) directly to the outfall.

.4 One (1) unit out of service: The facility is not designed to allow a pump to be taken out of service at any one time under maximum anticipated flow conditions. However, under most conditions, only four (4) duty pumps will be required. In the event a pump needs to be serviced, it should be removed and replaced and the shelf spare installed in its place.

3.4 Complete Pump System Failure

.1 Two (2) power supplies to the pumps minimizes the risk of the concurrent failure of all five (5) pumps. However, the loss of one (1) power supply will necessitate a manual changeover to the standby supply. All pumps will be off in the interim period until the switchover can be performed, and a short period of bypassing will occur.

.2 In the event of a *localized* catastrophic event that compromises both the normal and back-up power supplies which causes the pump station to shut down, *independently of the entire plant*, it will no longer be possible to disinfect. However, flow will still be entering the plant and the pump station and UV system will need to be bypassed.

.3 Due to hydraulic constraints, it is not possible to passively overflow the peak flow through the existing system. Without pumping, the capacity of the single Secondary Conduit falls from 400 ML/d to approximately 275 ML/d.

.4 If the flow is less than 250 ML/d, and the pumps fail, the condition will trigger a signal to restrict plant inflow at the Influent Pumps to 250 ML/d. The overflow weir at the pump intake will allow approximately 250 ML/d to overflow. The hydraulic gradeline in the SE conduit will increase approximately 500 mm, but at this flow and below, the secondary clarifier discharges should remain free.

.5 If the plant flow is greater than 250 ML/d, the Influent Pumps will also be slowed, but the effect on SE flows will not be immediate. The south secondary effluent conduit (SSECon) needs to be opened, and relatively quickly as there is minimal storage available in the SE Conduit system (approx 275,000 L under best conditions). An actuator (independent power source from the UV Pumps) will open the gate automatically (at lower flows the gate will not open automatically, but will open on active intervention of a human operator).

.6 In the event of a plant-wide power failure, the need to bypass is eliminated as no flow is entering the plant due to shut down of the influent pumps.

END OF SECTION

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DIVISION 16

Reviewed and Approved

Date

ELECTRICAL GENERAL REQUIREMENTS

1. GENERAL

1.1 Work Included

.1 Complete and operational electrical package for each process unit as required. A process unit is a supplier package or individual process equipment as specified in other Sections.

.2 Identify and submit to the Contract Administrator power requirements for each process unit. The Contractor shall identify the size of an over current protection device (fuses and/or breaker) and feeder size for each process unit supplied.

1.2 Quality Assurances

.1 Codes, Rules, Permits & Fees

.1 Comply with all laws, ordinances, rules, regulations, codes and orders of all authorities having jurisdiction relating to this Work.

.2 Comply with all rules of local Electrical Code and the applicable building codes.

.3 Quality of Work specified shall not be reduced by the foregoing requirements.

.4 All components shall be Underwriters Laboratories Inc. (UL) or Canadian Standards Association (CSA) approved.

.2 Standard of Workmanship:

.1 Execute all Work in a competent manner and to present an acceptable appearance when completed.

1.3 Submittals

.1 Submit samples as required where specified in Division 16.

.2 Refer to Section 01300 for general requirements for submittals.

.3 Indicate materials, methods of construction and attachment of support wiring, diagrams, connections, recommended installation details, explanatory notes and other information necessary for completion of Work. Where equipment is connected to other equipment, indicate that such items have been coordinated, regardless of the section under which the adjacent items will be supplied and installed.

Adjustments made on Shop Drawings by the Contract Administrator are not intended to change the Contract price. If adjustments affect the value of the Work state such in writing to the Contract Administrator prior to proceeding with the Work.

.4 Manufacture of Products shall conform to reviewed Shop Drawings.

1.4 Operation and Maintenance Manuals

.1 Refer to Section 01300 for general requirements for Operation and Maintenance (O&M) Manuals.

1.5 Product Handling

.1 Use all means necessary to protect the Products of this Division before, during, and after installation.

.2 Immediately make good any damage by repair or replacement at no additional cost to the City and to the approval of the Contract Administrator.

.3 Remove advertising labels from all electrical equipment. Do not remove identification or certification labels.

.4 Remove dirt, rubbish, grease, etc. resulting from this Work from all surfaces, including the inside of all cabinets, equipment enclosures, panelboard tubs, etc.

2. PRODUCTS

2.1 Selected Products and Equivalents

.1 Products and materials provided shall be new and free from all defects. Defective Products or materials will be rejected, regardless of previous inspections. The Contractor shall be responsible to remove and replace defective Products at their expense, and shall be responsible for any resulting delays and associated expenses, which result from defective Products being rejected. Related materials shall be by the same Manufacturer.

2.2 Quality of Products

.1 All Products provided shall be UL or CSA approved or approved by local authority having jurisdiction in the area where the equipment is going to be installed.

.2 If Products specified are not approved as specified above, obtain special approval from the local regulatory authority. Pay all applicable charges levied and make all modifications required for approval.

.3 Products provided, if not specified, shall be new, of a quality best suited to the purpose required and their use subject to approval by the Contract Administrator.

2.3 Uniformity of Manufacture

.1 Unless otherwise specifically called for in the Specifications, maintain uniformity of manufacture for similar Products throughout the Work.

3. EXECUTION

3.1 Equipment Identification

.1 3 mm thick plastic lamacoid name plates, black face, white core, mechanically attached with self tapping screws, 6 mm high lettering, to be attached to the front face of the following equipment:

.1 Starters, contactors, disconnects (Designation, voltage, load controlled)

.2 Terminal cabinets and pull boxes (system, voltage)

END OF SECTION

ELECTRICAL SCOPE OF SUPPLY

1. GENERAL

.1 Refer to Division 11.

.2 This Section describes the Electrical Division scope of supply for the UV Influent Feed Pumps and associated electrical equipment – Variable Frequency Drives (VFDs) and Harmonic Filters.

.3 The Supplier shall furnish all necessary components to provide a complete and fully functioning UV Influent Pump Station and associated Variable Frequency Drives and Harmonic Filters.

1.2 PROCESS AREA ENVIRONMENT

.1 This paragraph describes process area environment for various components electrical components associated with the VFD and Filtering Equipment.

.1 The electrical equipment associated with the UV Influent Pump VFD controllers and harmonic filters will be located in the Main UV Building Electrical Room. This room will be dry and be suitability conditioned with air handling units.

1.3 SCOPE OF SUPPLY

.1 For the UV Influent Pump electrical system the Supplier shall provide the following:

.1 All Variable Frequency Drives and Control Devices as required to operate the UV Influent Pumps.

.2 Harmonic filtering as may be required and indicated.

2. PRODUCTS - NOT USED

3. EXECUTION - NOT USED

END OF SECTION

VARIABLE FREQUENCY DRIVES

1. GENERAL

1.1 Standards

.1 All Variable Frequency Drives (VFDs) supplied under this Contract meet or exceed the following Specifications.

.2 Provide a complete inventory (as specified) of spare cooling fans, and fuses, for each VFD supplied.

.3 The adjustable frequency controller shall be designed to operate standard squirrel cage induction motor with a 1.15 S.F. or definite purpose motors meeting National Electrical Manufacturer's Association (NEMA) MG1 Part 31.

.4 Harmonic loading shall not exceed a motor service factor of 1.0.

.5 Products shall comply with Institute of Electrical and Electronic Engineers (IEEE) Standard 519.

.6 VFD unit shall be Underwriters Laboratories Inc. (UL) listed and Canadian Standards Association (CSA) certified.

.7 VFD unit shall comply with applicable requirements of the latest standards of CSA, American National Standards Institute (ANSI), IEEE and the Canadian Electrical Code (CEC).

1.2 Tests

.1 Factory testing

.1 VFD units are to be factory tested prior to shipment. Provide confirmation from factory of actual tests completed and results.

.2 Provide certified copies of production test results required by CSA and Electrical and Electronic Manufacturer's Association of Canada (EEMAC), prior to acceptance of the equipment.

.2 Field testing

.1 The Contractor shall provide on-site startup, fine-tuning, commissioning, operator training and instruction.

.2 The Contractor shall provide Site functionality test reports indicating loading/current levels during testing as well as control point proving results.

.3 The Contractor shall ensure shaft to ground voltages do not exceed 1.5 volts at any speed or load requirement.

.4 Allow for all costs and labour for as many trips as necessary to complete requirements.

.3 Provide certified copies of all production test results required by CSA and NEMA.

1.3 Warranty

.1 The Contractor shall provide warranty coverage as defined in Section D16.

.2 Contractor will review Specifications of motors for application compatibility. The Contractor shall obtain and submit written approval from both the motor and VFD suppliers confirming that both pieces of equipment are compatible when used together to maintain the required warranty.

.3 The Contractor shall indicate the level of local support detailing response time if a piece of equipment should happen to fail or malfunction. Details are to include estimated replacement part delivery times, as well as nearest parts depot location and a contact name and phone number. This must be included with all bid submissions.

.4 The Contractor shall guarantee that parts for VFD drive units will be available for a minimum of ten (10) years from time of delivery.

2. PRODUCTS

2.1 Variable Frequency Drives

.1 VFDs as supplied by the following acceptable Manufacturer:

.1 ABB ACS 800 series

.2 The VFD shall be designed to withstand a fault current of Eighteen Thousand (18000) Amps. All power distribution components of the VFD shall be rated for the Eighteen Thousand (18000) Amp short circuit current.

.3 Variable speed controller shall be electronic adjustable frequency and voltage output unit.

.4 The VFD shall employ a minimum 6-pulse PWM (pulse width modulated) inverter system utilizing Insulated Gate Bipolar Transistors (IGBT) power switching devices and come complete with line reactors or DC link filters.

.5 The drive shall be rated for continuous duty while operating a NEMA design induction motor of the sizes and operating voltages as shown in the following schedules and indicated on the Drawings. Drive output shall be sized for a 1.0 motor service factor. The VFD shall have a current rating at least 10% in excess of the motor full load amp rating. Overload

service factors of 110% for thirty minutes and 135% for one minute must be provided to ensure adequate safety margins. VFD selection shall be based on load current at constant torque ratings. Do not size VFDs based on variable torque maximums.

.6 The VFD shall have a fixed bridge type converter (PWM) with a minimum of 98% input displacement power factor over a 10 to 100% speed range. The efficiency shall be a minimum of 97% for all inverters when operated at full speed and load.

.7 Input voltage shall be as indicated on motor schedules and Drawings (line voltage variation ±10%). Based on 347/600 volt systems (Not 575v). Line frequency variation ±5%. Output voltage shall vary with motor speed to nominal motor voltage. Speed stability shall be ±1%. Drive shall match torque characteristic of load.

.8 Input frequency setting signal will be selective between 4 to 20 mA or 0-10v DC. Output speed monitoring signal shall be selective between 4 to 20 mA or 0-10v DC.

.9 Enclosure:

.1 Drive shall be installed in with individual CSA 1 enclosure, drip proof or NEMA 12. Filters to be provided for any forced air cooled enclosures as required by the supplier. VFDs shall be suitable for mounting in a typical building electrical room and shall be able to operate under these conditions with no special cleaning requirements. VFD cabinets shall be mounted in such a way that there is adequate room for ventilation and no build up of heat. The minimum clearance in front of VFDs is 1m.

.10 Protective devices to be incorporated are:

.1 Fast acting electronic circuit board protective devices for protection of electronic components.

.2 Line reactor, DC link or filter in the drive input to protect electronic components from transient voltage conditions.

.3 Integral electronic motor overload protection adjustable up to 150% of motor rating for 60 seconds.

.4 Overcurrent instantaneous trip 250%.

.5 Programmable short-circuit protection.

.6 Programmable ground fault protection.

.7 Overvoltage/overcurrent DC bus monitor/protection.

.8 Undervoltage protection.

.9 Loss of phase and phase unbalance protection.

.10 Inverter over-temperature protection.

.11 Capable of running without motor for startup.

.12 Input harmonic filters shall be similar to a Mirus International Inc. model UHF-(HP)-600-60Hz-(load type)-E1 or approved equal.

.13 Output filter package (as required) to limit motor voltage to 1200 volts maximum at motor terminals. A reflective wave trap mounted at the motor may be used to accomplish this.

.14 Longlead (motor feeder) filter package, as required for these installations. Contractor is responsible to determine where this will be required, and must indicate as to the requirement or non-requirement of longlead filter package components in their bid submission, and the Contractor is responsible for carrying all such costs in their Bid Price.

.15 Maximum acceptable noise level is 80 dBA at 1 m.

.11 Operation features:

.1 Flush mounted display on VFD enclosure cover with keypad for programming, monitoring and operating of drive, accessible through password or other acceptable security measure only. Remote keypads, completely duplicating functions of integral keypads, shall also be provided for all VFD(s) located inside a fan plenum. The remote keypads in these cases shall be located adjacent to the door entering the plenum.

.2 Each VFD and pump/motor assembly shall be provided complete with all process and safety interlocks, i.e., low level, temperature, vibration, leakage, moisture, emergency stop, etc. to prevent equipment damage and to provide personnel safety. The process and safety interlocks shall be included in the control wiring for the VFDs. All safety instruments, i.e., temperature, vibration, moisture, and leakage detection shall be provided as a part of the equipment supply. All process interlock instruments, i.e., low level switch, will be provided by others.

.3 Fault shutdown and indication.

.4 Automatic restart following power outage.

.5 Ability to disconnect motor load for setup or trouble.

.6 Manual speed control (potentiometer or keypad).

.7 Adjustable maximum and minimum speed.

.8 Acceleration and deceleration time adjustment.

.9 Controller “stop” interlock from a NC dry contact.

.10 Drive fault contact.

.11 Stop/start push buttons on key pad.

.12 Transient voltage protection.

.13 Provide three (3) dry “C” type contacts programmable for any combination of the following:

.1 Running (output frequency being generated)

.2 Fault lockout

.3 Stopped

.4 At speed

.5 Under speed

.6 Forward/Reverse

.7 Low reference

.8 Manual/Auto Mode

.9 Local/Remote Mode

.14 Soft start sequence.

.15 Regenerative braking.

.16 Minimum of three (3) skip frequencies.

.17 Provide Hand/Off/Auto selector switch. Keypad HOA is not an acceptable replacement.

.18 Password protection of parameter programming or some method to prevent unauthorized changes.

.19 Input speed control signal shall be optically isolated and shall selective between 4 to 20 mA or 0 to 10 volt.

.20 Output speed monitoring signal shall be optically isolated and shall be selective between 4 to 20 mA or 0 to 10 volt.

.12 Environmental Capabilities: The drive shall operate without mechanical or electrical damage under any combination of conditions as follows:

.1 Ambient temperature 0° to 40°C.

.2 Humidity 0 to 90% (non condensing).

.3 Vibration up to 0.5g.

.4 Altitude 0 to 1,250 m.

.13 Diagnostic and indicating features:

.1 Power On indication.

.2 Percentage speed indicator.

.3 Overload indication.

.4 Short circuit indication.

.5 Ground fault indication.

.6 Overvoltage indication.

.7 Undervoltage indication.

.8 High temperature (controller).

.9 AC voltmeter (output).

.10 AC ammeter (output).

.11 Inverter ready.

.12 Inverter fault.

.13 External fault.

.14 Cooling System:

.1 VFD supplier to provide adequate proven cooling devices for VFD equipment.

.2 VFD supplier to ensure any enclosure utilized will not allow a build up of heat. This can be accomplished by use of fans and/or sufficient guarded, filtered openings.

.15 Normal Distribution

.1 Normal power distribution is subject to voltage surges and sags as a normal condition of operation. Design and supply with each VFD the required inverter protection such that the VFD will not be stressed or damaged, in the following conditions:

.1 Line transients of up to 3,000 volts with energy levels of 50 joules.

.2 Line surges of up to 115% of rated voltage for up to ten (10) cycles. Based on 347/600 Volt systems.

.3 Line voltage sags down to 85% of rated voltage of up to one (1) second duration.

.2 Control wiring shall be TEW 105°C rise.

.3 Terminal blocks in separate control enclosures for remote interface shall be Weidmueller SAK6N or approved equivalent.

.4 Provide wire markers at both ends of all control wires, Electrovert Type Z or approved equivalent.

.16 Spare Parts

.1 Provide one (1) complete power module.

.2 Provide any special tools that are specific to the equipment being supplied.

3. EXECUTION

3.1 Operations Manual Information

.1 The Contractor shall provide the VFD Manufacturer with an “as built” of each motor application. Motor application data will include at a minimum, the following:

.1 Motor Manufacturer

.2 Class

.3 Motor model number

.4 Motor serial number

.5 Motor frame

.6 Motor horsepower (hp)

.7 Motor full load amps

.8 Motor conductor size

.9 Ground conductor

.10 Length of conductors from VFD to Motor

.11 Motor MCP or fuse and overload

END OF SECTION

CERTIFICATE OF EQUIPMENT DELIVERY

FORM 200

We certify that the equipment listed below has been delivered into the care of the Installation Contractor. The equipment has been found to be in satisfactory condition and meets its Basic Design Criteria. No defects in the equipment were found.

Project: _____

Item of Equipment: _____

_____

Tag No.: _____

Reference Specification: _____

_____

(Authorized Signing Representative of the Installation Contractor) (Date)

_____

(Authorized Signing Representative of the Contractor) (Date)

_____

(Authorized Signing Representative of the Contract Administrator) (Date)

CERTIFICATE OF INSTRUCTION

FORM 201

I have completed instruction of the installation of the equipment listed below:

(Authorized Signing Representative of the Contractor) (Date)

I certify that the party responsible for the installation of the equipment listed below has received satisfactory instructions from the Contractor.

(Authorized Signing Representative of the Installation Contractor) (Date)

ITEM OF EQUIPMENT:

TAG NO.:

CERTIFICATE OF SATISFACTORY INSTALLATION

FORM 202

I have completed my check and inspection of the installation listed below and confirm that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

Project: _____

Item of Equipment: _____

Tag No.: _____

Reference Specification: _____

Outstanding Defects: _____

_____

(Authorized Signing Representative of the Contractor) (Date)

CERTFICATE OF EQUIPMENT SATISFACTORY PERFORMANCE
FORM 203

We certify that the equipment listed below has been validated and has been operated for at least seven (7) consecutive days and that the equipment operates satisfactory and meets its Basic Design Criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

Project: _____

Item of Equipment: _____

Tag No.: _____

Reference Specification: _____

_____

(Authorized Signing Representative of the Contractor) (Date)

_____

(Authorized Signing Representative of the Installation Contractor) (Date)

_____

(Authorized Signing Representative of the Contract Administrator) (Date)

1. Acknowledgment of Receipt of Training for Operation Staff

_____

(Authorized Signing Representative of the City) (Date)

2. Acknowledgment of Receipt of Training for Maintenance Staff

_____

(Authorized Signing Representative of the City) (Date)