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**END OF SECTION**

**SUMMARY OF WORK**

## 1. GENERAL

### 1.1 Description

.1 The work in this Supply Contract comprises of the supply 480 V and 600 V transformers complete with all electrical and control appurtenances. Work also includes start-up, commissioning, training, performance testing and O&M manuals.

.2 The Work includes, but is not limited to the following elements:

.1 Supply and delivery of two (2) 4160V / 347-600V and two (2) 4160V / 277-480V transformers;

.2 Installation assistance, start-up, training, commissioning, performance testing and operations and maintenance (O&M) manuals and complete with Shop Drawings; and

.3 Spare parts and special tools required for maintenance.

.3 Equipment to be installed under a separate contract, with installation guidance from the transformers Supplier.

.4 Coordinate delivery, storage requirements, installation, training, start-up and commissioning with the Construction Contractor.

.5 All products or materials that are deemed no longer supported or the product is no longer produced at the expiration of the warranty period, shall not be acceptable and will be replaced with the subsequent product. The City shall be notified of these products prior to delivery.

### 1.2 Work Sequence

.1 Coordinate progress Schedule with the City and Contract Administrator during construction to minimize disruption and maintain disinfection.

.2 Proposed stages include:

.1 Award of Contract.

.2 Review and approval of Shop Drawings.

.3 Review and approval of O&M manual and training content.

.4 Delivery to Site.

.5 Installation assistance.

.6 Start-up, commissioning, and training.

### 1.3 Work Coordination

.1 Coordinate work with the General Contractor in regard to equipment delivery, storage, installation, start-up, commissioning and training.

### 1.4 City of Winnipeg Personnel Occupancy

.1 The City personnel will work around Site during the entire construction period for the execution of normal operations.

.2 Co-operate with the City personnel in scheduling operations to minimize conflict and maintain UV disinfection in the system at all times.

.3 Assist the City with operational strategies for when the City is operating the new UV system alongside the existing UV system to preserve disinfection capability.

## 2. PRODUCTS (NOT USED)

## 3. EXECUTION (NOT USED)

**END OF SECTION**

**SUBMITTALS**

## 1. GENERAL

### 1.1 Description

.1 Submit to the Contract Administrator the submittals required by individual Specification Sections for review. Submit promptly and in an orderly sequence according to the Schedule of Submittals to not cause a delay in Work. Failure to submit in the scheduled time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Provide a copy of all the Specification Sections in the Tender package with any applicable addenda with each paragraph check-marked to indicate Specification compliance or cross-marked to indicate non-compliance. Requested deviations and clarifications from the specified requirements shall be provided with the Shop Drawings.

.3 Do not proceed with Work affected by the submittal until reviewed by the Contract Administrator.

.4 Present Shop Drawings, product data, and samples in SI Metric units. Dual units are acceptable.

.1 Where items or information is not produced in SI Metric units, convert units to SI Metric.

.5 Review submittals prior to submission to the Contract Administrator. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with the requirements of Work and Contract Documents.

.6 The review by the Contract Administrator is for the sole purpose of ascertaining conformance with the general concept. It does not provide 'approval' of the detail design inherent in Shop Drawings (which remains with the Supplier), nor does it relieve the Supplier of responsibility for errors or omissions in Shop Drawings or for meeting all requirements of the construction and Contract Documents.

.7 Verify that field measurements and affected adjacent Work are coordinated.

.8 The Supplier shall make any corrections required by the Contract Administrator and shall resubmit the required number of corrected copies of submittals. The Supplier shall direct specific attention in writing on resubmitted submittals to revisions other than the corrections requested by the Contract Administrator on the previous submission.

.9 After the Contract Administrator’s review and return of copies, distribute copies to sub-trades as appropriate.

### 1.2 Submittals Procedures

.1 Details regarding submittals can be found in the individual Specification Sections.

.2 Direct submittals to the Contract Administrator.

.3 Hardcopy Submittals: Submit hard copies only where specifically required under individual Specifications Sections.

.4 Electronic Submittals: Submittals made in electronic format shall be as follows:

.1 Each submittal shall be an electronic file in a searchable Adobe Acrobat Portable Document Format (PDF), and native files (e.g., Word, Excel, AutoCAD, etc.). Use the 2010 version or newer.

.2 Electronic files that contain more than ten (10) pages in PDF format shall contain internal book marking from index page to major sections of the document.

.3 PDF files shall be set to open “Bookmarks and Page” view.

.4 Add general information to each PDF file, including title, subject, author, and keywords.

.5 PDF files shall be set up to print legibly at 215.9 mm by 279.4 mm, 279.4 mm by 431.8 mm or ISO A1 (594 mm by 841 mm). No other paper sizes will be accepted.

.6 Submit new electronic files for each resubmittal.

.7 Include copy of transmittal of Supplier’s submittal.

.8 Contract Administrator will reject submittals that are not accompanied by an electronic copy.

.9 Provide authorization for Contract Administrator to reproduce and distribute each file as many times as necessary for Project documentation.

.5 Transmittal of Submittal:

.1 Stamp each submittal with a uniform approval stamp before submitting to the Contract Administrator.

.1 Stamp to include project name, submittal number, Specification number, Supplier’s reviewer name, date of Supplier’s approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with Contract.

.2 Contract Administrator will not review submittals that do not bear Supplier’s approval stamp and will return them without action.

.3 Contract Administrator will not review submittals received directly from a Subcontractor and will return them without action.

.4 Complete, sign, and transmit with each submittal package, one (1) transmittal of Supplier’s submittal form.

.2 Identify each submittal with the following:

.1 Numbering and tracking system:

.1 Sequentially number each submittal.

.2 Resubmission of submittal shall have original number with sequential alphabetic suffix.

.2 Specification Section and paragraph to which submittal applies.

.3 Project title and City Tender number.

.4 Date of transmittal.

.5 Name of Supplier.

.3 Include Supplier's written response to each of Contract Administrator's review comments with resubmission of submittals stamped "Exceptions Noted, Resubmit".

.6 Format:

.1 Do not base Shop Drawings on reproductions of Contract Documents.

.2 Package submittal information by individual Specification Section. Do not combine different Specification Sections together in submittal package, unless otherwise directed in Specification.

.3 Present in a clear and thorough manner and in sufficient detail to show kind, size, arrangement, and function of components, materials, and devices, and compliance with Contract.

.4 Index with labeled tab dividers in orderly manner.

.7 Timeliness:

.1 Schedule and submit submittals in accordance with schedule of submittals and requirements of individual Specification Sections.

.2 Submit Shop Drawings and samples a minimum of two (2) months ahead of the scheduled delivery date for associated equipment and material and in an orderly sequence so as to cause no delay in the Work.

.8 Processing Time:

.1 Time for review shall commence on Contract Administrator's receipt of submittal.

.2 Contract Administrator will act upon Supplier's submittal and transmit response to Supplier no later than ten (10) Business Days after receipt, unless otherwise specified.

.3 Supplier shall make all submittal corrections and resubmit to the Contract Administrator within ten (10) Business Days after receipt of mark-ups.

.4 Resubmittals will be subject to the same review time.

.5 The review time required will not alleviate the Supplier of his responsibility to deliver the completed Work within the required time frame and schedule. Planning for submittal reviews and the risk to the delivery schedule remains the Supplier's sole responsibility.

.9 Resubmittals:

.1 Clearly identify each correction or change made and include revision date.

.2 No adjustment of the schedule outlined in the Supplemental Conditions or Contract Price will be allowed due to delays in progress of Work caused by rejection and subsequent resubmittals.

.10 Incomplete Submittals:

.1 The Contract Administrator will return the entire submittal for the Supplier's revision if preliminary review deems it incomplete.

.2 Incomplete Shop Drawing information will be considered as stipulated deductions for the purposes of progress payment certificates.

.3 When any of the following are missing, the submittal will be deemed incomplete:

.1 Supplier's review stamp completed and signed.

.2 Transmittal of Supplier's submittal form completed and signed.

.3 Insufficient number of copies.

.4 All requested information is not provided.

.5 Submittals missing Professional Engineer's seal and signature, where it is required.

.4 The submittal will be deemed incomplete if unusual high number of errors are identified on the submittal, making it difficult to proceed with the review.

.11 Submittals not required by Contract:

.1 Will not be reviewed and will be returned stamped "RECEIVED FOR INFORMATION".

.2 Contract Administrator will keep one (1) copy of all Shop Drawings and Product Data.

## 1.3 Shop Drawings and Product Data

.1 The term "Shop Drawing" as defined in the City's General Conditions for Construction (Revision 2020-01-31) means all drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are prepared by the Contractor, Subcontractor, Manufacturer, Supplier, or distributor and which illustrate some portion of the Work.

.2 All equipment to be installed at the Site shall require Shop Drawings, which shall be submitted to the Contract Administrator.

.3 Sales bulletins and other general publications are not acceptable as submittals for review except where necessary to provide supplemental technical data.

.4 Adjustments made on Shop Drawings by the Contract Administrator shall not change the Contract Price.

.5 All Shop Drawings shall include details as follows:

.1 General arrangement drawings, outline dimensions and weights.

.2 Anchoring method and dimensioned foundation template.

.3 Dimensioned cable entry locations.

.4 Dimensioned cable termination and pothead height.

.5 Electrical and instrumentation diagrams.

.6 Complete bill of materials listing the scope of supply.

.7 Identified internal and external component layout on assembly drawing.

.8 Insulating liquid type and materials.

.9 Insulating liquid capacity.

.10 Provide data on pressure-relief valves, oil sampling valves (drain, tap, sample), pressure/vacuum gauge, pressure/vacuum regulation, level gauge, liquid temperature indicator, and separable connectors.

.11 Nameplate data, including equipment certification.

.6 Provide recommended spare parts and prices.

.7 Provide estimated losses at no load, 50% load and full load in either Watts per hour (preferred), or BTUs per hour.

.1 Placement and installation of all equipment shall be subject to the approval of the City.

.8 Electrical and instrumentation and control system Shop Drawings shall include additional details as follows:

.1 Elevation layouts, bill of materials (BOM), fuse charts, schematics, interconnections, point-to-point wiring diagrams, loop wiring diagrams, motor control diagrams, single line diagram, 3-line diagram, and CSA/cUL panel plates in addition to the other wiring and detail requirements of the Contract.

.1 Panel plates shall be included in submissions, to be permanently affixed on the front exterior door of the enclosure. They shall contain all information required under CSA C22.1 and C22.2. At a bare minimum the short circuit current rating (SCCR) of panel plates shall be equal to the MCC or Panelboard from which they are fed.

.2 Wiring diagrams shall mark conductor identification, field terminals, changes, etc.

.3 Detailed listing of all nameplates.

.4 Identification in accordance with the Drawings.

.5 Network architecture showing all components of the network supplied by the Supplier. Tables showing data maps for communications with Plant PLC. Tables showing data map for communications with Plant HMI. Control schematics with plant PCS interconnect details. Interconnection diagrams shall show all electrical and network connections between equipment, panel, terminal junction.

.2 Instrument Loop Diagrams (ILDs) – detailed drawings showing typical interconnections for the specified instrumentation and control devices. The Supplier is to reproduce an ILD for each device and record all relevant notes and installation-specific information on each sheet. Update the ILDs as necessary and fill in all terminal and wiring number from relevant Shop Drawings as they become available.

.1 Loop wiring diagrams shall follow ISA 5.4 for standard drawing layout, symbols, and wiring depictions.

.3 Motor Control Schematics (MCS) – when these are included, they are detailed drawings showing typical interconnections of motor control equipment. The Supplier shall reproduce a MCS for each motor and record all relevant notes and installation-specific information on each sheet. Update the MCS as necessary and fill in all terminal and wiring numbers from relevant Shop Drawings as they become available.

.4 Equipment descriptive data and detailed information for the system hardware and software (i.e., cutsheets or product literature). Failure to provide product literature or cutsheets with drawing submissions is grounds for marking the submission “Revise and Resubmit” without review.

.1 Highlight only relevant information for the products provided. The intent of the literature is a technical review of the products suitability, technical ratings and limitations, and the installation/application. Sales literature, or custom-made sheets, or sales declarations shall not be included. Only manufacturer issued technical literature shall be accepted.

.2 Where products have configurable part numbers, the part number options shall be broken down and either circled in red or highlighted in yellow.

.3 All cutsheets and product literature shall be provided showing CSA or cUL markings either circled in red or highlighted in yellow.

.4 Where hazardous location products are required, they shall be submitted with their CSA or cUL certificates, and CSA or cUL required wiring diagrams for hazardous installations. The control system wiring diagrams shall capture these requirements, provide intrinsically safe barriers and methods as required by NFPA 820, and provide notes for the electrical installer.

.9 Notify the Contract Administrator in writing of any deviations in Shop Drawings from the requirements of the Contract.

.1 Contract Administrator will not assume the responsibility for searching out deviations in the Supplier’s drawings.

.10 The Supplier shall examine all Shop Drawings prior to submission to the Contract Administrator to ensure that all necessary requirements have been determined and verified and that each Shop Drawing has been checked and coordinated with the requirements of the Work and the Contract. Examination of each Shop Drawing shall be indicated by stamp, date, and signature of a responsible person of the Subcontractor for supplied items and of the Supplier for fabricated items. Shop Drawings not stamped, signed, and dated will be returned without being reviewed and stamped " REVISE AND RESUBMIT ". Ensure that the following are verified:

.1 Field measurements.

.2 Field construction criteria.

.3 Catalogue numbers and similar data.

.11 Submittals shall be in one (1) of the following formats:

.1 Submit three (3) copies of white prints and three (3) copies of all fixture cuts and brochures.

.2 Submit one (1) electronic searchable PDF copy.

.12 Shop Drawings will be returned to the Supplier with one (1) of the following notations:

.1 When stamped "REVIEWED" or "NO EXCEPTIONS TAKEN", distribute additional copies as required for execution of the Work.

.2 When stamped "REVIEWED AS MODIFIED" or "MAKE NOTED CORRECTIONS", ensure that all copies for use are modified and distributed, same as specified for "REVIEWED".

.3 When stamped "REVISE AND RESUBMIT", make the necessary revisions, as indicated, consistent with the Contract and submit again for review.

.4 When stamped "NOT REVIEWED" or "REJECTED", submit other Shop Drawings, brochures, etc., for review consistent with the Contract.

.5 Only Shop Drawings bearing "REVIEWED", "NO EXCEPTIONS TAKEN", "MAKE NOTED CORRECTIONS", or "REVIEWED AS MODIFIED" shall be used on the Work unless otherwise authorized by the Contract Administrator.

.13 After submittals are stamped "REVIEWED", "NO EXCEPTIONS TAKEN", "MAKE NOTED CORRECTIONS" or "REVIEWED AS MODIFIED", no further revisions are permitted unless re-submitted to the Contract Administrator for further review.

.14 Make changes in Shop Drawings, which the Contract Administrator shall require, consistent with Contract. When re-submitting, notify the Contract Administrator in writing of any revisions other than those requested by the Contract Administrator.

.15 The mark-up and comments on submittals and O&M package shall be incorporated within two (2) months of receipt from the Contract Administrator regardless of the status of the returned submittal. Supplier shall submit long-term storage requirements for equipment that is received by the Construction Contractor and stored prior to installation.

.16 Supplier shall provide a list of maintenance requirements for uninstalled equipment to be performed and documented by the Construction Contractor. The list shall be submitted one (1) month prior to the delivery of the equipment.

.17 Construction Contractor shall submit records of the maintenance schedules to the Contract Administrator on a monthly basis.

## 1.4 Description of Construction Methods

.1 The Supplier shall, if required by the Contract Administrator, submit for the review of the Contract Administrator method statements which describe in detail, supplemented with Drawings where necessary, the methods to be adopted for executing any portion of Work.

.2 These statements shall also include details of constructional plan and labour to be employed. Acceptance by the Contract Administrator shall not relieve the Supplier of any of his responsibilities, nor shall reasonable refusal to approve entitles the Supplier to extra payment or an extension of time.

.3 Other Considerations:

.1 Fabrication, erection, installation, and commissioning may require modifications to equipment and systems to conform to the design intent. Revise pertinent Shop Drawings and resubmit.

## 1.5 Requests for Information

.1 In the event that the Supplier or any Subcontractor involved in the Work, determines that some portion of the Drawings, Specifications, or other Contract Documents requires clarification or interpretation by the Contract Administrator, the Supplier shall submit a Request for Information (RFI) Form in writing to the Contract Administrator.

.2 Submission Procedure:

.1 Submit RFI's to the Contract Administrator on the "Request for Information" form appended to this Specification Section. The Contract Administrator shall not respond to a RFI except as submitted on this form.

.2 Number RFI's consecutively in one sequence in order submitted, in a numbering system established by the Contract Administrator.

.3 Submit one (1) distinct subject per RFI request. The unrelated items shall not be combined on one (1) form.

.4 Where RFI form does not have sufficient space, attach additional sheets as required.

.5 Submit with RFI form all necessary supporting documentation.

.3 In the RFI, the Supplier shall clearly and concisely provide:

.1 The issue for which clarification or interpretation is sought and why a response is needed from the Contract Administrator; and

.2 An interpretation or understanding of the requirement along with reasons why such an understanding was reached.

.4 The Contract Administrator will review all RFIs to determine whether they are valid RFIs. If it is determined that the document is not a valid RFI, it will be returned to the Supplier not having been reviewed with an explanation why it was deemed not valid.

.5 An RFI response shall be issued within ten (10) Business Days of receipt of the request from the Supplier unless the Contract Administrator determines that a longer time is necessary to provide an adequate response. When the RFI submission is received by the Contract Administrator before noon, the review period commences on that Business Day. When the RFI submission is received by the Contract Administrator after noon, the review period commences on the subsequent Business Day.

.6 If, at any time, the Supplier submits a large number of RFI's or the Contract Administrator considers the RFI to be of such complexity that the Contract Administrator cannot process the RFI's within ten (10) Business Days, the Contract Administrator shall confer with the Supplier within five (5) Business Days of receipt of such RFI's and the Contract Administrator and the Supplier will jointly prepare an estimate of the time necessary for processing the RFI as well as an order of priority among the RFI's submitted. The Supplier shall accommodate such necessary time at no impact to the schedule and at no additional cost to the Contract.

.7 If the Supplier submits a RFI on an activity with ten (10) Business Days or less of available time to the impacted activity on the current project schedule, the Supplier shall not be entitled to any time extension due to the time it takes the Contract Administrator to respond to the request provided that the Contract Administrator responds within the ten (10) Business Days set forth above.

.8 An RFI response from the Contract Administrator will not change any requirement of the Contract. In the event the Supplier believes that the RFI response from the Contract Administrator will cause a change to the requirements of the Contract, the Supplier shall within ten (10) Business Days give written notice to the Contract Administrator stating that the Supplier believes the RFI response will result in a change to the Contract and the Supplier intends to submit a change request. Failure to give such written notice of ten (10) Business Days shall waive the Supplier's right to seek additional time or cost under the requirements of the Contract.

## 1.6 Closeout Submittals

.1 Refer to Section 01 78 00 - Closeout Submittals.

## 1.7 Miscellaneous Submittals

.1 Prepare and submit required Contract Documents.

.2 Copies: Submit one (1) electronic copy to Contract Administrator. Method of electronic submission shall be coordinated with Contract Administrator after execution of the Contract.

.1 Submit hard copies for paint samples and other submittals where specifically required under individual Specifications Sections.

.3 The Contract Administrator will review submittals for general conformance with design concept and intent, and general compliance with Contract.

.4 The Contract Administrator's review does not relieve Supplier from compliance with requirements of Contract nor from errors in submittals or Supplier's design.

.5 The Construction Contractor shall be responsible for confirmation of dimensions at Site; fabrication processes; means, methods, techniques, sequences, and procedures of

construction; coordination of work of all trades; and performance of Work in safe and satisfactory manner and in accordance with Specification Sections 01 65 00 and 01 91 31.

.6 At the Contract Administrator's option, the Contract Administrator's review comments and review stamp will be placed either directly on submitted copies of submittals or on separate submittal review comment form.

.7 Where work is to be designed by the Supplier, comply with applicable codes and furnish submittals signed and sealed by a Professional Engineer licensed in the Province of Manitoba, as required by Specifications. If requested, calculations shall be submitted for review. Calculations shall be signed and sealed by a Professional Engineer registered in the Province of Manitoba.

**1.8 Supplements**

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

.1 Request for Information (RFI), RFI No.0.

**2. PRODUCTS (NOT USED)**

**3. EXECUTION (NOT USED)**

**END OF SECTION**

**SUBMITTALS**

For details and instructions on how to complete this document, click the [¶] icon under the Home tab to display the hidden text.

**RFI Title:** _____ **RFI No.:** 0

**Date RFI initiated:** _____ **Date Response Requested by:** _____

**Date Response Issued:** _____

**Project Name:** _____

| **Submitted To:** | | | |
|---|---|---|---|
| Contract Administrator (CA): | | Consultant Ref. No. | |
| Company/Dept.: | | Tender No. | |

| **Requested By:** | | ***For CA Use*** | |
|---|---|---|---|
| Name: | | City File No.: | |
| Title: | | Project ID: | |
| Company: | | Project Record Index No.: | |
| Email:: | | Purchase Order No.: | |

**Request/Question:** (to be completed by Contractor)

**Answer/Response:** (to be completed by Contract Administrator)

**Attachment(s):**

**Distribution** (to be completed by Contract Administrator)

- Contract Administrator
- Contractor
- City Project Manager
- Other:

Click here to enter text.

**COMMON PRODUCT REQUIREMENTS**

## 1. GENERAL

### 1.1 Standards

.1 Within text of each Specification Section, references are made to reference standards.

.2 Conform to these reference standards, in whole or in part as specifically requested in the Specifications.

.3 If there is question as to whether products or systems are in conformance with applicable standards, the Contract Administrator reserves the right to have such products or systems tested to prove or disprove conformance.

.4 Cost for such testing shall be borne by the City in event of conformance with Construction Contract Documents or by the Construction Contractor in event of non-conformance.

.5 Conform to latest date of issue of referenced standards in effect on date of submission of Bids.

### 1.2 Quality Assurance

.1 Products, materials, equipment and articles incorporated in the Work shall be new, not damaged or defective, and of the best quality for the purpose intended. If requested, furnish evidence as to type, source and quality of products provided.

.2 Defective products, whenever identified prior to completion of Work, shall be rejected, regardless of previous inspections. Inspection shall not relieve responsibility but is a precaution against oversight or error. Supplier shall remove and replace defective products at his own expense and shall be responsible for delays and expenses caused by rejection.

.3 Should disputes arise as to the quality or fitness of products, decision rests strictly with the Contract Administrator based upon the requirements of the Construction Contract Documents.

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

.5 Permanent labels, trademarks and nameplates on products shall not be acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

.6 The Construction Contractor shall be responsible for development of a quality plan to ensure all tasks are performed to the necessary requirements and Supplier specifications. The supplier shall provide requirements to the Construction Contractor.

### 1.3 Availability

.1 Immediately upon the City exercising its option to purchase, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, immediately notify Contract Administrator of such, in order that

substitutions or other remedial action shall be authorized in ample time to prevent delay in performance of Work.

.2 In event of failure to notify Contract Administrator at commencement of Work and should it subsequently appear to the Contract Administrator that Work may be delayed for such reason, Contract Administrator reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

## 1.4 Storage, Handling and Protection

.1 The Supplier shall provide the Construction Contractor with full instructions in writing of all preservation requirements, procedures and precautions for long-term storage and protection of the equipment. A copy of all instructions shall be provided to the Contract Administrator.

.2 The Construction Contractor shall be responsible for storage of the equipment, appurtenances, and materials and for protection against weather, loss, damage, or theft until equipment installation.

.3 The storage location shall be inspected and approved by the Contract Administrator and/or the City.

.4 The Construction Contractor shall:

.1 Handle and store products in a manner to prevent damage, adulteration, deterioration and soiling and in accordance with Supplier's instructions.

.2 Store packaged or bundled products in original and undamaged condition with Manufacturer's seal and labels intact. Items shall not be removed from packaging or bundling until provided to the Construction Contractor.

.3 Store products subject to damage from weather in above zero weatherproof enclosures.

.4 Store materials on flat, solid supports and keep clear of ground. Slope to shed moisture.

.5 Remove and replace damaged products at own expense and to the satisfaction of the Contract Administrator.

.6 Touch-up damaged factory finished surfaces to Contract Administrator’s satisfaction. Use touch-up materials to match original. Do not paint over nameplates.

.5 The Construction Contractor shall adhere to Supplier’s long-term storage and maintenance instructions.

.6 Preservation requirements and procedures as per Supplier’s recommendation shall be followed and documented by the Construction Contractor. Construction Contractor shall keep records of the maintenance schedules (lubrication, coatings, etc.) frequently and submit the records to the Contract Administrator on a monthly basis.

## 1.5 Transportation

.1 Pay costs of transportation of products required in performance of Work. Goods shall be delivered freight on board, all duties and taxes paid, to Winnipeg, MB.

.2 The Construction Contractor shall be responsible for receiving, off-loading, and placing into storage all equipment at the Site.

**1.6 Supplier's Instructions**

.1 Unless otherwise indicated in the Specifications, the Construction Contractor shall install or erect products in accordance with the Supplier's instructions.

**1.7 Quality of Work**

.1 Ensure Quality of Work is of the highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify the Contract Administrator if required Work is such as to make it impractical to produce required results.

.2 The Supplier and Contractor shall not employ anyone unskilled in their required duties for Work. The Contract Administrator reserves the right to require dismissal from Site for workers deemed incompetent or careless.

.3 Decisions as to the standard or fitness of Quality of Work in cases of dispute rest solely with the Contract Administrator, whose decision is final.

**1.8 Location of Fixtures**

.1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.

.2 Inform the Contract Administrator of conflicting installation. Install as directed.

**1.9 Fastenings**

.1 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wooden, or any other organic material, plugs are not acceptable.

.2 Keep exposed fastenings to a minimum, space evenly and install neatly.

.3 Fastenings which cause spalling or cracking of material to which anchorage is made shall not acceptable.

.4 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.

.5 Use heavy hexagon heads, semi-finished unless otherwise specified. Use 304 stainless steel unless specified otherwise.

.6 Bolts may not project more than one diameter beyond nuts.

.7 Prevent electrolytic action between dissimilar metals and materials.

.8 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

**2. PRODUCTS (NOT USED)**

**3. EXECUTION (NOT USED)**

**END OF SECTION**

# EQUIPMENT INSTALLATION

## 1. GENERAL

### 1.1 Description

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

.2 At least thirty (30) days prior to commencing equipment operation and the Running Test, the Supplier shall assist the Construction Contractor to prepare and submit a detailed start-up plan to indicate the schedule and sequence of equipment installation checks and tests required for the Contract Administrator's review and inputs. No testing Work shall commence until this plan has been discussed and reviewed by all parties involved and accepted by the Contract Administrator.

### 1.2 Definitions

.1 Supplier's Representative: A Supplier's Representative is a trained person empowered by the Supplier to provide:

.1 Witnessing of delivery.

.2 Installation instruction.

.3 Assistance in pre-start up checks and testing.

.4 Training to the City's staff.

### 1.3 Expertise and Responsibility

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

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

### 1.4 Inspection at Factory

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

.2 The City and/or the Contract Administrator may inspect or have an authorized inspector inspect the equipment factory or the process of manufacture or testing of the equipment at the Supplier's or Subcontractor equipment factory at any reasonable time. The City and/or the Contract Administrator or the inspector may notify the Supplier or Subcontractor at any time of unsatisfactory materials, workmanship, or processes.

.3 The Supplier shall provide every reasonable facility, access, and cooperation to assist the City and the Contract Administrator or an authorized inspector in carrying out inspection or testing at the equipment factory or facility.

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

**1.5 Equipment Delivery**

.1 Delivery shall be coordinated with and made to the Construction Contractor. Written acceptance of receipt, at delivery, by the Construction Contractor shall constitute "Delivery to Site" under this Contract. The shipping lists of materials shall be carefully checked by the Supplier's Representative in the presence of the Contract Administrator and the Construction Contractor. When the Construction Contractor accepts the equipment delivery, they shall certify the delivery by completing Form 100 – Certificate of Equipment Delivery, attached to this Specification.

.2 The Supplier shall provide a schedule within fifteen (15) calendar days after notification of acceptance of Shop Drawings. No delivery to the Site of the Work shall occur until Reviewed Shop Drawings are received by the Supplier.

.3 The schedule shall allow for:

.1 Two (2) weeks for the Contract Administrator to review and comment on the Supplier's Shop Drawings for the equipment to be supplied. Additional time for Shop Drawings corrections and resubmittals shall be accommodated in the schedule.

.4 The Supplier shall be entitled to an extension of the quoted delivery period on account of:

.1 Delay attributable to Acts of God or other matters, which were not the fault of the Supplier and over which it had no control, provided that the Supplier took all possible action to reduce delays and notified the City promptly of the occurrence of such delays.

.5 Ten (10) 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 shall be carefully checked by the Supplier in the presence of the Contract Administrator and the Construction Contractor.

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

.7 The Supplier shall adequately pack and crate each component to provide protection during transport, handling, and storage. Equipment suitable for outside storage will be stored to the satisfaction of the Supplier and the Contract Administrator. The Supplier shall identify each component with durable labels or tags securely attached to each piece of equipment, crate, or container. All crates shall be clearly labelled with five (5) (five) cm red font as "Indoor Storage" or "Outdoor Storage" on a minimum of four (4) faces of the crate.

.8 The Supplier shall protect polished and machined metal surfaces from corrosion and damage during shipment and storage and shall carefully pack and crate the equipment for

shipment. The Supplier shall protect threaded connections with threaded plugs or caps and shall protect open plain end pipes with caps.

.9 The Supplier shall pack electrical equipment and control panels to prevent scratching, access by dirt, moisture, or dust, or damage to insulation and shall cover equipment having exposed bearings and glands to exclude foreign matter. All openings in the equipment shall be covered before shipment. Sufficient lifting hooks shall be supplied for handling all crates and boxes and heavy pieces.

.10 The Construction Contractor shall provide temperature controlled, humidity controlled and secure local storage in Winnipeg, MB in a location to be inspected and approved by the City, between equipment delivery and installations according to Section 01 61 00.

.11 The Construction Contractor may elect to store the equipment for an extended duration (i.e.. 6 months or more), to accommodate the construction schedule. The Supplier shall provide any special packaging and protective coatings, lubricants, etc., which the Supplier deems necessary to protect the equipment during the protracted storage and prior to equipment performance testing. Coordinate with the Construction Contractor.

.12 The Supplier shall be responsible for providing the Construction Contractor with full instructions in writing of all precautions to be observed in connection with the storing and protection of the equipment.

.13 The Construction Contractor shall keep records of the maintenance schedules and submit to the Contract Administrator on a monthly basis.

.14 The Construction Contractor shall notify the Contract Administrator of any damages and loss occurred to the stored equipment during the storage period. Any damaged crate shall be fully inspected by the City and the Supplier. The Construction Contractor shall be responsible for the repair and replacement of the damaged and lost good.

.15 The Construction Contractor shall be responsible for removing any protective coatings prior to installation and equipment performance testing in accordance with the Supplier's written instructions.

.16 The Supplier's Representative shall be at the delivery Site to witness the off-loading, moving and placement of the equipment and to examine the equipment for damage and loss, and to inspect the Construction Contractor's storage facilities for the equipment supplied for compliance with the Supplier's recommendations. The Supplier shall maintain an inventory of all equipment supplied and delivered to the Construction Contractor.

.17 The Construction Contractor shall be responsible for receiving, off-loading, and placing into storage all equipment at the Site and/or the off-Site storage location.

### 1.6 Installation Assistance

.1 The equipment will be installed by the Construction Contractor adjacent to the UV building at separate time periods so that the existing UV system can be maintained. The Supplier's Representative shall assist in each installation period. It is currently anticipated that equipment installation (one (1) of each transformer type) will be separated by several months.

.2 Unless otherwise specifically stated in the Specifications, the Supplier shall provide, a factory-trained Representative who, in conjunction with the Contract Administrator or their agent, shall give instructions regarding the installation of the equipment.

.3 Before commencing installation of the equipment, the Construction Contractor shall arrange for the attendance of the Supplier's Representative who shall provide instructions in the methods, techniques, precautions, and any other information relevant to the successful installation of the equipment.

.4 The Construction Contractor shall inform the Contract Administrator, in writing, of the attendance at the Site of any Supplier's Representative for installation training at least fourteen (14) days prior to arrival.

.5 Before commencing the second installation period, the Supplier's Representative shall be at the storage site to inspect the stored equipment for damage and loss. The Supplier's Representative shall identify any outstanding deficiencies and shall provide a copy of the inspection report to the Contract Administrator. The deficiencies shall be rectified by the Construction Contractor and the Supplier's Representative shall re-inspect the equipment.

.6 When the Supplier's Representative is satisfied that the Construction Contractor is aware of all installation requirements, they shall so certify by completing Form 101 – Certificate of Readiness to Install, attached to this Specification.

.7 The completed form shall be delivered to the Contract Administrator prior to departure of the Supplier's Representative from the Site.

.8 Installation of the equipment shall not commence until the Contract Administrator has advised that he has received the completed Form 101.

.9 Separate copies of Form 101 shall be used for different equipment and for each installation period.

## 1.7 Installation

.1 If necessary, or if so directed by the Contract Administrator during the course of installation, the Construction Contractor shall contact the Supplier's Representative to receive clarification of installation procedures, direction and any other additional information necessary to continue and complete the installation in an appropriate manner.

.2 The Construction Contractor shall arrange for the Supplier's Representative to visit the Site to provide assistance and instruction during all of the separate installation periods, and including items such as all aspects of installation, at the Construction Contractor's cost. For clarity, the Supplier's Representative is not required to witness the entirety of the installation.

.3 Prior to completing each period of installation, the Construction Contractor shall inform the Supplier's Representative and arrange for the attendance at the Site of the Supplier's Representative to verify successful installation.

.4 The Supplier's Representative shall conduct a detailed inspection of the installation for each period of installation including alignment, electrical connections, workmanship and all other items as required to ensure successful operation of the equipment.

.5 The Supplier's Representative shall identify any outstanding deficiencies in the installation.

.6 The deficiencies shall be rectified by the Construction Contractor and the Supplier's Representative shall be required to re-inspect the installation, at the Construction Contractor's cost.

.7 When the Supplier's Representative accepts the installation, they shall certify the installation by completing Form 102 – Certificate of Satisfactory Installation, attached to this Specification.

.8 Separate copies of Form 102 shall be used for each transformer installation.

.9 Deliver the completed Form 102 to the Contract Administrator prior to departure of the Supplier's Representative from the Site.

.10 Tag the equipment with a 100 mm by 200 mm card stating "EQUIPMENT CHECKED. DO NOT RUN." stencilled in large black letters. Sign and date each card.

**1.8 Operation and Performance Verification**

.1 Equipment shall be subjected to a demonstration and Running Test after the installation has been verified and any identified deficiencies have been remedied.

.2 During the demonstration and Running Test, the Construction Contractor shall operate equipment as required by Section 01 91 31 to complete the Performance Verification.

.3 Inform the Contract Administrator at least fifteen (15) days in advance of conducting the tests and arrange for the attendance of the Supplier's Representative. The tests may be concurrent with the inspection of satisfactory installation if mutually agreed by the Construction Contractor and the Contract Administrator.

.4 The Supplier's Representative shall conduct all necessary checks to the equipment and if necessary, advise the Construction Contractor of any further checking, flushing, cleaning, or other work needed prior to confirming the equipment is ready to run.

.5 Testing shall be performed according to Section 01 91 31.

**1.9 Supplements**

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

.1 Form 100 – Certificate of Equipment Delivery.

.2 Form 101 – Certificate of Readiness to Install.

.3 Form 102 – Certificate of Satisfactory Installation.

**2. PRODUCTS (NOT USED)**

**3. EXECUTION (NOT USED)**

**END OF SECTION**

# CERTIFICATE OF EQUIPMENT DELIVERY
# FORM 100

We certify that the equipment listed below has been received and delivered into the care of the Construction 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 Construction Contractor) Date

_____ _____
(Authorized Signing Representative of the Supplier) Date

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

# CERTIFICATE OF READINESS TO INSTALL
# FORM 101

I have familiarized the Construction Contractor 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 Supplier) Date

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

_____ _____
(Authorized Signing Representative of the Construction Contractor) Date

# 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 Supplier) Date

_____ _____
(Authorized Signing Representative of the Construction Contractor) Date

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

# CLOSEOUT SUBMITTALS

## 1. GENERAL

### 1.1 Submittals

.1 Submittals shall be in accordance with Section 01 33 00.

.2 Prepare instructions and data using personnel experienced in the maintenance and operation of described products.

.3 A copy will be returned after final inspection with the Contract Administrator's comments.

.4 Revise the content of the documents as required prior to final submittal.

.5 All mark-ups identified from previous reviews shall be implemented for final O&M manuals.

.6 Four (4) weeks prior to Substantial Performance of the Work, the Construction Contractor will submit, to the Contract Administrator, six (6) final paper copies of the Operating and Maintenance (O&M) Manuals and one (1) searchable electronic copy (PDF) on USB drive in S.I. Units. Supplier shall submit the information contained herein, electronically and in a format such that the Construction Contractor can submit hard copies as specified herein.

.7 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of the same quality and manufacture as the products provided in Work.

.8 Furnish evidence, if requested, for type, source and quality of the products provided.

### 1.2 Format

.1 Organize data as an instructional manual.

.2 The Construction Contractor will submit the manual as follows. Binders shall be vinyl, hard covered, 3 'D' ring, loose leaf with spine and face pockets. The maximum width of each binder shall not exceed 125 mm; where there is more data than will fit in a binder of 125 mm maximum width, the number of binders shall be as required.

.3 When multiple binders are used, correlate the data into related consistent groupings. Identify contents of each binder on the spine.

.4 Covers shall be used to identify each binder with type or printed title "Operation and Maintenance Manual"; list date, title of project, the City, Construction Contractor and Contract Administrator, and identify subject matter of contents.

.5 Arrange content by systems, 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 The text shall be Manufacturer's printed data.

.8 Drawings shall be provided with reinforced punched binder tab. Bind in with text, fold larger drawings to size of text pages.

.9 Provide 1:1 scaled CAD files in dwg format on a USB drive.

.10 Provide one (1) electronic copy (on USB drive) of the entire manual. The electronic copy shall have a linked Table of Contents to each section and shall be word searchable.

.11 PDF files shall be set to open “Bookmarks and Page” view and contain internal book marking from index page to major sections of document.

**1.3 Contents - Each Volume**

.1 Table of Contents: provide title of project:

.1 Date of submission; names.

.2 Addresses and telephone numbers of the Contract Administrator, Contractor and Sub-Contractor with the names of responsible parties.

.3 Schedule of products and systems, indexed to content of volume.

.2 For each product and system:

.1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

.3 Product Data: mark each sheet to 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. Drawings larger than 210 mm x 300 mm (A4) shall be contained in plastic pouch. Provide a separate panel for each drawing.

.5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating Manufacturer's instructions.

.6 Training: refer to Section 01 79 00.

**1.4 As-Builts and Samples**

.1 Maintain one (1) record copy of:

.1 Contract Drawings.

.2 Specifications.

.3 Addenda.

.4 Change Orders and other modifications to Contract.

.5 Reviewed Shop Drawings, product data, and samples.

.6 Field test records.

.7 Inspection certificates.

.8 Manufacturer's certificates.

.2 Label record documents and file in accordance with Section number listings in the List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.

.3 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.

.4 Keep record documents and samples available for inspection by the Contract Administrator.

**1.5 Equipment and Systems**

.1 For each item of equipment and each system:

.1 Include the description of the unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

.2 Provide copy of reviewed submittals.

.3 Panel board circuit directories: provide electrical service characteristics, controls, and communications.

.4 Include installed colour coded wiring diagrams.

.5 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter, and any special operating instructions.

.6 Maintenance Requirements: include preventative and corrective maintenance routine, procedures and guide for troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

.7 For any equipment requiring measurement to be taken, the baseline values of all measurements shall be provided.

.8 Safety Data Sheets (SDSs) for all chemicals needed in operation and maintenance.

.9 Provide a maintenance and lubrication schedule, and a list of lubricants and quantities required. Use the summary forms provided at the end of this Section.

.10 Include Manufacturer's printed O&M instructions.

.11 Include the sequence of operation by the controls Manufacturer.

.12 Provide original Manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

.13 Provide a list of original Manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

.14 Additional requirements: as specified in individual Specification Sections.

**1.6 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.

.2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.3 Moisture-Protection and Weather-Exposed Products: include the Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.4 Additional Requirements: as specified in individual Specifications Sections.

**1.7 Spare Parts**

.1 Provide spare parts, in quantities specified in individual Specification Sections.

.2 Provide items of the same manufacture and quality as items in the Work.

.3 Deliver to Site, place and store.

.4 Receive and catalogue items. Submit inventory using the summary form at the end of this Section. Include approved listings in O&M Manual.

.5 Obtain receipt for delivered products and submit prior to final payment.

**1.8 Maintenance Materials**

.1 Provide maintenance and extra materials, in quantities specified in the individual Specification Sections.

.2 Provide items of the same manufacture and quality as items in the Work.

.3 Deliver to Site, place and store.

.4 Receive and catalogue items. Submit inventory listing to the Contract Administrator. Include approved listings in the O&M Manual.

.5 Obtain receipt for delivered products and submit prior to final payment.

**1.9 Special Tools**

.1 Provide special tools, in quantities specified in individual Specification Section.

.2 Provide items with tags identifying their associated function and equipment.

.3 Deliver to Site, place and store.

.4 Receive and catalogue items. Submit inventory listing to the Contract Administrator. Include approved listings in the O&M Manual.

**1.10 Storage, Handling and Protection**

.1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration and in accordance with the Manufacturer's preservation instruction.

.2 Store in original and undamaged condition with Manufacturer's seal and labels intact.

.3 Store components subject to damage from weather in weatherproof enclosures.

.4 Store paints and freezable materials in a heated and ventilated room.

.5 Remove and replace damaged products at own expense and to satisfaction of Contract Administrator.

**1.11 Warranties and Bonds**

.1 Develop a warranty management plan to contain information relevant to Warranties. Warranty management plan to include required actions and documents to assure that the Contract Administrator receives warranties to which it is entitled.

.2 Provide the plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.

.3 Submit warranty management plan to the Construction Contractor, a minimum of sixty (60) days before planned pre-warranty conference.

.4 Submit warranty information made available during the construction phase, to the Contract Administrator for approval prior to each monthly pay estimate.

.5 Assemble approved information for Construction Contractor and submit upon acceptance of work. Organize the information as follows:

.1 Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing.

.2 List Subcontractor, Supplier, and Manufacturer, with name, address, and telephone number of responsible principals.

.3 Obtain warranties and bonds, executed in duplicate by Subcontractors, Suppliers, and Manufacturers, within ten (10) days after completion of the applicable item of Work.

.4 Verify that documents are in proper form, contain full information, and are notarized.

.5 Co-execute submittals when required.

.6 Retain warranties and bonds until time specified for submittal.

.6 Conduct a joint ten (10) month warranty inspection, measured from the time of acceptance by the Contract Administrator. The inspection shall be attended by the Contract Administrator, Contractor, and Supplier's Representative.

.7 Include information contained in the warranty management plan as follows:

.1 Roles and responsibilities of personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of Construction Contractors, Subcontractors, Manufacturers or Suppliers involved.

.2 Provide a list for each warranted equipment, item, feature of construction or system indicating:

.1 Name of item.

.2 Model and serial numbers.

.3 Location where installed.

.4 Name and phone numbers of Manufacturers or Suppliers.

.5 Names, addresses and telephone numbers of sources of spare parts.

.6 Warranties and terms of warranty: include one (1) year overall warranty of construction after Substantial Performance for all the units functioning. Indicate items that have extended warranties and show separate warranty expiration dates.

.7 Cross-reference to warranty certificates as applicable.

.8 Starting point and duration of the warranty period.

.9 Summary of maintenance procedures required to continue warranty in force.

.10 Cross-Reference to specific pertinent O&M Manuals.

.11 Organization, names and phone numbers of persons to call for warranty service.

.12 Typical response time and repair time expected for various warranted equipment.

.3 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

.8 Respond in a timely manner to oral or written notification of required construction warranty repair work.

.9 Written verification will follow oral instructions. Failure to respond will be cause for the City to proceed with action against the Construction Contractor.

**1.12 Warranty Tags**

.1 Tag, at time of installation, each warranted item. Provide durable, oil and water-resistant tag approved by the Contract Administrator.

.2 Attach tags with a durable plastic tie.

.3 Leave the date of acceptance until project is accepted for occupancy.

.4 Indicate the following information on the tag:

.1 Type of product/material.

.2 Model number.

.3 Serial number.

.4 Construction Contract number.

.5 Warranty period.

.6 Inspector's signature.

.7 Construction Contractor.

**1.13 Supplements**

.1 The supplements listed below, following “End of Section”, are part of this Specification:

.1 Forms: Maintenance Summary Form.

**2. PRODUCTS (NOT USED)**

**3. EXECUTION (NOT USED)**

**END OF SECTION**

## MAINTENANCE SUMMARY FORM

PROJECT: _____ CONTRACT NO.: _____

1. EQUIPMENT ITEM _____
2. MANUFACTURER _____
3. MODEL _____
4. SERIAL NUMBER _____
5. EQUIPMENT/TAG NUMBER(S) _____
6. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 45 KG) _____
7. NAMEPLATE DATA (hp, voltage, speed, etc.) _____
8. MANUFACTURER' S LOCAL REPRESENTATIVE _____
   a. Name _____ Telephone No. _____
   b. Address _____
9. MAINTENANCE REQUIREMENTS

| **MAINTENANCE OPERATION COMMENTS** | **FREQUENCY** | **LUBRICANT (IF APPLICABLE)** |
|---|---|---|
| List briefly each maintenance operation required and refer to specific information in manufacturer's standard maintenance manual, if applicable. (Reference to manufacturer's catalog or sales literature is not acceptable.) | List required frequency of each maintenance operation | Refer by symbol to lubricant required. |
| | | |

10. LUBRICANT LIST

| **REFERENCE SYMBOL** | **[SHELL]** | **[STANDARD OIL]** | **[GULF]** | **[ARCO]** |
|---|---|---|---|---|
| List symbols used in No. 9. above. | List equivalent lubricants, as distributed by each manufacturer for the specific use recommended. | | | |
| | | | | |

11. RECOMMENDED SPARE PARTS FOR THE CITY'S INVENTORY.

| **PART NO.** | **DESCRIPTION** | **UNIT** | **QUANTITY** | **UNIT COST** |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| **Note:** Identify parts provided by this Contract with two asterisks. | | | | |

**DEMONSTRATION AND TRAINING**

## 1. GENERAL

### 1.1 Description

.1 This Section contains requirements for training City staff, by persons retained by the Contractor specifically for the purpose of proper operation and maintenance of all equipment supplied and installed under this Contract.

.2 The Contractor will develop the overall training plans for the equipment with input from the Supplier and the City. The Supplier shall be responsible for providing qualified training instructors and field lesson plans as detailed in the Specifications and as described herein.

.3 Arrange for Supplier's Representatives to supply detailed classroom and hands-on training to the City's operations personnel, maintenance personnel, and select on-call personnel on operation and maintenance of specified product (system, subsystem, and component) and as required in applicable Specifications.

.1 Be tailored for the specific audience in each course.

.2 Ensure that each course accommodates plant staff shift schedules by providing multiple sessions covering the same content if necessary.

.3 Arrange for and require plant staff to perform the demonstrated procedures and provide an evaluation of the Participants.

.4 The City shall require training for at least two (2) sessions for Electrical and Instrumentation staff. See Table 1.

**Table 1 : Training Requirements**

| Training Participant Groups | Approximate Number of Personnel | Minimum Number of Sessions | Constraints |
|---|---|---|---|
| Maintenance Personnel | | | |
| Electrical and Instrumentation Maintenance | 14 | 2 | |

.5 To facilitate scheduling of the City personnel, the City may elect to divide sessions into operation-specific topics and maintenance-specific topics as applicable, to allow operations/ on-call staff and maintenance staff to attend separately. The Contractor shall coordinate with the Contract Administrator and the City. Training to be scheduled and coordinated to not interfere with the operation and maintenance of the existing NEWPCC facility.

.6 Training will be scheduled at least four (4) weeks in advance of the respective training sessions.

.7 Furnish trained, articulate personnel to coordinate and expedite training, to be present during training coordination meetings with the City and familiar with Operation and Maintenance manual information specified in Section 01 78 00 - Closeout Submittals

.8 Training sessions shall be conducted by qualified Supplier's Representatives, with a minimum of two (2) years' experience. Supplier's Representatives shall be familiar with the specified equipment as well as with facility operation and maintenance requirements.

.9 The Contract Administrator has the authority to determine if the training is sufficient based on the lesson plan submitted by the Contractor.

.10 Furnish complete training materials, to include operation and maintenance data, to be retained by each trainee.

## 1.2 Submittals

.1 Submit the following information to the Contract Administrator thirty (30) Calendar Days prior to the first training session. The material will be returned as either "NO EXCEPTIONS TAKEN", "EXCEPTIONS NOTED" or "EXCEPTIONS NOTED - RESUBMIT".

.1 Lesson plan and supplemental training manuals, handouts, visual aids and other reference material required for each training session.

.2 Submit proposed lesson plan not less than twenty-one (21) Calendar Days prior to scheduled training and revise as necessary for acceptance.

.3 Lesson Plan: When training of the City personnel is specified, prepare for each required course, a lesson plan containing but not limited to the following information:

.1 Title and objectives.

.2 Recommended types of attendees (e.g., managers, engineers, operators, maintenance).

.3 Course description and outline of course content.

.4 Format (e.g., lecture, self-study, demonstration, hands-on).

.5 Instruction materials and equipment requirements, including supplemental training manuals, handouts, visual aids and other reference material required for each training session.

.6 Resumes of instructors providing the training.

.4 Training Schedule:

.1 Submit not less than twenty-one (21) Calendar Days prior to start of equipment installation and revise as necessary for acceptance.

.2 List specified equipment and systems that require training services and show:

.1 Respective Supplier.

.2 Estimated dates for installation completion.

.1 Training schedule to include:

.1 Course name;

.2 Course Lesson Plan submittal dates;

.3 Planned session dates and durations; and

.4 Planned Training Participant Groups.

.3 Adjust schedule to ensure training of appropriate personnel as deemed necessary by the City, and to allow full participation by Supplier's Representatives. Adjust schedule for interruptions in operability of equipment.

.4 Individual sessions shall not exceed four (4) hours. A break should be incorporated into sessions that exceed two (2) hours. Training session anticipated to exceed four (4) hours can be assigned to multiple-sessions; however, no more than one (1) – 3-hour and one (1) - 4-hour sessions (seven (7) hours total) may be delivered to the same participants in a single day. Two (2) successive 4-hour sessions may be delivered to alternating shifts of attendees in a single day (i.e., one group of attendees in the morning, and a second group of attendees in the afternoon). Training sessions requiring more than seven (7) hours may be delivered on separate days.

.5 Classes shall not be scheduled concurrently.

## 1.3 Location and Training Facilities

.1 The City shall provide the classroom training facilities.

.2 Field training sessions shall take place at the equipment location.

## 1.4 Format and Content

.1 The training program shall:

.1 Provide a high-level overview of maintenance requirements. Include a point-form outline of maintenance intervals consistent with the summary form in Section 01 78 00.

.2 Ensure training covers all aspects of the unit needed by operations or maintenance staff (such as operating the system locally, operating the system remotely, reviewing alarms and actions required, operating the system during fault or upset, returning the system to normal operating condition, etc.)

.3 Ensure training covers all aspects of the Process Control System (PCS) including screens and graphics, screen navigation, pre-configured and custom trending, pop-up dialog boxes, alarm management, remote/local and manual/automatic operating modes, and any programmed sequences.

.2 The training sessions shall be comprised of both classroom training and field training. As a minimum, they shall cover the following topics for each item of equipment or system:

.1 Classroom training shall cover:

.1 Familiarization.

.2 Safety.

.3 Operation, including reviewing alarms and required actions;

.4 Troubleshooting;

.5 Preventative and predictive maintenance;

.6 Corrective maintenance;

.7 Parts; and

.8 Local representation.

.2 Field Training:

.1 As a minimum, field equipment training for operations personnel shall include:

.1 Identification of equipment: location of primary element; location of instrument readout; discussion on purpose, basic operation, and information interpretation.

.2 Identification of instrumentation and calibration, if applicable.

.3 Discussion and demonstration of standard operating procedures, safe work procedure, and daily visual inspection of system operations.

.4 Discussion and demonstration of the preventative maintenance activities, and predictive maintenance activities where applicable.

.5 Discussion and demonstration of start-up and shutdown procedures.

.6 Demonstration of routine disassembly and assembly of equipment.

.7 Identification and review of safety items and demonstration of safety procedures.

.8 Review of Operation and Maintenance Manuals.

.9 Demonstration of operating parameter adjustment for optimized equipment and system operation.

## 1.5 Training Deliverables

.1 Supplier shall provide all material used in the training to the City;

## 1.6 Training Material

.1 The Training Material shall be provided in electronic native, editable file format.

.2 The Training Material shall be organized by course, with all material used and collected from Participant Groups during training systematically arranged in a consistent manner.

**1.7 Training Completion Forms**

.1 Form T1, attached to this Specification, shall be signed by the trainer, the Contract Administrator, and by a City Staff representative for each City shift when classroom training has been completed. One (1) form is to be used for each item of equipment and each system for which training has been provided. Once all classroom training sessions have been completed, Form T1 is to be submitted to the Contract Administrator.

.2 Form T2, attached to this Specification, shall be signed by the trainer, the Contract Administrator, and by a City Staff representative for each City shift when field training has been completed. One (1) form shall be used for each item of equipment and each system for which training has been provided. Once all field training sessions have been completed, Form T2 shall be submitted to the Contract Administrator.

.3 The supply of adequate training, including completion of Forms T1 and T2 shall be a required prerequisite for handover of equipment, as appropriate to the City.

**1.8 Supplement**

.1 Supplements listed below, following “End of Section,” is a part of this Specification:

.1 Form T1 Certificate of Satisfactory Classroom Training.

.2 Form T2 Certificate of Satisfactory Field Training.

**2. PRODUCTS (NOT USED)**

**3. EXECUTION (NOT USED)**

**END OF SECTION**

## CERTIFICATE OF SATISFACTORY TRAINING
## FORM T1

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

**PROJECT:** _____

**ITEM OF EQUIPMENT:** _____

_____

**TAG NO:** _____

**REFERENCE SPECIFICATION:** _____

_____ _____
(Trainer) Date

_____ _____
(City Staff Representative) Date

_____ _____
(Contract Administrator) Date

## CERTIFICATE OF SATISFACTORY TRAINING
## FORM T2

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

**PROJECT:** _____

**ITEM OF EQUIPMENT:** _____

**TAG NO:** _____

**REFERENCE SPECIFICATION:** _____

_____ _____
(Trainer) Date

_____ _____
(City Staff Representative) Date

_____ _____
(Contract Administrator) Date

**COMMISSIONING PLAN**

## 1. GENERAL

### 1.1 Description

.1 Provide a complete and fully functional system ensuring that:

.1 City personnel have been fully trained in aspects of installed systems as per Section 01 79 00.

.2 Documentation relating to installed equipment and systems has been completed as per Section 01 65 00.

.2 The Supplier shall cooperate with Construction Contractor in all commissioning activates pertaining to the supplied equipment.

.3 The Supplier shall cooperate with Construction Contractor to develop a Detailed Commissioning Plan and Commissioning Schedule using this Section as a Base Commissioning Plan.

.4 Use this Section as a master planning document for Commissioning as it:

.1 Outlines organization, scheduling, allocation of resources, and documentation pertaining to implementation of Commissioning.

.2 Communicates responsibilities of team members involved in Commissioning including scheduling, documentation requirements, and verification procedures.

.3 Sets out deliverables relating to operation, maintenance, process, and administration of Commissioning.

.4 Describes how the process of verification meets the design requirements of the completed Works.

.5 Sets out scope, standards, roles and responsibilities, expectations, deliverables and provides:

.1 An overview of Commissioning.

.2 A general description of elements that make up the Detailed Commissioning Plan.

.3 A process and methodology for successful Commissioning.

.5 The Contract Administrator shall witness and certify tests and reports of results.

.6 Commissioning activities shall be completed before issuance of Substantial Performance.

### 1.2 Definitions

.1 Acceptance: for the purpose of this Specification Section, acceptance shall be defined as the formal turnover of a system to the City. This shall occur after the successful end of Commissioning of each system through a formal acknowledgement between the Contract

Administrator, the City, and the Contractor. Success of the Commissioning period is determined by the Contract Administrator.

.2 Base Commissioning Plan: General Commissioning requirements within this Section to be used in the development of a Detailed Commissioning Plan.

.3 Commissioning: for the purpose of this Specification Section, Commissioning shall be defined as the successful completion of the Operating Test specified in Section 26 12 13.

.4 Commissioning Agent: Agent of the Contractor with experience in Commissioning, satisfactory to the Contract Administrator, responsible for the oversight and execution of Commissioning.

.5 Commissioning Report: the final Commissioning document as described in Clause 3.13.

.6 Commissioning Schedule: Gantt chart showing planned dates for performing all activities related to commissioning of all upgraded systems. The Commissioning Schedule is to be developed by the Contractor and submitted to the Contract Administrator for review, as described in Clause 3.1. The Supplier shall provide input as necessary.

.7 Detailed Commissioning Plan: Commissioning Plan developed by Contractor from the Base Commissioning Plan to be submitted and reviewed by the Contract Administrator, as described in Clause 3.2. Unless defined as “Base Commissioning Plan”, all other instances of “Commissioning Plan” refer to the Detailed Commissioning Plan.

.8 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.

## 1.3 Submittals

.1 Provide submittals in accordance with Section 01 33 00.

.2 Commissioning Schedule to be submitted and accepted by the Contract Administrator as per Clause 3.1.

.3 Detailed Commissioning Plan to be submitted and accepted by the Contract Administrator as per Clause 3.2.

.4 Detailed Commissioning Plan to be refined and resubmitted as required during the construction phase as per Clause 3.3.

## 1.4 Composition, Roles, and Responsibilities of Commissioning Team

.1 Commissioning Team to consist of the following members:

.1 Contract Administrator who is responsible for:

.1 Monitoring Commissioning activities.

.2 Witnessing and certifying reported results.

.3 Reviewing and approving Contractor submissions.

.4 Assisting in the resolution of issues resulting from all tests.

.5 Reviewing the final Commissioning Report.

.2 City personnel who are responsible for:

.1 Attending Commissioning activities to verify re-installed existing equipment operates as per the original sequence of operations.

.2 Attending Commissioning activities to verify newly installed equipment operates as intended.

.3 Performing necessary testing as noted in Clause 1.5.1.

.3 Construction Team: Contractor, Subcontractors, suppliers, and support disciplines, who are responsible for construction and/or installation in accordance with Contract Documents, including:

.1 Testing.

.2 Mechanical testing, adjusting and balancing (TAB).

.3 Integrating Commissioning activities into the Contractor's Project Schedule.

.4 Performing and documenting equipment installation as per Section 01 65 00.

.5 Performing and documenting start-up including installation and start-up checklists.

.4 Contractor's Commissioning Agent who shall be responsible for implementing specified Commissioning activities including:

.1 Planning and preparing checklists (installation/start-up checklists as required, product information) and test procedures.

.2 Determining operational training requirements.

.3 Developing a Detailed Commissioning Plan, updating information provided in the Base Commissioning Plan.

.4 Performing and documenting Running Test and Performance Testing.

.5 Preparing and updating issues logs.

.6 Verifying, reviewing, and conducting training.

.7 Preparing final Commissioning Report.

## 1.5 Extent of Commissioning

.1 Testing of electrical panels must be completed before proceeding with Commissioning activities.

.1 Testing after the electrical modifications shall conform to CSA C22.2 No. 14, CSA C22.2 No. 286 and related CSA standards. CSA special inspections shall be coordinated by the Contractor after operation is confirmed.

## 2. PRODUCTS

### 2.1 Equipment

.1 Provide sufficient instrumentation at the Supplier's expense to verify and commission the installed systems.

## 3. EXECUTION

### 3.1 Commissioning Schedule

.1 Provide input to the Construction Contractor as they prepare a detailed Commissioning Schedule. The Construction Contractor will submit to the Contract Administrator for review and approval at the same time as the Project Schedule. Include milestones, testing, documentation, training, and Commissioning activities of components, equipment, subsystems, systems, and integrated systems.

.2 After approval, incorporate the Commissioning Schedule into the Project Schedule.

.3 Contractor, Contractor's Commissioning Agent, and Contract Administrator will monitor progress of Commissioning against the approved Commissioning Schedule.

### 3.2 Development of Commissioning Plan

.1 This Section is to be considered a Base Commissioning Plan for the equipment, to be used by the Construction Contractor in the development of a Detailed Commissioning Plan. Provide assistance to the Construction Contractor when requested by the Construction Contractor.

.2 The Detailed Commissioning Plan and associated Commissioning Schedule shall be approved by the Contract Administrator at least twenty (20) Business Days prior to the planned start of Commissioning. The plan shall comply with the requirements that have been established by the Contract Administrator.

.3 The Detailed Commissioning Plan shall be drafted by the Contractor and reviewed by the Contract Administrator and shall incorporate the contents of the Base Commissioning Plan as specified in this Section. The Detailed Commissioning Plan shall include the following:

.1 Inform the Contract Administrator at least fifteen (15) Business 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.

.2 The Manufacturer's Representative shall conduct all necessary checks to the equipment and advise the Contractor of any further checking, flushing, cleaning, or other work needed prior to confirming the equipment is ready to run.

.3 Contingency plans in the event of a process malfunction.

.4 Drawings and sketches as required to illustrate the planned sequence of events.

.5 List and details for all temporary equipment or component (additional spool pieces, etc.) required to facilitate Commissioning.

.6 List of all personnel who the Contractor plans to be in attendance for Commissioning and handover with information indicating their qualifications for this Work.

.4 The Detailed Commissioning Plan shall take into account:

.1 Approved Shop Drawings and product data.

.2 Approved changes to the Contract.

.3 Project Schedule.

.4 Contractor's, Subcontractor's, and Suppliers' requirements.

.5 Project construction team's and Commissioning team's requirements.

.5 The Detailed Commissioning Plan shall include:

.1 Commissioning Schedule.

.2 Installation and start-up check lists provided by Manufacturers and Suppliers.

.3 Manufacturer Performance Testing forms provided by Manufacturers and Suppliers.

.1 Forms to include testing parameters at full range of operating conditions to verify responses of equipment and systems.

.6 Submit the completed Detailed Commissioning Plan to the Contract Administrator for review and acceptance. The Detailed Commissioning Plan shall be reviewed prior to its implementation. The Contract Administrator shall be the final arbiter.

### 3.3 Refinement of Commissioning Plan

.1 During the construction phase, the Construction Contractor will revise, refine, and update the Detailed Commissioning Plan to include approved design and construction changes. Provide input to the Construction Contractor as required.

.1 At each revision, indicate revision number and date.

.2 The Construction Contractor will submit each revised Detailed Commissioning Plan to the Contract Administrator for review and acceptance.

### 3.4 Equipment

.1 All process, electrical, control, and miscellaneous equipment related to the system shall be successfully installed and tested in accordance with Section 01 65 00, this Section, and any specific requirements noted in other Divisions. Form 103 shall be executed for each transformer.

.2 Temporary equipment or components will be installed and tested as necessary to ensure that it functions reliably and consistently through the Commissioning period.

## 3.5 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 or shall allow for the operation of the system without the features included in the Work of 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.

.3 In the event that achieving adverse operating condition was deemed impractical by the City operation, the I/O signals may be manipulated to achieve the necessary reaction of the system.

## 3.6 Plant Utility Service

.1 The City shall provide power and other ancillary services as necessary to operate the facility through the Commissioning period. Provision of these services shall be limited to reasonable levels.

## 3.7 Manpower

.1 Supply all staff required during Commissioning as necessary to assist the City's staff in the operation of the facility.

.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 Supplier'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.

## 3.8 Operating Descriptions

.1 Operating descriptions shall be prepared by the Contract Administrator for the facility systems. Other information outlining the operating requirements shall also be available from the Contract Administrator. The Supplier and the Construction Contractor will review these descriptions and shall make themselves familiar with the requirements in order that they can undertake Commissioning in an appropriate manner.

.1 Operating descriptions shall be considered part of documentation for systems as listed in Clause 3.13.2.

## 3.9 Design Parameters

.1 Design parameters for the system shall be as defined in the Specifications and/or the operating descriptions.

## 3.10 Pre-Commissioning Activities

.1 Conduct pre-start-up pressure, static, flushing, cleaning, "bumping" testing, and loop validation during construction as specified in the individual sections. This testing shall be witnessed and certified by the Contract Administrator and does not form part of Commissioning specifications. Include completed documentation with the Final Commissioning Report.

.2 Perform prestart up inspections prior to commencing Commissioning. Utilise approved installation and start-up check lists if required. Rectify any deficiencies to the Contract Administrator's satisfaction. Include completed documentation with the Final Commissioning Report.

.3 Pre-commissioning activities shall include, at minimum:

.1 Process systems:

.1 "Bump" each item of equipment in its "stand-alone" mode.

.2 Complete pre-start-up checks and complete relevant documentation.

.3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.

## 3.11 Commissioning of Instrumentation and Control

.1 Commissioning activities shall only proceed after instrumentation and control tests have been completed.

.2 A minimum written notice of two (2) weeks shall be required prior to commencing with process commissioning activities. To qualify for process commissioning the following activities shall be completed:

.1 Instrument calibrations;

.2 Initial Control Settings and adjustments have been made;

.3 All field devices have been set-up;

.4 Forms (i.e., 100 forms) have been completed;

.5 PLC/SCADA IO and loop checks have been completed; and

.6 Proper mounting and connections have been made.

.3 During Commissioning, demonstrate to the Contract Administrator proper calibration and correct operation of instruments and gauges.

.4 Commissioning of the instrumentation and control system shall include but not be limited to the following:

.1 Verify installation of components, wiring connections, and piping connections.

.2 Verify wiring continuity and pipe leak tests.

.3 Verify instrument calibrations and loop tests and provide a written report to the Contract Administrator.

.1 The report shall include record of functional checks and any adjustments required for the instruments and control equipment under operational conditions.

.4 Coordinate instruments and control equipment supplier's service personnel as required for complete system testing.

.5 Coordinate and cooperate with the City, Contract Administrator, and other contractors to commission the Control System I/O points.

.6 Direct plant personnel at hand-over as to final adjustment of the system for correct operation of plant as per Section 01 79 00.

.7 Ensure that the instrumentation and control equipment suppliers cooperate to complete the Work.

.8 Verify signal levels and wiring connections to all instrumentation and control equipment.

**3.12 Start-Up and Commissioning of Equipment**

.1 A Supplier’s Representative shall conduct all necessary checks to the equipment prior to start-up as described in Section 01 65 00.

.2 Following the installation and calibration of the equipment, the Construction Contractor shall perform an Operating Test of equipment which will be witnessed by the Supplier’s Representative and the Contract Administrator. It will be the responsibility of the Construction Contractor to arrange the times for testing and start-up activities. The Construction Contractor shall confirm that these times are acceptable to the Contract Administrator and the City.

.1 During the Operating Test, the Contractor shall operate equipment as required to meet the requirements from all Divisions of this Specification.

.2 If required, the Contractor shall supply any ancillary equipment or services required to complete the testing.

.3 Should the testing reveal any defects, then those defects shall be documented and promptly rectified, and the testing shall be repeated to the satisfaction of the Contract Administrator. Even if this shall require repeating of all commission procedures from the beginning, it will be at the sole discretion of the Contract Administrator.

.4 Additional costs incurred by the Contractor due to repeat testing shall be borne by the Contractor.

.3 On successful completion of the Operating Test, Form 103 – Certificate of Equipment Satisfactory Operating Test Performance (attached to this Specification) will be signed by the Supplier’s Representative, the Contractor, and the Contract Administrator. Form 103 is required for each transformer.

.4 Operating Test:

.1 The Running Test shall be performed in accordance with Section 26 12 13.

**3.13 Final Commissioning Report**

.1 Construction Contractor to submit the completed Commissioning Report within a maximum of two (2) weeks of completion of Commissioning. The final Commissioning Report is to be reviewed and accepted by the Contract Administrator prior to granting Substantial Performance. The Supplier shall provide documentation as required.

.2 Final Commissioning Report shall include:

.1 Start-up, pre- Commissioning activities, and documentation for systems and equipment.

.2 Description of Commissioning activities and documentation.

.3 Description of Commissioning of integrated systems and documentation.

.4 Completed installation checklists.

.5 Completed Running Test Report(s).

.6 Final settings of commissioned equipment.

.7 Training Plans.

.3 Before the final Commissioning Report is accepted, individual reported results to be subject to verification by the Contract Administrator.

**3.14 Training Plans**

.1 Refer to Section 01 79 00 - Demonstration and Training.

**3.15 Supplements**

.1 The supplements listed below, following “End of Section”, are part of this Specification:

.1 Form 103 – Certificate of Equipment Satisfactory Operating Test Performance.

**END OF SECTION**

# CERTIFICATE OF EQUIPMENT SATISFACTORY OPERATING TEST PERFORMANCE
# FORM 103

We certify that the equipment listed below has been operated and tested as per the Specifications and that the equipment meets its Operating Test 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 Supplier) 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

**LIQUID FILLED, MEDIUM VOLTAGE TRANSFORMERS**

## 1. GENERAL

### 1.1 Related Sections

.1 This Section provides comprehensive requirements for the design, installation, and other application specific requirements for liquid-filled Medium Voltage (MV) Transformers, substation type.

.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section. This section supplements requirements of other Divisions.

### 1.2 Description

.1 This Section covers the furnishing of all materials, equipment and services for the design, fabrication, supply and delivery, installation/labour, and testing of outdoor transformers.

.2 This Specification outlines only general performance and minimum requirements; it is not intended to relieve the Vendor of responsibility for the design of equipment in accordance with the latest applicable codes and standards.

.3 The intent of this Specification is to convey minimum requirements for complete, operable, safe, effective and approved equipment delivered to the Site ready for installation.

### 1.3 References

.1 ASTM International (ASTM):

.1 B117, Standard Practise for Operating Salt Spray (Fog) Apparatus.

.2 D117, Standard Guide for Sampling, Test Methods, and Specifications for Electrical Insulating Oils of Petroleum Origin.

.3 D4059, Standard Test Method for Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography (PCB).

.4 36, Standard Specification for Structural Steel.

.2 Canadian Standards Association (CSA):

.1 C2.1, Single-Phase and Three-Phase Liquid-Filled Distribution Transformers.

.2 CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

.3 C22.1, Canadian Electrical Code Part I (CEC) as amended by provincial, territorial or municipal authority having jurisdiction. References to CEC elsewhere in this document shall include reference to such amendments.

.4 C22.2 No. 0, General Requirements – Canadian Electrical Code – Part II.

.5 C88, Power Transformers and Reactors.

.6 C802.1, Minimum Efficiency Values for Liquid-Filled Distribution Transformers.

.7 C802.3, Minimum efficiency values for Power Transformers.

.3 Electrical and Electronic Manufacturers' Association of Canada (EEMAC), now known as Electro-Federation Canada.

.4 International Electrotechnical Commission (IEC):

.1 60076-8, Power Transformers – Application Guide.

.2 60214-2, Standard for Tap-changers.

.5 Institute of Electrical and Electronics Engineers (IEEE):

.1 C57.12.00, Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.

.2 C57.12.36, Standard Requirements for Liquid-Immersed Distribution Substation Transformers.

.3 C57.12.70, Standard for Standard Terminal markings and Connections for Distribution and Power transformers.

.4 C57.12.90, Test Code for Liquid-Immersed Distribution, Power, And Regulating Transformers.

.5 C57.109, Guide for liquid immersed transformer through-fault current duration.

.6 C57.131, Standard Requirements for Tap Changers.

.6 Manitoba Workplace Safety and Health Act, and Regulations.

.7 Manitoba Energy Code for Buildings (MECB):

.1 Manitoba amendments to the National Energy Code of Canada for Buildings.

.8 National Electrical Manufacturers Association (NEMA):

.1 TRI, Transformers, Regulators and Reactors.

.9 National Electrical Testing Association (NETA):

.1 ATS – Acceptance Testing Specifications for Electrical Power Equipment and Systems.

.10 Winnipeg Electrical By-law (WEB):

.1 Winnipeg amendments to the Canadian Electrical Code (CEC).

.11 Winnipeg Building By-law (WBB):

.1 Winnipeg amendments to the National Building Code of Canada (NBC).

## 1.4 Warranty

.1 As a minimum, the Vendor shall include a warranty for twelve (12) months of operation or eighteen (18) months after arrival on Site, whichever is less. The Vendor shall state their standard warranty for the Transformer specified.

.2 Vendor shall extend the warranty to three (3) years.

## 1.5 Submittals

.1 Provide submittals in accordance with Division 1 and Division 26.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, and limitations.

.3 Submit Shop Drawings giving equipment dimensions, centre of gravity points, anchoring information, total weight, ratings of the transformer, switches, fuses, and breakers. Provide data on pressure-relief valves, oil sampling valves (drain, tap, sample), pressure/vacuum gauge, pressure/vacuum regulation, level gauge, liquid temperature indicator, and separable connectors. Shop Drawings shall also indicate:

.1 Anchoring method and dimensioned foundation template.

.2 Dimensioned cable entry locations.

.3 Dimensioned cable termination and pothead height.

.4 General arrangement drawings and outline dimensions.

.5 Electrical and instrumentation diagrams.

.6 Complete bill of materials listing the scope of supply.

.7 Identified internal and external component layout on assembly drawing.

.8 Primary and secondary fuse make, model, size and time-current characteristics.

.9 Insulating liquid capacity.

.10 Insulating liquid materials.

.4 Provide recommended spare parts and prices.

.5 Provide estimated losses at no load, 50% load and full load in either Watts per hour (preferred), or BTUs per hour.

.6 Include Quality Assurance Submittals:

.1 Manufacturing and quality assurance procedures.

.2 Engineering, manufacturing and quality assurance milestone schedule.

.3 Factory Tests: Furnish manufacturer's certified standard test reports for the transformer ratings shown in the Drawings and for the tests specified herein.

.4 Instruction Manuals: Furnish manufacturer's installation and maintenance manuals on the transformers and accessories.

.7 Closeout Submittals:

.1 Provide operation and maintenance data for transformers for incorporation into manual specified in Division 1.

.2 Include insulating liquid maintenance data.

.3 Submit to the Contract Administrator standard factory test certificates of each transformer and type test of each transformer with high voltage accessories in accordance with CSA, manufacturer standard tests, and onsite testing/commission in accordance with Division 26. Include test results and documents in the O&M Manuals.

## 1.6 Quality Assurance

.1 Manufacturer Qualifications: Single source manufacturer regularly engaged in manufacturing transformers complying with requirements of these Specifications and experienced with at least five (5) projects of similar size and scope.

.2 Product Selection for Restricted Space: Drawings indicate size, profiles, and dimensions for transformer equipment including clearances between transformers and adjacent surfaces and items, and are based on manufacturer’s preliminary information.

.3 Regulatory Requirements:

.1 Components and installation shall comply with CSA.

.4 IEEE Compliance: Comply with applicable requirements of IEEE standards, including IEEE C2.1.

## 1.7 Delivery, Storage and Handling

.1 Coordinate delivery of transformers to allow movement into designated space.

.2 Handle transformers components in accordance with manufacturer’s instructions. Use factory installed lifting provisions.

.3 All radiator valves are to be properly gasketed and sealed off prior to shipment to ensure no loss of oil or moisture infiltration.

.4 Radiators are to be removed from transformer, properly packaged, sealed from atmospheric elements and shipped separately from the transformer.

.5 One (1) set of gaskets/O-rings shall be supplied with the transformer to replace bushing and radiator shipping seals.

.6 Transformer is to be shipped via an air-ride trailer. A suitable impact recorder that measures impacts in the X, Y and Z direction is to be installed on the transformer prior to shipping. This impact recorder is to be inspected prior to offloading of the transformer at its final destination.

.7 Complete installation instructions for any parts shipped separate from transformers shall accompany transformer shipment.

.8 Material safety data sheet(s) (MSDS's) for equipment shall be provided to shipper at time of shipping.

.1 MSDS's shall conform to all relevant regulations where equipment will be located.

.2 If any chemical so shipped is exempt from such laws, a statement to that effect shall be included on MSDS.

.3 MSDS's shall be provided to the City a minimum of two (2) weeks before shipment to allow for entrance to customer site.

.4 Oil shall be non-PCB.

### 1.8 Maintenance

.1 Provide maintenance materials for incorporation into O&M manuals in accordance with Division 1.

.2 Extra Materials:

.1 Furnish extra materials matching products installed as described below, packaged with protective covering for storage, and identified with labels clearly describing contents.

.2 Touch-Up Paint: 3 half-pint (240 mL) containers of paint matching enclosure exterior finish.

.3 Contact Lubricant: 1 container.

## 2. PRODUCTS

### 2.1 Acceptable Manufacturers

.1 Partner Technologies Incorporated (PTI).

.2 Eaton (Cooper Power Systems).

.3 Approved Equal.

### 2.2 Transformer Type

.1 Liquid cooled, outdoor, substation transformer type, KNAN.

.2 The transformer shall include additional accessories to form a complete factory assembled, self contained, steel fabricated unit for mounting on an existing concrete pad. Dimensions shall not exceed those indicated.

## 2.3 Supply Characteristics

.1 600 V Secondary:

.1 Each transformer shall have the following characteristics:

.1 Primary (HV)voltage: 4160 V, 60 Hz, delta connected, three-phase, three-wire.

.2 Secondary (LV) voltage: 600 V, grounded wye, three-phase, four-wire with neutral connected to ground. Low voltage neutral shall be a fully insulated X0 bushing with ground strap. Downstream LV MCC is three-phase, three-wire.

.3 Capacity: 1000 kVA, KNAN.

.2 480 V Secondary:

.1 Each transformer shall have the following characteristics:

.1 Primary (HV)voltage: 4160 V, 60 Hz, delta connected, three-phase, three-wire.

.2 Secondary (LV) voltage: 480 V, grounded wye, three-phase, four-wire with neutral conductor grounded. Low voltage neutral shall be a fully insulated X0 bushing with ground strap. Downstream LV MCC is three-phase, four-wire.

.3 K-Factor of K-4 to a harmonics of UV disinfection system.

.4 Capacity: 1000 kVA, KNAN.

## 2.4 Design Requirements

.1 The Transformer shall be designed and manufactured in accordance with the Vendor's standard and shall meet the applicable industrial standards. All transformers shall be by the same equipment vendor – no split packages are allowed.

.2 The Transformer shall be designed for outdoor use and for continuous operation, twenty-four (24) hours per day, 365 days per year.

.3 The Transformer shall be an oil filled, substation type, complete with cable compartments, options and accessories to form complete factory assembled, self contained, steel fabricated unit for mounting on a concrete pad.

.1 Type: KNAN (Oil with flash point greater than 300°C, oil natural, air natural), with provision for future fans (KNAF):

.1 Provision for future cooling equipment shall mean that all necessary terminal blocks, control panels, and fan wiring will be supplied at the time of transformer purchase. The only equipment accessories required at a later date will be the fans and their mounting brackets.

.2 The provision shall assume one external 208V three-phase 60 Hz power supply to the control cabinet of the transformer. The supply will be used to operate cooling

fans (when provided), auxiliary 208-120V control transformer, and controls section heater (if required).

.3 Oil type: Ester Dielectric (Environtemp FR3), PCB free, suitable for -40°C conditions.

.4 Refer to other Transformer requirements as provided further in this Specification and in the Drawings.

## 2.5 Transformer Characteristics

.1 The provided Ratings called out here are specific to the project or application, ratings not specifically called out here need to conform to industry recognized and standard specific requirements. Refer to other parts of this Specification for additional requirements.

.2 Basic Impulse Level (BIL):

.1 Primary Side BIL: 60 kV (minimum).

.2 Secondary Side BIL: 30 kV (minimum).

.3 Bushings:

.1 The type and design of the bushing is coordinated with the impulse level of the transformer to form an integrated insulation system. Transformers shall be shipped with the bushings mounted in place.

.4 The transformer shall be designed and constructed to be completely self-protected by its ability to withstand the external short-circuits, as defined and tested in accordance with CSA C88.

.1 Maximum rms short-circuit: 25 kA, on the primary side.

.2 Transformer shall withstand thermally and mechanically two second (or greater) short circuit at its secondary terminals.

.5 Minimum %Z Impedance:

.1 The minimum impedance (%Z) shall be based on the self-cooled rating of the transformer. The typical desired %Z has been provided below, and not more then 1.5% above minimum levels.

| kVA | % Z |
|---|---|
| 150 and smaller | 2.0 |
| 225 | 3.5 |
| 300 | 4.0 |
| 500 | 4.0 |
| 750 and larger | 5.75 |

.6 Losses:

.1 The no-load loss and exciting current for an individual three-phase transformer shall not exceed the guaranteed value by more than 7.5%.

## 2.6 Transformer Manufacture

.1 Transformer: Unit shall be dead front, 3-phase, two winding, 60 Hz, 65°C (117°F) rise above a 40°C (104°F) ambient, self-cooled, the windings shall be copper.

.1 The high potential (HP) winding of a three-phase transformer shall be delta-connected and the low potential (LP) winding shall be wye-connected with angular displacement of 30 degrees (Vector group Dyn1) in accordance with CSA Standard CSA C88.

.2 Core: Cold rolled grain-oriented steel lamination.

.2 Grounding:

.1 Tinned Copper grounding bus sized for the transformation, mounted on insulators rated for the system voltages. Separate Ground bus in HV & LV compartments.

.2 Provisions for connection for a minimum of six (6) ground cables to accommodate cable sizes as per the Drawings. Provisions shall be provided for additional 20% grounding connections.

.3 2-hole long barrel copper crimp connector type.

.4 Transformer shall be provided with stainless steel grounding pads at two diagonally opposite ends.

.3 Primary Compartment: Provide the following equipment as a minimum:

.1 Dead-front construction. Air terminal connection box configured to allow cable entry from bottom. Suitable clearance between concrete pad and bottom of connection box to allow cable entry with cable run in cable tray secured to concrete surface.

.2 Bushings: Separable insulated (dead front) connectors for power distribution systems above 600 V shall conform to IEEE 386. Bushing well connectors with bushing well inserts to shall also conform to IEEE 386.

.1 Medium-voltage bushing inserts and bushings for separable loadbreak elbow connectors, amperes continuous. Provide a parking stand for each elbow connector. Equip connector with steel-reinforced hook-stick eye, grounding eye, test point, and arc-quenching material.

.2 Shall be suitable for termination of conductors as indicated on the Drawings.

.3 Surge Protection Device (SPD) with 3-phase fuse box for primary side protection.

.1 Manufacturer: Magney Grande p/n MGFMV-40SB, or approved equal.

.4 Mechanical interlock to prevent access to primary compartment unless primary supply is isolated at source. Separate padlocking for primary compartment door.

.5 Tap Changer:

.1 External tap changing handle operable only when the transformer is de-energized.

.2 Fitted with a manually operated de-energized off-load-tap-changer on the primary winding, with four (4) taps at 2.5%, two (2) FCAN and two (2) FCBN, externally operated and equipped with a pad-lockable handle capable of pad-locking in each tap position.

.3 The tap changer shall be capable of carrying the full transformer short-circuit current without damage or contact separation.

.4 The tap changer shall be gang operated from a single operating point and shall have an easily visible position indicator.

.5 Tap changer shall be functional at minus (-) 40˚C ambient.

.4 Low-Voltage Compartment: Provide the following equipment as a minimum:

.1 Dead-front construction. Air terminal connection box configured to allow cable entry from bottom. Suitable clearance between concrete pad and bottom of connection box to allow cable entry with cable run in cable tray secured to concrete surface.

.2 Secondary low-voltage bushings with spade terminals designed for copper conductors. All customer connections shall be wired to terminal blocks and be clearly identified on the wiring diagrams.

.1 Minimum of NEMA 8-hole pad (copper) voltage terminals, suitable for a minimum of six (6) conductors per phase, size (6) conductors per neutral. Refer to the single line drawing for required cable connections.

.2 Low-voltage bushings shall be separable insulated connectors.

.3 All transformers shall have an insulated neutral X0 bushing with a removable ground strap accessible from the secondary cable compartment. X0 should not be connected to ground that is internal to the oil-filled transformer compartment.

.1 The wye point of the Low Potential (LP) winding shall be brought to a bushing for the connection to downstream MCC equipment as indicated.

.5 Accessories

.1 Infrared (IR) Scanning Windows in both the Primary and Secondary termination boxes. Windows to be suitable for scanning all connection points for both Primary and Secondary windings.

.2 A rapid pressure rise and gas accumulation relay. Provide two sets of pressure trip contacts, and one set of gas accumulation alarm contacts. Leads from the contacts shall be terminated in the transformer control cabinet.

.3 A dial type thermometer, equipped with four (4) separately adjustable contacts, two (2) sets of adjustable contacts between 60ºC and 100ºC for alarm, and the other two (2) sets of adjustable contacts between 100ºC and 125ºC for tripping, and with a scale legible from the ground. The temperature-sensitive element shall be installed in an oil-filled or close-fitting well, located in the hottest oil, as far as practicable.

.4 A dial type oil level indicator and relay to indicate oil level within the transformer. The indicator relay shall actuate on falling oil level at a point before the insulation system is compromised. Two (2) sets of relay contacts shall be provided.

.5 A winding temperature indicator and relay to indicate the hot-spot temperatures of the windings. Associated equipment, such as heating coils, thermometer bulb, heating well gauge and current transformer, shall be provided. The indicator relay shall be automatically reset at approximately 7.5ºC ±2.5ºC below the closing temperature and shall be provided with the following electrically independent, adjustable contacts:

.1 Two (2) sets to initiate a warning, setting to be adjustable between 60ºC and 110ºC to initiate cooling fans.

.2 Two (2) sets to initiate an alarm, setting to be adjustable between 60ºC and 110ºC.

.3 Two (2) sets to initiate tripping, setting to be adjustable between 100ºC and 125ºC.

.6 One 100-ohm platinum resistance type temperature detectors for the top oil temperature shall be provided on the transformer. Leads from the temperature detectors shall be terminated in the transformer control cabinet.

.7 Transformer control cabinet, NEMA 4X enclosure, housing DIN rail mounted terminal blocks for termination of CT secondaries, all alarm contacts, relay outputs, and RTDs. Provide heater, thermostat and disconnect switch to prevent condensation. Size the heater and disconnect switch to suit. Provide 120 V terminal blocks.

.8 Vacuum pressure gauge: dial size 95.25 mm (3.75”).

.9 Bottom drain valve with sampling device.

.10 Top filling and filter press connection.

.11 Transformer case grounding pad.

.6 Compliance:

.1 Transformer shall comply with the Energy Efficiency Standards for Distribution Transformers and CSA C802.1.

.2 The transformer shall be designed to meet the average sound-level specified in CSA C88 Table 8, and CSA C227.4 Table 5, in general dBA of approximately:

.1 Less then 750 kVA: 56 dBA.

.2 750 kVA through to 1000 kVA: 58 dBA.

.3 2500 kVA and above: 62 dBA.

.3 All steel welding shall conform to the requirements of CSA W59.

.7 Enclosures:

.1 All enclosures and sub-assemblies shall be weather-resistant for outdoor Canadian weather (-40C to +40C temperature swing), with lockable provisions, and tamper-proof. Isolate and interlock high- and low-voltage enclosure compartments, with separate hinged doors.

.2 Kirk Key Interlock between transformer door and upstream feeder breaker. Key is to be released via the upstream breaker rack-out mechanism.

.3 The minimum enclosure environmental ratings of CSA/NEMA/EEMAC 4.

.4 Enclosure base shall have a 4 mil (0.1 mm) thick tar-mastic undercoat.

.5 Doors shall be provided with pad-lockable three-point latch with penta-head bolts and shall include door stays to hold compartment doors in the 110˚ open position.

.6 Box type stiffeners shall be provided with drains to prevent accumulation of water or leaked insulating liquid.

.7 The transformer shall be fitted with four jacking steps, each capable of supporting one half the weight of the transformer when filled with oil. Each step shall have a minimum free surface area for the head of the jack of 160 mm x 200 mm. The distance from the base to the jacking points shall be at least 300 mm.

.8 Hauling eyes, or 50 mm diameter holes, shall be provided at the transformer base, in pairs, to permit the transformer to be moved in either direction along the major axis or the minor axis. Both eyes or holes of each pair shall be approximately equidistant from the center of gravity of the complete transformer.

.8 Equipment Identification, Signs, and Warnings:

.1 Provide equipment identification in accordance with Division 26.

.2 Install "DANGER--HIGH VOLTAGE--KEEP OUT" signs with tamper-proof stainless steel screws on each accessible side of pad-mounted transformers.

.3 Provide a warning nameplate located near the sampling valve “WARNING – EQUALIZE INTERNAL PRESSURE PRIOR TO TAKING SAMPLES”.

.4 Corrosion-resistant nameplate and connection diagram except that the number of gallons (litres) of coolant shall be shown.

.5 Provide additional labeling as required by the authority having jurisdiction (AHJ).

.9 Manufacturer Rating Plates:

.1 Provide metallic (stainless steel) CSA label on the outside of the transformer and on the inside of the transformer in the cable compartment.

.2 Transformer shall be furnished with a non-corrosive diagrammatic nameplate, permanently attached with non-corrosive hardware. The diagrammatic nameplate shall include the name of the manufacturer of the equipment as well as the location where the transformer was manufactured and tested.

.3 In addition to the main rating plate, plates with identification and characteristics of auxiliary equipment (bushings, tap changers, special cooling equipment etc.)

.4 The Load Tap Changer (LTC) shall also contain a tap changer nameplate, permanently attached to the LTC compartment.

.1 Includes impedances on extreme tap positions.

.2 Serial number, make and complete type designation of tap changers.

.3 A non-corrosive nameplate located next to the operating handle of the de-energized tap changer shall be provided which states the following: ‘Danger - Do not operate tap changer when the transformer is energized.”

.5 Includes notation of all standards used in its manufacturer, and the manufactured date.

.6 Non-linear devices, capacitors, resistors etc. as installed on the on the winding assembly or on any tap changer shall be indicated on the nameplate.

.7 The nameplate shall contain all connection and rating information in accordance with CSA C88 and CSA C227.4 including but not limited to the following:

.1 Phasor diagram for polyphase transformers including hour clock designation (Dyn11, Dyn1, etc.)

.2 MVA rating of the Transformer shall include existing and future MVA by cooling class. Provision for future includes Forced-cooling equipment.

.3 Voltage transformers, potential devices, current transformers, winding temperature, and other misc. devices when used shall be shown.

.4 All internal leads and terminals not permanently connected shall be identified with numbers or letters in a manner that permits convenient reference to prevent confusion with terminal and polarity markings.

.5 Contains no detectable level of PCB (less than 1 ppm) at the time of manufacture.

.6 Vacuum withstand capability of conservator and all oil circulating parts as appliable.

.7 Diagram showing the location of major valves (drain, filter etc.)

.8 Type of Oil.

.9 Sound Levels at all ratings (sound pressure or intensity).

.10 PCB content in oil (less than 1 ppm) at the time of first filling.

.8 Where applicable also show the following:

.1 Tie-in resistor including their rating and the manufacturer’s name.

.2 Type, make, and serial number of the LTC reactors.

.3 Current limiting reactors including their impedance values and the manufacturer's name.

.4 On nitrogen pressurized transformers minimum and maximum pressure setting of the regulator.

.5 Location of static cylinders when used (on the core, under LTC windings etc.)

.6 A statement that the voltages and currents marked are based on no-load and are not during the load.

.7 Zero sequence impedance.

.8 Make, serial number, voltage ratio and rating of series transformer and/or compensating transformer when used.

.9 Construction designation – core type or shell type. Core details – single, two, three, four, five or seven legged.

.10 Maximum current in common winding on autotransformers with loading and during the step-up operation.

.9 Rating plate shall indicate the transformer was built to CSA C2.1, is energy efficient per CSA-C802.1, and show markings suitable for use in Canada.

## 2.7 Factory Finish

.1 Provide with a factory-applied, corrosion-resistant finish which shall withstand 3,000 hours of exposure to the salt spray test specified in ASTM B117 without loss of paint or release of adhesion of paint primer coat to the metal surface in excess of 1/16 inch from the scribed test mark.

.2 Cut edges or otherwise damaged surfaces of galvanized steel shall be coated with a zinc-rich paint.

.3 Exterior Finish: Munsell 7GY3.29/1.5 Green.

## 2.8 Factory Test

.1 In addition to the production tests specified by CSA C88, perform the following factory tests:

.1 Test methods shall be in accordance with IEEE C57.12.90, and IEEE C57.12.00 Section 8.1.

.1 An impulse test shall be carried out on each terminal of every transformer. The tests shall be based on 100% of BIL and shall be carried out in the sequence given in CSA C88. Low potential windings rated less than 1.5 KV class need not be impulse tested.

.1 ANSI reduced full wave, chopped wave impulse test with oscillograph record.

.2 ANSI full wave impulse test, observed by oscilloscope.

.2 Load loss and impedance shall be measured at full load for every transformer.

.3 The core insulation shall be tested at 5000 V. The minimum insulation resistance shall be 100 M-ohms in each of the following tests:

.1 Before final assembly of coils, for each core or core section to:

.1 All others core sections.

.2 Each core bolt and ground.

.3 Ground.

.4 Perform the following tests/checks in accordance with CSA C2:

.1 Leak detection test at 50 kPA for a 24 hour period.

.2 Ratio test on all tap connections within 0.5% tolerance.

.3 Polarity Tested: Three phase, Angular displacement.

.4 Operation tests on all devices.

.5 Applied Voltage (60 Hz):

.1 HV to LV and Grd at 19kV for 1 minute.

.2 LV to HV and Grd at 10kV for 1 minute.

.6 Induce Potential at: 2 times 647V at 400 Hz for 18 seconds.

.5 Partial discharges shall be measured on one transformer of each type during the induced potential test.

.6 Complete ANSI temperature tests.

.7 A certified test report shall be submitted and shall contain the test data for each transformer serial number manufactured. The certified test report shall as a minimum contain the data as specified in ANSI C57.12.90.

.2 Transformer shall comply to CSA C2.1 and come factory certified with markings suitable for use in Canada. Factory install external CSA transformer nameplates, stainless steel, engraved. Affixed using rivets.

## 2.9 Equipment Identification

.1 Provide metallic (stainless steel) CSA label on the outside of the transformer and on the inside of the transformer in the cable compartment.

.2 Provide size 11, hard plastic equipment identification lamacoid on the outside of the transformer, example as follows:

| XFMR-Y701<br>10 00 kVA, 4.16 kV – 12.47 kV, 3Ø, 4W<br>FED FROM CS-Y701 |
|---|

**2.10 Warning Signs**

.1 Provide warning signs in accordance with in accordance with the requirements of the CEC.

.2 Provide high voltage warning signs in accordance with AHJ requirements.

**3. EXECUTION**

**3.1 Installation**

.1 Installation in accordance with Division 1.

.2 Installation shall be by Construction Contractor in accordance with Manufacturer recommendations, under separate contract, and is not included within the scope of equipment supply.

.3 The equipment will be installed by the Construction Contractor adjacent to the UV building at separate time periods so that the existing UV system can be maintained. The Supplier's Representative shall assist in each installation period. It is currently anticipated that equipment installation (one (1) of each transformer type) will be separated by several months.

**3.2 Grounding**

.1 Pad-mounted transformer shall have all noncurrent-carrying metal parts connected to a solid earth ground electrode.

.2 The transformer shall be supplied with two diagonally opposite stainless steel ground pads, one of which shall be fitted with a connector suitable for securely clamping 4/0 AWG copper cable.

.3 The transformer shall be equipped with four (4) grounding ball studs complete with covers. One ball stud shall be installed on the base exterior directly bolted to transformer ground bus. In addition, one ball stud shall be bolted to each secondary phase bushings/bus.

.4 Provide Bonding of the fencing/bollards surrounding the transformer installation.

**3.3 Field Tests and Quality Control**

.1 Perform tests in accordance with Division 1.

.2 The Supplier's Representative shall conduct all necessary checks to the equipment, including but not limited to:

.1 Check factory made connections of transformer unit for mechanical security and electrical continuity.

.2 Check transformer insulating liquid for correct quantity/level and specification according to manufacturer's instructions.

.1 Check oil level and temperature indicators.

.2 Inspect for oil leaks and excessive rusting.

.3 Confirm that the neutral X0 terminal is insulated and not internally grounded.

.4 Perform field tests in accordance with NETA ATS Part 7.2.2.

.1 Carry out following insulation tests using megger with 20,000 megohm scale and resulting insulation resistance corrected to base of 20°C.

.1 High voltage to ground with secondary grounded for duration of test.

.2 Low voltage to ground with primary grounded for duration of test.

.3 High to low voltage.

.2 Complete turn to turn ration tests for all tap changer positions.

.3 Inspect primary and secondary connections for tightness and for signs of overheating.

.4 Inspect and clean bushings and insulators.

.5 Check fuses for correctness of type and size.

.6 Check for grounding and neutral continuity between primary and secondary circuits of transformer.

.7 Set transformer taps to rated voltage as specified.

.1 Adjusting: Adjust primary taps so secondary voltage is above, and within 2% of rated voltage.

.8 After the installation has been completed, conduct an operating test demonstrating that all equipment devices operate in accordance with the requirements of the Drawings and specifications.

.9 Operating Test: Energize the transformer and adjust the output voltage to the specified value. Further readjust tap settings, if necessary, after the facility being served is in normal operation.

.10 Have transformer oil sample taken once transformer has been energized and conduct Oil and Gas analysis on sample.

.11 Have a second sample taken after three (3) months operation and conduct Oil and Gas analysis on sample. Test facility will produce a report comparing the results of both tests.

.12 Submit to the Contract Administrator the standard factory test certificates of each transformer and type test of each transformer with high voltage accessories in accordance with CSA C2.

.13 Prior to end of Transformer warranty period the Contractor will again take an oil sample and conduct Oil and Gas analysis on sample. Test facility will produce a report comparing the results of all three (3) tests.

## 3.4 Closeout Activities

.1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Provide operation and maintenance data for pad mounted distribution transformers for incorporation into manual specified in Division 1.

.3 Include insulating liquid maintenance data.

**END OF SECTION**