

**PART 1 GENERAL**

**1.1 Site Work**

- .1 After project completion return the outside site conditions back to original conditions. Photos of the Site will be taken before Work begins on Site to assist in confirming that after all Work is completed, the Site is returned to its original condition in accordance with City of Winnipeg Standard Specifications.

**1.2 Use of Site and Facilities**

- .1 Contractor may place a construction trailer on the Site and store materials in designated areas.
- .2 Potable water is not available on the Site. Make arrangements to provide drinking water for workers is required.
- .3 Existing washroom on Site may not be used by the Contractor's workers. Contractor to provide portable washroom facilities outside the pumping station.

**1.3 Regulations**

- .1 All Work shall be in full accordance with all applicable Codes, Regulations, By-laws, and ordinances.

**1.4 Permits, Fees and Inspections**

- .1 Apply for all permits, supply all test certificates and pay all fees to authorities having jurisdiction regarding the installation and inspection of the systems installed under this Contract.

**1.5 Existing Conditions and Other Trades**

- .1 Visit the Site to determine existing conditions affecting the Work of this Division.
- .2 Examine all drawings and become fully familiar with the Work of other trades in all divisions under this Contract.
- .3 Cooperate with all other trades. Pay particular attention to the proximity of the Work to all electrical cables, control conduits, and utilities. Maintain maximum clear ceiling heights throughout.

**1.6 Metric Conversion**

- .1 All units in this division are expressed in SI units.
- .2 Submit all Shop Drawings and maintenance manuals in SI units.
- .3 On all submittals (Shop Drawings, etc.) use the same SI units as stated in the Specifications.

### **1.7 Cutting and Patching**

- .1 Provide holes and sleeves, cutting and fitting required for mechanical Work. Relocate improperly located holes and sleeves.
- .2 Drill for expansion bolts, hanger rods, brackets, and supports.
- .3 Obtain written approval from the Contract Administrator before cutting or burning structural members.
- .4 Patch building where damaged from equipment installation, improperly located holes etc. Use matching materials.

### **1.8 Equipment Protection and Clean-up**

- .1 Protect equipment and materials in storage on-site during and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping systems.
- .2 Protect equipment with crates and polyethylene covers.

### **1.9 Temporary Usage**

- .1 Usage by the City of any process device, apparatus, machinery, or equipment prior to Total Performance being issued is not to be construed as acceptance.

### **1.10 Construction Plan**

- .1 A Construction Plan prepared by the Contract Administrator for the City has been included in Appendix A. The Contractor shall be responsible for performing project Work in accordance with the Work and procedures and responsibilities described in this document.
- .2 The Construction Plan describes a proposed procedure for completing the project Work. It also identifies procedures to be followed for each partial or complete shutdown of the station.
- .3 The Contractor can propose changes to this plan. But they will require approval by the Contract Administrator.

### **1.11 Site Sanitation**

- .1 The pumping station, piping and wet wells contain raw sewage. Also the station and piping contains accumulated debris and sludge. The Contractor shall ensure that all sewerage and related debris is handled and disposed of in a safe and appropriate manner.
- .2 No claim by the Contractor shall be made with respect to Site sanitation.

### **1.12 Contractor Use of Premises**

- .1 Limit use of premises for Work, for storage, and for access, to allow for City operations to operate the pumping station.

- .2 There may be other Subcontractors working on the Site. Co-ordinate use of the Site with the Contract Administrator.
- .3 Obtain and pay for use of appropriate additional storage or Work areas needed for operations under this Contract.
- .4 Remove or alter existing Work to prevent injury or damage to portions of existing Work which remain.
- .5 Repair or replace portions of existing Work which have been altered during construction operations to match existing or adjoining work, as directed by Contract Administrator.
- .6 Execute Work with least possible interference or disturbance to building operations, and normal use of premises. Arrange with Contract Administrator to facilitate execution of Work.

### **1.13 Site Occupancy**

- .1 The City will occupy premises during entire construction period for execution of normal operations.
- .2 Co-operate with The City in scheduling operations to minimize conflict and to facilitate The City's usage.

### **1.14 Existing Services**

- .1 Notify Contract Administrator of intended interruption of any service required in order to complete Work, and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Contract Administrator 48 hours notice for necessary interruption of mechanical or electrical service throughout course of Work. Minimize duration of interruptions.
- .3 Submit schedule to and obtain approval from Contract Administrator for any shut-down or closure of active service or facility including power services. Adhere to approved schedule and provide notice to Contract Administrator.

### **1.15 Documents Required**

- .1 Maintain at job Site, one copy of each document as follows:
  - .1 Contract Drawings.
  - .2 Specifications.
  - .3 Addenda.
  - .4 Reviewed Shop Drawings.
  - .5 List of Outstanding Shop Drawings.
  - .6 Change Notices and Change Orders.
  - .7 Field Test Reports.
  - .8 Copy of Approved Work Schedule.
  - .9 Health and Safety Plan and Other Safety Related Documents.
  - .10 Other documents as specified.

### **1.16 Use Of Site And Facilities**

- .1 Execute Work with least possible interference or disturbance to normal use of premises. Make arrangements with Contract Administrator to facilitate Work as stated.
- .2 Maintain existing services to building and provide for personnel and vehicle access.
- .3 Where security is reduced by Work, provide temporary means to maintain security.

### **1.17 Alterations, Additions Or Repairs To Existing Building**

- .1 Execute Work with least possible interference or disturbance to building operations and normal use of premises. Arrange with Contract Administrator to facilitate execution of Work.

### **1.18 Dangerous Work Conditions**

- .1 Further to clause C 6.24 of the General Conditions, the Contractor shall be aware of the potential hazards that can be encountered in the existing abandoned sewerage such as explosive gases, toxic gases and oxygen deficiency.
- .2 The air in an existing sewage pipe that is to be demolished may contain toxic or explosive gases. Care is required during disassembly to ensure they do not impact personnel.
- .3 The Contractor shall provide a photoionization detector (PID) on Site at all times to monitor potential hydrocarbon vapours. The gas detector and safety equipment conforming to the Act shall be made available to the Contract Administrator for his use during inspections.

### **1.19 Building Smoking Environment**

- .1 Comply with smoking restrictions. Smoking is not allowed in any City buildings.

### **1.20 Offices**

- .1 Subcontractors to provide their own offices as necessary.
- .2 Provide a heated, site trailer with electrical service for Contractor and Contract Administrator use. Trailer shall also be suitable for hosting site meetings. Provide suitable tables, chairs as required.

### **1.21 Demolition and Waste Disposal**

- .1 Unless specified otherwise, all material no longer required at the Site, including electrical MCCs, cabling, mechanical and civil/structural steel and other materials shall become the Contractor's property. Contractor may retain them for salvage value or dispose of them at an acceptable licensed disposal facility.

### **1.22 Cleaning**

- .1 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

- .2 Remove tools and waste materials on completion of Work, and leave work area in clean and orderly condition.
- .3 Clean-up work area as Work progresses.

### 1.23 Submittals Procedures

- .1 Administrative
  - .1 Submit to Contract Administrator for review. Submit with reasonable promptness and in orderly sequence so as not to cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of contract time and no claim for extension by reason of such default will be allowed. Work affected by submittals to proceed only after review is complete.
  - .2 Review submittals prior to submission to Contract Administrator. Stamp and sign submittals certifying review of submission. This review represents that necessary requirements have been checked and coordinated with requirements of Work and contract documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
  - .3 Notify Contract Administrator, in writing at time of submission, identifying deviations from requirements of contract documents stating reasons for deviations.
  - .4 Verify field measurements and that affected adjacent work is coordinated.
  - .5 Contractor's responsibility for errors and omissions in submission is not relieved by Contract Administrator's review of submittals.
  - .6 Contractor's responsibility for deviation in submission from requirements of Contract Documents is not relieved by Contract Administrator review.
  - .7 Keep one reviewed copy of each submission on Site.
- .2 Shop Drawings and Product Data
  - .1 Term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data provided by Contractor to illustrate details of portion of Work.
  - .2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
  - .3 Submit 1 electronic copy (pdf) of all shop drawings.
  - .4 Submit 1 electronic copy (pdf) of product data sheets or brochures for requirements requested in Project Manual Sections and as requested by

- Contract Administrator where shop drawings will not be prepared due to standardized manufacture of product.
- .5 Adjustments made on shop drawings by Contract Administrator are not intended to change contract price. If adjustments affect value of Work, state such in writing to Contract Administrator prior to proceeding with Work.
  - .6 Make changes in shop drawings as Contract Administrator may require, consistent with contract documents. When resubmitting, notify Contract Administrator in writing of any revisions other than those requested.
  - .7 Accompany submissions with transmittal letter, containing:
    - .1 Date and revision dates.
    - .2 Project title and number
    - .3 Contractor's name and address
    - .4 Identification and quantity of each shop drawing, product data and sample.
    - .5 Other pertinent data.
  - .8 Submissions to include:
    - .1 Date and revision dates.
    - .2 Project title and number
    - .3 Name and address of Subcontractor, Supplier, Manufacturer.
    - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval so submission, verification of field measurements and compliance with contract documents.
    - .5 Details of appropriate portions of Work as applicable:
      - .1 Fabrication.
      - .2 Layout, showing dimensions, including identified field dimensions, and clearances, relation to adjacent structure or materials.
      - .3 Setting or erection details.
      - .4 Capacities.
      - .5 Performance characteristics.
      - .6 Standards.
      - .7 Operating weight.
      - .8 Wiring diagrams.
      - .9 Single line and schematic diagrams.
  - .9 After Contract Administrator's review, distribute copies to subtrades as required.
  - .10 Supplement standard information to provide details applicable to project.
  - .11 If upon review by Contract Administrator, no errors or omissions are discovered or if only minor corrections are made, copy will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

## 1.24 Closeout Submittals

- .1 Project Record Documents
  - .1 Maintain at construction Site, two sets of white prints for record drawing purposes. Mark one set "FIELD DRAWINGS" and use to record initial data when field measurements are made. Mark other set "RECORD DRAWINGS".
  - .2 Store record drawings in field office apart from other documents used for construction. Maintain record drawings in clean, dry and legible condition. Do not use record drawings for construction purposes.
  - .3 Record "as-built" information in red ink, accurately and concurrently with construction progress. Do not conceal Work until required information is recorded.
  - .4 Legibly mark each item to record actual construction, including:
    - .1 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
    - .2 Changes made by Addendum, Change Order or Field Instruction.
    - .3 Details not on original Contract Drawings.
    - .4 References to related shop drawings and modifications.
    - .5 At completion of project and prior to final inspection, neatly transfer "as-built" notations to second set of white prints and submit to Contract Administrator along with field drawings.
  - .5 Provide an electronic copy (PDF) of all final shop drawing in an orderly fashion on one CD.
- .2 Spare Parts, Maintenance Materials And Special Tools
  - .1 Provide items of same manufacture and quality as items in Work, and of same production run and dye lot as installed materials.
  - .2 Provide special tools with tags identifying their associated function and equipment.
  - .3 Keys and Maintenance Tools for Hardware and Specialties.
    - .1 Turn over to Contract Administrator all keys and special tools required for maintenance of all finish hardware, cabinet hardware, equipment, etc. (including electrical and mechanical products) such as lock wrenches, door closer wrenches, dogging keys, etc.
    - .2 Properly tag all keys and tools, giving names of equipment, hardware, or item to which they are used.
  - .4 Deliver all items to Site or location as directed by Contract Administrator.
  - .5 Receive and catalogue all items, and submit inventory listing to Contract Administrator. Include copy of inventory listing in Operation and Maintenance Manuals.
  - .6 Obtain receipt of delivered spare parts, maintenance and extra materials from Contract Administrator and submit with request for final payment.

- .3 Storage, Handling And Protection
  - .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
  - .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
  - .3 Store paints and freezable materials in heated and ventilated room.
  - .4 Remove and replace damaged products at own expense and to satisfaction of Contract Administrator.
- .4 Operation And Maintenance Manuals
  - .1 Submit three (3) copies draft Operation and Maintenance Manual to Contract Administrator for review and comments. Submissions of individual data will not be accepted.
  - .2 Make changes as required.
  - .3 Prepare six (6) Final hard copies and one (1) Digital copy of Operation and Maintenance Manuals.
  - .4 Format.
    - .1 Organize data in form of an instructional manual.
    - .2 Binders: vinyl, hard covered, 3 "D" ring, loose leaf spine and fact pockets.
    - .3 When multiple binders are used, correlate data into related consistent groupings and identify contents of each binder on spine.
    - .4 Cover: identify each binder with printed title "Operation and Maintenance Manual". List title of project Bid Opportunity No. and identify subject matter of contents.
    - .5 Arrange content under Section numbers and sequence of Table of Contents.
    - .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
    - .7 Text: manufacturer's printed data, or typewritten data.
    - .8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pates.
  - .5 Contents (each volume).
    - .1 Table of Contents: provide title of project; date of submission; names, addresses, and telephone numbers of Contract Administrator and Contractor with name of responsible parties; schedule of products and systems, indexed to content of volume.
    - .2 For each product of system, list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement arts.
    - .3 Product Data: mark each sheet to clearly identify specific products and component parts and data applicable to installation. Delete inapplicable information.



- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified.
- .6 Equipment and Systems.
  - .1 Panel Board Circuit Directories: provide electrical service characteristics, controls, and communications.
  - .2 Include installed colour coded wiring diagrams.
  - .3 Operating Procedures: include complete list of equipment and parts list. Indicate nameplate information such as make, size, capacity, serial number. Provide written explanation of operation of each system with instructions for trouble shooting of operational failures. Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control stopping, shut-down, and emergency instructions. Include any special operating instructions.
  - .4 Maintenance Requirements: include routine procedures and guide for trouble-shooting, disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
  - .5 Provide servicing and lubrication schedule, and list of lubricants required.
  - .6 Include manufacturer's printed operation and maintenance instructions.
  - .7 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
  - .8 Provide installed control diagrams by controls manufacturer.
  - .9 Provide Contractor's coordination drawings.
  - .10 Loop drawings.
  - .11 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
  - .12 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
  - .13 Include test reports as specified.
  - .14 Include one complete set of final reviewed and stamped shop drawings, copy of hardware and paint schedules, requirements specified in individual specification Sections.
- .7 Materials and Finishes.
  - .1 Building Products, Applied Materials and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products as applicable.
  - .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
  - .3 Additional Requirements: as specified in individual specification Sections.
- .8 At completion of project and prior to final inspection, submit to Contract Administrator, three (3) copies of Structural, Mechanical and Electrical Operation and Maintenance Manuals.

- .5 Warranties And Bonds
  - .1 Provide warranties and bonds as specified.
  - .2 Assemble warranties and bonds, executed by each of respective manufacturers, suppliers, and subcontractors.
  - .3 Provide Table of Contents neatly typed, in orderly sequence. Provide complete information for each item:
    - .1 Product or work item.
    - .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
    - .3 Date of beginning of warranty or bond.
    - .4 Duration of warranty or bond.
    - .5 Proper procedure in case of failure.
    - .6 Instances which might affect validity of warranty or bond.
  - .4 Except for items put into use with Contract Administrator's permission, leave date of beginning of time of warranty until Date of Total Performance is determined.
  - .5 Verify that documents are in proper form, contain full information, and are notarized.
  - .6 Co-execute submittals when required.
  - .7 Retain warranties and bonds until time specified for submittal.
  - .8 Submit with Contractor's Application for Certificate of Total Performance, warranties and bonds as required, executed in duplicate by subcontractors, suppliers, and manufacturers.
  - .9 For items of Work, where acceptance is delayed materially beyond Date of Total Performance, provide updated submittal within 10 calendar days after acceptance, listing date of acceptance as start of warranty period.

## **1.25 Equipment Installation**

- .1 Intent
  - .1 This Section describes general requirements for all equipment supplied under the Contract relating to the supervision of installation, testing, operation, and performance verification. The Contractor shall be responsible for the supply, installation, testing, operation, and performance verification of the specified equipment.
- .2 Definitions
  - .1 Manufacturer: the manufacturer is the person, partnership, or corporation responsible for the manufacture and fabrication of equipment provided to the Contractor for the completion of the Work.
  - .2 Manufacturer's Representative: the manufacturer's representative is a trained serviceman empowered by the manufacturer to provide installation, testing, and commissioning assistance to the Contractor in his performance of these functions.

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- .3 Expertise and Responsibility
- .1 The Contract Administrator recognizes the expertise of the manufacturer.
- .2 Should the Contract Administrator issue a Field Order, Authorization for Contract Change, or Instruction 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 days.
- .4 Equipment Delivery
- .1 The equipment shall be delivered to the PRPS construction Site to the Contractor who shall be responsible for taking delivery of the equipment. Written acceptance of receipt, at delivery, by the 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 Supplier, Contractor, and Contract Administrator. A duly executed "Certificate of Equipment Delivery" (Form 100) shall be completed. Any minor damage identified during the inspection shall be repaired as per the manufacturer's recommendations by the Contractor at no cost to the City. Any severe damage will be grounds for rejection of the equipment. The severely damaged equipment will be replaced at no cost to the City.
- .2 Ten days before delivery, notice shall be given 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 supplier in the presence of the Contract Administrator and the Contractor.
- .3 The Contractor shall be responsible for receiving, off-loading, and placing into storage all equipment at the Site.
- .4 The Contractor shall ensure that he is fully informed of precautions to be taken in the unloading of equipment and its subsequent storage.
- .5 Installation Assistance
- .1 Before commencing installation of equipment, the Contractor shall arrange for the attendance of the manufacturer's representative to provide instructions in the methods, techniques, precautions, and any other information relevant to the successful installation of the equipment.
- .2 The Contractor shall inform the Contract Administrator, in writing, of the attendance at the Site of any manufacturer's representative for installation training at least 14 days prior to arrival.
- .3 When the manufacturer's representative is satisfied that the Contractor is aware of all installation requirements, he shall so certify by completing Form 101 attached to this Specification.
- .4 The completed form shall be delivered to the Contract Administrator prior to departure of the manufacturer's representative from the Site.
- .5 Installation of the equipment shall not commence until Contract Administrator has advised that he has received the completed Form 101.

.6 Separate copies of Form 101 shall be used for different equipment.

.6 Installation

.1 The Contractor shall install all equipment as defined in the Specifications. If necessary, or if so directed by the Contract Administrator during the course of installation, the Contractor shall contact the manufacturer to receive clarification of installation procedures, direction, or any other additional information necessary to continue or complete the installation in an appropriate manner.

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

.3 Prior to completing installation, the Contractor shall inform the manufacturer and arrange for the attendance at the Site of the manufacturer's representative to verify successful installation.

.4 The manufacturer's representative shall conduct a detailed inspection of the installation including alignment, electrical connections, rotation direction, running clearances, lubrication, workmanship, and all other items as required to ensure successful operation of the equipment.

.5 The manufacturer's representative shall identify any outstanding deficiencies in the installation.

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

.7 When the manufacturer's representative accepts the installation, he shall certify the installation by completing Form 102, attached to this Specification.

.8 Deliver the completed Form 102 to the Contract Administrator prior to departure of the manufacturer's representative from the Site.

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

.10 Provide separate copies of Form 102 for different equipment.

.7 Operation and Performance Verification

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

.2 Inform the Contract Administrator at least 14 days in advance of conducting the tests and arrange for the attendance of the manufacturer's representative. The tests may be concurrent with the inspection of satisfactory installation if mutually agreed by the Contractor and the Contract Administrator.

.3 The manufacturer's representative will conduct all necessary checks to equipment and if necessary, advise the Contractor of any further checking, flushing, cleaning, or other Work needed prior to confirming the equipment is ready to run.

- .4 The Contractor shall then operate the equipment for at least one hour to demonstrate to himself the operation of the equipment and any required ancillary services. Any remedial measures required to ensure satisfactory operation shall be promptly undertaken.
- .5 The Contractor shall then notify the Contract Administrator of his readiness to demonstrate the operation of the equipment. The Contract Administrator shall attend, as expeditiously as possible.
- .6 With the assistance of the manufacturer's representative, the 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 The equipment shall then be run for one hour. Local controls shall 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 manufacturer's recommended limits, whichever is more stringent.
- .8 On satisfactory completion of the one-hour demonstration, the equipment will be stopped and critical parameters, such as alignment, will be rechecked.
- .9 The equipment will be restarted and run continuously for three 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 manufacturer's representative, the Contractor, and Contract Administrator on the basis of the information contained in the Specifications, as well as the methods utilized to create the simulated conditions and the time periods allotted to each.
- .10 Performance tests will be conducted either concurrent with or subsequent to the running test, as practicable and agreed between the Contract Administrator, the manufacturer's representative, and the Contractor.
- .11 Performance tests shall be as dictated in the 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 Contractor shall 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 shall be accepted and handed over to the City prior to the satisfactory completion of the performance tests and receipt of the test reports.
- .13 All water, chemicals, temporary power, heating, or any other ancillary services required to complete the initial demonstration, running test and performance tests are the responsibility of the Contractor.
- .14 Should the initial demonstration, running test or performance tests reveal any defects, then those defects shall be promptly rectified and the demonstration, running tests, and/or performance tests shall be repeated to the satisfaction of the Contract Administrator. Additional costs incurred by the 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, Form 103 attached to this Specification will be signed by the manufacturer's representative, the Contractor, and the Contract Administrator.
- .16 The Contractor shall affix to the tested equipment a 100 mm by 200 mm card reading "Operable Condition - Do Not Operate without Contractor's Permission." stenciled on in large black letters.

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**CERTIFICATE OF EQUIPMENT DELIVERY  
FORM 100**

We certify that the equipment listed below has been delivered into the care of the Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

**PROJECT:** \_\_\_\_\_

**ITEM OF EQUIPMENT:** \_\_\_\_\_

\_\_\_\_\_

**TAG No:** \_\_\_\_\_

**REFERENCE  
SPECIFICATION:** \_\_\_\_\_

\_\_\_\_\_  
(Authorized Signing Representative of the Contractor)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the Sub-contractor)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the Contract Administrator)

\_\_\_\_\_  
Date

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**CERTIFICATE OF READINESS TO INSTALL  
FORM 101**

I have familiarized the installer of the specific installation requirements related to the equipment listed below and am satisfied that he understands the required procedures.

**PROJECT:** \_\_\_\_\_

**ITEM OF EQUIPMENT:** \_\_\_\_\_

**TAG No:** \_\_\_\_\_

**REFERENCE SPECIFICATION:** \_\_\_\_\_

\_\_\_\_\_  
(Authorized Signing Representative of the Manufacturer)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the Sub-contractor)

\_\_\_\_\_  
Date

I certify that I have received satisfactory installation instructions from the equipment Manufacturer / Supplier.

\_\_\_\_\_  
(Authorized Signing Representative of the Contractor)

\_\_\_\_\_  
Date

\_\_\_\_\_

\_\_\_\_\_



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**CERTIFICATE OF SATISFACTORY INSTALLATION  
FORM 102**

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 Manufacturer)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the Contractor)

\_\_\_\_\_  
Date

**CERTIFICATE OF EQUIPMENT SATISFACTORY PERFORMANCE  
FORM 103**

We certify that the equipment listed below has been continuously operated for at least three (3) consecutive days and that the equipment operates satisfactorily and meets its specified operating 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 Manufacturer)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the Sub-contractor)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the Contractor)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the Contract Administrator)

\_\_\_\_\_  
Date

Acknowledgement of Receipt of O&M Manuals.

\_\_\_\_\_  
(Authorized Signing Representative of the City)

\_\_\_\_\_  
Date

## 1.26 Training

### .1 Description

- .1 This Section contains requirements for training the City staff, by persons retained by the Contractor specifically for the purpose, in the proper operation and maintenance of the equipment and systems installed under this Contract.
- .2 Training sessions are required during the equipment testing.
- .3 As a minimum, the Contractor is to allow at least four hours of training per shift, 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 and systems 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.

### .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 factory-trained representatives of the various equipment suppliers with a minimum of two years experience. 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 trainers 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 1.23. For phased testing and start-up activities, separate submittals can be prepared for equipment items or systems. The material will receive a "REVIEWED" or "REVIEWED AS MODIFIED" status by the Contract Administrator no later than four 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, operations and maintenance 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 is to take place in the boardroom in the WEWPCC Boardroom. 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 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 Advise all suppliers providing training sessions that the training material may be videotaped. The City may record each training session, and the material may be edited and supplemented with professionally produced graphics to provide a permanent record for the City's use.
  
  - .8 General Requirements
    - .1 Conduct training in conjunction with the equipment testing period. 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 hours of classes scheduled for any one shift.
    - .2 Provide final O&M Manuals, as defined in Section 1.24, for the specific equipment to the City at least four weeks prior to the start of any training. (Video recording may take place concurrently with all training session).

.9 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.

.10 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.

.11 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.

.12 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.

.13 Equipment and Systems for Training

- .1 Provide training during the equipment testing period for the following equipment and systems:
  - .1 Pump P3
  - .2 Plug valve and actuator
  - .3 Magmeter
  - .4 VFD Drive

- .2 Coordinate and finalize with the Contract Administrator on training schedules and duration of each training session.
- .14 Training Completion Forms and Payment
- .1 Training for the Contract supplied equipment shall be conducted before the operation period as described in Form 103, included in Section 1.25.
  - .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 103 has been completed and signed.
  - .3 Form T1: to be completed for initial training. One (1) form is to be used for each item of equipment or system for which training has been provided.
  - .4 Form T2: to be completed for training during the warranty period. One (1) form is to be used for each equipment/system for which training has been provided.
  - .5 Payment for this Work will be released only when the training has been completed to the City's satisfaction and the respective forms are signed.
  - .6 A sample of Forms T1 and T2 are attached to this Specification Section.

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**CERTIFICATE OF SATISFACTORY TRAINING  
FORM T1**

We certify that the initial training for the equipment listed below has been provided as per the Specifications.

**PROJECT:** \_\_\_\_\_

**ITEM OF EQUIPMENT:** \_\_\_\_\_

\_\_\_\_\_

**TAG No:** \_\_\_\_\_

**REFERENCE SPECIFICATION:** \_\_\_\_\_

\_\_\_\_\_  
(Trainer)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the City)

\_\_\_\_\_  
Date



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**CERTIFICATE OF SATISFACTORY TRAINING  
FORM T2**

We certify that the initial training for the equipment listed below has been provided as per the Specifications.

**PROJECT:** \_\_\_\_\_

**ITEM OF EQUIPMENT:** \_\_\_\_\_

\_\_\_\_\_

**TAG No:** \_\_\_\_\_

**REFERENCE SPECIFICATION:** \_\_\_\_\_

\_\_\_\_\_  
(Trainer)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the City)

\_\_\_\_\_  
Date

## 1.27 Commissioning

### .1 General

- .1 At the time of commissioning, the Contract Administrator shall advise the Contractor of commissioning requirements.
- .2 The Contractor shall refer to all Sections for details on commissioning procedures not included in this Section.

### .2 Intent

- .1 This Section describes the Contractor's responsibilities in commissioning and handover of the process, electrical, and other systems to be installed as part of this Work.

### .3 Definitions

- .1 System: for the purpose of this Specification Section, a system shall be defined as the equipment, piping, controls, ancillary devices, electrical power, etc., which together perform a specific function at the facility.
- .2 Commissioning: for the purpose of this Specification Section, commissioning shall be defined as the successful operation of a system in accordance with its design requirements for a period of 28 days, the last 7 of which shall be consecutive, unless otherwise specified.
- .3 Acceptance: for the purpose of this Specification Section, acceptance shall be defined as the formal turnover of a system to the City for his operation and maintenance. This shall occur after the successful end of commissioning of each system through a formal agreement between the Contract Administrator, the City, and the Contractor. Success of the commissioning period is determined by the Contract Administrator.

### .4 Commissioning Team

- .1 The Work of commissioning will be conducted by the Contractor, the City, and the Contract Administrator.
- .2 The City's appointed staff shall represent process personnel and operating staff.
- .3 The Contractor shall provide personnel representing the appropriate trades, including I&C personnel during the commissioning. These personnel shall be skilled workmen, able to expedite any minor repairs, adjustments, etc., as required to complete commissioning with as few delays as possible.

### .5 Commissioning Plan

- .1 Develop a detailed methodology for the commissioning of each system at least 90 calendar days prior to planned start of commissioning. The plan shall be drafted by the Contractor and reviewed by the Contract Administrator and include the following:

- 
- .1 Detailed schedule of events, including but not limited to the schedule for completion of testing of all component parts of the system in accordance with Section 1.25 prior to commissioning of a system.
  - .2 Method for introducing process flow.
  - .3 Planned attendance schedule for manufacturer's representatives.
  - .4 Contingency plans in the event of a process malfunction.
  - .5 Drawings and sketches as required to illustrate the planned sequence of events.
  - .6 List and details for any temporary equipment required to facilitate Commissioning.
  - .7 List of all personnel required for commissioning and handover with information indicating their qualifications for this Work.
- .2 The commissioning plan shall be reviewed prior to its implementation. The Contract Administrator shall be the final arbiter.
- .6 Equipment
- .1 All process, mechanical, electrical, control, and miscellaneous equipment related to a system shall be successfully installed and tested in accordance with Section 1.25 and any specific requirements noted in other Sections. Form 103 shall be executed for each item.
  - .2 As required in Section 1.24, O&M Manuals will be submitted and then reviewed by the Contract Administrator.
  - .3 Staff training sessions shall be completed.
  - .4 Temporary equipment will be installed and tested as necessary to ensure that it functions reliably and consistently through the commissioning period.
- .7 Controls
- .1 All controls which are the responsibility of this Contractor shall be installed and tested prior to commissioning.
  - .2 The Contract Administrator shall arrange for the simulation of the control sequences from the equipment under this scope, upto and including the terminations within the field termination enclosure (FTE) next to the DCS cabinet. All wiring, termination, verification and commissioning between the FTE and the DCS is by others. Every effort shall be made to ensure that the commissioning period provides for the full and comprehensive operation of the equipment under all anticipated normal and adverse operating conditions.

- 
- .8 Manpower
- .1 Supply all staff required during commissioning as necessary to assist the City's staff in the operation of the station.
  - .2 Supply competent staff capable of maintaining, repairing, and adjusting the equipment and controls to achieve the intended design functions during the commissioning period.
  - .3 Ensure equipment manufacturer's representatives are available as necessary to certify adjustments in equipment, to guide in setting correct operating limits, and to generally provide input as required for the appropriate operation of the equipment.
- .9 Operating Descriptions
- .1 System operating descriptions are included in Appendix C. Other information outlining the operating requirements shall also be available from the Contract Administrator. The Contractor will review these descriptions and will make himself familiar with the requirements in order that he can undertake commissioning in an appropriate manner.
- .10 Design Parameters
- .1 Design parameters for the systems to be commissioned shall be as defined in the Specifications and/or the operating descriptions. The commissioning team will identify to the Contractor, which parameters shall be modified prior to commissioning and shall be responsible for any subsequent changes during the commissioning period.
- .11 Preparation
- .1 Each item of equipment included in the system to be commissioned shall be satisfactorily tested and Form 103 completed.
  - .2 Piping, wiring, and other conduit systems shall be finished and tested.
  - .3 Electrical connections shall be completed and inspected to the satisfaction of the governing authorities.
  - .4 All other regulatory inspections shall be completed to the satisfaction of the governing authorities.
  - .5 Control systems shall be completed and the related control software debugged.
- .12 Sequence
- .1 Systems shall be commissioned in a logical manner. Upstream components shall be commissioned first to the degree possible.

- 
- .2 The following sequence of events shall be followed:
- .1 O&M Manuals shall be available as per the requirements of Section 1.24 at least 14 days prior to the start of commissioning.
  - .2 Draft operating descriptions are included in Appendix C.
  - .3 Initial operator training shall be undertaken two weeks prior to commissioning.
  - .4 Equipment performance tests shall be conducted successfully.
  - .5 Start and run system in manual mode.
  - .6 Turn separate items of equipment to automatic in a planned and logical manner. Ensure that the control system is operating the equipment in a manner which precludes damage of the equipment and which is consistent with the process operating requirements.
  - .7 Commence commissioning period of 28 days. The equipment shall operate continuously and successfully through the last seven days of a commissioning period. Minor failures shall not void the commissioning period. A minor failure is defined as one which does not present a safety hazard, does not impact overall process functioning and can be temporarily overcome by the use of available standby equipment. The last seven days of the commissioning period shall be re-started if a critical failure occurs. A critical failure shall be deemed as one, which prohibits the process from functioning successfully for an eight hour period or one, which creates a safety hazard.
  - .8 Upon completing the commissioning period, the system shall be granted formal acceptance by the Contract Administrator.
- .13 Commissioning
- .1 Water will be introduced to the system in a manner which precludes the damage of any equipment or structures.
  - .2 Twice during the commissioning period, plant component settings will be modified to ensure that the system is subjected to flows and loads as close to design conditions as possible. Where necessary to achieve this, flows to the area being commissioned will be augmented to exaggerate the naturally occurring flows and loads. Where it is necessary to modify settings outside the limits of this Contract area within the plant, coordinate the changes with plant staff.
  - .3 All components and systems shall be operated in the automatic/manual and the remote/local modes as required to prove proper operation.
  - .4 Ensure all bypasses and backup provisions function satisfactorily.
  - .5 All minor and major alarm conditions will be induced to ensure that the process reacts as intended and the applicable alarms are annunciated.

.14 Acceptance

- .1 The commissioning of a system shall be considered acceptable when the process has operated in a stable manner, satisfying the design criteria for a period of 28 days, the last 7 of which shall be continuous and consecutive, unless otherwise specified.
- .2 When a process system has been commissioned satisfactorily, the process system shall be formally accepted for operation and routine maintenance by the City's forces. On successful completion of commissioning, Form 104 - Certificate of Satisfactory Process Performance attached to this Specification will be signed by the representative of the manufacturer, Contractor, Contract Administrator, and the City.
- .3 An acceptance meeting must be held at the end of the 28 day test to confirm the status of each system.
- .4 Notice of Acceptance for the entire project will be granted when all systems have been commissioned and accepted, and all requirements of the General Conditions have been completed.

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**CERTIFICATE OF SATISFACTORY PROCESS PERFORMANCE  
FORM 104**

We certify that the equipment listed below has been operated and tested as per the Specifications using water and that the equipment meets its performance testing criteria. The equipment is therefore classed as "conforming".

**PROJECT:** \_\_\_\_\_

**ITEM OF EQUIPMENT:** \_\_\_\_\_

**TAG No(s):** \_\_\_\_\_

**REFERENCE SPECIFICATION:** \_\_\_\_\_

\_\_\_\_\_  
(Authorized Signing Representative of the Manufacturer)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the Contractor)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the Contract Administrator)

\_\_\_\_\_  
Date

\_\_\_\_\_  
(Authorized Signing Representative of the City of Winnipeg)

\_\_\_\_\_  
Date

---

**PART 1 GENERAL**

**1.1 Intent**

- .1 Provide complete, fully tested and operational mechanical systems to meet the requirements described herein and in complete accord with applicable codes and ordinances.
- .2 In general, Work in this Division includes:
  - .1 Replace pump P3 and related inlet/outlet valves and piping.
  - .2 Replace ultrasonic flow meter with new magmeter.
  - .3 Replace pump P1 discharge plug control valve.
  - .4 Replace 900 mm valve FM-03 with two 450 mm knife gate valves.
- .3 Drawings are diagrammatic. They establish scope, material and installation quality and are not detailed installation instructions.
- .4 Follow Manufacturers' recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .5 Connect to equipment specified in other Sections. Uncrate equipment, move in place, install complete; start-up and test.
- .6 'Provide' shall mean; "supply and install".
- .7 Part C – General Conditions, Part D – Supplementary Conditions, Part E – Specifications and Section 100000 shall apply to Work in Division 23.

**1.2 Co-ordination of Work**

- .1 Make reference to electrical, mechanical and structural drawings when setting out Work. Consult with respective Divisions and the Contract Administrator to ensure valve stem orientations for example are correctly installed. Jointly resolve all conflicts on-site before fabricating or installing any materials or equipment.
- .2 Accuracy of dimensions for new piping, flanges, valves and other equipment items is the Contractor's responsibility. Any fit issues between Site conditions and new materials to be installed remain with the Contractor.
- .3 Where dimensional details are required, collect Site dimensions and coordinate with the applicable structural drawings. An electronic scan of the building has been taken and can be made available to the Contractor if requested. However responsibility for dimensional accuracy remains with the Contractor.

**1.3 Quality of Work**

- .1 All Work shall be by qualified tradesmen with valid Provincial Trade Qualification Certificates.



- .2 Work which does not conform to standards accepted by the Contract Administrator and the trade may be rejected.

#### **1.4 Mechanical Identification**

##### **.1 Summary**

- .1 This section includes:

- .1 Materials and requirements for the identification of piping systems, valves and controllers, including the installation and location of identification systems.

##### **.2 References**

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN.CGSB-24.3, Identification of Piping Systems.

##### **.3 Submittals**

- .1 Product data:
- .2 Submittals: in accordance with Section 100000, item 1.23 - Submittals Procedures.
- .3 Product data to include paint colour chips, other products specified in this section.
- .4 Samples:
  - .1 Submit samples in accordance with Section 100000, item 1.23 - Submittals Procedures.
  - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

#### **1.5 Quality Assurance**

- .1 Quality assurance submittals: submit following in accordance with Section 100000, item 1.23 - Submittals Procedures.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Contractor's COR Safety Program and requirements of authority-having-jurisdiction.

#### **1.6 Delivery, Storage, and Handling**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

- .2 Waste Management and Disposal:
  - .1 Dispose of unused paint and coating material at official hazardous material collections Site approved by Authorities having Jurisdiction.
  - .2 Do not dispose of unused paint and coating material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

### **1.7 Manufacturer's Equipment Nameplates**

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
  - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
  - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

### **1.8 System Nameplates**

- .1 Colours:
  - .1 Hazardous: red letters, white background
  - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
  - .1 3 mm thick white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.

### **1.9 Existing Identification Systems**

- .1 Apply existing identification system to new Work.
- .2 Where existing identification system does not cover for new Work, use identification system specified in this section.
- .3 Before starting Work, obtain written approval of identification system from Contract Administrator.

### **1.10 Manufacturer's Instructions**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

### **1.11 Timing**

- .1 Provide identification only after painting has been completed.

### **1.12 Installation**

- .1 Perform Work in accordance with CAN/CGSB-24.3 except as specified otherwise.

**1.13 Nameplates**

.1 Locations:

.1 In conspicuous location to facilitate easy reading and identification from operating floor.

.2 Protection:

.1 Do not paint or cover.

~End~

## **PART 1 GENERAL**

### **1.1 Scope**

- .1 The scope of this section includes the design, supply, delivery, installation assistance and commissioning of all equipment and appurtenances required for pump P3 and related monitoring system.
- .2 Scope of supply consists of the following major items:
  - .1 Process pump
  - .2 Pump power and control cables of suitable length to reach junction box.
  - .3 Pump monitoring equipment.
  - .4 Installation training.
  - .5 Supervise the installation of the equipment.
  - .6 Supervise equipment performance testing and commissioning.
  - .7 Provide As-Built mark-up drawings documenting all changes made.
  - .8 Provide technical support and remedy defects during the Warranty Period.
  - .9 Any special tools required for equipment maintenance or repair.
  - .10 Maintenance training.
- .3 Include all accessories required to ensure the supplied equipment safely and satisfactorily operates as an integral system as required by the Bid Opportunity.
- .4 Provide any appurtenances or services not specifically mentioned or included in the Contract Documents but which are necessary as part of the Work to ensure that the equipment is fully operational when installed.

### **1.2 Shop Drawings**

- .1 Provide shop drawings showing pump, monitoring equipment, and power and control cable system, including cable support and protection systems.
- .2 Indicate on shop drawings the minimum acceptable motor speed at which pump shall be permitted to operate in order to effectively cool the motor.
- .3 Indicate on shop drawing the minimum and maximum acceptable speed at which the pump can operate continuously without causing cavitation or undue vibration. See system curve attached as Appendix B.

### **1.3 Definitions**

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

- .5 Participation in the performance testing.

#### **1.4 Equipment Delivery**

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

#### **1.5 Installation Support**

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

#### **1.6 Shipment, Protection and Storage**

- .1 Ship, protect, and store equipment in a manner that prevents damage or premature aging.
- .2 Handle pump with suitable lifting equipment.
- .3 Store pump in heated, dry, weather-protected enclosure.

#### **1.7 Warranty**

- .1 Provide 2 year pump warranty from date of substantial performance.

## **PART 2 PRODUCTS**

### **2.1 Acceptable Pump / Motor Manufacturer**

- .1 KSB submersible sewage pump KRT K350-710 suitable for dry pit operation shall be considered an equal product.

### **2.2 Pump Capacity and Performance**

- .1 See also system curve in Appendix B which indicates the conditions under which this pump will operate.
- .2 Acceptable minimum flow shall be 0.115 m<sup>3</sup>/s or less under continuous operating conditions.
- .3 Flow at 17 m total head shall be minimum 0.59 m<sup>3</sup>/s
- .4 Flow at 33 m total head shall be minimum 0.33 m<sup>3</sup>/s.
- .5 Shut-off head at full flow shall be minimum 42 m.
- .6 With the wet well full and only P3 running, the system total head could drop as low as 14m (46ft). Under this condition the pump's NPSHr shall not exceed 11m.
- .7 With the wet well at its lowest level, and only P3 running, the system head can increase to an estimated 17m. Under this condition the pump's NPSHr shall not exceed 8m.
- .8 Pass 100 mm solids.
- .9 Maximum 700 RPM pump operation.
- .10 Suitable for continuous operation at variable speeds.
- .11 Suitable for operating in air or water.
- .12 Pump shall not overload the 250 HP motor at any point on its operating curve.

### **2.3 Pump Motor**

- .1 Maximum 250 HP heavy duty service suitable for inverter duty and for use with a variable speed drive.
- .2 Motor casing: Grey Coat Iron ASTM A48 Class 35B.
- .3 Squirrel cage induction type. Suitable for continuous operation.
- .4 For starting and torque characteristics, conform to Electrical and Electronic Manufacturers Association of Canada (EEMAC) Design B.
- .5 Provide motor nameplate rated for 575 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 1.15 shall run at not more than 100% of nameplate current rating.
- .7 Design motors for operating in an ambient air temperature of 40°C.
- .8 Design the pump control / monitoring system with solid modules for monitoring motor stator high temperature, high bearing temperature and moisture sensing / water intrusion into the stator housing and seal chamber.

- .9 Provide sealed ball bearing type bearings with an Anti-Friction Bearing Manufacturers Association (AFBMA) B10 life of 100,000 hours at 65% of the pump's best operating point. Top bearing shall be lubricated for life, and the lower pump side bearing shall be regreasable.
- .10 Motor starter insulation shall be minimum Class H insulation rated for 180°C.
- .11 Motor temperature monitors shall shut down the motor on high temperature indication.
- .12 Discharge motor heat to pumped fluid via an intermediate cooling fluid media.
- .13 Provide 304 or 316 stainless steel hardware.
- .14 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.

#### **2.4 Motor Power and Control Cables**

- .1 Supply submersible motors with cable, of a minimum length to reach the pump's junction box. The motor and cables shall 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.
- .6 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.
- .7 Use cable rated for 90°C.
- .8 Provide sufficient strain relief to prevent the cable from pulling out when handling, installing or operating the pump.

#### **2.5 Pump Detailed Specifications**

- .1 Grey cast iron ASTM A48 Class 35B casing and impeller. Provide both with 316 stainless steel wear rings.
- .2 Fabricate all exposed nuts and bolts of 304 stainless steel.
- .3 Non-clogging multi vane K-Type balanced impeller. Impeller shall be free from imperfections.
- .4 Use single piece stainless steel shaft and protective sleeve.
- .5 Completely isolate the shaft from the pumped liquid.
- .6 Provide bearings with a minimum Anti-Friction Bearings Manufacturers Association (AFBMA) B10 bearing life of 100,000 hours minimum at 65% of the pumps best operating point.
- .7 Provide non proprietary silicon carbide shaft seals or equal between the impeller and the motor.

- .8 Design the pump 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.
- .9 Seal the lower terminal board from the motor by an elastomer compression seal (O-ring) so that it is leakproof.
- .10 Provide a pump control status monitoring system. The motor starter, disconnect switch, and other power ancillaries will be provided by Division 26.
- .11 Design the pump control/monitoring system with solid state modules for monitoring motor stator high temperature, high temperature on both the lower and upper bearings, and moisture sensing if either the upper or lower mechanical seals leak.
- .12 Integral vibration sensor.
- .13 Control system shall have capabilities equal to KSB PMS (pump monitoring system).
- .14 As the pump will rotate in reverse on occasion, the impeller shall be secured to ensure it does not loosen under this condition.
- .15 Motor cooling liquid shall not freeze at temperatures down to -10°C.
- .16 Pump support angles / rails suitable for inserting into the pump concrete base and to accommodate pump fastening nuts and bolts as required. Provide stainless nuts and bolts.
- .17 Pump mounting base plate to suit inlet elbow/pump discharge orientation.
- .18 Any special tools required to monitor or disassemble and reassemble the pump.
- .19 Nuts and bolts: 316 Stainless Steel.
- .20 Back pull out design that permits the entire rotating assembly to be removed from the casing.
- .21 Stainless steel nameplate indicating manufacturer's name, year of manufacture, pump type, serial number and principle rating data.
- .22 Paint the pump/motor unit with a 2 component epoxy finish having minimum 83% solids by volume and approved for wastewater application.

## **2.6 Factory Tests**

- .1 Perform the following inspections and tests before shipment from the factory.
  - .1 Test motor and cable insulation for defects.
  - .2 Develop a certified test curve (per Hydraulic Institute Class A standards) showing performance curves for the pump at minimum speed, and maximum speed, from shut-off head down to 10 m total head. Include amperage and power values for the fall length of each curve.
  - .3 Repeat the insulation tests after the operational test.
- .2 Document the tests and submit the results.

## **2.7 Pump Base Elbow**

- .1 600 x 350 grey cast iron long radius elbow.
- .2 Minimum 100 mm diameter access opening suitable for visual and hand access to bottom side of impeller. Flush on inside of elbow and sealed with an O-ring.



- .3 Shop primer is not required.

## **2.8 Pump Performance On-Site Testing**

- .1 Once the pump and related controls are operational, test performance of pump under minimum and maximum flow and head conditions.
- .2 Operate the pump at minimum flow / RPM and maximum head condition for 2 hours. Check for abnormal operation. This test will not occur during regular working hours.
- .3 Operate the pump at full flow / speed and minimum head (full wet well) conditions for 2 hours. Check for abnormal operation.
- .4 Document the following for each test and submit in a written report:
  - .1 Motor amperage
  - .2 Voltages on each power leg
  - .3 Flow
  - .4 Head

## **2.9 Maintenance Tools**

- .1 Provide:
  - .1 Impeller puller;
  - .2 Mechanical seal jig for seal installation;
  - .3 Two special eye bolts for lifting the outer jacket; and
  - .4 Outer jacket installation jig.

## **2.10 Training**

- .1 Provide a qualified KSB maintenance instructor to provide a minimum of 4 hours training. Training shall be a combination of classroom time and a trip to the pumping station to view the actual pump installation.
- .2 Training shall include;
  - .1 Electrical and instrumentation/controls;
  - .2 A review of recommended maintenance procedures for the pump;
  - .3 Procedures for replacement of each pump wear component including the wear rings, impeller, bearings, and seals; and
  - .4 Instruction on use of the maintenance tools provided.

~End~

## **PART 1        GENERAL**

### **1.1        Scope**

- .1        This section includes the demolition of existing pump P3, and various valves and piping required to complete the project Work. It also includes the supply and installation new valves, piping and related materials required to complete project Work.

### **1.2        Shop Drawings**

- .1        Provide complete shop drawings of all valves, and other materials provided for this project.

### **1.3        Piping Standard**

- .1        Piping fabrication and installation shall be in accordance with ASME B31.3

## **PART 2        PRODUCTS**

### **2.1        Knife Gate Valves**

- .1        Dezurik, Fabri or equal in accordance with B6.
- .2        Dezurik. KGC Cast stainless steel (SS) valves.
- .3        Body – 304 SS. Complete with tapped lugs, cast gate guides and bottom jam to hold gate in position.
- .4        Gate 304 SS.
- .5        Gland / 6 bolt / washer / nut – SS.
- .6        Packing cord – acrylic PTFE coated.
- .7        Removable seat – chloroprene, NBR or Buna N. To provide leak tight seal to 50 PSI in both directions.
- .8        Yoke – SS.
- .9        Bevel gear and handwheel.
- .10       Purge ports in seat and chest area.
- .11       Provide 50 mm (2") nut at handwheel to permit powered operation without removing handwheel.
- .12       Locking device not required.
- .13       Replace bevel gear and handwheel with 480 kPa (70 psi) pneumatic on-off actuator where shown on the drawings. Pneumatic actuator shall include two position electric indicating switches mounted to indicate valve full open or full closed position. Actuator shall open or close valve in less than 30 seconds.
- .14       Double acting, air to open, air to close pneumatic actuator.

- .15 4 way solenoid valve with manual override operation capability if power is off.
- .16 Factory pressure test each valve.

## **2.2 Plug Valves (P1-02, P3-02)**

- .1 Milliken, Dezurik or equal in accordance with B6.
- .2 Milliken eccentric full port plug valves rated for 1030 kPa (150 psi) with flanged end connections.
- .3 Cast iron body.
- .4 Nickel seat.
- .5 Permanently lubricated 316 SS bearings located in the body and bonnet, along with upper and lower PTFE thrust washers.
- .6 Cast iron plug with face covered in a nitrite elastomer providing tight shut-off.
- .7 General cast iron / steel construction.
- .8 Suitable for operation in both directions of flow.
- .9 Provide Morin Series B or equal in accordance with B6, pneumatic actuators including the following features:
  - .1 Size actuator for line pressure of 480 kPa (70 psi).
  - .2 Double acting, air to open, air to close pneumatic actuator.
  - .3 4 way solenoid valve with manual override operation capability if power is off.
  - .4 Valve position monitor.
  - .5 Opening to permit visual confirmation of both actuator and valve shaft position.
  - .6 2-120 V water tight switches to permit full open / closed indication.
  - .7 Nema 4 electric rating.
  - .8 Design actuator system to open / close valve in a minimum of 5 seconds. Provide needle valve or other means to permit closing rate adjustment.

## **2.3 Plug Valves (P2-02)**

- .1 Replace 2 – 3 way solenoid valves with one 4-way solenoid valve so that the P2 valve will operate in the same way as the new P1 and P3 plug valves.
- .2 Provide additional set of limit switches for valve P2-02 to permit open/closed indication.

## **2.4 Sewage Pipe and Fittings**

- .1 Pipe: Standard weight carbon steel, seamless, ASTM A-106, Grade B.
- .2 Fittings: Standard weight butt welding, steel, ASTM A234 WPB.
- .3 Flanges 3" to 24": 150 lb raised face weld neck flanges, ASTM A105, ANSI B16.5.
- .4 Flanges over 24": ANSI B16.47 Series A.

- .5 Use flat faced flanges when connecting to flat faced flanges on equipment or in-line items.
- .6 Elbows: Unless noted otherwise elbows shall be standard long radius fittings.
  - .1 Pump P3 discharge elbow will have to be a custom 4 section mitered increasing elbow flanged directly to the pump.
  - .2 The new magmeter discharge increasing elbow shall be a 4 section fabricated elbow.
- .7 Existing Victaulic coupling joints where one pipe end is being replaced, will require a continuously welded raised joint Victaulic coupling in order to connect new pipe to existing.
- .8 Bolts: Grade 5, Hex semifin U.N.C. bolt, c/w semifin hex nut and flat washer (zinc plated).
- .9 Gaskets: Neoprene or equal.
- .10 Conform to most recent ANSI/ASTM Standards applicable to project Work.
- .11 Nipples 2" and under: Schedule 80 CS, SML5, A106-B.
- .12 Fittings 2" and under: NPT, 3000 lb, A105.

## **2.5 Flexible Connector**

- .1 Use ROMAX XR501 or equal in accordance with B6.
- .2 Ductile iron construction with steel bolts.
- .3 SBR rubber seal.
- .4 Shop coat primer not required.
- .5 Provide adjustable restraint bolts across the flexible connector as shown on the drawings and as recommended by the supplier.

## **2.6 Pipe Supports**

- .1 Use Standon Model S92 saddle supports or equal in accordance with B6 support system.
- .2 All 304 SS construction.
- .3 Provide neoprene liner on pipe saddle.
- .4 Install as per manufacturer's instructions.
- .5 Provide 304 Schedule 40 SS extension pipe to complete the support assembly.
- .6 Once adjusted to the correct height and the pipe is fully supported, tack weld in place as specified by supplier.

## **2.7 Painting**

- .1 Provide a 5 year warranty from project substantial performance date for entire painting system.
- .2 Paint the following both inside and outside.

- .1 Pump P3 inlet elbow (supplied by pump supplier).
  - .2 Pump P3 new suction and discharge piping.
  - .3 Pump P3 suction and discharge flexible connectors.
  - .4 Pump P1 plug valve upstream spool piece.
  - .5 New magmeter piping.
  - .6 New piping related to removal of 900 mm FM-03 gate valve.
  - .7 New Victaulic couplings.
- .3 For painting pipe interior, use Devoe Devgrip 238 abrasion resistant coating or equal on products listed in Item .2 above.
  - .4 Conform to Devoe and Intergard requirements regarding:
    - .1 Surface preparation including sand blasting.
    - .2 Conditions under which painting system can be applied.
    - .3 Prime and final coat thicknesses.
  - .5 For painting piping material exterior surface, use prime coat Interzinc 52 (2.5 mil) and then apply a finish coat Intergard 345 high build epoxy (6 mil) or equal in accordance with B6.
  - .6 Confirm exterior finish coat colour with the Contract Administrator before proceeding.
  - .7 Perform surface preparation and painting off site. Then deliver finished products to the Site for final assembly. Only touch-up surface preparation and painting will be permitted on-site.
  - .8 Handle piping with care during delivery to Site, storage and installation so as to minimize touch-up required.
  - .9 After piping system installation is complete, touch up paint to original condition.
  - .10 Do not paint on raised flange faces where gaskets will be applied.

## **2.8 Victaulic Couplings**

- .1 Where new couplings are required at an interface with an existing raised Victaulic joint, use the appropriate coupling to accommodate the existing joint. Weld a raised steel ring to the new pipe section as required to accommodate the new Victaulic coupling.
- .2 New couplings: Use Victaulic AGS (advanced groove system) W07 rigid couplings. Install as per manufacturer's instructions.
- .3 Paint the couplings with the same paint system specified for the remainder of the piping system.
- .4 Gaskets: Use Grade T Nitrile.
- .5 A Victaulic factory trained representative shall provide on-site training for Contractor's field personnel in the use of grooving tools and installation of grooved joint products. Victaulic's representative shall visit the jobsite and review installation. Contractor shall correct any joints deemed improperly installed.

## **2.9 Compressed Air Piping**

- .1 Use schedule 40 galvanized piping.

## **PART 3 EXECUTION**

### **3.1 Existing Concrete Supports for Pump and Pipe**

- .1 Remove existing supports where indicated on the drawings.
- .2 Saw cut supports flush with the existing floor using water to contain dust and debris to the immediate Work area. Do not use jack hammers.
- .3 Remove all debris from the Site.

### **3.2 Demolition**

- .1 Remove all demolition materials promptly from the Site.
- .2 Also remove any residual sewage solids remaining inside pipe to be removed.
- .3 Existing piping to be removed to accommodate the new magmeter will have to be cut into pieces to permit it to be removed over the existing main pump discharge header.
- .4 The new 90° elbow downstream of the new magmeter can be lifted over the main pump discharge header, if the existing FM03 valve stem and actuator above are cut off and removed. This will permit the elbow (and other new pipe fittings) to be slipped into this Work area by sliding them over the existing magmeter. Repair to existing hand railing will also be required.

### **3.3 Pipe Handling**

- .1 Inspect each pipe and fitting prior to installation. Do not install damaged pipe or pipe with damaged protective coatings.
- .2 Remove all foreign matter from inside of pipe prior to installation.
- .3 Repair pipe with damaged protective coatings with material similar to the original in accordance with the manufacturer's directions and to the satisfaction of the Contract Administrator.
- .4 Use proper implements, tools, and facilities for the proper protection of the pipe. Exercise care in the installation so as to avoid damage to pipe or coatings.
- .5 Provide temporary supports as necessary during construction to prevent overstressing of equipment, valves, or pipe.

### **3.4 Pipe Stress**

- .1 Fabricate and assemble pipe runs so that the pipework is not stressed to achieve the desired alignment and that no stresses are transferred to equipment or equipment flanges. The "springing" of pipework to ensure alignment is not permitted. Undo and subsequently remake all pipework connections to ensure that springing does not occur. Take care not to damage equipment, valves, or flanges.

### 3.5 Mild Steel Piping

- .1 Use manual shielded metallic arc welding (SMAW), submerged arc welding (SAW), or inert gas shield arc welding (GMAW) or gas tungsten arc welding (GTAW).
- .2 Welding procedures shall conform to CSA Z183.
- .3 Butt-weld according to ASME Boiler and Pressure Vessel Code. Flanges shall conform to ANSI B16.5, Class 150.
- .4 Bevel plain pipe ends prior to welding.
- .5 Clean and dry welding surfaces thoroughly prior to welding, in an area not less than 0.3 m wide on each side around the welding line.
- .5 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.
- .6 Maintain flanges, pipes, fittings, etc., in alignment during welding. Ensure that no part of the weld is offset by more than 20 percent of the pipe wall thickness.
- .7 Make tack welds of material equal to the root pass. Tack welds which have not cracked may be incorporated in the root pass.
- .8 Ensure the first bead obtains full root penetration with a minimum of weld materials projecting within the pipe.
- .9 Between passes, visually inspect bead for pinholes or other defects. Repair any defects prior to the placement of the next pass.
- .10 Clean all flux, slag and other foreign material from the weld prior to applying a successive bead, and on completion of the weld.
- .11 Do not start successive passes at the same point.
- .12 Completely fill the joint with weld, and have reinforcement greater than 1.5 mm and less than 3.0 mm, with no undercutting at the weld edges.
- .13 Provide a smooth surface for coating application to exterior surfaces of pipe. Grind or buff all welds to a minimum radius of 6 mm on all edges and corners. Adhere to latest edition of NACE RP0178.
- .15 Repair linings and coatings after welding.

### 3.6 Flanged Joints

- .1 Clean flanges and gaskets prior to connection.
- .2 Lubricate gaskets with soapy water and apply anti-seize compound to the bolts.
- .3 Bring flanges into close parallel and lateral alignment.
- .4 Tighten bolts progressively. Proceed from side to side of the flange.
- .5 Washers may not be used to take up excess bolt length.
- .6 Provide approximately two full threads bolt projection beyond nuts.
- .7 When joining steel to cast iron flanges, take care to avoid damage to the cast iron flange. Ensure both flanges are flat-faced and use full face gaskets.
- .8 Align flanges which connect piping to mechanical equipment to close parallel and lateral alignment prior to tightening bolts. Do not place undue strain on the equipment.

### 3.7 Instrument Air Connections

- .1 Provide instrument air connections to each valve actuator with 13 mm galvanized steel piping from the nearest instrument air header to within close proximity of each device requiring instrument air.
- .2 Support piping using stainless steel supports fastened to the concrete structure (See piping for existing valve P2-02).
- .3 Terminate each instrument air supply pipe with a 13 mm ball valve (stainless steel), and an in-line oil filter within 1500 mm horizontal distance of the device and 1500 mm off the floor.
- .4 Run 690 kPa (100 psi) rated 13 mm rubber hosing to the valve actuator.
- .5 Provide a vertical riser connection at the header to avoid condensate entrainment. From the top of the riser, slope the tubing generally down to the device.
- .6 Compressed air tie-ins will have to be made during shut-down 3 (see Appendix A) to avoid interfering with station operation.

### 3.8 Testing

- .1 New compressed air piping –. Wet all joints using a mixture of soap and water in systems tested with air. Remake all joints which display leakage and retest.
- .2 All new sewage piping joints and nearby joints that leak following completion of project Work shall be repaired to stop all leakage. The Contractor shall resolve any leakage observed prior to the end of the warranty period.

~End~



## **PART 1 - GENERAL**

### **1.1 Summary**

- .1 Section Includes:
  - .1 General requirements for Control Systems that are common to NMS Control Sections.
- .2 Related Sections:
  - .1 Section 25 05 54 - Controls: Identification.
  - .2 Part C – General Conditions, Part D – Supplementary Conditions, Part E – Specifications and Section 10 00 00 shall apply to Work in Division 25.

### **1.2 References**

- .1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).
  - .1 ANSI/ISA 5.5-1985, Graphic Symbols for Process Displays.
- .2 American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).
  - .1 ANSI/IEEE 260.1-1993, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).
- .3 Canadian Standards Association (CSA International).
  - .1 CAN/CSA-Z234.1-89(R1995), Canadian Metric Practice Guide.
- .4 Electrical and Electronic Manufacturers Association (EEMAC).
  - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).

### **1.3 System Description**

- .1 The controls shall include but not be limited to:
  - .1 Station discharge valves (FV-M601 and FV-M651)
  - .2 Station discharge magnetic flowmeters (FIT-M600 and FIT-M650)
  - .3 Station dry well high level alarm (LSH-620)
  - .4 Pump M100 discharge valve (FV-M100)
  - .5 Pump M200 discharge valve (FV-M200)
  - .6 Pump M300 discharge valve (FV-M300)
  - .7 Pump M300 new VFD and other protection
  - .8 Pump M100 and M200 control modifications to suit there respective discharge valves.
  - .9 Well water Pump M810
  - .10 Termination of control wiring to terminals within existing field termination section.

#### **1.4 Scope of Control Work**

- .1 The Contractor shall engage a factory trained representative to supervise the installation, setup, calibrate and operationally verify and commission the following:
  - .1 VFD's
  - .2 Magnetic Flowmeters
- .2 The Contractor shall provide a certified instrument technician in order to operate all field devices that are wired to the field termination section in order for City of Winnipeg staff to verify the loop is correctly wired.
- .3 The Contractor shall submit written reports identifying the commissioning work, together with any parameter settings and final adjustments.
- .4 The Contractor is only responsible for termination to the terminals within the field termination section next to the DCS cabinet. All DCS cabinet wiring and programming is to be completed by the City of Winnipeg.

#### **1.5 Submittals**

- .1 Make submittals in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.
- .2 Submit for review:
  - .1 Equipment list and systems manufacturers 10 days after award of contract.

#### **PART 2 - PRODUCTS**

- .1 Not Used

#### **PART 3 - EXECUTION**

##### **3.1 Manufacturer's Recommendations**

- .1 Installation: to manufacturer's recommendations.

##### **3.2 Painting**

- .1 Painting: as follows:
  - .1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.
  - .2 Restore to new condition, finished surfaces too extensively damaged to be primed and touched up to make good.
  - .3 Clean and prime exposed hangers, racks, fastenings, and other support components.
  - .4 Paint unfinished equipment installed indoors to EEMAC 2Y-1.

~End~

## **PART 1 - GENERAL**

### **1.1 Summary**

- .1 Section Includes.
  - .1 Requirements and procedures for identification of devices, sensors, wiring tubing, conduit and equipment, the Control System Work and nameplates materials, colours and lettering sizes.
- .2 Related Sections.
  - .1 Section 25 05 01 - Controls: General Requirements.
  - .2 Section 26 05 01 - Common Work Results - Electrical.
  - .3 Part C – General Conditions, Part D – Supplementary Conditions, Part E – Specifications and Section 10 00 00 shall apply to Work in Division 25.

### **1.2 References**

- .1 Canadian Standards Association (CSA International).
  - .1 CSA C22.1-06, The Canadian Electrical Code, Part I (20th Edition), Safety Standard for Electrical Installations.

### **1.3 Definitions**

- .1 For acronyms and definitions refer to Section 25 05 01 - Controls: General Requirements.

### **1.4 System Description**

- .1 Language Operating Requirements: provide identification for control items in English.

### **1.5 Submittals**

- .1 Submit to Contract Administrator for approval samples of nameplates, identification tags and list of proposed wording.

## **PART 2 - PRODUCTS**

### **2.1 Nameplates for Panels**

- .1 Provide panel identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Nameplate for each panel size 4 engraved as indicated.
- .3 Nameplate for each panel mounted device size 2 engraved as indicated.

### **2.2 Nameplates for Field Devices**

- .1 Provide field device identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Nameplate for field device size 7 engraved as indicated.
- .3 Nameplate shall be attached by chain.

### **2.3 Wiring**

- .1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.
- .2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.
- .3 Power wiring: identify circuit breaker panel/circuit breaker number inside each control panel.

### **2.4 Pneumatic Tubing**

- .1 Numbered tape markings on tubing to provide uninterrupted tracing capability.

## **PART 3 - EXECUTION**

### **3.1 Nameplates and Labels**

- .1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

### **3.2 Existing Panels**

- .1 Correct existing nameplates and legends to reflect changes made during Work.

~End~

## **PART 1 - GENERAL**

### **1.1 Summary**

- .1 Section Includes:
  - .1 Instrumentation devices integral to the Control System: transmitters, sensors, controls, meters, switches, dampers, damper operators, valves, valve actuators, and low voltage current transformers.
  - .2 Related Sections:
    - .1 Section 10 00 00 – General Requirements
    - .2 Section 25 05 01 - Controls: General Requirements.
    - .3 Section 25 05 54 - Controls: Identification.
    - .4 Section 26 05 01 - Common Work Results - Electrical.
    - .5 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings
    - .6 Section 26 27 26 - Wiring Devices.
    - .7 Part C – General Conditions, Part D – Supplementary Conditions, Part E – Specifications and Section 10 00 00 shall apply to Work in Division 25.

### **1.2 References**

- .1 American National Standards Institute (ANSI).
  - .1 ANSI C12.7-1993(R1999), Requirements for Watthour Meter Sockets.
  - .2 ANSI/IEEE C57.13-1993, Standard Requirements for Instrument Transformers.
- .2 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM B148-97(03), Standard Specification for Aluminum-Bronze Sand Castings.
- .3 National Electrical Manufacturer's Association (NEMA).
  - .1 NEMA 250-03, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .4 Canadian Standards Association (CSA International).
  - .1 CSA-C22.1-06, Canadian Electrical Code, Part 1 (20th Edition), Safety Standard for Electrical Installations.

### **1.3 Definitions**

- .1 Acronyms and Definitions: refer to Section 25 05 01 - Controls: General Requirements.

### **1.4 Submittals**

- .1 Submit shop drawings and manufacturer's installation instructions.
- .2 Pre-Installation Tests.
  - .1 Submit samples at random from equipment shipped, as requested by Contract Administrator, for testing before installation. Replace devices not meeting specified performance and accuracy.
- .3 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions for specified equipment and devices.

## **PART 2 - PRODUCTS**

### **2.1 General**

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant assembly.
- .3 Operating conditions: 0 - 32 degrees C with 10 - 90 % RH (non-condensing) unless otherwise specified.
- .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.
- .6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.

### **2.2 18 inch Magnetic Flow Meter and Transmitter**

- .1 Magnetic Flow Meter Requirements (FE-M650):
  - .1 Magnetic Flowmeter Flow tube,
  - .2 Lining Material: Polyurethane,
  - .3 Electrode Material: 316L Stainless Steel,
  - .4 Electrode Type: Standard, Two Measurement Electrodes,
  - .5 Line Size: 18 inches (450mm),
  - .6 Housing (electrode): Sealed, Welded Housing,
  - .7 Safety Approvals: FM/CSA Class 1, Div.2 Approval.

Approved Manufacture; Rosemount Model 8705PSA180S1W0N0.

- .2 Remote Magnetic Flow Transmitter Meter Requirements (FIT-M650):
  - .1 Remote Magnetic Flow Meter,
  - .2 Transmitter Class: Standard,
  - .3 Surface mount
  - .4 Power supply: AC (90 to 250V AC, 60Hz),
  - .5 Outputs: 4-20 mA Digital Electronics (HART Protocol),
  - .6 Safety Approvals: FM/CSA Class 1 Div. 2,
  - .7 Display Option: Local Operator Interface (LOI)

Approved Manufacture; Rosemount Model 8712ESR1A1N0M4.

## 2.3 Electromechanical Relays

### .3 Requirements:

- .1 Double voltage, DPDT, plug-in type with termination base.
- .2 Coils: rated for 120 Vac or 24 Vdc. Other voltage: provide transformer.
- .3 Contacts: rated at 5 amps at 120 Vac.
- .4 Relay to have visual status indication

## 2.4 Watthour Meters and Current Transformers

### .1 Requirements:

- .1 Include three phases, test and terminal blocks for watthour meter connections and connections for monitoring of current. Accuracy: plus or minus 0.25 % of full scale.
- .2 Watthour meter sockets: to ANSI C12.7.
- .3 Potential and current transformers: to ANSI/IEEE C57.13.
- .4 Potential transformers: provide two primary fuses.
- .5 Demand meters: configure to measure demand at 15 minute intervals.

## 2.6 Panels

- .1 Free-standing or wall mounted enamelled steel cabinets with hinged and key-locked front door as indicated on drawings.
- .2 Multiple panels as required to handle requirements with additional space to accommodate 25% additional capacity as required by Contract Administrator without adding additional cabinets.
- .3 Panels to be lockable with same key.

## 2.7 Wiring

- .1 In accordance with Section 26 27 26 - Wiring Devices.
- .2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.
- .3 Wiring must be continuous without joints.
- .4 Sizes:
  - .1 Field wiring to digital device: #14 AWG Teck 90 Cu or RW90 Cu in conduit in accordance with Section 26 05 26 - Conduits, Conduit Fastenings and Conduit Fittings.
  - .2 Analog input and output: shielded #18 minimum stranded twisted pair ACIC Cu.

## PART 3 - EXECUTION

### 3.1 Installation

- .1 Instrument components are not specifically located on drawings, but located on drawings in the general vicinity. The instrument components shall be field located as defined by mechanical piping and in accordance with the following:

- .1 Instrument components shall not be attached to vibrating equipment, but shall be remotely mounted to a solid structure or on approved instrument mounting stands.
  - .2 Location of instruments, when shown on the drawings, is only approximate. The Contractor is responsible for actual location of field devices and must avoid interferences between conduit, pipes, equipment and instruments while providing maximum accessibility.
  - .3 Locate instruments components at eye level and in an easily accessible location.
  - .4 Instrument components that must be removed for servicing shall be installed with re-usable connectors, unions and flexible conduit.
  - .5 Electrical connections and terminations for field instruments and other field devices shall be in strict compliance with the manufacturer's instructions and loop drawings. This will include wire, wire termination, labelling, rigid and flexible conduit, fittings, and seals where required.
- .2 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
  - .3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.
  - .4 Support field-mounted panels, transmitters and sensors on wall or pipe stands with approved mounting brackets or stands at a nominal height of 1.4 meters off floor.
  - .5 For instruments with pre-terminated cable lengths provide a junction box as close as practical to connect with armoured cable or cable in conduit.
  - .6 Allow for a variation of 3 meters from locations of devices as shown on drawings without extra cost provided pertinent information is provided prior to installation. Exact location will be determined by the installation of piping and mechanical equipment.
  - .7 Threaded fastenings for mounting instrument components shall have either lock nuts or double nuts.
  - .8 Cover locally mounted instrument components, after installation, with plastic bags to protect them from dust, dirt, paint spray, insulation materials, etc. Protect from mechanical damage.
  - .9 Set output pressure of local air sets to pressure recommended for instrument to which it is to be connected.
  - .10 Independently support solenoids, regulators or similar control devices on solid, vibration free structures and not on control valves. Minimize load on pneumatic tubing.
  - .11 Field instruments located out doors shall be winterized to prevent process or measurement fluids from freezing. The use of steam or electrical tracing, fill fluids, or enclosures will be shown on the Installation Detail drawings.
  - .12 All instrument signal wiring and 120 Vac wiring shall be run by the Contractor from the field instrument to the field device as shown on the loop drawings. This includes wiring, rigid and flexible conduit, fittings and seals where shown. Conduit penetrations are not permitted into the top of any field junction box.
  - .13 Electrical:
    - .1 Provide and route all instruments, power and control signal cabling.



- .2 Complete installation in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .3 Refer to electrical control schematics included as part of control design schematics on drawings. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by Contract Administrator before beginning Work.
- .4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
- .5 Install communication wiring in conduit.
  - .1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).
  - .2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
  - .3 Maximum conduit fill not to exceed 40%.
  - .4 Design drawings do not show conduit layout.
- .6 Install conduit systems in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

### **3.2 Instrument Supports**

- .1 Clean and paint fabricated galvanized carbon steel mounting stands and brackets.
- .2 Before a mounting stand is attached to a concrete floor the surface of the concrete to be in contact with grout shall be roughed and cleaned of all dirt, oil, grease and loose material.

### **3.3 Temperature and Humidity Sensors**

- .1 Stabilize to ensure minimum field adjustments or calibrations.
- .2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.

### **3.4 Panels**

- .1 Arrange for conduit and tubing entry from bottom or either side.
- .2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.
- .3 Identify wiring and conduit clearly.

### **3.5 Calibration Tagging**

- .1 When satisfactorily inspected and calibrated, the item shall have a tag affixed to it in an immediately visible location, which shall indicate that the device has been calibrated, by whom and the date of the calibration. Calibration procedures and records shall be available to the Contract Administrator throughout the course of the project and shall be delivered to the Contract Administrator upon the completion of Work.

### **3.6 Identification**

- .1 All field-mounted instrument items shall have an approved identification tag permanently attached by the Contractor upon completion of the initial inspection and calibration. This tag shall reflect the device's identification as shown on the appropriate drawing.

- .2 The tag will be permanently attached to the instrument with screws, rivets, or stainless steel or Monel wire, as appropriate. If an instrument is inside a protective enclosure or mounted behind a panel, instrument identity tags shall be mounted twice, once on the instrument and again on the enclosure. All instruments mounted on a control panel shall have an identity tag mounted on the instrument body and again on the face of the panel below the instrument face.
- .3 Identify field devices in accordance with Section 25 05 54 - Controls: Identification.

### **3.7 Testing and Commissioning**

- .1 Calibrate and test field devices for accuracy and performance.

~End~

## **PART 1 - GENERAL**

### **1.1 Related Sections**

- .1 This section covers items common to sections of Division 26.
- .2 The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.
- .3 Part C – General Conditions, Part D – Supplementary Conditions, Part E – Specifications and Section 10 00 00 shall apply to Work in Division 26.

### **1.2 References**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.1-06, Canadian Electrical Code, Part 1 (20th Edition), Safety Standard for Electrical Installations.
  - .2 CAN3-C235-83(R2000), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
  - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
  - .2 EEMAC Y1-1-1955, Equipment Green Colour for Outdoor Electrical Equipment.
- .3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
  - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

### **1.3 Definitions**

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

### **1.4 Design Requirements**

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
  - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates and labels for control items in English.

### **1.5 Submittals**

- .1 Part C – General Conditions, Part D – Supplementary Conditions, Part E – Specifications and Section 10 00 00 shall apply to Work in Division 26.
- .2 Submit for review single line electrical diagrams and locate under plexiglass as indicated.
  - .1 Electrical distribution system in main electrical room.
- .3 Shop drawings in accordance with the City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Provinces of Manitoba, Canada.
  - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
  - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
  - .4 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
  - .5 Submit copies of 600 x 600 mm minimum size drawings and product data to authority having jurisdiction.
  - .6 If changes are required, notify Contract Administrator of these changes before they are made.
- .4 Quality Control
- .1 Provide CSA certified equipment and material. Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction for special approval before delivery to Site.
  - .2 Submit test results of installed electrical systems and instrumentation.
  - .3 Permits and fees: in accordance with General Conditions of contract.
  - .4 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
  - .5 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Contract Administrator.
- .5 Manufacturer's Field Reports: submit to Contract Administrator manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

## 1.6 Quality Assurance

- .1 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices as per the conditions of Provincial Act respecting manpower vocational training and qualification.
  - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
  - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

## 1.7 Delivery, Storage and Handling

- .1 Material Delivery Schedule: provide Contract Administrator with schedule within 2 weeks after award of Contract.

## 1.8 Waste Management and Disposal

- .1 Separate waste materials for reuse and recycling.
- .2 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material for recycling.
- .3 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Contract Administrator.

- .4 Fold up metal banding, flatten and place in designated area for recycling.
- .5 Remove from Site and dispose of all packaging materials at appropriate recycling facilities.
- .6 Place materials defined as hazardous or toxic waste in designated containers.
- .7 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .8 Unused sealant material must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
- .9 Do not dispose of preservative treated wood through incineration.
- .10 Do not dispose of preservative treated wood with other materials destined for recycling or reuse.
- .11 Dispose of treated wood, end pieces, wood scraps and sawdust at sanitary landfill approved by Contract Administrator.

### **1.9 Care, Operation and Startup**

- .1 Instruct Contract Administrator in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant will aspects of its care and operation.

### **1.10 Operating and Maintenance Manuals**

- .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- .2 Operating instructions to include following:
  - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
  - .2 Service instructions: Including a list of spare parts and replacement parts and the names and addresses of all suppliers.
  - .3 Maintenance instructions: Including start up, proper adjustment, lubrication and shutdown procedures.
  - .4 Installation instructions.
  - .5 Operating instructions.
  - .6 Safety precautions.
  - .7 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- .3 Operating instructions have to be laminated and placed within the station next to its equipment. Operating instructions to be reviewed by Engineer prior to laminating.
- .4 Post instructions where directed.

- .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
- .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

### **1.11 Potential Asbestos Hazard**

- .1 There is some asbestos content in some of the existing building materials. Coordinate with other trades on precautions taken during demolition of existing electrical equipment.

## **PART 2- PRODUCTS**

### **2.1 Materials And Equipment**

- .1 Provide material and equipment.
- .2 Material and equipment to be CSA certified. Where CSA certified material and equipment is not available, obtain special approval from Electrical Inspections Department before delivery to Site and submit such approval as described in PART 1 - SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

### **2.2 Electric Motors, Equipment And Controls**

- .1 Provide all power and control wiring and connections including mechanical control wiring as specified on mechanical and electrical drawings.
- .2 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .3 Control wiring and conduit: in accordance with Section 250501 - Controls: General Requirements except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

### **2.3 Warning Signs**

- .1 Warning Signs: in accordance with requirements of Electrical Inspection Department and Contract Administrator.
- .2 Decal signs, minimum size 175 x 250 mm.

### **2.4 Wiring Terminations**

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

### **2.5 Equipment Identification**

- .1 Identify electrical equipment with nameplates and labels as follows:
  - .1 Nameplates: lamicoid 3 mm thick plastic engraving sheet, matt white finish face, black core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.
  - .2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by Contract Administrator prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Identify equipment with Size 3 labels engraved with equipment tag.
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .8 Terminal cabinets and pull boxes: indicate system and voltage.
- .9 Transformers: indicate capacity, primary and secondary voltages.

## 2.6 Wiring Identification

- .1 Identify wiring with permanent indelible identifying markings, using Electrovert Type Z cable markers (or equal in accordance with B6), on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.
- .5 Use number coded wires in control cables, matched throughout system. Identify conductors with permanent indelible identifying markings, numbered on both ends.
- .6 Use number coded pairs in instrument cables, matched throughout system. Pairs shall be also colour coded black and white for polarity indication. Identify conductor pairs with permanent identifying markings at both ends.

## 2.7 Finishes

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
  - .1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1.
  - .2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

## **2.8 Electrical Single Line Diagrams**

- .1 Provide electrical single line diagrams under plexiglass as follows:
  - .1 Electrical distribution system: locate in main electrical room
- .2 Drawings: 280 x 432 mm minimum size.

## **PART 3- EXECUTION**

### **3.1 Installation**

- .1 Do complete installation in accordance with the current edition of the Canadian Electrical Code, CSA C22.1, except where specified otherwise.
- .2 Do overhead and underground systems in accordance with the current edition of CSA C22.3 No.1 except where specified otherwise.
- .3 Perform all Work in accordance with local codes and bylaws.

### **3.2 Nameplates and Labels**

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

### **3.3 Conduit and Cable Installation**

- .1 Install conduit and sleeves prior to pouring of concrete.
  - .1 Sleeves through concrete: pvc, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

### **3.4 Location of Outlets**

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings, and as shown on the drawings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.
  - .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

### **3.5 Mounting Heights**

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.



- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation. Install electrical equipment at following heights unless indicated otherwise.
  - .1 Local switches: 1400 mm.
  - .2 Wall receptacles:
    - General: 300 mm.
    - Above top of continuous baseboard heater: 200 mm.
    - Above top of counters or counter splash backs: 175 mm.
    - In mechanical rooms: 1400 mm.
  - .3 Panelboards: as required by Code or as indicated.
  - .4 Telephone and interphone outlets: 300 mm.
  - .5 Wall mounted telephone and interphone outlets: 1500 mm.
  - .6 Fire alarm stations: 1500 mm.
  - .7 Fire alarm bells: 2100 mm.
  - .8 Wall mounted speakers: 2100 mm.

### 3.6 Co-ordination of Protective Devices

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

### 3.7 Field Quality Control

- .1 Load Balance:
  - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
  - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
  - .3 Provide upon completion of Work, load balance report as directed in PART 1 - SUBMITTALS: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct and pay for the following tests:
  - .1 Point to point wire continuity test for all conductors.
  - .2 Power generation and distribution system including phasing, voltage, grounding and load balancing.
  - .3 Circuits originating from branch distribution panels.
  - .4 Lighting and its control.
  - .5 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
  - .6 Systems: fire alarm system and communications.
  - .7 Test resistance to ground of the completed grounding electrode.
  - .8 Insulation resistance testing:
    - Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
    - Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
    - Check resistance to ground before energizing.

- .3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .4 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- .5 Submit test results for Contract Administrator's review.

### **3.8 Cleaning**

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

~End~

## **PART 1– GENERAL**

### **1.1 Section Includes**

- .1 Materials and installation for wire and box connectors.

### **1.2 References**

- .1 Canadian Standards Association (CSA International)
  - .1 CAN/CSA-C22.2 No.18-98, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
  - .2 CSA C22.2 No.65-93(R1999), Wire Connectors.

## **PART 2- PRODUCTS**

### **2.1 Materials**

- .1 Pressure type wire connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Clamps or connectors for armoured cable and flexible conduit as required to: CAN/CSA-C22.2 No.18.

## **PART 3- EXECUTION**

### **3.1 Installation**

- .1 Remove insulation carefully from ends of conductors and:
  - .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
  - .2 Install fixture type connectors and tighten. Replace insulating cap.

~End~

## **PART 1 - GENERAL**

### **1.1 Related Sections**

- .1 Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.
- .2 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

### **1.2 References**

- .1 CSA C22.2 No .0.3-96, Test Methods for Electrical Wires and Cables.
- .2 CAN/CSA-C22.2 No. 131-M89(R1994), Type TECK 90 Cable.

## **PART 2 PRODUCTS**

### **2.1 Building Wires**

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

### **2.2 1 kV TECK90 Power Cable**

- .1 Cable: to CAN/CSA-C22.2 No. 131.
- .2 Conductors:
  - .1 Grounding conductor: copper.
  - .2 Circuit conductors: copper, size as indicated. (#12 AWG minimum where not indicated)
- .3 Insulation:
  - .1 Type: ethylene propylene rubber.
  - .2 Chemically cross-linked thermosetting polyethylene rated type RW90, 1000 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking aluminum.
- .6 Overall covering: thermoplastic polyvinyl chloride material.
- .7 Fastenings:
  - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
  - .2 Channel type supports for two or more cables at 300 mm centers.
  - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .8 Connectors:
  - .1 Watertight, explosion-proof approved for TECK cable.

### 2.3 600 V TECK90 Control Cable

- .1 Cable: to CAN/CSA-C22.2 No. 131.
- .2 Conductors:
  - .1 Grounding conductor: copper.
  - .2 Circuit conductors: copper, size as indicated. (#14 AWG minimum where not indicated)
- .3 Insulation:
  - .1 Type: ethylene propylene rubber.
  - .2 Chemically cross-linked thermosetting polyethylene rated type RW90, 600 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking aluminum.
- .6 Overall covering: thermoplastic polyvinyl chloride material.
- .7 Fastenings:
  - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
  - .2 Channel type supports for two or more cables at 300 mm centers.
  - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .8 Connectors:
  - .1 Watertight, explosion-proof approved for TECK cable.

### 2.4 300 V Instrument Cable – Armoured

- .1 Conductors: #14 AWG, 7 strand concentric lay, Class B tinned copper, twisted pairs/triads.
- .2 Insulation: PVC TW75, 75 °C Wet, 105 °C Dry (-40 °C), 300 Volt.
- .3 Twisted pairs/triads cabled with staggered lays.
- .4 Shielding: Individual twisted pair(s)/triads Aluminum/mylar shield with ST drain wire, 100 % shield. Overall aluminum/mylar shield with ST drain wire. Individual drain wires one size smaller than conductor AWG. Overall drain wire the same AWG as conductors.
- .5 Armour: interlocking aluminum.
- .6 Overall covering: thermoplastic polyvinyl chloride material (90 °C, -40 °C).
- .7 Fastenings:
  - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
  - .2 Channel type supports for two or more cables at 300 mm centers to prevent cable from drooping.
- .8 Connectors:
  - .1 Watertight, explosion proof approved for armoured cable.

## **2.5 Type RW90 Conductor**

- .1 In accordance with CSA C22.2 No.38
- .2 Circuit conductors shall be concentric stranded soft copper, size as indicated (#12 AWG minimum where not indicated).
- .3 Insulation to be chemically cross-lined thermosetting polyethylene rated type RW90 XLP, 600V
- .4 Suitable for installation in temperatures down to minus 40 °C.
- .5 90 °C conductor operating temperature.

## **2.6 Type TEW Conductor**

- .1 Circuit conductors shall be stranded soft copper, as per ASTM B-3 and B-8.
- .2 Insulation to be thermoplastic compound meeting the requirements of Canadian Standards Association Type TEW, per CSA 22.2 Part 1, No.127.
- .3 Insulation rated to 600 Volts.
- .4 Suitable for installation in temperatures down to minus 40 °C
- .5 105 °C conductor operating temperature.
- .6 Use #16 AWG for PLC cabinet internal wiring.

## **2.7 Wiring Identification**

- .1 Provide wiring identification in accordance with Section 26 05 01 – Common Work Results – For Electrical.

## **PART 3– EXECUTION**

### **3.1 Installation of Building Wires**

- .1 Install wiring as follows:
  - .1 In conduit systems in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

### **3.2 Installation of TECK Cable 0 -1000 V**

- .1 Install cables.
  - .1 Group cables wherever possible on channels.
- .2 Terminate cables in accordance with Section 26 05 20- Wire and Box Connectors - 0 - 1000 V.

### **3.3 Installation Of Armoured Cables**

- .1 Group cables wherever possible.
- .2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

**3.4 Installation of Control Cables**

- .1 Install control cables in conduit.
- .2 Ground control cable shield.

~End~

## **PART 1 - GENERAL**

### **1.1 Related Sections**

- .1 Section 26 05 01 - Common Work Results - Electrical.

### **1.2 References**

- .1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

### **1.3 Description**

- .1 Supply and install a complete grounding system. Securely and adequately ground all components of the electrical system in accordance with the requirements of all related sections in the current edition of the Canadian Electrical Code, CSA C22.1, as adopted by the Province of Manitoba.
- .2 The system to consist of cables, ground rods, supports, and all necessary materials and inter-connections to provide a complete system. Measured resistance to ground of the network shall not exceed 5 ohms.

## **PART 2 - PRODUCTS**

### **2.1 Equipment**

- .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
- .2 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size as required.
- .3 Rod electrodes: copper clad steel 19 mm dia by 3 m long.
- .4 Grounding conductors: bare stranded copper, tinned, soft annealed, size as indicated.
- .5 Insulated grounding conductors: stranded copper type RW90 complete with a green jacket.
- .6 Ground bus: copper, size as required, complete with insulated supports, fastenings, connectors.
- .7 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
  - .1 Grounding and bonding bushings.
  - .2 Protective type clamps.
  - .3 Bolted type conductor connectors.
  - .4 Thermit welded type conductor connectors.
  - .5 Bonding jumpers, straps.
  - .6 Pressure wire connectors.



## **PART 3 - EXECUTION**

### **3.1 Installation General**

- .1 Connect grounds to existing building grounding system.
- .2 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.
- .3 Install connectors in accordance with manufacturer's instructions.
- .4 Protect exposed grounding conductors from mechanical injury.
- .5 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process.
- .6 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .7 Soldered joints not permitted.
- .8 Include a separate green ground wire in all power conduits including branch circuit wiring sized to Table 16 of the current edition of the Canadian Electrical Code.
- .9 Expansion joints and telescoping sections of raceways shall be bonded using jumper cables as per the current edition of the Canadian Electrical Code.
- .10 Use Burndy compression connectors or approved equal in accordance with B6 for all grounding splices and terminations unless otherwise shown on the Drawings. For bolted ground connections use Burndy Engineering Company's "Durium" hardware or approved equal in accordance with B6.
- .11 Connect all transformer neutrals to the main building ground wire, using compression terminations.
- .12 Install rigid conduit sleeves c/w bushings where ground wires pass through concrete slab.
- .13 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .14 Install separate ground conductor to outdoor lighting standards.
- .15 Connect building structural steel and metal siding to ground by welding copper to steel.
- .16 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .17 Bond single conductor, metallic armoured cables to cabinet at supply end, and load end.
- .18 Ground secondary service pedestals.

### **3.2 System And Circuit Grounding**

- .1 Install system and circuit grounding connections to neutral of secondary 120 V system.

### 3.3 Equipment Grounding

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.
- .2 All frames and metallic enclosures of all electrical equipment and electrically operated equipment shall be grounded through the conduit system and/or via a ground wire.
- .3 All transformers, switchgear, motor control centres, panelboards and splitters fed from the main distribution center shall be grounded by grounding conductors sized in accordance with the current edition of the Canadian Electrical Code. The ground wire shall be terminated at each end with an appropriate grounding lug which shall be connected to the equipment ground bus.
- .4 All sub panels such as lighting panels, local distribution panels, etc., shall be grounded with a green ground wire run back to the panel from which it is fed. The ground conductor shall be sized according to the current edition of the Canadian Electrical Code.
- .5 All main distribution centres, switchgear, motor control centres, and all panels requiring equipment grounds shall contain a ground bus of adequate size, and tapped for lugs for the ground wire required.
- .6 All motors shall be grounded by means of an adequately sized ground wire contained within the feeder conduit.

### 3.4 Field Quality Control

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Contract Administrator and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

~End~

## **PART 1 - GENERAL**

### **1.1 References**

- .1 Canadian Standards Association (CSA International)
- .1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

## **PART 2 - PRODUCTS**

### **2.1 Support Channels**

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, solid configuration surface mounted or suspended.

## **PART 3 - EXECUTION**

### **3.1 Installation**

- .1 Secure equipment to solid concrete or steel structures.
- .2 Secure equipment to hollow or solid masonry, tile and plaster surfaces with lead anchors and to toggle bolts.
- .3 Secure equipment to poured concrete with expandable inserts.
- .4 Secure equipment to wood trusses with ¼" lag screws.
- .5 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .6 Support equipment, conduit or armoured cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .7 Fasten exposed conduit or cables to building construction or support system using straps.
  - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
  - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
  - .3 Beam clamps to secure conduit to exposed steel work.
- .8 Suspended support systems.
  - .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
  - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .9 For surface mounting of two or more conduits use channels at spacing as per Rule 12-1010(1) of the current edition of the Canadian Electrical Code.
- .10 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .11 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

- .12 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .13 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Contract Administrator.
- .14 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

~End~

## **PART 1 - GENERAL**

### **1.1 Related Sections**

- .1 The City of Winnipeg Standard Construction Specification Section CW1110 – General Instructions

### **1.2 Shop Drawings And Product Data**

- .1 Submit shop drawings and product data for cabinets.

## **PART 2 - PRODUCTS**

### **2.1 Splitters**

- .1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3 At least three spare terminals on each set of lugs in splitters less than 400 A.

### **2.2 Junction And Pull Boxes**

- .1 PVC construction with screw-on flat covers for surface mounting.
- .2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

### **2.3 Cabinets**

- .1 Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing sheet steel backboard for surface mounting.

## **PART 3 - EXECUTION**

### **3.1 Splitter Installation**

- .1 Install splitters and mount plumb, true and square to the building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

### **3.2 Junction, Pull Boxes and Cabinets Installation**

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor.
- .3 Install terminal block as indicated in Type T cabinets.
- .4 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

**3.3 Identification**

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Install size 2 identification labels indicating system name, voltage and phase.

~End~

## **PART 1 - GENERAL**

### **1.1 References**

- .1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

## **PART 2 - PRODUCTS**

### **2.1 Outlet and Conduit Boxes General**

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

### **2.2 Conduit Boxes**

- .1 Cast FS or FD copper free aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle for rigid conduit or Teck Cable.
- .2 PVC boxes for PVC conduit.

### **2.3 Fittings - General**

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

## **PART 3 - EXECUTION**

### **3.1 Installation**

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of Work.
- .3 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

~End~

## **PART 1 - GENERAL**

### **1.1 References**

- .1 Canadian Standards Association (CSA)
  - .1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.
  - .2 CAN/CSA C22.2 No. 18-98, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
  - .3 CSA C22.2 No. 45-M1981(R1992), Rigid Metal Conduit.
  - .4 CSA C22.2 No. 211.2-M1984(R1999), Rigid PVC (Unplasticized) Conduit.

### **1.2 Preferences**

- .1 In general power and control wiring shall be by TECK or armoured cable. Where suitable, PVC conduit may be used in wet areas and RGS may be used in dry areas.

## **PART 2 - PRODUCTS**

### **2.1 Conduits**

- .1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.
- .2 Rigid pvc conduit: to CSA C22.2 No. 211.2.

### **2.2 Conduit Fastenings**

- .1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at spacing as per Rule 12-1010 of the current edition of the Canadian Electrical Code for rigid metal conduit.
- .4 Channel type supports for two or more conduits at spacing as per Rule 12-1114 of the current edition of the Canadian Electrical Code for pvc conduit.
- .5 Threaded rods, 6 mm dia., to support suspended channels.

### **2.3 Conduit Fittings**

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Factory "ells" where 90° bends are required for 25 mm and larger conduits.

### **2.4 Expansion Fittings for Rigid Conduit**

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.



## **2.5 Fish Cord**

- .1 Polypropylene.

## **PART 3 - EXECUTION**

### **3.1 Installation**

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Surface mount conduits.
- .3 Install conduit sealing fittings in hazardous areas. Fill with compound.
- .4 Minimum conduit size for lighting and power circuits: 19 mm.
- .5 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .6 Mechanically bend steel conduit over 19 mm dia.
- .7 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .8 Install fish cord in empty conduits.
- .9 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .10 Dry conduits out before installing wire.
- .11 Connect conduit to equipment securely to maintain continuity for the purpose of bonding to ground.
- .12 Provide for expansion and contraction of the conduit system.

### **3.2 Surface Conduits**

- .1 Run parallel or perpendicular to building lines.
- .2 Run conduits in flanged portion of structural steel.
- .3 Group conduits wherever possible on suspended or surface channels.
- .4 Do not pass conduits through structural members except as indicated.

### **3.3 Concealed Conduits**

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

### **3.4      Conduits In Cast-In-Place Concrete**

- .1      Locate to suit reinforcing steel. Install in centre one third of slab.
- .2      Protect conduits from damage where they stub out of concrete.
- .3      Install sleeves where conduits pass through slab or wall.
- .4      Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.
- .5      Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.
- .6      Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .7      Organize conduits in slab to minimize cross-overs.

### **3.5      Conduits Underground**

- .1      Slope conduits to provide drainage.
- .2      Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

~End~

## **Part 1 General**

### **1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CAN/CSA C22.1 No.126.1-02, Metal Cable Tray Systems.
- .2 National Electrical Manufacturers Association (NEMA)
  - .1 NEMA VE 1-2002, Metal Cable Tray Systems.
  - .2 NEMA VE 2-2001, Cable Tray Installation Guidelines.

### **1.2 SUBMITTALS**

- .1 Product Data: submit manufacturer's product data sheets for cable tray indicating dimensions, materials, and finishes, including classifications and certifications.
- .2 Shop Drawings: submit shop drawings showing materials, finish, dimensions, accessories, layout, and installation details.
- .3 Identify types of cabletroughs used.
- .4 Show actual cabletrough installation details and suspension system.

### **1.3 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling.

## **Part 2 Products**

### **2.1 CABLETROUGH**

- .1 Cabletroughs and fittings: to NEMA VE 1 and CAN/CSA C22.1 No. 126.1.
- .2 Ladder type, Class D1 to CAN/CSA C22.2 No. 126.1.
- .3 Trays: extruded aluminum, minimum 300 mm wide with minimum depth of 75 mm.
- .4 Fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cabletrough supplied.
  - .1 Radii on fittings: 300 mm minimum.
- .5 Solid covers for complete cabletrough system including fittings.
- .6 Barriers where different voltage systems are in same cabletrough.
- .7 Ground cable trays with #2 AWG bare copper conductor attached to each tray section in accordance with CEC requirements.
- .8 Provide fire stop material at firewall penetrations.

## **2.2 SUPPORTS**

- .1 Provide splices, supports for a continuously grounded system as required.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install complete cabletrough system in accordance with NEMA VE 2.
- .2 Support cabletrough on both sides.
- .3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

### **3.2 CABLES IN CABLETROUGH**

- .1 Install cables individually.
- .2 Lay cables into cabletrough. Use rollers when necessary to pull cables.
- .3 Secure cables in cabletrough at 6 m centres, with nylon ties.
- .4 Identify cables every 30 m with size 2 nameplates in accordance with Section 26 05 01 – Common Work Results – For Electrical.

~End~

## **PART 1 - GENERAL**

### **1.1 Section Includes**

- .1 Materials and installation for standard and custom breaker type panelboards.

### **1.2 Related Sections**

- .1 Section 26 05 01 - Common Work Results - Electrical.
- .2 Section 26 28 21 - Moulded Case Circuit Breakers.

### **1.3 References**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.2 No.29-M1989(R2000), Panelboards and enclosed Panelboards.

### **1.4 Shop Drawings**

- .1 Submit shop drawings in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.
- .2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

## **PART 2 - PRODUCTS**

### **2.1 Panelboards**

- .1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
  - .1 Install circuit breakers in panelboards before shipment.
  - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .2 250 V panelboards: Bus and breakers rated as indicated on drawings. 10 kA (symmetrical) interrupting capacity minimum.
- .3 600 V panelboards: Bus and breakers rated as indicated on drawings. 22 kA (symmetrical) interrupting capacity minimum.
- .4 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .5 Panelboards: tin plated copper mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .6 Two keys for each panelboard and key panelboards alike.
- .7 Tin plated copper bus with neutral of same ampere rating as mains.
- .8 Mains: suitable for bolt-on breakers.
- .9 Trim with concealed front bolts and hinges.
- .10 Trim and door finish: baked grey enamel.

## **2.2 Breakers**

- .1 Breakers: to Section 26 28 21 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Lock-on devices for 10% of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to City of Winnipeg.

## **2.3 Secondary Surge Arrester**

- .1 Able to withstand a maximum surge current of 40 kA per phase.
- .2 SCCR Rating of 200 kA.
- .3 Acceptable Product: Square D Part No. SDSA3650

## **2.4 Equipment Identification**

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Nameplate for each panelboard size 4 engraved as indicated.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.

## **PART 3 - EXECUTION**

### **3.1 Installation**

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height specified in Section 26 05 01 - Common Work Results - Electrical or as indicated.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.

~End~

## **PART 1 - GENERAL**

### **1.1 Related Sections**

- .1 Section 26 29 10 – Motor Starters to 600 V

### **1.2 Submittals**

- .1 Submit product data sheets for sills, busbars and compartments. Include product characteristics, physical size and finish.
- .2 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence and cleaning procedures.
- .3 Submit shop drawings and indicate:
  - .1 Outline dimensions.
  - .2 Configuration of identified compartments.
  - .3 Floor anchoring method and dimensioned foundation template.
  - .4 Cable entry and exit locations.
  - .5 Dimensioned position and size of busbars and details of provision for future extension.
  - .6 Schematic and wiring diagrams.
- .4 Closeout Submittals: provide operation and maintenance data for motor control centre for incorporation into manual specified in Section 10000 - General Requirements, Closeout Submittals.
  - .1 Include data for each type and style of starter.

### **1.3 Waste Management And Disposal**

- .1 Separate waste materials for reuse and recycling.
- .2 Collect, package and store existing busbars, wireways, sills, copper ground straps and other associated components for recycling and reuse.

### **1.4 Extra Materials**

- .1 Provide maintenance materials in accordance with Section 10000 - General Requirements, Closeout Submittals.

## **Part 2 PRODUCTS**

### **2.1 Metering**

- .1 Each MCC shall utilize a metering system capable of measuring and displaying at minimum the following on a digital display.
  - .1 Voltage L-N
  - .2 Voltage L-L
  - .3 Current per phase
  - .4 Watts

- .5 VAr
- .6 VA
- .7 Frequency
- .8 Power factor
- .9 Watt hrs
- .10 VAr hrs
- .11 VA hrs
- .2 Metering devices shall utilize three (3) current transformers and three (3) potential transformers.
- .3 Separate potential transformer secondary fuses, shall be used for relaying and metering.
- .4 Each meter to have at minimum 2 programmable 4-20 mA analog outputs and 2 programmable discrete relay outputs (pulse).
- .5 The metering equipment shall be capable of transmitting all data via Modbus TCP protocol over an Ethernet network.

## 2.2 General Description

- .1 Compartmentalized vertical sections with common power busbars.
- .2 Floor mounting, free standing, enclosed dead front.
- .3 Indoor CSA 1 gasketed enclosure, back to back mounting.
- .4 Class II, Type B.

## 2.3 Vertical Section Construction

- .1 Independent vertical sections fabricated from rolled flat steel sheets bolted together to form rigid, completely enclosed assembly.
- .2 Each vertical section divided into compartment units, minimum 305 mm high, as indicated.
- .3 Each unit to have complete top and bottom steel plate for isolation between units.
- .4 Horizontal wireways, equipped with cable supports, across top and bottom, extending full width of motor control centre, isolated from busbars by steel barriers.
- .5 Vertical wireways c/w doors for load and control conductors extending full height of vertical sections, and equipped with cable tie supports. Installation wiring to units accessible with doors open and units in place.
- .6 Openings, with removable cover plates, in side of vertical sections for horizontal wiring between sections.
- .7 Cables to enter at top and/or bottom as required.
- .8 Removable lifting means.



- .9 Provision for future extension of both ends of motor control centre including busbars without need for further drilling, cutting or preparation in field.
- .10 Divide assembly for shipment to Site, complete with hardware and instructions for re-assembly.

## 2.4 Sills

- .1 Continuous channel iron floor sills for mounting bases with 19 mm diameter holes for bolts.

## 2.5 Busbars

- .1 Main horizontal and branch vertical, three phase and neutral high conductivity tin plated copper busbars in separate compartment bare self-cooled, extending entire width and height of motor control centre, supported on insulators and rated:
  - .1 Main horizontal busbars: 600 A as indicated.
  - .2 Branch vertical busbars: 300 A as indicated.
- .2 Branch vertical busbars for distribution of power to units in vertical sections.
- .3 No other cables, wires, equipment in main and branch busbar compartments.
- .4 Brace buswork to withstand effects of short-circuit current of 42 kA rms symmetrical.
- .5 Bus supports: with high dielectric strength, low moisture absorption, high impact material and long creepage surface designed to discourage collection of dust.

## 2.6 Ground Bus

- .1 Copper ground bus extending entire width of motor control centre.
- .2 Vertical ground bus strap, full height of section, tied to horizontal ground bus, engaged by plug-in unit ground stab.

## 2.7 Motor Starters And Devices

- .1 As per Section 26 29 10 – Motor Starters to 600 V.
- .2 Quantity and ratings as per single line drawings.

## 2.8 Starter Unit Compartments

- .1 Units EEMAC size 5 and smaller, circuit breaker units 225A and smaller, plug-in type with self-disconnect. Guide rail supports for units to ensure that stabs make positive contact with vertical bus. Provision for units to be installed or removed, off load, while buses energized.
- .2 Unit mounting:
  - .1 Engaged position - unit stabbed into vertical bus.
  - .2 Withdrawn position - unit isolated from vertical bus but supported by structure. Terminal block accessible for electrical testing of starter.
  - .3 Provision for positive latching in either engaged or withdrawn position and padlocking in withdrawn position.

- .4 Stab-on connectors free floating tin plated clips, self-aligning, backed up with steel springs.
- .3 External operating handle of circuit switch interlocked with door to prevent door opening with switch in "on" position. Provision for 3 padlocks to lock operating handle in "off" position and lock door closed.
- .4 Hinge unit doors on same side.
- .5 Overload relays manually reset from front with door closed.
- .6 Pushbuttons and indicating lights mounted on door front.
- .7 Devices and components by one manufacturer to facilitate maintenance.
- .8 Pull-apart terminal blocks for power and control to allow removal of starter units without removal of field wiring.

## **2.9 Wiring Identification**

- .1 Provide wiring identification in accordance with Section 26 05 01 - Common Work Results - For Electrical.

## **2.10 Equipment Identification**

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - For Electrical.
  - .1 Motor control centre main nameplate: size No. 7, engraved "NON ESSENTIAL MCC".
  - .2 Individual compartment nameplates: size No. 5, engraved as indicated.

## **2.11 Finishes**

- .1 Apply finishes in accordance with Section 26 05 01 - Common Work Results - For Electrical.
- .2 Paint motor control centre exterior light gray and interiors white.

## **2.12 Source Quality Control**

- .1 Provide manufacturer's type test certificates including short circuit fault damage certification up to short circuit values specified under bus bracing.

## **2.13 Acceptable Product**

- .1 Cutler Hammer or approved or equal in accordance with B6.

## **Part 3 EXECUTION**

### **3.1 Installation**

- .1 Set and secure motor control centre in place on channel bases, rigid, plumb and square to building floor and wall.

- .2 Make field power and control connections as indicated.
- .3 Ensure correct overload heater elements are installed.

**3.2 Field Quality Control**

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - For Electrical.
- .2 Ensure moving and working parts are lubricated where required.
- .3 Operate starters in sequence to prove satisfactory performance of motor control centre during 8 hours period.

~End~

## **PART 1 - GENERAL**

### **1.1 Related Sections**

- .1 Part C – General Conditions, Part D – Supplementary Conditions, Part E – Specifications and Section 10 00 00 shall apply to Work in Division 26.

## **PART 2 - PRODUCTS**

### **2.1 Materials**

- .1 NEMA 4X rated enclosure for all locations except within electrical rooms and control rooms.
- .2 NEMA 12 rated enclosures for devices within electrical rooms or control rooms.
- .3 Door: minimum 1 m wide, hinged, minimum 3 point latching, with padlocking means.
- .4 Door interlocks

## **PART 3 - EXECUTION**

### **3.1 Installation**

- 1. Assemble enclosure in accordance with manufacturer's instructions and mount on concrete pad.
- 2. Mount equipment in enclosure.

~End~

## **PART 1 - GENERAL**

### **1.1 Section Includes**

- .1 Switches, receptacles, wiring devices, cover plates and their installation.

### **1.2 Related Sections**

- .1 Section 26 05 01 - Common Work Results - Electrical.

### **1.3 References**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA-C22.2 No.42-99(R2002), General Use Receptacles, Attachment Plugs and Similar Devices.
  - .2 CSA-C22.2 No.42.1-00, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
  - .3 CSA-C22.2 No.55-M1986(July 2001), Special Use Switches.
  - .4 CSA-C22.2 No.111-00, General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).

### **1.4 Shop Drawings And Product Data**

- .1 Submit shop drawings and product data in accordance The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

## **PART 2 - PRODUCTS**

### **2.1 Switches**

- .1 15 A, 120 V, single pole, double pole, three-way, four-way industrial grade switches to: CSA-C22.2 No.55 and CSA-C22.2 No.111 as required.
- .2 Manually-operated general purpose ac switches with following features:
  - .1 Terminal holes approved for No. 10 AWG wire.
  - .2 Silver cadmium oxide contacts.
  - .3 Fully enclosed with urea or melamine moulding for parts subject to carbon tracking.
  - .4 Suitable for back and side wiring.
  - .5 Brown toggle.
- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .4 Switches of one manufacturer throughout project.
- .5 Acceptable materials: Hubbell 1200 Series or equivalent.

### **2.2 Receptacles**

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA-C22.2 No.42 with following features:
  - .1 Brown urea moulded housing.
  - .2 Suitable for No. 10 AWG for back and side wiring.

- .3 Break-off links for use as split receptacles.
- .4 Eight back wired entrances, four side wiring screws.
- .5 Triple wipe contacts and rivetted grounding contacts.
- .2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:
  - .1 Brown urea moulded housing.
  - .2 Suitable for No. 10 AWG for back and side wiring.
  - .3 Four back wired entrances, 2 side wiring screws.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.
- .5 Acceptable materials: Hubbell 5252 or equivalent.

### **2.3 Cover Plates**

- .1 Stainless steel or pvc cover plates for wiring devices.
- .2 Cover plates from one manufacturer throughout project.
- .3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .4 Stainless steel, vertically brushed, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.
- .5 Weatherproof double lift spring-loaded stainless steel or pvc cover plates, complete with gaskets for duplex receptacles as indicated on the drawings.
- .6 Weatherproof spring-loaded stainless steel or pvc cover plates complete with gaskets for single receptacles or switches as indicated on the drawings.

## **PART 3 - EXECUTION**

### **3.1 Installation**

- .1 Switches:
  - .1 Install single throw switches with handle in "UP" position when switch closed.
  - .2 Install switches in gang type outlet box when more than one switch is required in one location.
  - .3 Mount toggle switches at height in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Receptacles:
  - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
  - .2 Mount receptacles at height in accordance with Section 26 05 01 - Common Work Results - Electrical.
  - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
  - .4 Mount lighting fixture receptacles local to fixtures.

- .3 Cover plates:
  - .1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
  - .2 Install suitable common cover plates where wiring devices are grouped.
  - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

~End~

## **Part 1 GENERAL**

### **1.1 Related Sections**

- .1 Section 26 05 01 - Common Work Results - Electrical.
- .2 The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

### **1.2 References**

- .1 Canadian Standards Association (CSA)
  - .1 CSA C22.2No.248.12-94, Low Voltage Fuses Part 12: Class R (Bi-National Standard with, UL 248-12 (1st Edition).

### **1.3 Shop Drawings And Product Data**

- .1 Submit shop drawings and product data.
- .2 Submit fuse performance data characteristics for each fuse type and size. Performance data to include: average melting time-current characteristics.

### **1.4 Waste Management And Disposal**

- .1 Separate and recycle waste materials.
  - .1 Place materials defined as hazardous or toxic waste in designated containers.
  - .2 Ensure emptied containers are sealed and stored safely for disposal away from children.
  - .3 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

### **1.5 Delivery And Storage**

- .1 Ship fuses in original containers.
- .2 Do not ship fuses installed in switchboard.
- .3 Store fuses in original containers in moisture free location.

### **1.6 Maintenance Materials**

- .1 Three spare fuses of each type and size installed above 600 A.
- .2 Six spare fuses of each type and size installed up to and including 600 A.

## **Part 2 PRODUCTS**

### **2.1 Fuses General**

- .1 Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.
- .2 Fuses: product of one manufacturer for entire project.



## 2.2 Fuse Types

- .1 Class L fuses (formerly HRC-L ).
  - .1 Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
  - .2 Type L2, fast acting.
- .2 Class J fuses (formerly HRCI- J).
  - .1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
  - .2 Type J2, fast acting.
- .3 Class R -R fuses (formerly HRCI- R). For UL Class RK1 fuses, peak let-through current and its= peak let-through values not to exceed limits of UL 198E-1982, table 10.2.
  - .1 Type R1, (UL Class RK1), time delay, capable of carrying 500% of its rated current for 10 s minimum, to meet UL Class RK1 maximum let-through limits.
  - .2 Type R2, time delay, capable of carrying 500% of its rated current for 10 s minimum.
  - .3 Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.
- .4 Class -C fuses (formerly HRCII- C).

## Part 3 EXECUTION

### 3.1 Installation

- .1 Install fuses in mounting devices immediately before energizing circuit.
- .2 Ensure correct fuses fitted to physically matched mounting devices.
  - .1 Install Class R rejection clips for HRCI-R fuses.
- .3 Ensure correct fuses fitted to assigned electrical circuit.
- .4 Where UL Class RK1 fuses are specified, install warning label "Use only UL Class RK1 fuses for replacement" on equipment.

~End~

## **PART 1 - GENERAL**

### **1.1 Section Includes**

- .1 Materials for moulded-case circuit breakers, circuit breakers, and ground-fault circuit-interrupters, fused circuit breakers, and accessory high-fault protectors.

### **1.2 Related Sections**

- .1 Part C – General Conditions, Part D – Supplementary Conditions, Part E – Specifications and Section 10 00 00 shall apply to Work in Division 26.

### **1.3 References**

- .1 Canadian Standards Association (CSA International).
  - .1 CSA-C22.2 No. 5-02, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

### **1.4 Submittals**

- .1 Submit product data in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.
- .2 Include time-current characteristic curves for breakers with ampacity of 600 A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

## **PART 2 - PRODUCTS**

### **2.1 Breakers General**

- .1 Moulded-case circuit breakers, Circuit breakers, and Ground-fault circuit-interrupters, Fused circuit breakers, and Accessory high-fault protectors: to CSA C22.2 No. 5
- .2 Bolt-on and Plug-in moulded case circuit breaker: quick-make, quick-break over center switching mechanism that is mechanically trip-free, for manual and automatic operation with temperature compensation for 40 degrees C ambient. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy, and arc extinguishing shall be accomplished by means of DE-ION arc chutes.
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
  - .1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .5 Circuit breakers with interchangeable trips as indicated.
- .6 Circuit breakers to have minimum symmetrical rms interrupting capacity rating as indicated on the drawings.
- .7 Circuit breakers identified as MCP will operate on the magnetic principle with a current sensing element in each pole.

- .8 Circuit breakers 600 A through 2500 A frame shall be Cutler-Hammer type Westinghouse Series C with microprocessor-based RMS sensing trip units or approved equal in accordance with B6.
- .1 Each moulded case circuit breaker microprocessor-based tripping system shall consist of three current transformers, and a flux-transfer shunt trip. The trip unit shall use microprocessor-based technology to provide the adjustable time-current protection functions. True RMS sensing circuit protection shall be achieved by analysing the secondary current signals received from the circuit breaker current transformers and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached.
- .2 Interchangeable rating plugs shall establish the continuous trip ratings of each circuit breaker. Rating plugs shall be fixed. Rating plugs shall be interlocked such that a breaker cannot be closed and latched with the rating plug removed.
- .3 The microprocessor-based trip unit shall have thermal memory capabilities to prevent the breaker from being reset following an overload condition until after a preset time delay.
- .4 When the adjustable instantaneous setting is omitted, the trip unit shall be provided with an instantaneous override. Internal ground fault protection adjustable pick-up ratings shall not exceed 1200 amperes.
- .5 Breakers shall have built-in test points for testing the long time delay, instantaneous, and ground fault functions of the breaker by means of a 120 Volt operated test set. Provide one test set capable of testing all breakers 600 ampere frame and above.
- .6 System coordination shall be provided by the following microprocessor-based time-current curve shaping adjustments:
- .1 Adjustable long time pick-up and delay.
- .2 Adjustable short time pick-up and delay.
- .3 Adjustable instantaneous pick-up.
- .7 Circuit Breakers shall be Cutler-Hammer type Westinghouse Series C circuit breakers, microprocessor-based RMS sensing trip units type Digitrip RMS 310 LSI or LSI trip units or approved equal in accordance with B6.
- .8 Accessories:
- .1 Provide shunt trips, bell alarms, and auxiliary switches as shown on the contract drawings.
- .9 Enclosure:
- .1 All enclosed circuit breakers shall have EEMAC 1 general purpose enclosures.
- .2 All enclosed circuit breakers shall have metal nameplates, front cover mounted, that contain a permanent record of catalog number and maximum rating. Provide handle mechanisms that are padlockable in the "OFF" position.

## 2.2 Thermal Magnetic Breakers

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.
- .2 Acceptable Product: Cutler-Hammer type Westinghouse Series C or approved equal in accordance with B6.

## 2.3 Magnetic Breakers

- .1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

### **PART 3 - EXECUTION**

#### **3.1 Factory Testing**

- .1 Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of CSA standard.

#### **3.2 Installation**

- .1 Install circuit breakers as indicated on drawings per the manufacturer's recommendations.

#### **3.3 Field Settings**

- .1 The Contractor shall perform field adjustments of the circuit breakers as required to place the equipment in final operating condition. The settings shall be in accordance with the drawings.

~End~

## **PART 1 - GENERAL**

### **1.1 Section Includes**

- .1 Materials and installation for fused and non-fused disconnect switches.

### **1.2 Related Sections**

- .1 Section 26 05 01 - Common Work Results - Electrical.
- .2 Part C – General Conditions, Part D – Supplementary Conditions, Part E – Specifications and Section 10 00 00 shall apply to Work in Division 26.

### **1.3 References**

- .1 Canadian Standards Association (CSA International).
  - .1 CAN/CSA C22.2 No.4-M89 (R2000), Enclosed Switches.
  - .2 CSA C22.2 No.39-M89 (R2003), Fuseholder Assemblies.

## **PART 2- PRODUCTS**

### **2.1 Disconnect Switches**

- .1 Fusible, non-fusible, horsepower rated disconnect switch in CSA Enclosure, to CAN/CSA C22.2 No.4 sized as per drawings.
- .2 Provision for padlocking in off switch position by three locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fuses: size as indicated on drawings.
- .5 Fuseholders: to CSA C22.2 No.39 relocatable and suitable without adaptors, for type and size of fuse indicated.
- .6 Quick-make, quick-break action.
- .7 ON-OFF switch position indication on switch enclosure cover.

### **2.2 Equipment Identification**

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

### **PART 3 - EXECUTION**

#### **3.1 Installation**

- .1 Install disconnect switches complete with fuses if applicable.

~End~

## **PART 1 - GENERAL**

### **1.1 Section Includes**

- .1 Materials and installation for industrial control devices including pushbutton stations, control and relay panels.

### **1.2 Related Sections**

- .1 Section 26 05 01 - Common Work Results - Electrical.
- .2 Part C – General Conditions, Part D – Supplementary Conditions, Part E – Specifications and Section 10 00 00 shall apply to Work in Division 26.

### **1.3 References**

- .1 Canadian Standards Association (CSA International)
- .1 CSA C22.2 No.14-95(R2001), Industrial Control Equipment.
- .2 National Electrical Manufacturers Association (NEMA)
- .1 NEMA ICS 1-2001, Industrial Control and Systems: General Requirements.

### **1.4 Shop Drawings**

- .1 Include schematic, wiring, interconnection diagrams.

### **1.5 Quality Assurance**

- .1 Submit to Contract Administrator one copy of test results.

### **1.6 Waste Management And Disposal**

- .1 Separate and recycle waste materials.
- .2 Remove from Site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Contract Administrator.

## **Part 2 PRODUCTS**

### **2.1 AC Control Relays**

- .1 Control Relays: to CSA C22.2 No.14 and NEMA ICS 1.
- .2 Convertible contact type: contacts field convertible from NO to NC, electrically held, with poles to suit. Coil rating: 120 Vac. Contact rating: 120 Vac, 2 A minimum or 24 Vdc, 2 A minimum as required.

- .3 Fixed contact plug-in type: general purpose with poles to suit. Coil rating: 120 V. Contact rating: 120 Vac, 2 A minimum or 24 Vdc, 2 A minimum as required.

## **2.2 DC Control Relays**

- .1 Control Relays: to CSA C22.2 No.14 and NEMA ICS 1.
- .2 Convertible contact type: contacts field convertible from NO to NC, electrically held, with poles to suit. Coil rating: 24 Vdc. Contact rating: 120 Vac, 2 A minimum or 24 Vdc, 2 A minimum as required.
- .3 Fixed contact plug-in type: general purpose with poles to suit. Coil rating: 24 Vdc. Contact rating: 120 Vac, 2 A minimum or 24 Vdc, 2 A minimum as required.

## **2.3 Relay Accessories**

- .1 Standard contact cartridges: normally-open - convertible to normally-closed in field.

## **2.4 Solid State Timing Relays**

- .1 Construction: AC operated electronic timing relay with solid-state timing circuit to operate output contact. Timing circuit and output contact completely encapsulated to protect against vibration, humidity and atmospheric contaminants.
- .2 Operation: on-delay or off-delay.
- .3 Supply voltage: 120 V, AC, 60 Hz.
- .4 Temperature range: minus 20 degrees C to 60 degrees C.
- .5 Output contact rating: maximum voltage 300 V AC or DC. Current: NEMA ICS 1.
- .6 Timing ranges: minimum 1.0 s, maximum 5, 30 or 60 s.

## **2.5 Operator Control Stations**

- .1 Enclosure:
  - .1 In general CSA Type 4X, surface mounting.
  - .2 In clarifier electrical room with positive pressure CSA Type 1, surface mounting.

## **2.6 Pushbuttons**

- .1 Heavy duty Oil tight. Operator extend type. Black, with 1-NO and 1-NC contacts rated at 2 A minimum, AC, labels as indicated. Stop pushbuttons coloured red, labelled as indicated.

## **2.7 Selector Switches**

- .1 Maintained, 2 or 3 position as required labelled as indicated heavy duty oil tight, operators standard, contact arrangement as indicated, rated 120 V, 2 A, AC minimum or 24 Vdc, 2 A minimum as required.

## **2.8 Indicating Lights**

- .1 Heavy duty Oil tight, full voltage, LED type, lens colour: as indicated, supply voltage: 120 V, lamp voltage: 120 V, labels as indicated.



## **2.9 Control And Relay Panels**

- .1 CSA Type 1 sheet steel enclosure with hinged padlockable access door, accommodating relays timers, labels, as indicated, factory installed and wired to identified terminals.

## **2.10 Control Circuit Transformers**

- .1 Single phase, dry type.
- .2 Primary: 600 V, 60 Hz ac.
- .3 Secondary: 120 V, AC.
- .4 VA Rating: as required by loads plus 20%.
- .5 Secondary fuse rating: as required by loads
- .6 Close voltage regulation as required by magnet coils and solenoid valves.

## **Part 3 EXECUTION**

### **3.1 Installation**

- .1 Install pushbutton stations, control and relay panels, control devices and interconnect.

### **3.2 Field Quality Control**

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time and check out operation of section.
- .3 Upon completion of sectional test, undertake group testing.
- .4 Check out complete system for operational sequencing.

~End~

## **Part 1 GENERAL**

### **1.1 Related Sections**

- .1 Section 26 05 01 - Common Work Results - Electrical.

### **1.2 References**

- .1 National Electrical Manufacturer's Association (NEMA)
  - .1 NEMA Standards Publication ICS 2-2000: Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.

### **1.3 Shop Drawings And Product Data**

- .1 Indicate:
  - .1 Mounting method and dimensions.
  - .2 Starter size and type.
  - .3 Layout of identified internal and front panel components.
  - .4 Enclosure types.
  - .5 Wiring diagram for each type of starter.
  - .6 Interconnection diagrams.

### **1.4 Closeout Submittals**

- .1 Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 10000 - General Requirements, Closeout Submittals.
- .2 Include operation and maintenance data for each type and style of starter.

### **1.5 Extra Materials**

- .1 Provide maintenance materials.
- .2 Provide listed spare parts for each different size and type of starter:
  - .1 3 contacts, stationary.
  - .2 3 contacts, movable.
  - .3 1 contacts, auxiliary.
  - .4 1 control transformer.
  - .5 1 operating coil.
  - .6 2 fuses.
  - .7 10% indicating lamp bulbs used.

### **1.6 Waste Management And Disposal**

- .1 Separate and recycle waste materials.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

## Part 2 PRODUCTS

### 2.1 Materials

- .1 Starters: to NEMA ICS 2-2000

### 2.2 Manual Motor Starters

- .1 Three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
  - .1 Switching mechanism, quick make and break.
  - .2 Three overload heaters, manual reset, trip indicating handle.
- .2 Accessories:
  - .1 Pushbutton: heavy duty oil tight labelled as indicated.
  - .2 Indicating light: heavy duty oil tight type and colour as indicated.
  - .3 Locking tab to permit padlocking in "ON" or "OFF" position.

### 2.3 Full Voltage Magnetic Starters

- .1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
  - .1 Contactor solenoid operated, rapid action type.
  - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
  - .3 Wiring and schematic diagram inside starter enclosure in visible location.
  - .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include motor circuit interrupter with operating lever on outside of enclosure to control motor circuit interrupter, and provision for:
  - .1 Locking in "OFF" position with up to 3 padlocks.
  - .2 Independent locking of enclosure door.
  - .3 Provision for preventing switching to "ON" position while enclosure door open.
- .3 Accessories:
  - .1 Pushbuttons and selector switches: heavy duty oil tight labelled as indicated.
  - .2 Indicating lights: heavy duty oil tight type and color as indicated.
  - .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

### 2.4 CONTROL TRANSFORMER

- .1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.
- .2 Size control transformer for control circuit load plus 20% spare capacity.

## **2.5 Finishes**

- .1 Apply finishes to enclosure in accordance with Section 26 05 01 - Common Work Results - Electrical.

## **2.6 Equipment Identification**

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.
- .3 Magnetic starter designation label, white plate, black letters, size 4 engraved as indicated.

## **Part 3 EXECUTION**

### **3.1 Installation**

- .1 Install starters, connect power and control as indicated.
- .2 Ensure correct fuses and overload devices elements installed.

### **3.2 Field Quality Control**

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical and manufacturer's instructions.
- .2 Operate switches, contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

~End~

**Part 1 General**

**1.1 SCOPE**

- .1 This specification shall apply to the materials, design, fabrication, inspection, and testing of 600 V Variable Frequency Drives (VFD) used to control the speed and torque of NEMA design B induction motors.
- .2 Detailed specifications on the VFD shall be indicated in this specification, drawings and attachments. In case of a conflict between the various specifications, the vendor shall contact the Contract Administrator for clarification. The VFD shall be manufactured by ABB.
- .3 Ensure VFD can handle the motor loads of the equipment actually purchased by the Contractor.

**1.2 RELATED SECTIONS**

- .1 Section 26 05 01 - Common Work Results - Electrical.
- .2 Part C – General Conditions, Part D – Supplementary Conditions, Part E – Specifications and Section 10 00 00 shall apply to Work in Division 26.

**1.3 REFERENCES**

- .1 The VFD shall be designed, manufactured and tested in accordance with the latest applicable standards of CSA, NEMA, ANSI and UL, including but not limited to:
  - .1 CSA C22.2 No. 14-M91—Industrial Control Equipment
  - .2 IEEE 519-1992 – Guide for Harmonic Content and Control
  - .3 NEMA ICS7—Industrial Control and Systems Adjustable Frequency Drives
  - .4 NEMA MG1—Motors and Generators
  - .5 NEMA ICS 7.1—Safety Standards for Construction and Guide for Selection Installation and Operation of Adjustable Frequency Drives
- .2 In all cases where more than one regulation, code, standard or specification applies to the same conditions, the most stringent one shall apply. Conflicts among any of the provisions of these listed codes, standards or specifications shall be referred to the Contract Administrator for resolution.

**1.4 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Drawings shall be in SI units. If imperial units are used as well, they shall be shown in parenthesis after the SI units. In case of conflict between the two, SI units shall be considered to be correct.
- .2 Equipment tag number, purchase order number and project name shall be shown on all Supplier supplied drawings. Data shall be located close to the title block.
- .3 All drawings and data shall be submitted in a form that is easily reproduced. All data and drawings shall be submitted in both paper and electronic form. Final drawings are all required to be as-built.
- .4 Review or approval of Supplier's drawings, design calculations and other documentation does not relieve Supplier of any responsibility for correctness of such drawings, calculations or other documentation.

- .5 The following information shall be submitted to the Contract Administrator for approval:
  - .1 Master drawing index
  - .2 Dimensioned front view elevation
  - .3 Dimensioned floor plan
  - .4 Dimensioned top view
  - .5 Unit control schematics and wiring diagrams
  - .6 Nameplate schedule
  - .7 Cable entry/exit locations
  - .8 Assembly ratings, including short circuit, voltage, and continuous current ratings
  - .9 Major component ratings
  - .10 Minimum clearances to other equipment.
  - .11 Frequency spectrum for harmonic currents at line side of filter (where provided) at 50% and 100% of rated load.
  - .12 Compliance to IEEE 519 – harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD). The VFD manufacturer shall provide calculations specific to the installation, showing total harmonic voltage distortion is less than 5%. Input filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE electrical system standard 519. All VFDs shall include a minimum of 3% equivalent impedance reactors. VFDs shall include some form of active mitigation.
  - .13 Manufacturers technical data sheets

## **1.5 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance data for motor starters for incorporation into manual.
- .2 Operation and maintenance manuals shall include as a minimum for each type and style of starter: instruction books and/or leaflets, recommended renewal parts list and a complete set of as-built drawings.
- .3 The following information shall be submitted to Contract Administrator for record purposes:
  - .1 Final as-built drawings and information
  - .2 Certified production test reports
  - .3 Installation information
  - .4 Seismic certification and equipment anchorage details (where applicable)

## **Part 2 Products**

### **2.1 GENERAL**

- .1 All VFDs shall be a solid state AC to AC inverter controlled device utilizing the latest isolated gate bipolar transistor (IGBT) technology. The VFD shall utilize Direct Torque Control (DTC) as the primary motor control, employing an inner loop torque control strategy that mathematically determines the optimal motor torque and flux every 25 microseconds. The VFD must also provide an optional motor control operational mode for scalar of V/Hz operation.
- .2 The VFDs will be fed from a MCC and be protected by Breakers. Manufacturer shall indicate recommended breaker size.

- .3 The benefits that the motor control DTC shall make available for the operation of a NEMA design B induction motor shall be:
  - .1 Steady state speed accuracy within 1/10th the slip without an encoder, for process repeatability.
  - .2 100% motor torque from zero speed available for acceleration with the VFD continuous current rating or equal in accordance with B6 to or greater than the motor full load amp rating.
  - .3 At and below 90% speed, 100% torque is achievable even with 10% low line voltage.
  - .4 Ability to limit torque to protect the mechanical system with a common single torque setting above and below field weakening.
  - .5 Ability to provide torque in % of motor shaft torque (with in +/- 4% linearity) on the VFD control panel, analog output or via field bus of actual.
  - .6 Quiet motor operation for audibly friendly working environment in comparison to other low voltage PWM solutions utilizing a carrier frequency.
  - .7 Have available the ability to operate in open loop torque control, with an ability to switch between speed and torque control on the fly with the change of state to a digital input.
  - .8 Have an ability to share load or speed between two or more induction AC motors connected to the same system, when those motors are controlled by separate VFDs.

## 2.2 RATINGS

- .1 The VFD shall be designed for heavy-duty applications and in accordance with applicable datasheets.
- .2 The VFD shall be rated to operate from 3-phase power at 525 to 690 VAC (600 Vac, UL and CSA) +10/-10%. The overvoltage trip level shall be a minimum of 30% over nominal, and the undervoltage trip level shall be a minimum 35% under the nominal voltage.
- .3 The VFD shall be rated to operate at the following environmental operating conditions: ambient temperature 0 to 40°C continuous. VFDs that can operate at 40° C intermittently (during a 24 hour period) are not acceptable and must be oversized. Altitude 0 to 3300 feet above sea level without derating, less than 95% humidity, non-condensing.
- .4 The VFD shall be rated to operate from input power from 48Hz to 63Hz.
- .5 Output voltage and current ratings shall match the adjustable frequency operating requirements of standard NEMA design A or NEMA design B motors.
- .6 The Heavy Duty overload current capacity shall be 150% of rated current for one (1) minute out of five (5) minutes.
- .7 The VFD efficiency shall be 98% or better of the full rated capability of the VFD at full speed and load.
- .8 The VFD shall be capable of starting when fed from temporary diesel generator (nominal size of 500 kVA).
- .9 Drive rated for a minimum fault current of 65 kA Sym. I.C.

## 2.3 CONSTRUCTION

- .1 All models shall provide a complete, ready-to-install solution.

- .2 The latest, most efficient IGBT power technology shall be used. This technology shall be used for all power and voltage ranges offered by the manufacturer.
- .3 The VFD shall offer microprocessor based control logic that is isolated from power circuitry.
- .4 The VFD shall use the same main control board for all ratings.
- .5 Control connections shall remain consistent for all power ratings.
- .6 Wall mountable VFDs shall be available from 1.0 to 200HP and have the following features;
  - .1 Wall mounted NEMA Type 12 enclosures for electrical / mechanical rooms
  - .2 Wall mounted NEMA Type 4X enclosures for plant floor locations
  - .3 Include a control panel mounted on the front of the VFD
  - .4 Include coated circuit boards as standard
  - .5 Include integrated internal AC line reactor or DC choke
  - .6 Offer option internally mounted braking chopper for use in dynamic braking with 100% continuous duty operation.
- .7 Desired optional features shall be furnished and mounted by the VFD manufacturer and shall also be available as field installable kits as an alternative. All optional features shall carry all of the necessary certifications as described above. Field installed kits shall not affect the VFD's certification.
- .8 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical. Nameplates shall be permanently attached with screws.
- .9 The enclosure shall have appropriate warning labels indicating "CAUTION MULTIPLE CONTROL POWER SOURCES"
- .10 A panel mounted non-resetable elapsed-time meter to measure operating hours with a minimum 6 digits display.

## **2.4 OPERATOR INTERFACE**

- .1 The VFD shall be equipped with a front mounted operator control panel consisting of a four-(4) line by 20-character back-lit alphanumeric LCD display and a keypad with keys for Run/Stop, Local/Remote, Increase/Decrease, Reset, Menu navigation and Parameter select/edit.
- .2 The control panel shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.
- .3 The display of the control panel shall have the following features:
  - .1 The LCD display shall have contrast adjustment provisions to optimize viewing at angle.
  - .2 All parameter names, fault messages, warnings and other information shall be displayed in complete English words or standard English abbreviations to allow the user to understand what is being displayed without the use of a manual or cross-reference table.
  - .3 During normal operation, one (1) line of the control panel shall display the speed reference, and run/stop forward/reverse and local/remote status. The remaining three (3) lines of the display shall be programmable to display the values of any three (3) operating parameters. The selection shall include at least the following values:
    - .1 Speed/torque in percent (%), RPM or user-scaled units



- .2 Output frequency, voltage, current and torque
  - .3 Power and kilowatt hours
  - .4 Heatsink temperature and DC bus voltage
  - .5 Status of discrete inputs and outputs
  - .6 Values of analog input and output signals
  - .7 Values of PID controller reference, feedback and error signals
- .4 The control panel shall be used for local control, for setting all parameters, and for stepping through the displays and menus.
- .5 A copy function to upload and store parameter settings from an VFD and download stored parameter settings to the same VFD or to another VFD shall exist.
- .6 An intelligent start-up assistant shall be provided as standard. The Start-up routine will guide the user through all necessary adjustments to optimize operation.
- .1 The Start-Up routine shall include “plug and produce” operation, which automatically recognizes the addition of options and fieldbus adapters and provides the necessary adjustment assistance.
  - .2 The Start-Up routine shall prompt the user for Motor Nameplate Data including power, speed, voltage, frequency and current.
  - .3 An auto-tune function shall identify the optimal motor tuning parameters for typical applications.
  - .4 An auto-tune function shall also be available to tune the PID speed regulator loop. Manual adjustments shall also be allowed.
  - .5 A selection of at least six (6) pre-programmed application macro parameter sets shall be provided to minimize the number of parameter adjustments required during start-up. Macros offered shall include Factory Default, Hand/Auto, PID Control, and Torque Control. A selection of two (2) user defined macros shall be also be available.
  - .6 Selection shall be offered for both 2-wire and 3-wire Start/Stop control.

## 2.5 PROTECTIVE FEATURES

- .1 For each programmed warning and fault protection function, the VFD shall display a message in complete English words or Standard English abbreviations. The five (5) most recent fault messages and times shall be stored in the VFD's fault history.
- .2 The VFD shall include internal MOV's for phase to phase and phase to ground line voltage transient protection.
- .3 Output short circuit and ground fault protection rated for 100,000 amps without relying on line fuses shall be provided per UL508C.
- .4 Motor phase loss protection shall be provided.
- .5 The VFD shall provide electronic motor overload protection qualified per UL508C.
- .6 Protection shall be provided for AC line or DC bus overvoltage at 130% of maximum rated voltage or undervoltage at 65% of min. rated voltage.
- .7 The VFD shall protect itself against input phase loss.
- .8 A power loss ride through feature shall allow the VFD to remain fully operational after losing power as long as kinetic energy can be recovered from the rotating mass of the motor and load.

- .9 Stall protection shall be programmable to provide a warning or stop the VFD after the motor has operated above a programmed torque level for a programmed time limit.
- .10 Underload protection shall be programmable to provide a warning or stop the VFD after the motor has operated below a selected underload curve for a programmed time limit.
- .11 Over-temperature protection shall provide a warning if the power module temperature is less than 5°C below the over-temperature trip level.
- .12 Input terminals shall be provided for connecting a motor thermistor (PTC type) to the VFD's protective monitoring circuitry. An input shall also be programmable to monitor an external relay or switch contact.

## 2.6 CONTROL INPUTS AND OUTPUTS

- .1 Discrete Inputs
  - .1 Minimum of six (6) discrete inputs shall be provided.
  - .2 A minimum of six (6) of the inputs shall be independently programmable with function selections (run/stop using 2 wire or 3 wire control, hand-off-auto, etc.).
  - .3 Inputs shall be designed for use with either the VFD's internal 24 VDC supply or a customer supplied external 24 VDC supply.
- .2 Discrete outputs
  - .1 Minimum of three (3) form C relay contact outputs shall be provided
  - .2 All outputs shall be independently programmable to activate with at least 30 function selections including;
    - .1 Operating conditions such as drive ready, drive running, reversed and at set speed
    - .2 General warning and fault conditions
    - .3 Adjustable supervision limit indications based on programmed values of operating speed, speed reference, current, torque and PID feedback.
    - .4 Relay contacts shall be rated to switch 2 Amps at 24 VDC or 115/230 VAC.
- .3 Analog Inputs
  - .1 Minimum of two (2) analog inputs shall be provided:
    - .1 At least one (1) must support bi-polar voltage input
    - .2 Resolution of analog inputs must be at least 11bit total resolution
  - .2 Inputs shall be independently programmable to provide signals including speed / frequency reference, torque reference or set point, PID set point and PID feedback / actual.
  - .3 A differential input isolation amplifier shall be provided for each input.
  - .4 Analog input signal processing functions shall include scaling adjustments, adjustable filtering and signal inversion.
  - .5 If the input reference is lost, the VFD shall give the user the option of the following. The VFD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus.
    - .1 Stopping and displaying a fault
    - .2 Running at a programmable preset speed
    - .3 Hold the VFD speed based on the last good reference received
    - .4 Cause a warning to be issued, as selected by the user.

- .6 When inputs are used as speed references, reference signal processing shall include increase/decrease floating point control and control of speed and direction using a "joystick" reference signal. Two (2) analog inputs shall be programmable to form a reference by addition, subtraction, multiplication, minimum selection or maximum selection.
- .4 Analog Outputs
  - .1 Minimum of two (2) 0 / 4-20 mA analog outputs shall be provided.
  - .2 Outputs shall be independently programmable to provide signals proportional to output function selections including output speed, frequency, voltage, current and power.

## **2.7 CONTROL FUNCTIONS AND ADJUSTMENTS**

- .1 Output frequency shall be adjustable between 0Hz and 300Hz. Operation above motor nameplate shall require programming changes to prevent inadvertent high-speed operation.
- .2 Stop mode selections shall include coast to stop and ramp to stop.
- .3 The VFD shall be capable of controlling deceleration of a load without generating an overvoltage fault caused by excessive regenerated energy. Overvoltage control on deceleration shall extend the ramp time beyond the programmed value to keep the amount of regenerated energy below the point that causes overvoltage trip.
- .4 The VFD shall be capable of starting into a rotating motor with or without existing magnetic flux on the motor regardless of the motor direction. From the time the start signal is given to the VFD to the time the VFD has control of the motor shall not exceed two (2) seconds. Once the VFD has control of the motor it will then accelerate or decelerate the motor to the active reference speed without tripping or faulting or causing component damage to the VFD. The VFD shall also be capable of flux braking at start to stop a reverse spinning motor prior to ramp.
- .5 The VFD shall have the ability to automatically restart after an overcurrent, overvoltage, undervoltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable.
- .6 Control functions shall include two (2) sets of acceleration and deceleration ramp time adjustments with linear and an s-curve ramp time selection.
- .7 Speed control functions shall include:
  - .1 Adjustable min/max speed limits.
  - .2 Selection of up to 15 preset speed settings for external speed control.
  - .3 Three sets of critical speed lockout adjustments.
  - .4 A built-in PID controller to control a process variable such as pressure, flow or fluid level.
- .8 Functions shall include flux optimization for optimizing energy efficiency and limit the audible noise produced by the motor by providing the optimum magnetic flux for any given speed / load operating point.
- .9 The VFD shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The VFD shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay output shall include programmable time delays that will allow for VFD acceleration from zero speed without signaling a false underload condition.

- .10 Three (3) programmable critical frequency lockout ranges shall be provided to prevent the VFD from operating the load continuously at an unstable speed.
- .11 The VFD shall offer software to select the VFDs action in the event of a loss of the primary speed reference.
- .12 The VFD shall have fifteen (15) internal adaptive programming blocks capable of twenty (20) different functions. These blocks shall be connectable to VFD's actual signals and functions allowing the user to tailor the VFD to the specific application requirements without additional hardware. These blocks shall be programmable through the standard operator panel and through the use of programming software.

## **2.8 COMMUNICATIONS**

- .1 The VFD shall be capable of communicating with other VFDs or controllers via a serial communications link. A variety of communications interface modules for the typical overriding control systems shall be available.
- .2 The VFD shall have a Modbus/TCP interface module for remote interrogation by a DCS or PLC controller. Vendor shall indicate all drive parameters that are accessible from this interface.
- .3 Interface modules shall mount directly to the VFD control board or be connected via fiber optic cables to minimize interference and provide maximum throughput.
- .4 I/O shall be accessible through the serial communications adapter. Serial communication capabilities shall include, but not be limited to:
  - .1 Run-Stop control
  - .2 Hand-Off-Auto Control
  - .3 Speed Adjustment
  - .4 PID (proportional/integral/derivative) control adjustments
  - .5 Current Limit
  - .6 Accel/Decel time adjustments
- .5 The VFD shall have the capability of allowing the overriding controller to monitor feedback such as process variable feedback, output speed/frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), relay outputs, and diagnostic warning and fault information.
- .6 A connection shall also be provided for personal computer interface. Software shall be available for VFD setup, diagnostic analysis, monitoring and control. The software shall provide real time graphical displays of VFD performance.

## **2.9 FACTORY TESTING**

- .1 The manufacturer's standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of CSA and NEMA standards. Results from the test shall be provided with closeout submittals.

## **2.10 ACCEPTABLE PRODUCT**

- .1 ABB ACS800-37-0400-7 Series VFD for pump M300PP, or equal in accordance with B6.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install in accordance with Manufacturer's installation instructions and recommendations.
- .2 Hire factory trained representative for setup and commissioning of VFD. Provide written report to Contract Administrator.
- .3 Hire factory trained representative to provide one day of training for City of Winnipeg personnel.
- .4 Confirm power lugs and VFD can accommodate the pump motor cables leads.

~End~