

Approved: 2009-12-31

Part 1 General

1.1 DEFINITIONS

- .1 **“Blackout Review Period”** means the period between December 24 and January 2 in each calendar year that will not be considered Business Days with respect to the timeframes noted for review and / or response as set out in this section.
- .2 **“RFI Procedure”** means the review procedure for RFIs in accordance with 1.6 of this section.
- .3 **“Submittals”** has the meaning as set out in D4 of the Tender.
- .4 **“Submittal Procedure”** means the procedure for Submittals in accordance with 1.3 of this section.
- .5 **“Submittal Schedule”** has the meaning as set out in D4 of the Tender.

1.2 ADMINISTRATIVE

- .1 Submit to the Contract Administrator Submittals listed for review in the Contract Documents. Submit in accordance with 1.3.11 and in orderly sequence to not cause delay in Work. Failure to provide adequate review time in accordance with 1.3.12 is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Do not proceed with Work affected by the Submittal until review is complete and returned by the Contract Administrator.
- .3 Present Submittals including but not limited to Shop Drawings, product data, samples, and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units, converted values are acceptable.
- .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 co-ordinated with the requirements of the Work and the Contract Documents. Submittals not stamped, signed, dated, and identified as to the Work will be returned without being examined and considered rejected.
- .6 Notify the Contract Administrator, in writing at time of submission, of any deviations from the requirements of the Contract Documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent Work are co-ordinated.
- .8 If, upon review by the Contract Administrator, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If Submittals are rejected,

noted copy will be returned and resubmission of corrected Submittals, through same procedure indicated above, must be performed before the Work affected by the Submittal may proceed.

- .9 The Contractor shall make any corrections required by the Contract Administrator and shall resubmit the required number of corrected copies of Submittals. The Contractor shall direct specific attention in writing or on resubmittals to revisions other than the corrections requested by the Contract Administrator on previous submission.
- .10 Where Work is to be designed by the Contractor, comply with applicable codes and ensure Submittals are 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 also be signed and sealed by a professional engineer licensed in the Province of Manitoba.
- .11 The Contract Administrator will review Submittals for general conformance with the design concept and intent, and general compliance with the Contract.
- .12 The Contract Administrator's review does not relieve the Contractor from compliance with requirements of the Contract nor from errors in Submittals or the Contractor's design.
 - .1 For clarity, the Contractor's responsibility for errors and omissions in submission is not relieved by the Contract Administrator's review of Submittals.
- .13 After the Contract Administrator's review and return of copies, distribute copies to Subcontractors as appropriate.
- .14 Keep one reviewed copy of each submission on Site.

1.3 SUBMITTAL PROCEDURES

- .1 Direct Submittals to the Contract Administrator:
 - .1 The Contract Administrator will not review Submittals received directly from a Subcontractor and the Submittals will be returned without being examined and considered rejected.
- .2 Procedures:
 - .1 Detailed procedures for handling electronic Submittals will be discussed at the pre-construction meeting.
 - .2 The Contractor shall submit Submittals in accordance with reasonable instructions provided by the Contract Administrator throughout the execution of the Work.
 - .3 At the Contract Administrator's discretion, 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, or both.

- .3 Transmission of Submittals:
 - .1 The Contractor shall submit one electronic copy of Submittals for each requirement included in the Contract Documents and as the Contract Administrator may reasonably request.
 - .2 Hardcopies will only be submitted where specifically required under the Contract Documents or where requested by the Contract Administrator in accordance with 1.3.4.
- .4 Hardcopy Submittals:
 - .1 The Contractor shall submit hardcopies only where specifically required under the Contract Documents or requested by the Contract Administrator.
 - .2 All hardcopy Submittals require an electronic Submittal, with the exception of physical samples or similar.
- .5 Electronic Submittals:
 - .1 Submittals made in electronic format shall be as follows:
 - .1 Each Submittal shall be submitted in electronic form as Adobe Acrobat PDF, and native files (e.g. Word, Excel, AutoCAD, etc.), if requested by the Contract Administrator. For Microsoft Office files, use the version available at time of execution of Contract.
 - .2 Electronic files that contain more than 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 searchable and not be scanned files, unless signed authorization is required.
 - .6 PDF files shall be accepted at the following printing sizes: 8.5 inches by 11 inches, 11 inches by 17 inches, or 22 inches by 34 inches. No other paper sizes will be accepted.
 - .7 The printing size for PDF files shall be set to print legibly.
 - .2 The Contract Administrator will not review Submittals that are not accompanied by an electronic copy and the Submittals will be returned without being examined and considered rejected.
 - .3 The City may, in reviewing any matter or Submittal in accordance with this section, refer such matter or Submittal to other City departments, or any of the City's servants, agents, advisers, consultants, contractors, or subcontractors.
- .6 Numbering and Tracking System:
 - .1 Number Submittals consecutively in one sequence in the order submitted, in a numbering system established by the Contract Administrator.

- .2 Resubmission of Submittals shall have the original Submittal number with a sequential numeric suffix for the revision number (e.g., R1, R2, etc.).
- .7 Submittal Schedule:
 - .1 The Contractor shall prepare and submit the Submittal Schedule to the Contract Administrator prior to commencement of Work and in accordance with D14 of the Tender.
 - .2 Submittal Schedule shall:
 - .1 Include a table listing of all anticipated Submittals required to complete the Work.
 - .2 Take into account that more than one submission will likely be required for Submittals.
 - .3 Illustrate that Submittals are reasonably spread over the entire period required for the Work and meets minimum review period in accordance with 1.3.12, is reasonable to achieve, and the Blackout Review Period is adhered to.
 - .4 For each Specification show, at a minimum, the following within the Submittal Schedule:
 - .1 Specification reference.
 - .2 Total number of Submittals for each Specification reference.
 - .3 Identify each Submittal by its name or title.
 - .4 Identify the estimated date of submission to the Contract Administrator.
 - .5 State the revision number and status for each Submittal.
 - .3 The Contract Administrator reserves the right to review and comment on the Submittal Schedule. The Contractor shall update the Submittal Schedule with reasonable instructions provided by the Contract Administrator.
 - .4 Submit an updated Submittal Schedule to the Contract Administrator in accordance with D14 of the Tender. The updated Submittal Schedule shall also show the actual submission dates.
 - .8 Transmittal Form:
 - .1 The Contractor shall accompany each submission with a transmittal form containing:
 - .1 Date.
 - .2 Project title and Tender number.
 - .3 The Contractor's name and address.
 - .4 Identification and quantity of each Submittal (Shop Drawing, product data, sample, etc.).
 - .5 Signature of authorized representative.
 - .6 Other pertinent data.

- .2 The Contractor shall include a copy of the transmittal form for each Submittal and resubmittal.
- .3 Include the Contractor's written response to each of the Contract Administrator's review comments with resubmittals stamped "REVISE AND RESUBMIT".
- .9 Submissions to include:
 - .1 Date and revision dates.
 - .2 Project title and Tender number.
 - .3 Name of:
 - .1 Contractor.
 - .2 Subcontractor.
 - .3 Supplier.
 - .4 Manufacturer.
 - .4 The Contractor's stamp, signed by the Contractor's authorized representative certifying approval of submissions, verification of field measurements, and compliance with Contract Documents.
 - .1 Stamp to include project name, Submittal number, Specification section(s), the Contractor's reviewer name, date of the Contractor's approval, and statement certifying that Submittal has been reviewed, checked, and approved by the Contractor for compliance with the Contract.
 - .5 Identify and describe each deviation or variation from the Contract.
- .10 Format:
 - .1 Do not base Submittals 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 the Specification or by the Contract Administrator.
 - .3 Present in a clear and thorough manner and in sufficient detail to show kind, size, arrangement, function of components, materials and devices, and compliance with the Contract.
- .11 Timeliness:
 - .1 Schedule and submit in accordance with 1.3.7, and the requirements of the Contract Documents.
 - .2 The Contractor shall submit Submittals well in advance of scheduled delivery date for associated equipment or material and in orderly sequence so as to cause no delay in the Work.
- .12 Review Time:
 - .1 Allow 10 Business Days for review of Submittals by the Contract Administrator unless otherwise noted in the Contract Documents.

- .2 Time for review shall commence on the Contract Administrator's receipt of the Submittal. When the Submittal is received by the Contract Administrator before noon, the review period commences on that Business Day. When the Submittal is received by the Contract Administrator after noon, the review period commences on the subsequent Business Day.
 - .3 Submittals will not be reviewed between the Blackout Review Period. These dates will not be included within the review timelines outlined in this section.
 - .4 The Contract Administrator will act upon the Contractor's Submittal and transmit response to the Contractor no later than 10 Business Days after receipt, unless otherwise specified.
 - .5 Resubmittals will be subject to same review time with the response to the Contractor no later than 10 Business Days after receipt, unless otherwise specified.
 - .6 The review time required for Submittals and resubmittals does not alleviate the Contractor of the Contractor's responsibilities to deliver the completed Work within the required time frame and schedule. Planning for Submittal reviews and the risk to the construction schedule remains the Contractor's sole responsibility.
- .13 Submittal Response:
- .1 Submittals will be returned to the Contractor with one of the following notations:
 - .1 "REVIEWED, NO COMMENT"
 - .1 When stamped "REVIEWED, NO COMMENT", distribute additional copies as required for execution of the Work.
 - .2 "REVIEWED, SEE COMMENTS"
 - .1 When stamped "REVIEWED, SEE COMMENTS" ensure that all copies for use are modified and distributed additional copies as required for execution of the Work.
 - .3 "REVISE AND RESUBMIT"
 - .1 When stamped "REVISE AND RESUBMIT", make the necessary revisions, as indicated, consistent with the Contract and submit again for review as specified in 1.3.14.
 - .4 "REJECTED"
 - .1 When stamped "REJECTED", resubmit Submittal in accordance with Submittal Procedures or as indicated in the Contract Documents.
 - .5 "FOR INFORMATION"
 - .1 When stamped "FOR INFORMATION", the submittal is not required as a submission for the Contract and has not been reviewed in detail and is intended for reference only.

- .6 Only Submittals bearing “REVIEWED, NO COMMENT” and “REVIEWED, SEE COMMENTS”, shall be used on the Work unless otherwise authorized by the Contract Administrator.
- .14 Resubmittals:
 - .1 Submit new electronic files for each resubmittal.
 - .2 Clearly identify each correction or change made and include revision date.
 - .3 Notify the Contract Administrator in writing of any revisions other than those requested by the Contract Administrator.
 - .4 Review time for resubmittals are outlined in 1.3.12.
 - .5 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.
 - .6 The City may deduct cost of additional reviews exceeding two submissions from the Contract Price at their sole discretion. Contractor will be charged for the Contract Administrator subsequent reviews of Submittal packages exceeding two submissions. Each additional review will be charged to the Contractor at the Contract Administrator’s scheduled rates. The Contract Administrator’s charges for additional reviews for Work will be deducted from the payment to the Contractor.
- .15 Incomplete Submittals:
 - .1 The Contract Administrator will return the entire Submittal package for the Contractor’s revision, if preliminary review deems it incomplete.
 - .2 When any of the following are missing, the Submittal will be deemed incomplete:
 - .1 The Contractor’s review stamp, completed and signed.
 - .2 The Contractor’s transmittal form, completed and signed.
 - .3 Insufficient number of copies.
 - .4 Electronic copies or hard copies required by the Contract or requested by the Contract Administrator.
 - .5 All requested information.
 - .6 Professional engineer’s seal and signature, where it is required.
- .16 Submittals not required by the Contract:
 - .1 Will not be reviewed in detail and will be returned stamped “FOR INFORMATION”.

1.4 SHOP DRAWINGS AND PRODUCT DATA

- .1 The Contractor shall prepare the Shop Drawings in accordance with the Contract Documents or as the Contract Administrator may reasonably request. Shop Drawings are to clearly indicate Materials, weights, dimensions, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes, and other information necessary for completion of Work.

Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of section under which adjacent items will be supplied and installed. Indicate cross references to design Drawings and Specifications. Notify the Contract Administrator in writing of any deviations in Shop Drawings from the requirements of the Contract Documents.

- .1 For clarity, in general all equipment / Material to be installed at the Site will require Shop Drawings.
- .2 Adjustments made on Shop Drawings by the Contract Administrator are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to the Contract Administrator prior to proceeding with Work.
- .3 The Contractor 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 Documents. Examination of each Shop Drawings shall be indicated by stamp, date, and signature of a responsible person of the Subcontractor for supplied items and of the Contractor for fabricated items. Shop Drawings not stamped, signed, and dated will be returned without being examined and considered rejected. Ensure that the following are verified:
 - .1 Field measurements.
 - .2 Field construction criteria.
 - .3 Catalogue numbers and similar data.
- .4 The Contractor shall submit Shop Drawings stamped and signed by a professional engineer registered or licensed in the province of Manitoba as required in the Specifications.
- .5 Product Data shall include, at a minimum, the following:
 - .1 Make.
 - .2 Model.
 - .3 Size.
 - .4 Other pertinent information.
- .6 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, relation to adjacent structure or materials, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.

- .9 Single line and schematic diagrams.
- .10 Relationship to adjacent work.
- .7 Only submit information related to the Work.
- .8 Supplement standard information to provide details applicable to the Work.

1.5 DESCRIPTION OF CONSTRUCTION METHODS

- .1 The Contractor shall, if required by the Contract Administrator or as indicated in the Specifications, submit for the review of the Contract Administrator method statements which describe in detail, supplement with Drawings where necessary, the methods to be adopted for executing any portion of the Work.
- .2 These statements shall also include details of constructional plant and labour to be employed. Acceptance by the Contract Administrator shall not relieve the Contractor of any responsibilities, nor shall reasonable refusal to approve entitle the Contractor to extra payment or an extension of time.

1.6 RFI PROCEDURE

- .1 The Contractor shall submit a RFI in writing to the Contract Administrator in the event that the Contractor 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.
- .2 Procedures:
 - .1 Submit RFIs to the Contract Administrator on the "Request for Information" form appended to this section. The Contract Administrator will return RFIs submitted without the RFI form without being examined and considered rejected. Resubmission of the RFI using the RFI form will be required for review and response by the Contract Administrator.
 - .2 Number RFIs consecutively in one sequence in the order submitted, in a numbering system established by the Contract Administrator.
 - .3 Submit one distinct subject per RFI request. Do not combine multiple requests or unrelated items on one form.
 - .4 Where the RFI form does not have sufficient space, attach additional sheets as required.
 - .5 Submit the RFI form with all necessary supporting documentation.
- .3 In the RFI, the Contractor shall clearly and concisely set forth:
 - .1 The issues for which clarification or interpretation is sought and why a response is needed from the Contract Administrator.
 - .2 An interpretation or understanding of the requirement along with reasons why 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 Contractor not having been reviewed with an explanation why it was deemed not valid.

- .5 For clarity, RFIs are considered a Submittal and will follow the same review timelines as set out in 1.3.12.
- .6 If, at any time, the Contractor submits a large number of RFIs or the Contract Administrator considers the RFI to be of such complexity that the Contract Administrator cannot process the RFIs within 10 Business Days, the Contractor Administrator shall confer with the Contractor within five Business Days of receipt of such RFIs, and the Contract Administrator and the Contractor will jointly prepare an estimate of the time necessary for processing as well as an order of priority among the RFIs submitted. The Contractor shall accommodate such necessary time at no impact to the schedule and at no additional cost to the Contract.
- .7 If the Contractor submits a RFI on an activity with 10 Business Days or less of available time to the impacted activity on the current project schedule, the Contractor 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 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 Contractor believes that the RFI response from the Contract Administration will cause a change to the requirements of the Contract, the Contractor shall within 10 Business Days give written notice to the Contract Administrator stating that the Contractor believes the RFI response will result in a change in the Contract and the Contractor intends to submit a change request. Failure to give such written notice of 10 Business Days shall waive the Contractor's right to seek additional time or cost under the requirements of the Contract.
- .9 The City may, in reviewing any matter or RFI in accordance with this Submittal procedure, refer such matter or RFI to other City departments, or any of the City's servants, agents, advisers, consultants, contractors, or subcontractors.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION



Request for Information (RFI)

RFI No. 0

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: d _____

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:

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Part 1 General

1.1 REFERENCE STANDARDS

- .1 Conform to reference standards, in whole or in part as specifically requested in the Contract Documents.
- .2 If there is a 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.
- .3 Cost for such testing will be borne by the City in event of conformance with the Contract Documents or by the Contractor in event of non-conformance.

1.2 QUALITY

- .1 Products, materials, equipment, and articles incorporated in Work shall be new, not damaged or defective, and of best quality for 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, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is a precaution against oversight or error. Remove and replace defective products at the Contractor's own expense and be responsible for delays and expenses caused by rejection.
- .3 Should disputes arise as to quality or fitness of products, the decision rests strictly with the Contract Administrator based upon the requirements of the Contract Documents.
- .4 Unless otherwise indicated in Specifications, maintain uniformity of manufacture for any particular or like item throughout the Work.

1.3 AVAILABILITY

- .1 Immediately upon signing the Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify the Contract Administrator of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of the Work.
- .2 In the event of failure to notify the Contract Administrator at the commencement of Work, and should it subsequently appear that Work may be delayed for such reason, the Contract Administrator reserves right to substitute more readily available products of similar character, at no increase in the Contract Price or Contract Time.

1.4 DELIVER, STORAGE, HANDLING, AND PROTECTION

- .1 Delivery and Acceptance Requirements: deliver materials to Site in original factory packaging, labelled with manufacturer's name and address.

- .2 Deliver, handle, and store products in manner to prevent damage, adulteration, deterioration and soiling, and in accordance with manufacturer's instructions when applicable.
- .3 Deliver and store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .4 Deliver and store products subject to damage from weather in weatherproof enclosures.
- .5 Storage and Protection:
 - .1 Store materials indoors, in dry location, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.
- .6 Store paints and freezable materials in a heated and ventilated room.
- .7 Remove and replace damaged products at own expense and to the satisfaction of the Contract Administrator.
- .8 Touch-up damaged factory finished surfaces to the Contract Administrator's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.5 TRANSPORTATION

- .1 Pay costs of transportation of products required in the performance of the Work.

1.6 MANUFACTURER'S INSTRUCTIONS

- .1 Unless otherwise indicated in Specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify the Contract Administrator in writing of conflicts between Specifications and manufacturer's instructions so the Contract Administrator can establish a course of action.
- .3 Improper installation or erection of products due to failure in complying with these requirements authorizes the Contract Administrator to require the removal and re-installation at no increase in the Contract Price or Contract Time.

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 Do not employ anyone unskilled in their required duties. The Contract Administrator reserves the right to require the dismissal from Site, workers deemed incompetent or careless.

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

1.8 REMEDIAL WORK

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.
- .2 Perform remedial work by specialists familiar with Materials affected. Perform in a manner to neither damage nor put at risk any portion of the Work.

1.9 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.

1.10 FASTENINGS

- .1 Provide metal fastenings and accessories in same texture, colour, and finish as adjacent materials, unless indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior Work, unless stainless steel or other material is specifically requested in affected Specification section.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly, and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.11 PROTECTION OF WORK IN PROGRESS

- .1 Prevent overloading of parts of building. Do not cut, drill, or sleeve load bearing structural members, unless specifically indicated, without written approval of the Contract Administrator.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

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Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit written request of demolition, cutting, or alteration at least two weeks prior to the scheduled demolition, cutting, or alteration in accordance with this section.

1.2 PREPARATION

- .1 Submit written request in advance of demolition, cutting, or alteration which affects:
 - .1 Structural integrity of elements of Work.
 - .2 Integrity of weather-exposed or moisture-resistant elements.
 - .3 Efficiency, maintenance, or safety of operational elements.
 - .4 Visual qualities of sight-exposed elements.
 - .5 Work of the City or separate contractor.
- .2 Include in request:
 - .1 Identification of project.
 - .2 Location and description of affected Work.
 - .3 Statement on necessity for cutting or alteration.
 - .4 Description of proposed Work and products to be used.
 - .5 Alternatives to cutting and patching.
 - .6 Effect on Work of the City or separate contractor.
 - .7 Written permission of affected separate contractor.
 - .8 Date and time Work will be executed.
- .3 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- .4 After uncovering, inspect conditions affecting performance of Work.
- .5 Beginning of cutting or patching means acceptance of existing conditions.
- .6 Provide supports to assure structural integrity of surroundings are maintained; provide devices and methods to protect other portions of Work from damage.
- .7 Provide protection from elements for areas which are to be exposed by uncovering Work; maintain excavations free of water.
- .8 Exercise care where cutting holes in existing concrete elements so as not to damage existing reinforcing or conduit.
 - .1 For reinforced concrete floors and walls, locate existing reinforcing and conduit by x-ray or ground penetrating radar scanning and mark out on the surface of the concrete prior to cutting.

- .1 Mark the location of the proposed hole and all adjacent rebar and conduits.
- .2 Obtain approval from the Contract Administrator prior to cutting.
- .2 Concrete scanning device shall to be capable of detecting rebar and conduit in the full depth of the floor.
- .9 The Contractor shall exercise care where installing anchors into existing concrete elements so as not to damage existing reinforcing. All anchors shall be installed utilizing carbide tip drill bits. The existing reinforcing shall be located utilizing a reinforcing bar locator and marked out on the surface of the concrete. The drill holes shall be advanced to the required depth for installation of the anchors. Should reinforcement be encountered while drilling, terminate the hole and reposition to clear the reinforcement. Do not use core bits that can easily intercept and damage/cut the reinforcing during drilling. Patch and repair damages.

1.3 EXECUTION

- .1 Execute cutting, fitting, and patching including excavation and fill, to complete Work.
- .2 Fit several parts together, to integrate with other Work.
- .3 Uncover Work to install ill-timed Work.
- .4 Remove and replace defective and non-conforming Work.
- .5 Remove samples of installed Work for testing.
- .6 Provide openings in non-structural elements of Work for penetrations of electrical Work.
- .7 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
- .8 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval from the Contract Administrator. Where significant removals are required, the Contractor to engage a Professional Engineer and provide sealed Shop Drawings for modifications.
- .9 Restore Work with new products in accordance with requirements of Contract Documents.
- .10 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .11 Penetrations though a floor above another space shall have a pipe sleeve extending above the floor to prevent water running to the floor below.
- .12 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with fire stopping with a rated fire stopping assembly to full thickness of the construction element.
- .13 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

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Part 1 General

1.1 PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris.
- .2 Remove waste materials from the Site at daily regularly scheduled times or dispose of as directed by the Contract Administrator. Do not burn waste materials on Site.
- .3 Make arrangements with and obtain permits from Authorities Having Jurisdiction for disposal of waste and debris.
- .4 Provide on-site containers for collection of waste materials and debris.
- .5 Dispose of waste materials and debris off Site.
- .6 For clarity, handling and disposal of asbestos waste in accordance with Section 02 82 00.01 Asbestos Abatement – Minimum Precautions and Section 02 82 00.02 - Asbestos Abatement – Intermediate Precautions.
- .7 Clean interior areas prior to the start of finishing Work and maintain areas free of dust and other contaminants during finishing operations.
- .8 Store volatile waste in covered metal containers and remove from the premises at the end of each day.
- .9 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .10 Use only cleaning materials recommended by the manufacturer of the surface to be cleaned and as recommended by the cleaning material manufacturer.
- .11 Schedule cleaning operations so that resulting dust, debris, and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.
- .12 Clean and maintain bathroom facilities utilized by construction staff on a daily basis.

1.2 FINAL CLEANING

- .1 When Work is substantially performed, remove surplus products, tools, construction machinery, and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .3 Prior to Total Performance, remove remaining surplus products, tools, construction machinery, and equipment.
- .4 Vacuum clean and dust building interiors.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Approved: 2009-06-30

Part 1 General

1.1 SECTION INCLUDES

- .1 Closeout Submittals include O&M Manuals, As-Built Drawings, and Maintenance Materials.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 O&M Manuals
 - .1 Prepare in accordance with this section and the Contract Documents.
- .3 As-Built Drawings
 - .1 Prepare in accordance to this section and the Contract Documents.
- .4 Maintenance Material
 - .1 Provide spare parts, extra stock material, and special tools of same quality and manufacture as products provided in the Work in accordance with this section and Contract Documents.
 - .2 Provide evidence, if requested, for type, source, and quality of products supplied.

1.3 OPERATION AND MAINTENANCE MANUALS

- .1 Develop the O&M Manuals throughout the course of the Work.
- .2 Operation and maintenance instructions and technical data to be sufficiently detailed with respect to design elements, construction features, component function, correct installation procedure, and maintenance requirements to permit effective start-up, operation, maintenance, repair, modification, extension, and expansion of any portion or feature of installation. Technical data to be in the form of approved Shop Drawings, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and maintenance material lists.
- .3 For the guidance of the City's operation and maintenance personnel, the Contractor shall prepare O&M Manuals for the Work, describing in detail the construction of each part of the Work and the recommended procedure for operation, servicing, and maintenance.
- .4 All instructions in these O&M Manuals shall be in simple language to guide the City in the proper operation and maintenance of this installation.
- .5 Separate O&M Manuals (a total of seven unique manuals) will be required for each facility as follows:
 - .1 RDS/WTP SCADA Integration.
 - .2 TBPS.

- .3 SLAIF.
- .4 McPhillips RPS.
- .5 MacLean RPS.
- .6 Hurst RPS.
- .7 DBPS and DCFF.
- .6 Submit one advance copy of the draft O&M Manual for the respective facility two weeks prior to facility closeout for review and comments.
 - .1 Modify and supplement the O&M Manuals as required by the Contract Administrator.
 - .2 After review and acceptance, continue compilation of the O&M Manuals for the final submission.
 - .3 After review and acceptance, submit two hard copies and one searchable PDF copy in accordance with Section 01 33 00 – Submittal Procedures, on a flash memory drive, of the advanced draft O&M Manuals within two weeks of facility closeout. Mark the O&M Manual cover page “ADVANCED DRAFT”.
- .7 Submit completed final O&M Manuals, including all facilities, four weeks prior to Substantial Performance of the Work.
 - .1 Copy will be returned after final inspection of Substantial Performance with the Contract Administrator’s comments.
 - .2 Revise content of documents as required and provide final Submittal.
 - .3 Insert final Functional Requirement Specification updated to align with the Work performed in accordance with E8 of the Tender and the final control narrative updated to align with the Work performed in accordance with Appendix C – Process Control Narrative to be inserted into the O&M Manuals.
 - .4 After review and acceptance of the final Submittal, submit four hard copies and one searchable PDF copy in accordance with Section 01 33 00 – Submittal Procedures, on a flash memory drive, of the final O&M Manuals prior to Substantial Performance. Mark the O&M Manual cover page “FINAL”.
- .8 Further to the requirements set out in the Contract Documents, the O&M Manuals shall contain the following:
 - .1 Product data:
 - .1 Mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
 - .2 Typewritten Text: as required to supplement product data.
 - .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.
 - .2 Training documents: include training documents outlined in E11 of the Tender.

- .3 Equipment and systems – provide the following:
 - .1 All equipment and systems documentation shall have project specific equipment tags clearly indicating the systems.
 - .2 Survey record of underground systems (cables, conduit, piping, etc.).
 - .1 Provide precise location of all buried systems.
 - .3 Brochures and catalogue excerpts for all components of the Work.
 - .4 Installation, start-up, and individual equipment operation and maintenance manuals.
 - .5 Calibration procedures for equipment.
 - .6 Final functional requirement specification outlining the programming of the PLC systems for individual processes or systems.
 - .7 Final instrumentation set points including but not limited to:
 - .1 Units
 - .2 Scale
 - .3 Alarm points (low-low, low, high, high-high)
 - .4 4-20 mA settings
 - .8 List names, addresses, and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
 - .9 For each item of equipment and each system include description of unit or system, and component parts.
 - .1 Give function, normal operation characteristics, and limiting conditions.
 - .2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
 - .10 Panelboard circuit directories: provide electrical service characteristics, controls, and communications.
 - .11 Installed colour coded wiring diagrams.
 - .12 Operating procedures: include start-up, break-in, and routine normal operating instructions and sequences.
 - .1 Include regulation, control, stopping, shut-down, and emergency instructions.
 - .2 Include summer, winter, and any special operating instructions.
 - .13 Maintenance requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
 - .14 Include manufacturer's printed operation and maintenance instructions.

- .15 Original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .16 Installed control diagrams by controls manufacturer.
- .17 List of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .18 Additional requirements: as specified in the Contract Documents.
- .4 Materials and finishes – provide the following:
 - .1 Building products, applied materials, and finishes: include product data with catalogue number, size, composition, and colour and texture designations.
 - .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 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 the Contract Documents.
- .5 Other documents – provide the following:
 - .1 Maintain manufacturer's certifications, field test records, in accordance with Section 26 05 00 – Common Work Results for Electrical and required by individual Specifications sections to be included on the O&M Manuals.
 - .2 Certificates and Permits:
 - .1 Include certificate of inspection from the AHJ, manufacturer's certifications, electrical permits, and warranty certificate, signed and dated in accordance with Section 26 05 00 – Common Work Results for Electrical and required in the Contract Documents.
 - .3 Tests:
 - .1 Include testing, field test records, start-up tests, commissioning, and all test results documentation in accordance with E10 of the Tender and Section 26 05 00 – Common Work Results for Electrical and as required in the Contract Documents.
- .6 Digital photographs – provide the following:
 - .1 In accordance with the Contract Documents or as requested.
- .7 Drawings – provide the following:
 - .1 Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
 - .2 Shop Drawings and cutsheets of all equipment and materials.
 - .1 Do not utilize the cutsheet and Shop Drawing submittals that were sent to the Contract Administrator for review as these may contain inaccurate information and markups.

- Only provide cutsheets and Shop Drawings representing the final materials and equipment supplied, without any markups from the Contract Administrator.
- .2 For generic cutsheets and Shop Drawings that list multiple model numbers or configurations, place a rectangle around the specific model that was supplied and cross out other models.
 - .3 Sections for the record drawings and As-Built Drawings of all installations. Drafted record drawings and As-Built Drawings of size 432x279mm (11 x 17") will be inserted by the Contract Administrator, based on the As-Built Drawings marked up by the Contractor.
- .9 The O&M Manuals shall be provided in the following Format:
- .1 Organize data as an instructional manual.
 - .2 Main Cover page:
 - .1 Labelled "Operation and Maintenance Instructions".
 - .2 Facility name included in the volume.
 - .3 Project name and Tender number.
 - .4 Date of submission.
 - .3 List of Contents
 - .1 Indicate facilities updated by the Work.
 - .2 Name, addresses, and telephone numbers of the City, Contract Administrator, Contractor, and Subcontractors with name of responsible parties.
 - .3 Schedule of products and systems, indexed to content of volume.
 - .4 List subject matter of contents for each volume.
 - .4 Binders: vinyl, hard covered, 3 'D' ring, with spine and face pockets.
 - .1 When multiple binders are used correlate data into related consistent groupings.
 - .2 Identify contents of each binder on spine.
 - .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 Text: manufacturer's printed data, or typewritten data.
 - .8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

1.4 AS-BUILT DRAWINGS AND RECORD INFORMATION

- .1 Print a complete full-sized set of Contract Drawings for the purpose of maintaining As-Built Drawings.

- .2 Submit draft As-Built Drawings for each facility two weeks after the facility closeout in accordance with E13 of the Tender.
- .3 Submit final As-Built Drawings prior to Total Performance in accordance with E13 of the Tender.
- .4 Accurately record information on Contract Drawings. All Work deviations from the original Contract to be provided as As-Built Drawings.
 - .1 Recorded information shall be updated on a daily basis with a red marker.
 - .2 Recorded information shall be concurrent with construction progress.
 - .1 Do not conceal Work until required information is recorded.
 - .3 Recorded information on the drawings shall include but not limited to:
 - .1 Locations of devices.
 - .2 Location of all equipment.
 - .3 Electrical circuiting and networking of all devices.
 - .4 Conduit and feeder runs (complete with conductor size and number).
 - .5 Measured heights of installed equipment in relation to finished floor.
 - .6 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .7 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .8 Field changes of dimension and detail.
 - .9 Changes made by Change in Work.
 - .10 Details not on original Contract Drawings.
- .5 Keep one complete set of the following to maintain at Site for the Contract Administrator, identify this set as "PROJECT RECORD COPY":
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change in Work and other modifications to the Contract.
 - .5 Reviewed Shop Drawings, product data, and samples.
 - .6 Field test records.
 - .7 Inspection certificates.
 - .8 Manufacturer's certificates.
 - .9 Site Instructions.
 - .10 Clarifications.
- .6 Store project record copy in field office apart from documents used for construction.
- .7 Maintain project record copy in good condition.

- .8 Keep project record copy assessable for inspection by Contract Administrator.

1.5 MAINTENANCE MATERIALS

- .1 Provide spare parts, extra stock materials, and special tools, in quantities specified in individual Specification sections.
 - .1 Special tools: provide items with tags identifying their associated function and equipment.
- .2 Provide spare parts, extra stock materials, and special tools of same manufacture and quality as items in Work.
- .3 Deliver spare parts, extra stock materials, and special tools to Site; place and store in accordance with Section 01 61 00 – Common Product Requirements.
- .4 Receive and catalogue spare parts, extra stock materials, and special tools.
 - .1 Submit inventory listing to Contract Administrator.
 - .2 Include approved listings in O&M Manuals.
- .5 Obtain receipt from the City for delivered products and submit to Contract Administrator prior to final payment.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Approved: 2008-12-31

Part 1 General

1.1 SUMMARY

- .1 Both confirmed asbestos and presumed asbestos have been identified at the DBPS/DCFF, Hurst RPS, MacLean RPS, McPhillips RPS, and SLAIF which will or may be affected by the Work. Refer to the following HMIS reports for further details:
 - .1 DBPS_2019 12 19_HMIS Confirmed Asbestos and Presumed Asbestos Report
 - .2 Hurst RPS_2020 05 22_HMIS Confirmed Asbestos and Presumed Asbestos Report
 - .3 MacLean RPS_2019 10 28_HMIS Confirmed Asbestos and Presumed Asbestos Report
 - .4 McPhillips RPS_2020 06 30_HMIS Confirmed Asbestos and Presumed Asbestos Report
 - .5 SLAIF Forman's Residence_2019 12 19_HMIS Confirmed Asbestos and Presumed Asbestos Report
 - .6 SLAIF Lakeview Residence_2019 12 19_HMIS Confirmed Asbestos and Presumed Asbestos Report
 - .7 SLAIF Residence_2019 12 19_HMIS Confirmed Asbestos and Presumed Asbestos Report
 - .8 SLAIF Staffhouse_2019 12 19_HMIS Confirmed Asbestos and Presumed Asbestos Report
 - .9 SLAIF Storage Shed_2019 12 19_HMIS Confirmed Asbestos and Presumed Asbestos Report
- .2 The presumed ACMs detailed in the Appendix J - Asbestos Reports shall be assumed to be ACM.
- .3 The Contractor is responsible for the removal and disposal of all confirmed ACMs and presumed ACMs affected by the Work.
- .4 Where penetrations through confirmed or presumed ACMs are required, the Contractor shall conduct the Work in accordance with this section.
- .5 The Contractor shall put in place a removal / disposal work plan and shall remove all confirmed and presumed ACMs to perform the Work as indicated in the Contract Documents which impact the Contractors activities, in a safe manner, as part of the required Work.
- .6 Provide training for all workers, including but not limited to:
 - .1 Asbestos Workers.
 - .2 Asbestos Visitors.
- .7 Comply with requirements of this section when performing following the Work:

- .1 Removing ceiling tiles that are ACM, if the tiles cover an area less than 7.5 square metres and are removed without being broken, cut, drilled, abraded, ground, sanded, or vibrated.
 - .2 Removing Non-Friable ACMs, other than ceiling tiles, if the material is installed or removed without being broken, cut, drilled, abraded, ground, sanded, or vibrated.
 - .3 Break, cut, grind, sand, drill, scrape, vibrate, or abrade Non-Friable ACMs using non-powered hand-held tools, and wet the material to control the spread of dust or fibres.
 - .4 Removing less than one square metre of drywall in which joint-filling compounds that are ACMs have been used.
- .8 The Contractor shall ensure that Work does not impede the ongoing operations of the facility. The facility will continue to be operated by City staff.

1.2 REFERENCE STANDARDS

- .1 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act, 1999 (CEPA).
 - .2 SOR/2018-196 Prohibition of Asbestos and Products Containing Asbestos Regulations.
- .2 Manitoba Workplace Safety and Health Regulation, Reg 217/2006
- .3 SAFE Work Manitoba
 - .1 Guide For Asbestos Management, May 2017.
- .4 The Workplace Safety & Health Act, Manitoba, Chapter W210 C.C.S.M.
- .5 Health Canada / WHMIS
 - .1 SDS.
- .6 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA).

1.3 DEFINITIONS

- .1 **“Amended Water”** means water with non-ionic surfactant wetting agent added to reduce water tension to allow thorough wetting of fibres.
- .2 **“Asbestos-Containing Materials”** or **“ACMs”** has the meaning as set out in D4 of the Tender;
- .3 **“Asbestos Abatement Monitoring & Inspection Agent”** means a person qualified to provide asbestos abatement monitoring and inspection services in the jurisdiction where the services are to be provided.
- .4 **“Asbestos Worker”** means a Competent Worker who is employed by an employer to perform a service that may include the disturbance or removal of ACMs.

- .5 “**Asbestos Work Area**” means area where Work takes place which will, or may, disturb ACMs.
- .6 “**Authorized Visitors**” means the Contract Administrator or designated representatives, the City, and representatives of regulatory agencies.
- .7 “**Competent Worker**” means in relation to specific work, means a worker who:
 - .1 Is qualified because of knowledge, training and experience to perform the Work.
 - .2 Is familiar with the provincial laws, federal laws, and the provisions of the regulations that apply to the Work.
 - .3 Has knowledge of all potential or actual danger to health or safety in the work.
- .8 “**Friable Materials**” means material that when dry can be crumbled, pulverized, or powdered by hand pressure and includes such material that is crumbled, pulverized, or powdered.
- .9 “**HEPA**” means high efficiency particulate air.
- .10 “**HEPA vacuum**” means HEPA filtered vacuum equipment with filter system capable of collecting and retaining fibres greater than 0.3 microns in any direction at 99.97 percent efficiency.
- .11 “**Non-Friable ACMs**” means material that when dry cannot be crumbled, pulverized, or powdered by hand pressure.
- .12 “**polyethylene**” means polyethylene sheeting or rip-proof polyethylene sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide protection and isolation.
- .13 “**sprayer**” means garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must have appropriate capacity for work.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit removal / disposal work plan two weeks prior to the schedule removal / disposal work in accordance with this section and E6 of the Tender.
- .3 Submit proof of the Contractor's insurance in accordance with D11 of the Tender.
- .4 Submit daily air monitoring results and recommendations in accordance with this section.

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: comply with Federal, Provincial/Territorial, and local requirements pertaining to asbestos, provided that in case of conflict among these requirements or with these Specifications, the more stringent requirement applies. Comply with regulations in effect at time Work is performed.
- .2 Health and Safety:

- .1 Safety Requirements: Provide all requirements for Asbestos Worker protection.
 - .1 Protective equipment and clothing to be worn by Asbestos Workers and Authorized Visitor while in Asbestos Work Area include:
 - .1 Air purifying half-mask respirator with N-100, R-100, or P-100 particulate filter, personally issued to Asbestos Worker and marked as to efficiency and purpose, suitable for protection against asbestos and acceptable to Provincial Authority Having Jurisdiction. The respirator to is be fitted so that there is an effective seal between the respirator and the Asbestos Worker's face, unless the respirator is equipped with a hood or helmet. The respirator is to be cleaned, disinfected, and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one Asbestos Worker, or after each use when used by more than one Asbestos Worker. If the respirator has damaged or deteriorated parts, it is to be replaced prior to being used by an Asbestos Worker. The respirator, when not in use, is to be stored in a convenient, clean, and sanitary location. The Contractor is to establish written procedures regarding the selection, use, and care of respirators, and a copy of the procedures are to be provided to and reviewed with each Asbestos Worker who is required to wear a respirator. An Asbestos Worker is not to be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while using the respirator.
 - .2 Disposable-type protective clothing that does not readily retain or permit penetration of asbestos fibres. Protective clothing to be provided by the Contractor and worn by every Asbestos Worker who enters the Asbestos Work Area. The protective clothing shall consist of a head and full body covering that fits snugly at the ankles, wrists, and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing. Suitable footwear must be worn with the protective clothing. Protective clothing to be repaired or replaced if torn.
 - .2 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.
 - .3 Before leaving the Asbestos Work Area, the Asbestos Worker can decontaminate his or her protective clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing, or, if the protective clothing will not be reused, place it in a container for dust and waste. The container to

be dust tight, suitable for asbestos waste, impervious to asbestos, identified as asbestos waste, cleaned with a damp cloth or a vacuum equipped with a HEPA filter immediately before removal from the Asbestos Work Area, and removed from the Asbestos Work Area frequently and at regular intervals.

- .4 Facilities for washing hands and face shall be provided within or close to the Asbestos Work Area.
- .5 Ensure Asbestos Workers wash hands and face when leaving Asbestos Work Area.
- .6 Ensure that no person required to enter an Asbestos Work Area has facial hair that affects the seal between the respirator and the face.
- .7 Authorized Visitor Protection:
 - .1 Provide protective clothing and approved respirators to Authorized Visitors to the Asbestos Work Areas.
 - .2 Instruct Authorized Visitors in the use of protective clothing, respirators, and procedures.
 - .3 Instruct Authorized Visitors in proper procedures to be followed in entering into and exiting from the Asbestos Work Areas.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial, Territorial, and Municipal regulations. Dispose of asbestos-containing waste in sealed double thickness 6 mils bags or leak proof drums. Label containers with appropriate warning labels.
- .2 Provide manifests describing and listing waste created. Transport containers by approved means to licensed landfill for burial.

1.7 REMOVAL / DISPOSAL WORK PLAN

- .1 The following shall be included in the removal / disposal work plan:
 - .1 Anticipated duration for the asbestos abatement work.
 - .2 Submit proof satisfactory to the Contract Administrator that suitable arrangements have been made to dispose of asbestos-containing waste in accordance with requirements of Authority Having Jurisdiction.
 - .3 Submit Provincial/Territorial and/or local requirements for notice of project form.
 - .4 Submit to the Contract Administrator necessary permits for transportation and disposal of asbestos-containing waste and proof that asbestos-containing waste has been received and properly disposed.
 - .5 Submit proof satisfactory to the Contract Administrator that all Asbestos Workers and/or supervisor have received appropriate training and education by a Competent Worker in the hazards of asbestos exposure, good personal hygiene and work practices while working in Asbestos

Work Areas, and the use, cleaning, and disposal of respirators and protective clothing.

- .6 Submit proof satisfactory to the Contract Administrator that Asbestos Workers have completed respirator fitting and testing. Asbestos Workers must be fit tested (irritant smoke test) with respirator that is personally issued.

1.8 EXISTING CONDITIONS

- .1 Notify the Contract Administrator of any Friable Material discovered during Work and not apparent from Drawings, Specifications, or reports pertaining to the Work. Do not disturb such material until instructed by the Contract Administrator.

1.9 SCHEDULING

- .1 All Work will be carried out so as not to affect normal operations of the facility taking place at the time of the abatement.

1.10 PERSONNEL QUALIFICATIONS

- .1 Asbestos Worker:
 - .1 Maintenance and custodial staff, and workers of all trades who may work with, or near ACMs, should hold a record of attendance for asbestos awareness training.
 - .2 All workers who work with asbestos should hold a record of attendance for training on the procedures for working with asbestos (typically of two days' duration); best practice would yield a certificate of completion that the worker can carry on their person while working at asbestos sites.
 - .3 Workers must be able to demonstrate their knowledge in each type of asbestos work procedure they will be assigned to carry out (type 1, 2 and/or 3).
 - .4 Workers should be directly supervised on all new procedures for a minimum of three days.

1.11 PERSONNEL TRAINING

- .1 Before beginning Work, provide the Contract Administrator with satisfactory proof that every Asbestos Worker has had instruction and training in hazards of asbestos exposure, in personal hygiene and work practices, and in use, cleaning, and disposal of respirators and protective clothing.
- .2 Instruction and training related to respirators includes, at minimum:
 - .1 Fitting of equipment.
 - .2 Inspection and maintenance of equipment.
 - .3 Disinfecting of equipment.
 - .4 Limitations of equipment.
- .3 Instruction and training must be provided by a Competent Worker.

Part 2 Products

2.1 MATERIALS

- .1 Drop Sheets:
 - .1 Polyethylene: 0.15 mm thick.
 - .2 Fire retardant polyethylene: 0.15 mm thick woven fibre reinforced fabric bonded both sides with polyethylene.
- .2 Wetting Agent: 50 percent polyoxyethylene ester and 50 percent polyoxyethylene ether mixed with water in a concentration to provide thorough wetting of ACM.
- .3 Waste Containers: contain waste in two separate containers.
 - .1 Inner container: 0.15 mm thick sealable polyethylene waste bag.
 - .2 Outer container: sealable metal or fibre type where there are sharp objects included in waste material; otherwise outer container may be sealable metal or fibre type or second 0.15 mm thick sealable polyethylene bag.
 - .3 Labelling requirements: affix pre-printed cautionary asbestos warning in both official languages that is visible when ready for removal to disposal site.
- .4 Tape: fibreglass - reinforced duct tape suitable for sealing polyethylene under both dry conditions and wet conditions using Amended Water.
- .5 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least eight hours and designed for purpose of trapping residual asbestos fibres.
 - .1 Sealer: flame spread and smoke developed rating less than 50 and be compatible with new fireproofing.

Part 3 Execution

3.1 PROCEDURES

- .1 Before beginning Work, isolate the Asbestos Work Area using, minimum, preprinted cautionary asbestos warning signs in both official languages that are visible at access routes to the Asbestos Work Area.
 - .1 Remove visible dust from surfaces in the Asbestos Work Area where dust is likely to be disturbed during course of Work.
 - .2 Use HEPA vacuum or damp cloths where damp cleaning does not create a hazard and is otherwise appropriate.
 - .3 Do not use compressed air to clean-up or remove dust from any surface.
- .2 Prevent the spread of dust from the Asbestos Work Area using measures appropriate to Work to be done.

- .1 Use fire retardant polyethylene drop sheets over flooring such as carpeting that absorbs dust and over flooring in Asbestos Work Area where dust and contamination cannot otherwise be safely contained. Drop sheets are not to be reused.
- .3 Wet ACM to be cut, ground, abraded, scraped, drilled, or otherwise disturbed unless wetting creates hazard or causes damage.
 - .1 Use garden reservoir type low-velocity fine-mist sprayer.
 - .2 Perform Work to reduce dust creation to lowest levels practicable.
- .4 Frequently and at regular intervals during Work and immediately on completion of Work:
 - .1 Dust and waste to be cleaned up and removed using a vacuum equipped with a HEPA filter, or by damp mopping or wet sweeping, and placed in a waste container.
 - .2 Drop sheets to be wetted and placed in a waste container as soon as practicable.
- .5 Clean-up:
 - .1 Place dust and asbestos-containing waste in sealed dust-tight waste bags. Treat drop sheets and disposable protective clothing as asbestos-containing waste; wet and fold these items to contain dust, and then place in plastic bags.
 - .2 Clean exterior of each waste-filled bag using damp cloths or HEPA vacuum and place in second clean waste bag immediately prior to removal from Asbestos Work Area.
 - .3 Seal waste bags and remove from Site. Dispose of in accordance with requirements of Provincial/Territorial and Federal Authority Having Jurisdiction. Supervise dumping and ensure that dump operator is fully aware of hazardous nature of material to be dumped and that the appropriate guidelines and regulations for asbestos disposal are followed.
 - .4 Perform a final thorough clean-up of Asbestos Work Areas and adjacent areas affected by Work using HEPA vacuum.

3.2 ASBESTOS ABATEMENT MONITORING & INSPECTION AGENT

- .1 Asbestos abatement work shall be subject to visual inspection and air monitoring by the Asbestos Abatement Monitoring & Inspection Agent.
- .2 Visual inspection and air monitoring will be paid via cash allowance included in the Contract. To access the cash allowance, the Contractor shall submit invoices for the Asbestos Abatement Monitoring & Inspection Agent. The invoices shall conform to C7 of the General Conditions for Construction.
- .3 The Asbestos Abatement Monitoring & Inspection Agent shall maintain a certificate of accreditation for lab analysis through Canadian Association for Laboratory Accreditation Inc. (CALA) or National Voluntary Laboratory Accreditation Program (NVLAP) and a proficiency testing accreditation.

3.3 AIR MONITORING

- .1 From the beginning of asbestos abatement work until completion of cleaning operations, the Contractor shall take air samples on daily basis outside of Asbestos Work Area in accordance with Provincial/Territorial Occupational Health and Safety Regulations.
 - .1 The Contractor shall retain an Asbestos Abatement Monitoring & Inspection Agent to preform air monitoring and provide air samples.
 - .2 Asbestos Abatement Monitoring & Inspection Agent shall be responsible for monitoring inside the enclosure in accordance with applicable Provincial/Territorial Occupational Health and Safety Regulations.
 - .3 Asbestos Abatement Monitoring & Inspection Agent to measure fibre content of air outside Asbestos Work Areas by means of air samples analyzed by Phase Contrast Microscopy (PCM).
 - .1 Stop Work when PCM measurements exceed 0.05 f/cc and correct procedures.
 - .4 Asbestos Abatement Monitoring & Inspection Agent shall submit daily air monitoring results and recommendations to the Contract Administrator.
- .2 Contamination of surrounding areas indicated by visual inspection or air monitoring will require complete enclosure and clean-up of affected areas. The costs of clean-up of affected surrounding areas due to contamination shall be borne by the Contractor and no adjustments to the Contract Price will be permitted.
- .3 If air monitoring shows that areas outside Asbestos Work Area are contaminated, enclose, maintain, and clean these areas in same manner as that applicable to Asbestos Work Area. The costs to enclose, maintain, and clean-up these areas shall be borne by the Contractor and no adjustments to the Contract Price will be permitted.
- .4 Ensure that respiratory safety factors are not exceeded.

END OF SECTION

Approved: 2008-12-31

Part 1 General

1.1 SUMMARY

- .1 Both confirmed asbestos and presumed asbestos have been identified at the DBPS/DCFF, Hurst RPS, MacLean RPS, McPhillips RPS, and SLAIF which will or may be affected by the Work. Refer to the following HMIS reports for further details:
 - .1 DBPS_2019 12 19_HMIS Confirmed Asbestos and Presumed Asbestos Report
 - .2 Hurst RPS_2020 05 22_HMIS Confirmed Asbestos and Presumed Asbestos Report
 - .3 MacLean RPS_2019 10 28_HMIS Confirmed Asbestos and Presumed Asbestos Report
 - .4 McPhillips RPS_2020 06 30_HMIS Confirmed Asbestos and Presumed Asbestos Report
 - .5 SLAIF Forman's Residence_2019 12 19_HMIS Confirmed Asbestos and Presumed Asbestos Report
 - .6 SLAIF Lakeview Residence_2019 12 19_HMIS Confirmed Asbestos and Presumed Asbestos Report
 - .7 SLAIF Residence_2019 12 19_HMIS Confirmed Asbestos and Presumed Asbestos Report
 - .8 SLAIF Staffhouse_2019 12 19_HMIS Confirmed Asbestos and Presumed Asbestos Report
 - .9 SLAIF Storage Shed_2019 12 19_HMIS Confirmed Asbestos and Presumed Asbestos Report
- .2 The presumed ACMs detailed in the Appendix J – Asbestos Reports shall be assumed to be ACM.
- .3 The Contractor is responsible for the removal and disposal of all confirmed ACMs and presumed ACMs affected by the Work.
- .4 Where penetrations through confirmed or presumed ACMs are required, the Contractor shall conduct the Work in accordance with this section.
- .5 The Contractor shall put in place a removal / disposal work plan and shall remove all confirmed and presumed ACMs to perform the Work as indicated in the Contract Documents which impact the Contractors activities, in a safe manner, as part of the required Work.
- .6 Provide training for all workers, including but not limited to:
 - .1 Asbestos Supervisor.
 - .2 Asbestos Workers.
 - .3 Asbestos Visitors.

- .7 Comply with requirements of this section when performing the following Work:
 - .1 Removing all or part of a false ceiling to obtain access to a Work area, if ACM is likely lying on the surface of the false ceiling.
 - .2 Removing more than 7.5 square metres of asbestos-containing suspended ceiling tiles, as indicated.
 - .3 Removal or disturbance of one square metre or less of friable ACM during the repair, alteration, maintenance, or demolition of all or part of machinery or equipment, or of a building.
 - .4 Enclosure of friable ACM.
 - .5 Removing Non-Friable ACMs by breaking, cutting, drilling, abrading, grounding, sanding, or vibrating if:
 - .1 The material is not wetted to control the spread of dust or fibres; and,
 - .2 The Work is done only by means of non-powered hand-held tools.
 - .6 Removing Non-Friable ACMs by breaking, cutting, drilling, abrading, grounding, sanding, or vibrating if the Work is done by means of power tools that are attached to dust-collecting devices equipped with HEPA filters.
 - .7 Removing more than one square metre of drywall in which joint-filling compounds that are ACMs have been used.
 - .8 Removing of ACM from a pipe, duct, or similar structure using a Glove Bag.
 - .9 Removing filters used in an air handling unit in a building that has sprayed-on asbestos-containing fireproofing.
- .8 The Contractor shall ensure that Work does not impede the ongoing operations of the facility. The facility will continue to be operated by City staff.

1.2 REFERENCE STANDARDS

- .1 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act, 1999 (CEPA).
 - .2 SOR/2018-196 Prohibition of Asbestos and Products Containing Asbestos Regulations.
- .2 Manitoba Workplace Safety and Health Regulation, Reg 217/2006
- .3 SAFE Work Manitoba
 - .1 Guide For Asbestos Management, May 2017.
- .4 The Workplace Safety & Health Act, Manitoba, Chapter W210 C.C.S.M.
- .5 Health Canada / WHMIS
 - .1 SDS.
- .6 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA).

1.3 DEFINITIONS

- .1 **“Amended Water”** means water with non-ionic surfactant wetting agent added to reduce water tension to allow wetting of fibres.
- .2 **“Asbestos-Containing Materials”** or **“ACMs”** has the meaning as set out in D4 of the Tender;
- .3 **“Asbestos Abatement Monitoring & Inspection Agent”** means a person qualified to provide asbestos abatement monitoring and inspection services in the jurisdiction where the services are to be provided.
- .4 **“Asbestos Supervisor”** means a Competent Worker who has charge of an Asbestos Work Area or authority over an Asbestos Worker.
- .5 **“Asbestos Work Area”** means area where Work takes place which will, or may disturb ACMs.
- .6 **“Asbestos Worker”** means a Competent Worker who is employed by an employer to perform a service that may include the disturbance or removal of ACMs.
- .7 **“Authorized Visitors”** means the Contract Administrator or designated representatives, the City, and representatives of regulatory agencies.
- .8 **“Competent Worker”** means in relation to specific Work, means a worker who:
 - .1 Is qualified because of knowledge, training, and experience to perform the Work.
 - .2 Is familiar with the provincial and federal laws and with the provisions of the regulations that apply to the Work.
 - .3 Has knowledge of all potential or actual danger to health or safety in the Work.
- .9 **“Friable Materials”** means material that when dry can be crumbled, pulverized, or powdered by hand pressure and includes such material that is crumbled, pulverized, or powdered.
- .10 **“Glove Bag”** means prefabricated Glove Bag as follows:
 - .1 Minimum thickness 0.25 mm (10 mil) polyvinyl-chloride bag.
 - .2 Integral 0.25 mm (10 mil) thick polyvinyl-chloride gloves and elastic ports.
 - .3 Equipped with reversible double pull double throw zipper on top and at approximately mid-section of the bag.
 - .4 Straps for sealing ends around pipe.
- .11 **“HEPA”** means high efficiency particulate air.
- .12 **“HEPA vacuum”** means HEPA filtered vacuum equipment with filter system capable of collecting and retaining fibres greater than 0.3 microns in any dimension at 99.97 percent efficiency.
- .13 **“Non-Friable ACMs”** means material that when dry cannot be crumbled, pulverized, or powdered by hand pressure.

- .14 **“polyethylene”** means polyethylene sheeting or rip-proof polyethylene sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide protection and isolation.
- .15 **“sprayer”** means garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must have appropriate capacity for the Work.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit removal / disposal work plan two weeks prior to the schedule removal / disposal work in accordance with this section and E6 of the Tender.
- .3 Submit proof of the Contractor's insurance in accordance with D11 of the Tender.
- .4 Submit daily air monitoring results and recommendations in accordance with this Section.

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: comply with Federal, Provincial/Territorial and local requirements pertaining to asbestos, provided that in case of conflict among these requirements or with these Specifications, the more stringent requirement applies. Comply with regulations in effect at the time Work is performed.
- .2 Health and Safety:
 - .1 Safety Requirements: Provide all requirements for Asbestos Worker and Authorized Visitor protection.
 - .1 Protective equipment and clothing to be worn by Asbestos Workers while in Asbestos Work Area include:
 - .1 Air purifying half-mask respirator with N-100, R-100, or P-100 particulate filter, personally issued to Asbestos Worker and marked as to efficiency and purpose, suitable for protection against asbestos and acceptable to Provincial Authority Having Jurisdiction. The respirator is to be fitted so that there is an effective seal between the respirator and the Asbestos Worker's face, unless the respirator is equipped with a hood or helmet. The respirator is to be cleaned, disinfected, and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one Asbestos Worker, or after each use when used by more than one Asbestos Worker. If the respirator has damaged or deteriorated parts, it is to be replaced prior to being used by an Asbestos Worker. The respirator, when not in use, is to be stored in a convenient, clean, and sanitary location. The Contractor is to establish written procedures regarding the selection, use, and care of respirators, and a copy of the procedures to be provided to and reviewed with each Asbestos Worker

who is required to wear a respirator. An Asbestos Worker is not to be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while using the respirator.

- .2 Disposable type protective clothing that does not readily retain or permit penetration of asbestos fibres. Protective clothing is to be provided by the Contractor and worn by every Asbestos Worker who enters the Work area, and the protective clothing is to consist of a head covering and full body covering that fits snugly at the ankles, wrists, and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing. Suitable footwear must be worn with the protective clothing. Protective clothing to be repaired or replaced if torn.
- .2 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.
- .3 Before leaving the Asbestos Work Area, the Asbestos Worker can decontaminate his or her protective clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing, or, if the protective clothing will not be reused, place it in a container for dust and waste. The container is to be dust tight, suitable for asbestos waste, impervious to asbestos, identified as asbestos-containing waste, cleaned with a damp cloth or a vacuum equipped with a HEPA filter immediately before removal from the Asbestos Work Area, and removed from the Asbestos Work Area frequently and at regular intervals.
- .4 Facilities for washing hands and face shall be provided within the Asbestos Work Area.
- .5 Ensure Asbestos Workers wash hands and face when leaving Asbestos Work Area.
- .6 Ensure that no person required to enter an Asbestos Work Area has facial hair that affects seal between respirator and face.
- .7 Authorized Visitor Protection:
 - .1 Provide protective clothing and approved respirators to Authorized Visitors to the Asbestos Work Areas.
 - .2 Instruct Authorized Visitors in the use of protective clothing, respirators, and procedures.
 - .3 Instruct Authorized Visitors in proper procedures to be followed in entering into and exiting from the Asbestos Work Areas.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Disposal of asbestos-containing waste generated by removal activities must comply with Federal, Provincial/Territorial and Municipal regulations. Dispose of asbestos-containing waste in sealed double thickness 6 mils bags or leak proof drums. Label containers with appropriate warning labels.

- .2 Provide manifests describing and listing waste created. Transport containers by approved means to licenced landfill for burial.

1.7 REMOVAL / DISPOSAL WORK PLAN

- .1 The following shall be included in the removal / disposal work plan:
 - .1 Anticipated duration for the asbestos abatement work.
 - .2 Submit proof satisfactory to the Contract Administrator that suitable arrangements have been made to dispose of asbestos-containing waste in accordance with requirements of Authority Having Jurisdiction.
 - .3 Submit Provincial/Territorial and/or local requirements for notice of project form.
 - .4 Submit to the Contract Administrator necessary permits for transportation and disposal of asbestos-containing waste and proof that asbestos-containing waste has been received and properly disposed.
 - .5 Submit proof satisfactory to the Contract Administrator that all Asbestos Workers and Asbestos Supervisor have received appropriate training and education by a Competent Worker in the hazards of asbestos exposure, good personal hygiene, entry, and exit from Asbestos Work Area, aspects of Work procedures and protective measures while working in Asbestos Work Areas, and the use, cleaning, and, disposal of respirators and protective clothing.
 - .6 Submit proof to the Contract Administrator that Asbestos Supervisor have attended asbestos abatement course, of not less than two days duration. Minimum of one Asbestos Supervisor for every 10 Asbestos Workers.
 - .7 Submit documentation to the Contract Administrator including test results, fire and flammability data, and SDS for chemicals or materials including:
 - .1 Encapsulants.
 - .2 Amended Water.
 - .3 Slow drying sealer.
 - .8 Submit proof satisfactory to the Contract Administrator that Asbestos Workers have completed respirator fitting and testing. Asbestos Workers must be fit tested (irritant smoke test) with respirator that is personally issued.

1.8 EXISTING CONDITIONS

- .1 Notify the Contract Administrator of any Friable Material discovered during Work and not apparent from Drawings, Specifications, or report pertaining to the Work. Do not disturb such material until instructed by the Contract Administrator.

1.9 SCHEDULING

- .1 All Work will be carried out so as not to affect normal operations of the facility taking place at the time of the abatement.

1.10 PERSONNEL QUALIFICATIONS

- .1 Asbestos Supervisor:
 - .1 Should hold a record of attendance certificate for training on asbestos work procedures.
 - .2 Must have demonstrated knowledge of the procedures for working with ACMs, at minimum, for the type of work they are supervising – types 1, 2, and/or 3.
 - .3 Must be able to evaluate worker competency.
- .2 Asbestos Worker:
 - .1 Maintenance and custodial staff, and workers of all trades who may work with, or near ACMs, should hold a record of attendance for asbestos awareness training.
 - .2 All workers who work with asbestos should hold a record of attendance for training on the procedures for working with asbestos (typically of two days' duration); best practice would yield a certificate of completion that the worker can carry on their person while working at asbestos sites.
 - .3 Workers must be able to demonstrate their knowledge in each type of asbestos work procedure they will be assigned to carry out (type 1, 2, and/or 3).
 - .4 Workers should be directly supervised on all new procedures for a minimum of three days.

1.11 PERSONNEL TRAINING

- .1 Before beginning Work, provide the Contract Administrator with satisfactory proof of personnel qualifications for the Asbestos Supervisor.
- .2 Before beginning Work, provide the Contract Administrator with satisfactory proof that every Asbestos Worker has had instruction and training in hazards of asbestos exposure, in personal hygiene and work practices, in use of Glove Bag procedures, and in use, cleaning, and disposal of respirators and protective clothing.
- .3 Instruction and training related to respirators includes, at minimum:
 - .1 Fitting of equipment.
 - .2 Inspection and maintenance of equipment.
 - .3 Disinfecting of equipment.
 - .4 Limitations of equipment.
- .4 Instruction and training must be provided by a Competent Worker.

Part 2 Products

2.1 MATERIALS

- .1 Drop and Enclosure Sheets:

- .1 Polyethylene: 0.15 mm thick.
- .2 Fire retardant polyethylene: 0.15 mm thick woven fibre reinforced fabric bonded both sides with polyethylene.
- .2 Wetting Agent: 50 percent polyoxyethylene ester and 50 percent polyoxyethylene ether mixed with water in concentration to provide thorough wetting of ACM.
- .3 Waste containers: contain waste in two separate containers.
 - .1 Inner container: 0.15 mm thick sealable polyethylene bag or where Glove Bag method is used, Glove Bag itself.
 - .2 Outer container: sealable metal or fibre type where there are sharp objects included in waste material; otherwise outer container may be sealable metal or fibre type or second 0.15 mm thick sealable polyethylene bag.
 - .3 Labelling requirements: affix preprinted cautionary asbestos warning, in both official languages, that is visible when ready for removal to disposal site.
- .4 Glove Bag:
 - .1 Acceptable materials: safe-T-Strip products in configuration suitable for Work or approved equal in accordance with B7 of the Tender.
 - .2 The Glove Bag to be equipped with:
 - .1 Sleeves and gloves that are permanently sealed to the body of the bag to allow the Asbestos Worker to access and deal with the insulation and maintain a sealed enclosure throughout the Work period.
 - .2 Valves or openings to allow insertion of a vacuum hose and the nozzle of a water sprayer while maintaining the seal to the pipe, duct, or similar structure.
 - .3 A tool pouch with a drain.
 - .4 A seamless bottom and a means of sealing off the lower portion of the Glove Bag.
 - .5 A high strength double throw zipper and removable straps, if the Glove Bag is to be moved during the removal operation.
- .5 Tape: tape suitable for sealing polyethylene to surfaces under both dry and wet conditions using Amended Water.
- .6 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least eight hours and designed for purpose of trapping residual asbestos fibres.
 - .1 Sealer: flame spread and smoke developed rating less than 50 and be compatible with new fireproofing.
- .7 Encapsulants: penetrating, surface film forming type conforming to CAN/CGSB-1.205.

Part 3 Execution

3.1 SUPERVISION

- .1 Minimum of one Asbestos Supervisor for every 10 Asbestos Workers is required.
- .2 Approved supervisor must remain within Asbestos Work Area during disturbance, removal, or other handling of ACM.

3.2 PROCEDURES

- .1 Before beginning Work, at each access to the Asbestos Work Area, install warning signs in both official languages reading as follows, where number in parentheses indicates font size to be used: 'CAUTION ASBESTOS HAZARD AREA (25 mm) / NO UNAUTHORIZED ENTRY (19 mm) / WEAR ASSIGNED PROTECTIVE EQUIPMENT (19 mm) / BREATHING ASBESTOS DUST MAY CAUSE SERIOUS BODILY HARM (7 mm)'.
 - .2 Before beginning Work remove visible dust from surfaces in the Asbestos Work Area where dust is likely to be disturbed during course of Work.
 - .1 Use HEPA vacuum or damp cloths where damp cleaning does not create hazard and is otherwise appropriate.
 - .2 Do not use compressed air to clean up or remove dust from any surface.
 - .3 Prevent spread of dust from the Asbestos Work Area using measures appropriate to the Work to be done.
 - .1 Use fire retardant polyethylene drop sheets over flooring such as carpeting that absorbs dust and over flooring in Work areas where dust or contamination cannot otherwise be safely contained.
 - .2 When removing ACM from piping or equipment and "Glove Bag" method is not used, removing suspended ceilings and walls themselves do not enclose Asbestos Work Area, erect enclosure of polyethylene sheeting around Asbestos Work Area Work Area, shut off mechanical ventilation system serving Work area and seal ventilation ducts to and from Asbestos Work Area.
 - .4 Before removing suspended ceilings, remove Friable Material on upper surfaces using HEPA vacuum equipment.
 - .1 Remove and clean surfaces of ceiling panels using HEPA vacuum, wrap clean panels in 0.10 mm thick polyethylene, and store in building as directed by the Contract Administrator.
 - .2 Clean "T" grid suspension system, disconnect, wrap in 0.10 mm thick polyethylene, and store in building as directed by the Contract Administrator.
 - .5 Remove loose material by HEPA vacuum; thoroughly wet Friable Material containing asbestos to be removed or disturbed before and during Work unless wetting creates hazard or causes damage.
 - .1 Use garden reservoir type low - velocity sprayer or airless spray equipment capable of producing mist or fine spray.

- .2 Perform Work in a manner to reduce dust creation to lowest levels practicable.
- .6 Pipe insulation removal using Glove Bag:
 - .1 A Glove Bag is not to be used to remove insulation from a pipe, duct, or similar structure if:
 - .1 It may not be possible to maintain a proper seal for any reason including, without limitation:
 - .1 The condition of the insulation.
 - .2 The temperature of the pipe, duct, or similar structure.
 - .2 The bag could become damaged for any reason including, without limitation.
 - .1 The type of jacketing.
 - .2 The temperature of the pipe, duct, or similar structure.
 - .2 Upon installation of the Glove Bag, inspect bag for any damage or defects. If any damage or defects are found, the Glove Bag is to be repaired or replaced. The Glove Bag to be inspected at regular intervals for damage and defects, and repair or replaced, as appropriately. The asbestos-containing contents of the damaged or defective Glove Bag found during removal are to be wetted and the Glove Bag and its contents are to be removed and disposed of in an appropriate waste disposal container. Any damaged or defective Glove Bags are not to be reused.
 - .3 Place tools necessary to remove insulation in tool pouch. Wrap bag around pipe and close zippers. Seal bag to pipe with cloth straps.
 - .4 Place hands in gloves and use necessary tools to remove insulation. Arrange insulation in bag to obtain full capacity of bag.
 - .5 Insert nozzle of garden reservoir type sprayer into bag through valve and wash down pipe and interior of bag thoroughly. Wet surface of insulation in lower section of bag.
 - .6 To remove bag after completion of stripping, wash top section and tools thoroughly. Remove air from top section through elasticized valve using a HEPA vacuum. Pull polyethylene waste container over Glove Bag before removing from pipe. Release one strap and remove freshly washed tools. Place tools in water. Remove second strap and zipper. Fold over into waste container and seal.
 - .7 After removal of bag ensure that pipe is free of residue. Remove residue using HEPA vacuum or wet cloths. Ensure that surfaces are free of sludge which after drying could release asbestos dust into atmosphere. Seal exposed surfaces of pipe and ends of insulation with slow drying sealer to seal in any residual fibres.
 - .8 Upon completion of Work shift, cover exposed ends of remaining pipe insulation with polyethylene taped in place.

- .7 Clean-up:
 - .1 Frequently during Work and immediately after completion of Work, clean up dust and asbestos-containing waste using HEPA vacuum or by damp mopping.
 - .2 Place dust and asbestos-containing waste in sealed dust tight waste bags. Treat drop sheets and disposable protective clothing as asbestos waste and wet and fold to contain dust and then place in waste bags.
 - .3 Immediately before their removal from Asbestos Work Area and disposal, clean each filled waste bag using damp cloths or HEPA vacuum and place in second clean waste bag.
 - .4 Seal and remove double bagged waste from Site. Dispose of in accordance with requirements of Provincial/Territorial and Federal Authority Having Jurisdiction. Supervise dumping and ensure that dump operator is fully aware of hazardous nature of material to be dumped and that guidelines and regulations for asbestos disposal are followed.
 - .5 Perform a final thorough clean-up of Asbestos Work Areas and adjacent areas affected by Work using HEPA vacuum.

3.3 ASBESTOS ABATEMENT MONITORING & INSPECTION AGENT

- .1 Asbestos abatement work shall be subject to visual inspection and air monitoring by the Asbestos Abatement Monitoring & Inspection Agent.
- .2 Visual inspection and air monitoring will be paid via cash allowance included in the Contract. To access the cash allowance, the Contractor shall submit invoices for the Asbestos Abatement Monitoring & Inspection Agent. The invoices shall conform to C7 of the General Conditions for Construction.
- .3 The Asbestos Abatement Monitoring & Inspection Agent shall maintain a certificate of accreditation for lab analysis through Canadian Association for Laboratory Accreditation Inc. (CALA) or National Voluntary Laboratory Accreditation Program (NVLAP) and a proficiency testing accreditation.

3.4 AIR MONITORING

- .1 From the beginning of asbestos abatement work until completion of cleaning operations, the Contractor shall take air samples on daily basis outside of Asbestos Work Area in accordance with Provincial/Territorial Occupational Health and Safety Regulations.
 - .1 The Contractor shall retain an Asbestos Abatement Monitoring & Inspection Agent to preform air monitoring and provide air samples.
 - .2 Asbestos Abatement Monitoring & Inspection Agent shall be responsible for monitoring inside the enclosure in accordance with applicable Provincial/Territorial Occupational Health and Safety Regulations.
 - .3 Asbestos Abatement Monitoring & Inspection Agent to measure fibre content of air outside Asbestos Work Areas by means of air samples analyzed by Phase Contrast Microscopy (PCM).

- .1 Stop Work when PCM measurements exceed 0.05 f/cc and correct procedures.
- .4 Asbestos Abatement Monitoring & Inspection Agent shall submit daily air monitoring results and recommendations to the Contract Administrator.
- .2 Work is subject to visual inspection and air monitoring. Contamination of surrounding areas indicated by visual inspection or air monitoring will require complete enclosure and clean-up of affected areas. The costs of clean-up of affected surrounding areas due to contamination shall be borne by the Contractor and no adjustments to the Contract Price will be permitted.
- .3 If air monitoring shows that areas outside Asbestos Work Area are contaminated, enclose, maintain, and clean these areas in same manner as that applicable to Asbestos Work Area. The costs to enclose, maintain, and clean-up these areas shall be borne by the Contractor and no adjustments to the Contract Price will be permitted.
- .4 Ensure that respiratory safety factors are not exceeded.

END OF SECTION

Approved: 2007-03-31

Part 1 General

1.1 REFERENCE STANDARDS

- .1 National Research Council Canada (NRC)
 - .1 National Building Code of Canada [2015] (NBC).
- .2 Standards Council of Canada
 - .1 CAN/ULC-S115-2015 Standard Method of Fire Tests of Firestop Systems.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications, and datasheet and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Shop Drawings:
 - .1 Submit Shop Drawings to show location, proposed material, reinforcement, anchorage, fastenings, and method of installation.
 - .2 Construction details should accurately reflect actual job conditions.

1.3 DELIVER, STORAGE, HANDLING, AND PROTECTION

- .1 Packing, shipping, handling, and unloading:
 - .1 Deliver, store, and handle materials in accordance with Section 01 61 00 – Common Product Requirements.

Part 2 Products

2.1 MATERIALS

- .1 Fire stopping and smoke seal systems: in accordance with CAN-ULC-S115.
 - .1 Asbestos-free materials and systems capable of maintaining effective barrier against flame, smoke, and gases in compliance with requirements of CAN-ULC-S115 and not to exceed opening sizes for which they are intended.
- .2 Service penetration assemblies: systems tested to CAN-ULC-S115.
- .3 Service penetration fire stop components: certified by test laboratory to CAN-ULC-S115.
- .4 Fire-resistance rating of installed fire stopping assembly in accordance with NBC.

- .5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.
- .6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork, and other mechanical items requiring sound and vibration control: elastomeric seal.
- .7 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
- .8 Water (if applicable): potable, clean, and free from injurious amounts of deleterious substances.
- .9 Damming and backup materials, supports, and anchoring devices: to manufacturer's recommendations and in accordance with tested assembly being installed as acceptable to Authorities Having Jurisdiction.
- .10 Sealants for vertical joints: non-sagging.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PREPARATION

- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.
 - .1 Ensure that substrates and surfaces are clean, dry, and frost free.
- .2 Prepare surfaces in contact with Fire Stopping Materials and smoke seals to manufacturer's instructions.
- .3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.
- .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.3 INSTALLATION

- .1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.
- .2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
- .3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .4 Tool or trowel exposed surfaces to neat finish.

- .5 Remove excess compound promptly as work progresses and upon completion.

3.4 FIELD QUALITY CONTROL

- .1 Inspections: notify the Contract Administrator when ready for inspection and prior to concealing or enclosing Fire Stopping Materials and service penetration assemblies.

3.5 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools, and equipment.
- .3 Remove temporary dams after initial set of fire stopping and smoke seal materials.

3.6 SCHEDULE

- .1 Fire stop and smoke seal at:
 - .1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.
 - .2 Top of fire-resistance rated masonry and gypsum board partitions.
 - .3 Intersection of fire-resistance rated masonry and gypsum board partitions.
 - .4 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.
 - .5 Penetrations through fire-resistance rated floor slabs, ceilings, and roofs.
 - .6 Openings and sleeves installed for future use through fire separations.
 - .7 Around mechanical and electrical assemblies penetrating fire separations.
 - .8 Rigid ducts: greater than 129 cm²: fire stopping to consist of bead of Fire Stopping Material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

END OF SECTION

Approved: 2010-12-31

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Health Canada/ WHMIS
 - .1 SDS.
- .2 The Master Painters Institute (MPI)
 - .1 Maintenance repainting manual.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, and data sheets for paint and coating products and include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 Submit WHMIS SDS.
- .3 Samples:
 - .1 Submit for review and acceptance of each unit.
 - .2 Samples will be returned for inclusion into Work.
 - .3 Submit sample panels for specified paint or coating in colours, gloss/sheen, and textures required to MPI painting specification manual standards.

1.3 DELIVERY, STORAGE, HANDLING, AND PROTECTION

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Storage and Handling Requirements:
 - .1 Provide and maintain dry, temperature controlled, secure storage.
 - .2 Store painting materials and supplies away from heat generating devices.
 - .3 Store materials and equipment in well ventilated area within temperature as recommended by manufacturer.
- .3 Fire Safety Requirements:
 - .1 Supply one 9 kg dry chemical Type ABC fire extinguisher adjacent to storage area.
 - .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers, and remove from Site on a daily basis.

- .3 Handle, store, use, and dispose of flammable and combustible materials in accordance with National Fire Code of Canada requirements.

1.4 SITE CONDITIONS

- .1 Heating, Ventilation, and Lighting:
 - .1 Ventilate enclosed spaces.
 - .2 Co-ordinate use of existing ventilation system and ensure its operation during and after application of paint as required.
 - .3 Provide minimum lighting level of 323 Lux on surfaces to be painted.
- .2 Temperature, Humidity, and Substrate Moisture Content Levels:
 - .1 Apply paint finishes when ambient air and substrate temperatures at location of installation can be satisfactorily maintained during application and drying process, within MPI and paint manufacturer's prescribed limits.
 - .2 Test concrete, masonry, and plaster surfaces for alkalinity as required.
 - .3 Apply paint to adequately prepared surfaces, when moisture content is below paint manufacturer's prescribed limits.
- .3 Additional application requirements:
 - .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
 - .2 Apply paint in occupied facilities during time of application subject to the Contract Administrator approval. Schedule operations to approval of the Contract Administrator such that painted surfaces will have dried and cured sufficiently before occupants are affected.

Part 2 Products

2.1 MATERIALS

- .1 Supply paint materials for paint systems from single manufacturer.
- .2 Conform to latest MPI requirements for painting work including preparation and priming.
- .3 Materials in accordance with MPI "Approved Product" listing.
- .4 Colours:
 - .1 Submit proposed colour schedule to the Contract Administrator for review.
- .5 Mixing and tinting:
 - .1 Perform colour tinting operations prior to delivery of paint to Site, in accordance with manufacturer's written recommendations.
 - .2 Use and add thinner in accordance with paint manufacturer's recommendations.

- .1 Do not use kerosene or similar organic solvents to thin water-based paints.
- .3 Thin paint for spraying in accordance with paint manufacturer's written recommendations.
- .4 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.
- .6 Gloss/sheen ratings:
 - .1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

Gloss Level-Category	Gloss @ 60 degrees	Sheen @ 85 degrees
Gloss Level 1 - Matte Finish	Max. 5	Max. 10
Gloss Level 2 - Velvet	Max.10	10 to 35
Gloss Level 3 - Eggshell	10 to 25	10 to 35
Gloss Level 4 - Satin	20 to 35	min. 35
Gloss Level 5 - Semi-Gloss	35 to 70	
Gloss Level 6 - Gloss	70 to 85	
Gloss Level 7 - High Gloss	More than 85	

- .2 Gloss level ratings of painted surfaces as noted on finish schedule.
- .7 Interior painting:
 - .1 Structural Steel and Metal Fabrications: columns, beams, joists, and miscellaneous metal.
 - .1 INT 5.1E Alkyd, finish to match existing.
 - .2 Galvanized Metal: high contact/high traffic areas (doors, frames, railings and handrails, etc.).
 - .1 INT 5.3C – Alkyd, finish to match existing (over cementitious primer).
- .8 Interior re-painting:
 - .1 Structural Steel and Metal Fabrications: columns, beams, joists, and miscellaneous metal.
 - .1 RIN 5.1E – Alkyd, finish to match existing.
 - .2 Galvanized Metal: high contact/high traffic areas (doors, frames, railings and handrails, etc.).
 - .1 RIN 5.3C – Alkyd, finish to match existing.

Part 3 Execution

3.1 GENERAL

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

- .2 Perform preparation and operations for interior painting in accordance with MPI except where specified otherwise.
- .3 Paint all surfaces which are affected by the Work. Paint to match existing finishes.

3.2 EXAMINATION

- .1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to the Contract Administrator any damages, defects, unsatisfactory, or unfavourable conditions before proceeding with Work.

3.3 PREPARATION

- .1 Protection of in-place conditions:
 - .1 Protect existing building surfaces and adjacent structures from paint spatters, markings, and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by the Contract Administrator.
 - .2 Protect items that are permanently attached such as fire labels on doors and frames and name plates on equipment.
 - .3 Protect factory finished products and equipment.
- .2 Surface Preparation:
 - .1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories, and other surface mounted equipment, fittings, and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-install after painting is completed.
 - .2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
 - .3 Place "WET PAINT" signs in occupied areas as painting operations progress.
 - .4 Clean and prepare surfaces in accordance with MPI specific requirements and coating manufacturer's recommendations.
 - .5 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil, and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pre-treatment as soon as possible after cleaning and before deterioration occurs.
 - .6 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.
 - .1 Apply vinyl sealer to MPI #36 over knots, pitch, sap, and resinous areas.
 - .2 Apply wood filler to nail holes and cracks.
 - .3 Tint filler to match stains for stained woodwork.

- .7 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1,000 mm.
- .8 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease, and other foreign substances in accordance with MPI requirements.
- .9 Touch up of shop primers with primer as specified.

3.4 APPLICATION

- .1 Paint only after prepared surfaces have been accepted by the Contract Administrator.
- .2 Use method of application approved by the Contract Administrator.
 - .1 Conform to manufacturer's application recommendations.
- .3 Apply coats of paint in continuous film of uniform thickness.
 - .1 Repaint thin spots or bare areas before next coat of paint is applied.
- .4 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .5 Sand and dust between coats to remove visible defects.
- .6 Finish surfaces both above and below sight lines as specified for surrounding surfaces.
- .7 Finish top, bottom, edges, and cutouts of doors after fitting as specified for door surfaces.
- .8 Mechanical / Electrical Equipment:
 - .1 Paint piping, hangers, ductwork, and other mechanical and electrical equipment exposed in finished areas, to match adjacent surfaces, except as indicated.
 - .2 Do not paint over nameplates.
 - .3 Keep sprinkler heads free of paint.
 - .4 Paint both sides and edges of backboards for telephone and electrical equipment before installation.
 - .1 Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories, and other unfinished items.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools, and equipment in accordance with Section 01 74 00 - Cleaning.

- .3 Remove over-spray, paint splatter, and spills from exposed surfaces that were not intended for painting. Remove smears and splatter immediately as operations progress, using appropriate methods as per manufacturer's instructions.
- .4 Place paint, stains, primer defined as hazardous or toxic waste, including tubes and containers, in containers or areas designated for hazardous waste.

END OF SECTION

Approved: 2013-06-30

Part 1 General

1.1 SECTION INCLUDES

- .1 General requirements that are common to Specification sections found in Division 26 - Electrical. This section supplements requirements of Division 1 - General Requirement and Part D - Supplemental Conditions and Part E - Specifications of the Tender.

1.2 RELATED SECTIONS

- .1 Part C - General Conditions.
- .2 Part D - Supplemental Conditions.
- .3 Part E - Specifications.
- .4 Division 1 - General Requirements.
- .5 Division 26 - Electrical.

1.3 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.
 - .2 CSA C22.2.
 - .3 CAN/CSA-C22.3 No.1, Overhead Systems.
 - .4 CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .1 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC).
 - .1 IEEE SP1122, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
 - .1 EEMAC 2Y-1, Light Gray Colour for Indoor Switch Gear.
- .3 Health Canada / WHMIS
 - .1 SDS.
- .4 City of Winnipeg Water and Waste Department Drawing Standard.
<https://winnipeg.ca/waterandwaste/pdfs/dept/CAD-GIS-Specifications.pdf>
- .5 City of Winnipeg Water and Waste Department Electrical Identification Standard.
<https://winnipeg.ca/waterandwaste/pdfs/dept/IdentificationStandard.pdf>
- .6 City of Winnipeg Water and Waste Department Electrical Design Guide.
<https://winnipeg.ca/waterandwaste/pdfs/dept/ElectricalDesignGuide.pdf>

- .7 Comply with all laws, ordinances, rules, regulations, codes, and orders of all Authorities Having Jurisdiction relating to this Work.

1.4 DRAWINGS AND SPECIFICATIONS

- .1 The intent of the Drawings and Specifications is to include all labour, products, and services necessary for the completion and testing of the Work, and to render the system ready for operation.
- .2 All materials, equipment, labour, and work denoted on the Drawings is to be considered as new work, to be provided by the Contractor unless specifically noted otherwise. Some of the electrical and automation Drawings show existing systems (with modifications to these systems). These Drawings specifically indicated that there are existing systems shown. Where Drawings do not specifically indicate that existing systems are depicted, the Contractor shall assume that the materials, equipment, labour, and work indicated will form part of their scope, and the Contractor shall include all costs (including materials, labour, etc.) to perform the Work.
- .3 Prior to installing power and control cabling for equipment, review the equipment Shop Drawings and ensure that cabling requirements are understood. There may be variations in wiring requirements with equipment that may require alternate wiring requirements from that shown on the Drawings. This shall result in no additional cost to the Contract.
- .4 The intent of the Drawings and Specifications is to indicate labour, products, and services necessary for a complete, installed, tested, commissioned, and functional installation.
- .5 The Drawings, in some cases indicate the size of cables, breakers, conduits, etc. These sizes are based on the supply of specific sizes of equipment. For cases where the Contractor supplies equipment that varies from these assumptions it is the responsibility of the Contractor to provide the correct size of breaker, cable, etc. to suit the installation, at no additional cost to the Contract.
- .6 The Drawings in some cases, may indicate approximate route to be followed by conduits, cable tray, and cables and general location of electrical equipment. They do not show all structural, architectural, and mechanical details. In some cases conduit, cable tray, or wiring is only shown diagrammatically on the Drawings. The details on exact cable, cable tray, or conduit routing and exact equipment installation location is to be determined on Site and coordinated with all other Subcontractors.
- .7 Where circuit numbers are shown adjacent to equipment, provide all wiring, conduit, supports, and any other requirements to provide power to that piece of equipment from the circuit indicated. Where circuit numbers are not shown refer to the single line Drawings for connections details. Provide all wiring, conduit, cable tray, supports, and any other requirements to provide power to that piece of equipment.
- .8 Provide all minor items and work not shown or specified but which are reasonably necessary to complete the Work.

- .9 To provide sufficient detail and maximum degree of clarity on the Drawings, symbols used for various electrical devices, particularly wall mounted devices, take up more space on the Drawings than devices physically do. Locate devices with primary regard for convenience of operation, accessibility and space utilization, rather than locating devices to comply with the exact scaled locations of the electrical symbols.
- .10 Where systems are shown as being removed or demolished, this means all associated systems back to the source power supply. For example – removal of light fixtures means complete removal of all wiring, conduit, and controls back to source power supply. Rewire and reconnect any systems to remain that are adversely affected by the demolition work. Site trace and site confirm wiring and circuits prior to removals.
- .11 All new systems shall have new wiring and new conduit. Do not re-use existing conduit unless specifically indicated as acceptable. Provide new wiring and new conduit systems for all new devices.
- .12 All equipment shall be installed and oriented in a manner such that maintenance can be performed on the equipment. Do not block components that are meant to be replaced or maintained.

1.5 DEFINITIONS

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

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature, and data sheets.
 - .2 Certificates:
 - .1 Provide CSA certified equipment and Material.
 - .2 Submit test results of installed electrical systems and instrumentation.
 - .3 Submit certificate of acceptance from Authority Having Jurisdiction upon completion of Work to Contract Administrator.
- .3 Shop Drawings:
 - .1 Submit installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
 - .2 Indicate on Drawings clearances for operation, maintenance, and replacement of operating equipment devices.

- .4 Manufacturer's field reports:
 - .1 Submit manufacturer's written report.
- .5 Nameplates and Labels:
 - .1 The Contract Administrator will provide an overall lamacoid list indicating equipment that requires labels as well as a draft loop tag number. This list is for reference only and the Contractor shall submit lamacoid labels to the Contract Administrator for review.

1.7 QUALITY ASSURANCE

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

1.8 CLOSEOUT SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures and Section and 01 78 00 – Closeout Submittals.
- .2 O&M Manuals:
 - .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
 - .2 Operating instructions to include the following:
 - .1 Control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
 - .3 Post instructions where directed.

1.9 SYSTEM START-UP

- .1 System start-up to be performed in accordance with E10 of the Tender.

1.10 PERMITS, FEES, AND INSPECTION

- .1 Submit to the Electrical Inspection Department and Supply Authority the necessary number of Drawings and Specifications for examination and approval prior to commencement of Work.
- .2 Acquire permits and pay associated fees in accordance with Part C - General Conditions of the Tender.
 - .1 The Contractor to obtain all permits for each Site.
- .3 Provide Drawings and Specifications required by the Electrical Inspection Department and Supply Authority at no cost.
- .4 Notify the Contract Administrator of changes required by the Electrical Inspection Department prior to making changes.
- .5 Furnish certificates of acceptance from Authorities Having Jurisdiction on completion of Work to the Contract Administrator.

1.11 SITE AREA CLASSIFICATIONS

- .1 Classification of Pumping Station Areas:
 - .1 Control Room: Ordinary (NEMA 1 equipment rating required).
 - .2 Electrical Room: Ordinary (NEMA 1 equipment rating required).
 - .3 Pump Floor: Ordinary (NEMA 12 equipment rating required).
 - .4 Basement or Crawl Space: Ordinary (NEMA 12 equipment rating required).
 - .5 Chlorine Room: Category 2 (NEMA 4X equipment rating required).

Part 2 Products

2.1 DESIGN REQUIREMENTS

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

2.2 MATERIALS AND EQUIPMENT

- .1 Provide Material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material and equipment to be CSA certified. Where CSA certified Material and equipment are not available, obtain special approval from Authority Having

Jurisdiction before delivery to Site and submit for special approval before delivery to Site.

- .3 Material and equipment shall be new and free from all defects.
- .4 Factory assemble control panels and component assemblies.
 - .1 Verify spacing requirements onsite prior to purchasing equipment.

2.3 ELECTRIC MOTORS, EQUIPMENT, AND CONTROLS

- .1 Verify installation and coordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring and conduit: in accordance with Division 29 – Instrumentation and Control.

2.4 WARNING SIGNS

- .1 Warning signs: in accordance with requirements of inspection authorities.
- .2 Lamacoid labels: minimum size 175 x 250 mm.

2.5 WIRING TERMINATIONS

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

2.6 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates in accordance with City of Winnipeg Water and Waste Department Electrical Identification Standard and as follows:
 - .1 Nameplates: lamacoid 3 mm thick plastic engraving sheet, white face with black core, lettering accurately aligned and engraved into core mechanically attached with self-tapping stainless steel screws.
 - .2 Lamacoids as follows:

Application	Text Size	Text
Electrical Equipment - General	5 mm	Line 1: Identifier
Circuit Breaker - Separate	5 mm	Line 1: Identifier Line 2: Load Identifier Line 3: Load Description
Disconnect Switch - Separate	5 mm	Line 1: Identifier Line 2: Load Identifier Line 3: Load Description
Fire Alarm Devices	8 mm	Line 1: Identifier
Light Switches	3 mm	Source Panel and Circuit Number
MCC	8 mm	Line 1: Identifier Line 2: Description Line 3: System Voltage Line 4: Fed By
Motor Starter or MCC Bucket	5 mm	Line 1: Load Identifier Line 2: Load Description

Application	Text Size	Text
Panelboards	8mm	Line 1: Identifier Line 2: Description Line 3: System Voltage Line 4: Fed By
Receptacles	3 mm	Source Panel and Circuit Number
Switchgear	8 mm	Line 1: Identifier Line 2: Description Line 3: System Voltage Line 4: Fed By
Switchgear Breaker	8 mm	Line 1: Identifier Line 2: Description Line 3: System Voltage Line 4: Fed By
Transformer - Indoor	8 mm	Line 1: Identifier Line 2: Rating, System Voltage Line 3: Fed By
Transformer – Outdoor	10 mm	Line 1: Identifier Line 2: Rating, System Voltage Line 3: Fed By

2.7 WIRING IDENTIFICATION

- .1 Identify wiring in accordance with City of Winnipeg Water and Waste Department Electrical Identification Standard.
- .2 Identify wiring with permanent indelible identifying markings, coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .3 Maintain phase sequence and colour coding throughout.
- .4 Colour coding: to CSA C22.1 and City of Winnipeg Water and Waste Department Electrical Design Guide.
- .5 Use colour coded wires in communication cables, matched throughout system.

2.8 CONDUIT AND CABLE IDENTIFICATION

- .1 Identify conduit and cable in accordance with City of Winnipeg Water and Waste Department Electrical Design Guide.
- .2 Colour code conduits, boxes, and metallic sheathed cables.
- .3 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 5 m intervals.
- .4 Colours: 38 mm wide prime colour and 19 mm wide auxiliary colour.
- .5 Colour Codes

	Prime	Auxiliary
Power, 120/208/240 VAC	Black	
UPS Power, 120/208/240 VAC	Black	Green
Control Wiring, 120VAC	Black	Orange

	Prime	Auxiliary
Fire Alarm	Red	
Low Voltage Communication/General	Blue	
Low Voltage Control Wiring, <50 V	Blue	Orange
Intrinsically Safe	Blue	White
Up to 250 V	Yellow	
Up to 600 V	Yellow	Green
Other Communication Systems	Green	Blue

2.9 FINISHES

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

Part 3 Execution

3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels, and identification nameplates are visible and legible after equipment is installed.
- .2 Submit lamacoid wording to the Contract Administrator prior to manufacture.
 - .1 If changes are required, notify the Contract Administrator of these changes prior to manufacturing of labels.

3.3 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1400 mm.
 - .2 Wall receptacles:
 - .1 General: 300 mm.
 - .2 Above top of continuous baseboard heater: 200 mm.

- .3 In mechanical rooms: 1400 mm.
- .3 Panelboards: as required by Code or as indicated.
- .4 LAN outlets: 300 mm.

3.4 COORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays, and fuses are installed to required values and settings as per the short circuit coordination study which will be provided by the Contract Administrator.
 - .1 The Contractor shall request the short circuit coordination study after award of the Contract.

3.5 FIELD QUALITY CONTROL

- .1 Conduct the following tests:
 - .1 Continuity tests on circuits originating from branch distribution panels.
 - .2 Continuity tests on control circuits originating from the PLC and terminating at the appropriate field device.
 - .3 Communication systems: in accordance with Section 29 15 01 - Instrumentation Cable.
 - .4 Insulation resistance testing:
 - .1 Megger circuits, feeders, and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders, and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .2 Carry out tests in presence of the Contract Administrator.
- .3 Provide instruments, meters, equipment, and personnel required to conduct tests during and at conclusion of Work.
- .4 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting, and cleaning of product and submit manufacturer's field reports within three days of manufacturer's review, verifying compliance of Work and electrical system and instrumentation testing.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic Site visits for inspection of product installation in accordance with manufacturer's instructions.
- .5 Perform tests using qualified personnel. Provide necessary instruments and equipment.
- .6 Check phase rotation and identify each phase conductor of each feeder.
- .7 Site Acceptance Tests
 - .1 Ensure that terminations and accessory equipment are disconnected.

- .2 Ground shields, ground wires, metallic armour, and conductors not under test.
- .8 Provide Contract Administrator with list of test results showing location at which each test was made, circuit tested, and result of each test.
- .9 Remove and replace entire length of cable if cable fails to meet any of test criteria.

3.6 TRAINING

- .1 Provide training to the City personnel in the operation, care, and maintenance of systems, system equipment, and components in accordance with E11 of the Tender.

3.7 CLEANING

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 Clean and prime exposed non-galvanized hangers, racks, and fastenings to prevent rusting.
- .3 Progress cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work area clean at the end of each day.
- .4 Final cleaning: upon completion remove surplus Materials, rubbish, tools, and equipment in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

Approved: 2017-04-25

Part 1 General

1.1 SECTION INCLUDES

- .1 Requirements for selective demolition and removal of electrical and communications components including removal of conduit, junction boxes, and panels to source (home run removal) and incidentals required to complete Work.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.3 REFERENCE STANDARDS

- .1 CSA
 - .1 CSA S350 M1980 (R2003), Code of Practice for Safety in Demolition of Structures.

1.4 DEFINITIONS

- .1 **“Demolish”** means detach items from existing construction and legally dispose of items off site, unless indicated as Removed and Salvaged, or Removed and Reinstalled.
- .2 **“Remove”** means planned deconstruction and disassembly of electrical items from existing construction including removal of conduit, junction boxes, cabling, and wiring from electrical component to panel taking care not to damage adjacent assemblies designated to remain; legally dispose of items off site, unless indicated as Removed and Salvaged, or Removed and Reinstalled.
- .3 **“Remove and Salvage”** means detach items from existing construction and deliver them to the City ready for reuse.
- .4 **“Remove and Reinstall”** means detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- .5 **“Existing to Remain”** means existing items of construction that are not removed and that are not otherwise indicated as being Removed and Salvaged, or Removed and Reinstalled.
- .6 **“Hazardous Substances”** means dangerous substances, dangerous goods, hazardous commodities, and hazardous products which may include asbestos, mercury and lead, printed circuit boards, poisons, corrosive agents, flammable substances, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly as defined by Federal Hazardous Products Act (RSC 1985) including latest amendments.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.

- .2 Submit written request of demolition, cutting, or alteration at least two weeks prior to the scheduled demolition, cutting, or alteration in accordance with this section and Section 01 73 00 - Execution.

1.6 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: coordinate Work of this section to avoid interference with Work by other sections.
- .2 Scheduling: account for the City's continued occupancy requirements during selective demolition and schedule staged occupancy and Site activities.

1.7 SITE CONDITIONS

- .1 Existing conditions: condition of Materials identified as being salvaged or Demolished are based on their observed condition at time of Site examination before tendering.
- .2 Existing Hazardous Substances: the City has performed a Hazardous Substances assessment and identified materials requiring asbestos abatement as follows:
 - .1 Hazardous Substances are as defined in Hazardous Products Act.
 - .2 Hazardous Substances will be Removed by Contractor as a part of Contract before starting Work.
 - .3 The Contractor shall adhere to E2 of Tender for any Hazardous Materials encountered on Site.
 - .4 Any asbestos abatement work shall follow the requirements set out in Section 02 82 00.01 – Asbestos Abatement – Minimum Precautions and Section 02 82 00.02 – Asbestos Abatement – Intermediate Precautions.
 - .1 HMIS Asbestos reports for all Sites containing confirmed and presumed asbestos are provided as Appendix J – Asbestos Reports.

Part 2 Products

2.1 SALVAGE AND DEBRIS MATERIALS

- .1 Material ownership: Demolished materials become the Contractor's property and will be Removed from Site; except for items indicated as being reused, salvaged, reinstalled, or otherwise indicated to remain the City's property.
 - .1 For clarity, automation equipment (PLCs, MPRs, HMIs, PMCMs) are to be returned to the City as indicated on the Drawings. Wire, cable, conduit that is salvaged is Contractors responsibility.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of existing conditions: visit all Work facilities and Sites, thoroughly examine and become familiar with conditions that may affect Work.

3.2 PREPARATION

- .1 Submit written request in advance of demolition in accordance with Section 01 73 00 – Execution.
- .2 Protection of existing systems to remain: protect systems and components indicated to remain in place during selective demolition operations and as follows:
 - .1 Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.
 - .2 Notify the Contract Administrator and cease operations where safety of buildings being Demolished, adjacent structures or services appears to be endangered and await additional instructions before resuming demolition Work specified in this section.
 - .3 Prevent debris from blocking drainage inlets.
 - .4 Protect mechanical systems that will remain in operation.
 - .5 Protect electrical systems that will remain in operation.
- .3 Protection of building occupants: sequence demolition Work so that interference with use of the building by the City and users is minimized.
 - .1 Prevent debris from endangering safe access to and egress from all buildings.
 - .2 Notify the Contract Administrator and cease operations where the safety of occupants appears to be endangered and await additional instructions before resuming demolition Work specified in this section.

3.3 EXECUTION

- .1 Removal and Demolition:
 - .1 Disconnect electrical circuits and panel feeders; maintain electrical service and main distribution panel as is, ready for subsequent Work.
 - .2 Remove existing electrical devices and equipment including associated conduits, boxes, wiring, and similar items.
 - .3 Disconnect and Remove communication systems including associated conduits, boxes, cabling, and similar items unless specifically noted otherwise.
 - .4 Perform demolition Work in a neat and workmanlike manner:
 - .1 Remove tools or equipment after completion of Work and leave Site clean and ready for subsequent renovation Work.

- .2 Repair and restore damages caused as a result of Work of this section to match existing materials and finishes.
- .5 Disconnect panel feeders back to main distribution panel and re-label respective circuit breaker as "SPARE".
- .6 Remove existing conduits, boxes, cabling, and wiring associated with Removed electrical devices and equipment.
- .7 Seal open ends of conduit with silicone sealant and leave in place where they are inaccessible or cannot be removed without damaging adjacent construction.

END OF SECTION

Approved: 2011-12-31

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CAN/CSA-C22.2 No.18-), Outlet Boxes, Conduit Boxes and Fittings.
 - .2 CAN/CSA-C22.2 No.65-), Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2-, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 NEMA® standard

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors ten AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2 or NEMA to consist of:
 - .1 Connector body and stud clamp for copper conductors.
 - .2 Clamp for round stranded copper conductors.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper bar.
- .4 Clamps or connectors for flexible conduit, armoured cable, non-metallic sheathed cable as required to: CAN/CSA-C22.2 No.18.

Part 3 Execution

3.1 INSTALLATION

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

- .3 Install bushing stud connectors in accordance with EEMAC 1Y-2 or NEMA.

END OF SECTION

Approved: 2008-12-31

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 05 20 - Wire and Box Connectors (0-1000 V).
- .3 Section 26 05 34 - Conduits, Conduit Fastenings, and Conduit Fittings.
- .4 Section 26 05 36 - Cable Trays for Electrical Systems.
- .5 Section 29 05 00 - Common Works - Instrumentation and Control.

1.2 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CSA C22.2 No.0.3, Test Methods for Electrical Wires and Cables.
 - .2 CAN/CSA-C22.2 No.131, Type TECK 90 Cable.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Provide numbered wire collars for control wiring. Numbers to correspond to the control legend. Obtain wiring diagram for control wiring.

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger.
- .2 Minimum size: 12 AWG.
- .3 Copper conductors: size as indicated, with 1000 V insulation of cross-linked thermosetting polyethylene rated RWU90 XLPE or RW90 XLPE.

2.2 TECK 90 CABLE

- .1 Cable: to CAN/CSA-C22.2 No.131.
- .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
 - .1 Cross-linked polyethylene XLPE.
 - .2 Rating: 1000 V.

- .4 Inner jacket: PVC.
- .5 Armour: interlocking, aluminum.
- .6 Overall covering: thermoplastic PVC.
- .7 Fastenings:
 - .1 One-hole stainless steel straps to secure surface cables 50 mm and smaller.
 - .2 Two-hole stainless steel straps for cables larger than 50 mm.
 - .3 Channel type supports for two or more cables at 900 mm centers.
 - .4 Stainless steel threaded rods: 8 mm diameter to support suspended channels.
- .8 Connectors:
 - .1 Watertight, approved for TECK cable.

2.3 CONTROL CABLES

- .1 Type:
 - .1 Low voltage thermostat: soft annealed copper conductors, sized as indicated.
 - .2 Insulation: thermoplastic.
 - .3 Sheath: thermoplastic jacket and armour of closely wound aluminum wire.
- .2 Type:
 - .1 Low energy 300 V control cable: solid annealed copper conductors sized as indicated.
 - .2 Low voltage thermostat: soft annealed copper conductors, sized as indicated.
 - .3 Insulation: PVC.
 - .4 Shielding: braid over each conductor group.
 - .5 Overall covering: polyethylene jackets.
- .3 Type:
 - .1 600 V conductors, sizes as indicated, annealed copper.
 - .2 Insulation: PVC or cross-linked polyethylene type RW90.
 - .3 Shielding: metallized tapes over each pair of conductors.
 - .4 Overall covering: thermoplastic jacket interlocked armour and jacket over sheath of PVC.
- .4 Fastenings:
 - .1 One-hole stainless steel straps to secure surface cables 50 mm and smaller.
 - .2 Two-hole stainless steel straps for cables larger than 50 mm.
 - .3 Channel type supports for two or more cables at 900 mm centers.

- .4 Stainless steel threaded rods: 8 mm diameter to support suspended channels.
- .5 Stainless steel straps, hardware, channels, supports for NEMA 4, NEMA 4x, CSA enclosure type 4, CSA enclosure type 4X areas, all wet areas.
- .5 Connectors:
 - .1 Watertight, approved for TECK cable.
 - .1 An elastomeric bevelled bushing.
 - .2 A funnel entry, splined gland nut.
 - .3 A taper threaded hub.
 - .4 A hexagonal body and gland nut

Part 3 Execution

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

- .1 Do not splice cables. A continuous length is required for all feeds.
- .2 Exercise care in stripping insulation from wire.
 - .1 Make certain conductors are not nicked.
- .3 Lay cable in cable trays in accordance with Section 26 05 36 - Cable Trays for Electrical Systems.
- .4 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors (0-1000 V).
- .5 Cable colour coding in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .6 Conductor length for parallel feeders to be identical.
- .7 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .8 Provide numbered wire collars for control wiring. Numbers to correspond to control Shop Drawing legend. Obtain wiring diagram for control wiring.
- .9 Provide scanning, coring, and drilling for installation of all wire and cables in accordance with Section 26 05 34 - Conduits, Conduit Fastenings, and Conduit Fittings.

3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:

- .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings, and Conduit Fittings.

3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)

- .1 Group cables wherever possible on channels.
- .2 Lay cable in cable troughs/cable tray in accordance with Section 26 05 36 - Cable Trays for Electrical Systems.
- .3 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors (0-1000 V).

3.5 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit or cable troughs as indicated on Drawings.
 - .1 Separate cables in conduit and cable troughs as required by the CEC and Section 29 05 00 - Common Works - Instrumentation and Control.
- .2 Ground control cable shield at one end only. Where possible, ground shields at the end where power is supplied to the cable. Utilize shield grounding bar in panels, where present, to ground overall shields. Individual pair shields to be grounded on appropriate terminals.
- .3 Shield drain wires, at the ungrounded end, are to be taped back to the cable. Fully insulate the shield. Do not cut the shield drain wire off.

END OF SECTION

Approved: 2011-12-31

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 05 00 - Common Work Results for Electrical.
- .3 Section 26 05 36 - Cable Trays for Electrical Systems

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE).
 - .1 ANSI/IEEE 837-02, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit Shop Drawings indicating ground connection details.

Part 2 Products

2.1 EQUIPMENT

- .1 Grounding conductors: bare stranded copper, soft annealed, size as required.
- .2 Insulated grounding conductors: green, copper conductors, size as required, type RW90.
- .3 Ground bus: copper, size as required complete with insulated supports, fastenings, connectors.
- .4 Non-corroding accessories necessary for grounding system, type, size, Material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermit welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.

Part 3 Execution

3.1 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including conductors, connectors, and accessories.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .5 Soldered joints not permitted.
- .6 Install bonding wire for flexible conduit, connected at one end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of the flexible conduit.
- .7 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

3.2 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to neutral of primary 600 V system, secondary 208 V system.

3.3 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to, following list: service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting, and cable trays.
- .2 All new or modified metallic components installed as a part of this Work shall be bonded to ground.
- .3 Ground cable tray in accordance with Section 26 05 36 - Cable Trays for Electrical Systems.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to Site conditions and approval of Contract Administrator and local Authority Having Jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

END OF SECTION

Approved: 2014-06-30

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Shop Drawings:
 - .1 Submit Shop Drawings indicating connection details.

Part 2 Products

2.1 FRAMING AND SUPPORT SYSTEM

- .1 Materials:
 - .1 Indoors, dry locations: Conduit support structures shall employ aluminium strut framing system together with the manufacturer's connecting components and fasteners for a complete system.
 - .2 Exterior and wet locations, including chlorine areas: 316 stainless steel.
- .2 Accessories:
 - .1 Exterior and wet locations, including chlorine areas: 316 stainless steel.
 - .2 Nuts, bolts, washers, machine screws, fittings, accessories: 316 stainless steel.

2.2 CONCRETE AND MASONRY ANCHORS

- .1 Materials: hardened steel inserts, zinc plated for corrosion resistance.
- .2 Components: non-drilling anchors for use in predrilled holes, sized to safely support the applied load with a minimum safety factor of four.
- .3 Manufacturer: Hilti (Canada) Limited or approved equal in accordance B7 of the Tender.

2.3 SPACERS

- .1 PVC coated malleable metal spacers, CSA approved for the purpose.

- .2 Aluminium or stainless steel (wet and chlorine locations) channel may be utilized where conduits are grouped; however, a non-metallic spacer must be provided between the metallic channel and concrete.

Part 3 Execution

3.1 INSTALLATION

- .1 Secure equipment to hollow or solid masonry, tile, and plaster surfaces with lead anchors.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Support equipment, conduit, or cables using clips, spring loaded bolts, and cable clamps designed as accessories to basic channel members.
- .5 Maximum spacing between conduit supports:
 - .1 16 mm conduit: 1.0 m
 - .2 21 mm conduit: 1.5 m
 - .3 27 mm conduit: 1.5 m
 - .4 35 mm conduit: 2.0 m
 - .5 41 mm conduit and larger: 2.5 m
- .6 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole stainless steel straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole stainless steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .7 Suspended support systems.
 - .1 Support individual cable or conduit runs with 8 mm diameter stainless steel threaded rods and spring clips.
 - .2 Support two or more cables or conduits on channels supported by 8 mm diameter stainless steel threaded rod hangers where direct fastening to building construction is impractical.
- .8 For surface mounting of two or more conduits use channels at 1 m on center spacing.
- .9 Provide metal brackets, frames, hangers, clamps, and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Do not install conduit directly onto concrete, provide offset supports.

- .11 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .12 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .13 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the Contract Administrator.
- .14 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .15 Bond all metallic components to ground, utilizing 2/0 AWG copper conductor for all systems that are part of a facility in accordance with CEC.

END OF SECTION

Approved: 2008-06-30

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 05 00 - Common Work Results for Electrical.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets.

Part 2 Products

2.1 SPLITTERS

- .1 Construction: sheet metal enclosure, welded corners, and formed hinged cover suitable for locking in closed position.
- .2 Terminations: main and branch lugs, connection blocks to match required size and number of incoming and outgoing conductors as indicated.
- .3 Spare terminals: minimum three spare terminals or lugs on each connection or lug block sized less than 400 A.

2.2 JUNCTION AND PULL BOXES

- .1 Junction and pull boxes installed in dry, non-hazardous, non-corrosive locations:
 - .1 Construction: welded steel enclosure CSA enclosure type 2 or greater for normal dry area. Use sealed, gasketed, CSA enclosure type 12 for sprinklered areas.
 - .2 Covers Flush Mounted: 25 mm minimum extension all around.
 - .3 Covers surface mounted: screw-on flat covers.
- .2 Junction and pull boxes installed in wet or wet and corrosive locations:
 - .1 Construction: CSA enclosure type 4X, gasketed.

2.3 CABINETS

- .1 Cabinets installed in dry, non-hazardous, non-corrosive locations:
 - .1 Construction: welded sheet steel, or as indicated, hinged door, handle. CSA enclosure type 12 or greater, gasketed.
 - .2 Type E empty: flush overlapping sides mounting as indicated.

- .3 Type T terminal: flush overlapping sides mounting as indicated containing sheet steel 19 mm backplane.
- .2 Cabinets installed in wet or wet and corrosive locations:
 - .1 Construction: 316 stainless steel, CSA enclosure type 4X, gasketed, hinged door, handle.
 - .2 Back-plate with offsets for installation of devices.

Part 3 Execution

3.1 SPLITTER INSTALLATION

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

3.2 JUNCTION, PULL BOXES, AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
- .3 Install terminal blocks as indicated in Type T cabinets.
- .4 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.
- .5 Install junction and pull boxes to not exceed 30 m of conduit runs between devices. Add additional boxes to meet all code requirements.

3.3 IDENTIFICATION

- .1 Equipment identification: to Section 26 05 00 - Common Work Results for Electrical.

END OF SECTION

Approved: 2008-06-30

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1, 20th Edition.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

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

2.2 GALVANIZED STEEL OUTLET BOXES

- .1 One-piece electro-galvanized construction.
- .2 Single and multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .5 Extension and plaster rings for flush mounting devices in finished plaster or tile walls.

2.3 MASONRY BOXES

- .1 Electro-galvanized steel masonry and multi single gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 CONDUIT BOXES

- .1 Cast FS or FD aluminium boxes with factory-threaded hubs and mounting feet for surface wiring of devices in non-hazardous areas.
- .2 PVC boxes with non-threaded hubs for surface wiring of devices in wet or wet and corrosive areas.

2.6 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges, foam, or similar approved material to prevent entry of debris during construction. Remove upon completion of Work.
- .3 For flush installations, mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit. Do not install reducing washers.
- .5 Extension rings shall not be utilized to accommodate conductor fill requirements.
- .6 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .7 Do not distort boxes during installation. If boxes are distorted, replace with new boxes.

END OF SECTION

Approved: 2006-12-31

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 00 - Cleaning.

1.2 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
 - .2 CSA C22.2 No. 45, Rigid Metal Conduit.
 - .3 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83, Electrical Metallic Tubing.
 - .5 CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit.
 - .6 CAN/CSA C22.2 No. 227.3, Nonmetallic Mechanical Protection Tubing (NMPT).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings and Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets.

Part 2 Products

2.1 CONDUITS

- .1 Rigid aluminum conduit: to CSA C22.2 No. 45, aluminum threaded.
- .2 Rigid PVC conduit: to CSA C22.2 No. 211.2 FT4 rated.
- .3 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

2.2 CONDUIT FASTENINGS

- .1 One-hole stainless steel straps to secure surface conduits 50 mm and smaller.
- .2 Two-hole stainless steel straps for conduits larger than 50 mm.
- .3 Beam clamps to secure conduits to exposed steel Work.
- .4 Channel type supports for two or more conduits at 1 m spacing on centre.
- .5 Stainless steel threaded rods, 8 mm diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified.
- .2 Coating: same as conduit.
- .3 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.
- .4 Watertight connectors and couplings for EMT.
 - .1 Set-screws are not acceptable.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

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

2.5 CONDUIT SPACERS

- .1 PVC coated malleable iron spacers, CSA approved for the purpose.
- .2 Aluminium channel may be utilized in non-hazardous areas where conduits are grouped; however, a non-metallic spacer must be provided between the aluminum channel and concrete.

2.6 FISH CORD

- .1 Polypropylene.

Part 3 Execution

3.1 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 X-ray cast walls and floors before coring to confirm location of embedded items.
- .3 Use rigid steel threaded conduit in ordinary locations.
- .4 Use PVC conduit in cast in place concrete and Category 1 and 2 locations.
- .5 Use PVC conduit underground.
- .6 Use flexible metal conduit for connection to motors in dry areas.
- .7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet, or corrosive locations.
- .8 Minimum conduit size for lighting and power circuits: 19 mm.
- .9 Bend Conduit Cold.

- .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .10 Mechanically bend steel conduit over 19 mm diameter.
- .11 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .12 Install fish cord in empty conduits.
- .13 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .14 Dry conduits out before installing wire.
- .15 Where conduit leaves a warm room and enters a cooler atmosphere, seal the conduit and arrange the conduit in a manner to avoid condensation accumulation at the seal.

3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on surface or suspended aluminum channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.3 CONDUITS UNDERGROUND

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

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 On completion and verification of performance of installation, remove excess Materials, rubbish, tools, and equipment.

END OF SECTION

Approved: 2006-09-30

Part 1 General

1.1 SUMMARY

- .1 Provide a complete system of cable trays required to fully support all new cables and conduit throughout the facility. System shall provide separate trays or barriers for 600 VAC systems, 120 VAC systems, and 24 VDC systems. System shall be complete with all supports and hangers and seismic bracing necessary for the installation.
- .2 Existing cable trays to be utilized where possible.
- .3 Coordinate the location of the support channels so as not to interfere with other services or maintenance activities.
- .4 Utilize common supports with process and mechanical piping where practical.
- .5 Not all cable trays required are indicated on the Drawings. Provide additional trays as required to fully support all new cable and conduit throughout the facility.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.3 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CAN/CSA C22.1 No.126, Cable Tray Systems.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's product data sheets for cable tray indicating dimensions, Materials, and finishes, including classifications and certifications.
- .3 Shop Drawings:
 - .1 Include:
 - .1 Show Materials, finish, dimensions, accessories, layout, and installation details.
 - .2 Identify types of cable troughs used.
 - .3 Show actual cable trough installation details and suspension system.

Part 2 Products

2.1 CABLE TROUGH

- .1 All power trays shall be rigid aluminum ladder type, Class E to CSA C22.2 No. 126 with 300 mm rung spacing, 150 mm side rails and width as indicated.
 - .1 All power cable tray in chlorine areas to be galvanized steel.
- .2 All instrumentation and control trays to be rigid aluminum ventilated, Class E to CSA C22.2 No. 126, 150 mm side rails and width as indicated.
 - .1 All instrumentation and control cable tray in chlorine areas to be galvanized steel.
- .3 Horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints, reducers, and other fittings where required. Field fabricate only those fittings not available from manufacturer.
- .4 Provide stainless steel rod hanger clamps, rod hangers, floor mounted support frames, and all necessary accessories for complete installation.
- .5 Provide barriers where different voltage systems or electrical systems are in the same cable trough, or as indicated.
- .6 Approved Manufacturers:
 - .1 Pilgrim, Unitray.
 - .2 B-Line, Comtray.
 - .3 Canstrut.
 - .4 ElectroTray.
 - .5 Or approved equal in accordance with B7 in the Tender.
- .7 Unless otherwise approved by the Contract Administrator, provide cable trays of the same manufacturer throughout the Work.
- .8 Ground cable trays to ground bar in electrical room with #2 AWG insulated copper conductor attached to each tray section in accordance with CEC requirements.
 - .1 Fasten with electrically conducting metal clamps at 6 m centres and at each end of terminated cable troughs.
- .9 Provide fire stop material at firewall penetrations.
- .10 De-rate power cables according to the electrical code.

2.2 SUPPORTS

- .1 Provide stainless steel rod hangers, rod hanger clamps, and accessories as required.
- .2 Floor mounted support brackets: provide aluminum channel strut supports mounted vertically and supported on floor complete with mounting brackets sized to suit cable tray width and loading.

Part 3 Execution

3.1 INSTALLATION

- .1 Support cable trays as required by loading classification rating and not more than 3000 mm on centers. Fasten channels securely mounted to the structure.
- .2 Install trays and raceways generally as indicated on Drawings. Coordinate this Work with existing systems to ensure adequate horizontal and vertical clearances.
- .3 Provide the minimum vertical clearance above the trays as indicated on the Drawings.
- .4 Provide a minimum 600 mm horizontal clearance on one side of cable tray throughout.
- .5 All trays are shown diagrammatically on the Drawings. Determine the exact location in the field. Install tray runs to prevent interference with process or service piping and ducting and to maintain clearance for tray access. Coordinate the exact location of tray supports and runs with the Work of other NMS divisions.
- .6 Do not install tray routes and tray supports until the location of same has been reviewed by the Contract Administrator.
- .7 Install tray systems in such a manner as to conserve head-room and minimize the use of free space through which they pass. Maintain a minimum 2100 mm clear head-room wherever possible.
- .8 Run trays parallel to building lines unless otherwise shown on the Drawings. A tray in tunnel areas to run parallel with the ceiling lines as the floor is graded for drainage. Where two or more trays run the same route, make parallel and ensure offsets and bends are uniform.
- .9 When the ends on u-channel type shelf brackets are below 2100 mm above finished floor in a walking area, cut flush with tray. Permanently cap the end of u-channel, etc. with plastic caps. Suitably protect sharp corners and edges of tray to prevent personal hazard.
- .10 Use beam clamps to fasten support systems to structural steel. Do not weld, drill, or cut structural steel without approval by the Contract Administrator.
- .11 Extend a stranded #2 tin plated bare, or green insulated, copper ground conductor the length of each new tray route, and solidly connect sections of new tray runs to the ground bus of the electrical room. Connect ground conductor to the new tray every 15 m with approved grounding clamps suitable for connecting aluminum tray with copper conductor.
- .12 Generally run cables of different voltage classes in separate trays. Where a common tray is shown on Drawings, separate the cables for different voltage classes from each other by metal barriers as supplied by the tray manufacturer.
- .13 Check all trays for surface smoothness prior to installation and remove all burrs, ridges, etc. on tray surfaces facing cables.

- .14 Size cable trays as indicated on Drawings. If any discrepancies are found or changes in tray size are required, advise the Contract Administrator before installing the tray.

3.2 CABLES IN CABLE TROUGH

- .1 Install cables individually.
- .2 Do not exceed cable tray weight capacity.
- .3 Lay cables into cable trough. Use rollers when necessary to pull cables.
- .4 Secure cables in cable trough at 3 m centres, with:
 - .1 Nylon ties in horizontal applications.
 - .2 Cable clips in vertical applications.
- .5 Identify cables every 30 m with size two nameplates.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 05 00 - Common Work Results - Electrical.

1.2 REFERENCE STANDARDS

- .1 CSA International.
- .2 Insulated Cable Engineers Association, Inc. (ICEA).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Quality Tests:
 - .1 Submit Site acceptance tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

Part 2 Products

2.1 CABLE PROTECTION

- .1 100mm wide detectable marking tape.

Part 3 Execution

3.1 DIRECT BURIAL OF CABLES

- .1 The Contractor shall be advised that potential ground disturbances or excavation may be required at the SLAIF site to complete the Work and shall follow the requirements set out in E14 of the Tender.
- .2 After the 75 mm sand bed is in place, lay cables maintaining 75 mm clearance from each side of trench to nearest cable. Do not pull cable into trench.
- .3 Provide offsets for thermal action and minor earth movements. Offset cables 150 mm for each 60 m run, maintaining minimum cable separation and bending radius requirements.
- .4 Make termination only as indicated leaving 0.6 m of surplus cable in each direction.
 - .1 Make terminations in accordance with manufacturer's instructions using approved splicing kits.
- .5 Underground cable splices not acceptable.
- .6 Minimum permitted radius at cable bends for rubber, plastic, or lead covered cables, eight times diameter of cable; for metallic armoured cables, 12 times diameter of cables, or in accordance with manufacturer's instructions.
- .7 Cable Separation:

□

- .1 Maintain 75 mm minimum separation between cables of different circuits.
- .2 Maintain 300 mm horizontal separation between low and high voltage cables.
- .3 When low voltage cables cross high voltage cables maintain 300 mm vertical separation with low voltage cables in upper position.
- .4 At crossover, maintain 75 mm minimum vertical separation between low voltage cables and 150 mm between high voltage cables.
- .5 Maintain 300 mm minimum lateral and vertical separation for fire alarm and control cables when crossing other cables, with fire alarm and control cables in upper position.
- .6 Install treated planks on lower cables 0.6 m in each direction at crossings.
- .8 After 75 mm sand protective cover spec is in place, install continuous row of overlapping detectable marking tape.

3.2 CABLE INSTALLATION IN DUCTS

- .1 Install cables as indicated in ducts.
- .2 Install multiple cables in duct simultaneously.
- .3 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .4 To facilitate matching of colour coded multi-conductor control cables reel off in same direction during installation.
- .5 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.
- .6 After installation of cables, seal duct ends with duct sealing compound.

3.3 MARKERS

- .1 Mark cable every 150 m along cable and duct runs and changes in direction.
- .2 Where markers are removed to permit installation of additional cables, reinstall existing markers.
- .3 Install concrete cable markers within 180 m from each side of runway centreline; 45 m from each side of taxi way centreline; 50 m from edge of taxi ramps or aprons.
- .4 Install cedar post type markers.
- .5 Lay concrete markers flat and centred over cable with top flush with finish grade.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

END OF SECTION

Approved: 2011-12-31

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 00 - Cleaning.
- .3 Section 01 78 00 - Closeout Submittals.
- .4 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CAN3-C17, Alternating - Current Electricity Metering.
- .2 American National Standards Institute (ANSI)
 - .1 ANSI/IEEE C37.90A, Surge Withstand Capability Test.
- .3 Federal Communications Commission (FCC)
 - .1 FCC Title 47, Telecommunication.
- .4 International Electrotechnical Commission (IEC)
 - .1 IEC 61000-4, Electromagnetic Compatibility (EMC) Testing and Measurement Techniques.

1.3 DEFINITIONS

- .1 “**bps**” means basis point.
- .2 “**F**” means Frequency.
- .3 “**FCC**” means Federal Communications Commission.
- .4 “**kWd**” means Kilowatt demand.
- .5 “**kVARH**” means Kilo-VAR-hours.
- .6 “**MVA**” means Mega Volt Amp.
- .7 “**MVAR**” means Mega Volt Amp Reactive.
- .8 “**MW**” means Mega Watt.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for metering and switchboard instruments and include product characteristics, performance criteria, physical size, finish, and limitations.

- .2 Include meter, instrument, outline dimensions, panel drilling dimensions, and installation cut-out template.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 78 00 - Closeout Submittals.
- .2 O&M Manuals:
 - .1 Power meter product data manufacturer's instructions.

Part 2 Products

2.1 DIGITAL METERING INSTRUMENT

- .1 Microprocessor-based data collection and storage meter to monitor power conditions on main service as shown on the Drawings.
- .2 Meter to display true RMS value of:
 - .1 Amps 3-phase current.
 - .2 Volts Line-to-line or line-to-neutral 3-phase voltage.
 - .3 kW kilowatts.
 - .4 kVA kilovoltamperes.
 - .5 Pf power factor.
 - .6 F frequency.
 - .7 kWd kilowatt demand.
 - .8 Ad amperes demand.
 - .9 kWh kilowatt hours.
 - .10 Total kWh as an accumulating total, providing bi-directional (import/export) indication.
 - .11 Total kVARH (kilo-VAR-hours) as an accumulating total, providing bi-directional (import/export) indication.
 - .12 kW demand, user-programmable length of each demand period and the number of periods averaged to match local utility billing method.
 - .13 Amps demand.
 - .14 kVA demand, user-programmable length of each demand period, and the number of periods averaged to match local utility billing method.
 - .15 Total harmonic current and voltage.
 - .16 Individual harmonic true RMS current and voltage to the 63rd harmonic.
- .3 Each power meter to have:
 - .1 True RMS measurement.
 - .2 Direct connection to:
 - .1 Existing fused 4200:120V PT and 1200:5A CTs at Hurst RPS.
 - .3 Fourth current input for measurement of ground or neutral current.

- .4 Eight digital inputs for status/counter inputs, self-excited dry contact sensing, to remotely monitor breaker status, ground fault relay status, or any other dry contact input.
- .5 Storage in non-volatile memory for the following:
 - .1 A time-stamped alarm and event log of up to 800 events, which records event date, time (to 0.001 sec), event type, and value for all over/under limit conditions, all status input activity, and all relay operations.
 - .2 A time-stamped minimum/maximum log, which records the value of any parameter exceeding the previous highest or lowest value recorded. Log to be read from the front panel display or via the communications port.
 - .3 All setup data.
- .6 Waveform capture capability allowing any of the eight voltage and current input channels to be digitally sampled at 256 samples/60 Hz cycle. Waveform capture to be initiated using commands made via the communications port or event triggered. Waveform capture data is to be made accessible via the communications port.
- .7 LCD, 320 x 240 pixels resolution, backlight.
- .8 Serial communications ports:
 - .1 One RS-232C/RS-485, and one RS-485.
 - .2 Protocols: Modbus RTU.
 - .3 Baud rate: RS-232, 300 bps to 115,200 bps.
 - .4 Baud rate: RS-485, 300 bps to 57,600 bps.
- .9 Ethernet port:
 - .1 Protocols: Modbus TCP.
 - .2 10BaseT, 100BaseT, and/or 1000BaseT.
- .10 Field programmability as follows:
 - .1 Volts scale, volts mode (wye, delta, single phase), amps scale, Vaux scale, baud rate, TCP/IP address, and the relay operation are programmable from the front panel.
 - .2 All parameters in 10.1 above, plus additional alarm/event parameters may be programmed via the communications port using a portable terminal or a computer.
 - .3 Ensure programming is password protected and shared with the City.
- .11 Compliance with the following standards:
 - .1 ULC certified.
 - .2 CSA approved.
 - .3 Voltage, current, status, relay, and power inputs pass the ANSI/IEEE C37.90A surge withstand and fast transient tests.
 - .4 Certified to comply with FCC Part 15 Subpart B for Class A computing devices.

- .5 Immunity to electrostatic discharge, radiated fields, fast transients, surges, conducted disturbances, power frequency magnetic fields, voltage dips and interruptions, and ring waves to IEC 61000-4 standards.
- .12 300 amps for one second surge protection on all four current inputs.
- .13 The following accuracy, resolution, range, and power supply ratings specifications:

Parameter	Accuracy	Resolution	Range
Volts (V1, V2, V3)	0.1%	0.1%	0 - 1,000,000 ¹
Amps (I1, I2, I3)	0.1%	0.1%	0 - 30,000
Neutral Current (I4)	0.4%	0.1%	0 - 9,999
kW	class 0.2	0.1%	0 - 1,000,000 ²
kVAR	class 0.2	0.1%	0 - 1,000,000 ²
kVA	class 0.2	0.1%	0 - 1,000,000 ²
Power Factor	0.2%	1.0%	1.0 to ±0.6
Frequency	0.005 Hz	0.1 Hz ³	40 to 450 Hz
kW Demand	class 0.2	0.1%	0 - 1,000,000
Amps Demand	class 0.2	0.1%	0 - 30,000
kWH (-F, -R)	class 0.2	1 kWH	0 - 1,000,000,000
kVARH (-F, -R)	class 0.2	1 kVARH	0 - 1,000,000,000

- .1 Reads in kV for voltages over 9,999.
 - .2 Reads in MVA, MW, MVAR for readings over 9,999 K.
 - .3 One Hz resolution at 400 Hz range.
- .4 Power Supply
- .1 85 to 250 VAC.
 - .2 Burden: 15 VA typical, 35 VA maximum.
 - .3 Record and store the following information in meter memory. Recall and reset stored data via meter controls and meter indicator.
 - .1 Volts max/min at 1 second interval.
 - .2 Amps max/min at 1 second interval.
 - .3 F max/min at 1 second interval.
 - .4 kW max/min at 1 second interval.
 - .5 Pf max/min (or kVA max/min) at one second interval.
 - .6 kWd at field programmable intervals of one minute to 30 minutes; set at one minute.
 - .7 Ad per kWd.
 - .5 10BaseT, 100BaseT, and/or 1000BaseT communications port for connection to Ethernet network.
 - .6 Field programmable for set-up and system variables.
 - .7 Test terminal blocks as required.
 - .8 Relay output signalling loss of phase. Relay to open on phase loss.

- .9 CSA approved.
- .10 Approved Product:
 - .1 Schneider Electric PowerLogic ION9000.
 - .2 Or approved equal in accordance with B7 of the Tender.

Part 3 Execution

3.1 INSTALLATION

- .1 Install instruments in existing equipment and ensure accessibility.
 - .1 Installation to occur during facility shutdown in accordance with E5.
- .2 Ensure adequate spacing between current transformers installed on each phase.
- .3 Provide equipment identification as per Section 26 05 00 - Common Work Results for Electrical.

3.2 METERING INSTALLATION

- .1 Install instruments and meters in locations as indicated.
- .2 Make connections in accordance with diagrams.
- .3 Connect meter and instrument transformer cabinets to ground.

3.3 FIELD QUALITY CONTROL

- .1 Conduct tests in accordance with Section 26 05 00 - Common Work Results for Electrical and in accordance with manufacturer's recommendations.
- .2 Perform simulated operation tests with metering, instruments disconnected from permanent signal and other electrical sources.
- .3 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources, and electrical supplies.
- .4 Perform tests to obtain correct calibration.
- .5 Do not dismantle meters and instruments.

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 Progress Cleaning
 - .1 Leave Work area clean at end of each day.
- .3 Final Cleaning
 - .1 Upon completion remove surplus Materials, rubbish, tools, and equipment.

3.5 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by metering and switchboard instrument installation.

END OF SECTION

Approved: 2007-03-31

Part 1 General

1.1 RELATED SECTIONS

- .1 Tender Part E - Specifications.
- .2 Section 01 33 00 - Submittal Procedures.
- .3 Section 01 78 00 - Closeout Submittals.
- .4 Section 26 05 00 - Common Work Results for Electrical.
- .5 Section 26 22 19 - Control and Signal Transformers.
- .6 Section 26 29 03 - Control Devices.

1.2 REFERENCE STANDARDS

- .1 NEMA® standard

1.3 DEFINITIONS

- .1 “**dcmA**” means Direct Current Milliamp.
- .2 “**IRIG**” means Inter-Range Instrumentation Group.
- .3 “**IEC**” means International Electrotechnical Commission.
- .4 “**IED**” means Intelligent Electronic Device.
- .5 “**IPC**” means Institute for Interconnecting and Packaging Electronic Circuits.
- .6 “**LCD**” means Liquid Crystal Display.
- .7 “**MMS**” means Manufacturing Message Specification.
- .8 “**OPC-UA**” means Open Platform Communications - Unified Architecture.
- .9 “**RADIUS**” means Remote Authentication Dial-in Service Server.
- .10 “**RBAC**” means Role Based Access Control.
- .11 “**SNTP**” means Simple Network Time Protocol.
- .12 “**SLD**” means Single Line Diagrams.
- .13 “**SYSLOG**” means System Logging Protocol.
- .14 “**SFTP**” means Secure File Transfer Protocol.
- .15 “**SSH**” means Secure shell.
- .16 “**XML**” means Extensible Markup Language format.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.

- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet and include product characteristics, performance criteria, and limitations.
- .3 Shop Drawings:
 - .1 Include time-current characteristics of protective devices and schematic and wiring diagrams.
- .4 Quality Control:
 - .1 Provide Submittals accordance with Part E – Specifications of the Tender.
 - .2 Submit manufacturer's type test certificates indicating controller cubicle and components tested as integrated assembly.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide submittals in accordance with Section 01 78 00 - Closeout Submittals.
- .2 O&Ms:
 - .1 Include product data, shop drawings and maintenance data for motor controllers for incorporation into manual.

1.6 MAINTENANCE MATERIALS:

- .1 Provide spare parts in accordance with Section 01 78 00 – Closeout Submittals and Part 2 of this section.
- .2 Include one spare set power fuses of each type and rating used.
- .3 Provide MPR spare parts quantities as listed below:

DESCRIPTION	PRODUCT LINE	PART	SPARE PARTS
Motor Protection Relay	GE Multilin	869	1

Part 2 Products

2.1 MPR

- .1 Protection, monitoring, and metering shall be supplied in one integrated digital relay package for application to motors suitable for incorporation into an integrated station control system.
- .2 The digital relay shall have a common hardware and firmware platform that shall support feeder, motor, transformer, and generator applications. The relay shall be equipped with separate processors for protection and for communication related functions. The relay shall be equipped with the following protection monitoring, control, automation, and reporting functions. If supporting functions are not available within the relay, suitable external devices shall be provided to meet the specification requirements.

- .3 Protection and Control
 - .1 The built-in motor thermal model (49) shall include the following:
 - .1 Motor thermal limit curves - NEMA® standard, voltage dependent, and customized motor curves.
 - .2 IEC 60255-8 thermal overload curves.
 - .3 Smoothing filter for cyclic loads.
 - .4 Current unbalance biasing.
 - .5 Independent running and stopped exponential cooling curves.
 - .6 Optional RTD biasing of the thermal model to adapt to real-time temperature measurements.
 - .7 Compensation for hot/cold motor condition.
 - .8 Two speed motor thermal protection.
 - .2 The relay shall provide the following functions for motor start-up and control.
 - .1 Reduced voltage start.
 - .2 Stall protection.
 - .3 Lockout (86).
 - .4 Thermal inhibit.
 - .5 Maximum starting rate.
 - .6 Time between starts and number of starts.
 - .7 Restart delay (Backspin Protection).
 - .8 Acceleration time.
 - .3 The relay shall provide the following current-based protection functions:
 - .1 Short circuit protection.
 - .2 Ground fault protection.
 - .3 Undercurrent (37).
 - .4 Mechanical jam.
 - .5 Current unbalance (46).
 - .6 Motor stator differential protection (87S) with options: internal summation percent differential and core balance percent differential is required. Differential protection shall include dual slope characteristics and CT saturation detection. The relay also shall provide directionality check for both AC and DC saturation. The relay shall provide core balanced differential protection with biasing to secure differential protection during motor starting. Two speed motor current based protection.
 - .7 Phase/neutral/ground instantaneous overcurrent (50P/N/G).
 - .8 Phase/neutral/ground time overcurrent (51P/N/G).
 - .9 Negative sequence instantaneous overcurrent (50_2).
 - .10 Phase/neutral directional overcurrent (67P/N).
 - .11 Breaker failure (50BF).

- .4 The phase time overcurrent can be selected to operate either on RMS or fundamental value.
- .5 The relay shall provide the following voltage based functions:
 - .1 Phase reversal protection.
 - .2 Phase overvoltage and phase undervoltage (59P, 27P).
 - .3 Auxiliary overvoltage (59x).
 - .4 Neutral overvoltage (59N).
 - .5 Negative sequence overvoltage (59_2).
 - .6 Directional power (32).
 - .7 Overfrequency/underfrequency (81O/81U).
 - .8 Voltage restrained phase time overcurrent (51V) with adjustable voltage lower limit.
 - .9 Underpower (37P).
- .6 The relay shall support V/Hz with voltage mode options:
 - .1 Phase-ground.
 - .2 Phase-phase.
- .7 The V/Hz shall support definite time, inverse A, inverse B, inverse C, flex curve A, flex curve B, flex curve C, and flex curve D.
- .8 The relay shall have four programmable flexcurves with graphical manipulation of the individual points.
- .9 The relay shall be capable of detecting loss of excitation (40).
- .10 The relay shall be capable of detecting reactive power (40Q).
- .11 The relay shall be capable of detecting out of step.
- .12 The relay shall provide support for up to 13 RTD inputs for temperature based protection, an ability to detect open and shorted RTDs, and configurable voting using two or three RTDs. In addition, the relay shall support 100 Ohm Nickel, 120 Ohm Nickel, 100 Ohm Platinum, or 10 Ohm Copper RTDs.
- .13 The relay shall be capable of being configured for a breaker or contactor controlled scheme.
- .14 The relay shall provide protection for motors driven by variable frequency drives and provide frequency tracking for the range of three to 72 Hz. In addition, the relay shall be capable of automatically switching between voltage-based or current-based frequency tracking.
- .15 The relay shall be capable of setting lead/lag power factor (55) for the monitoring and protection of synchronous motors.
- .16 The relay shall have an ability to build trip and alarm matrices and directly assign a corresponding output relay without using programmable logic.
- .17 The relay shall have configurable options to select any protection elements to be used as a trip, alarm, or latched alarm function without using programmable logic.

- .18 The relay shall have six switchable setting groups for dynamic reconfiguration of the protection elements based on user-defined conditions.
- .19 The relay shall support eight flex elements that can use any available/calculated analog parameters within the relay (e.g., comparator, inverter, over/under, etc.).
- .20 The relay shall support up to 16 digital counters.
- .21 It should be possible to test the binary inputs, outputs, and protection functions without the need for an external test kit.
- .22 The relay shall be capable of measuring the motor speed.
- .4 Programmable Logic
 - .1 Relays shall support 1024 lines of user defined logic to build control schemes supporting logic gates, timers, and non-volatile latches.
 - .2 The programmable logic in the relay shall be executed at eight times per power system cycle.
 - .3 The relay configuration tool shall have embedded graphical user interface to build programmable logic.
 - .4 The relay shall provide up to 96 virtual outputs plus 64 virtual inputs.
 - .5 The relays shall support logic designer and logic monitor – i.e., graphical logic editing tool and online monitoring of logic states in a graphical way.
- .5 Communications/Integration
 - .1 The relay shall support the following communication protocols: Modbus RTU, Modbus TCP/IP, IEC 61850 GOOSE, IEC 61850 edition 2 MMS, DNP 3.0, IEC 60870-5-104, IEC 60870-5-103, and OPC-UA.
 - .2 The relay shall have the ability to configure both protection and IEC 61850 related settings directly from a single setting (IEC 61850-6 based XML format) file. There shall be direct uploading of single IEC 61850-6 based XML file into the relay. There shall be no further proprietary file format conversion required. All setting managements through a single IEC 61850-6 based file shall be supported.
 - .3 The relay shall support up to eight IEC61850 concurrent client connections.
 - .4 The relay shall support GOOSE analog reception and transmission.
 - .5 The relay shall support up to 128 virtual outputs and virtual inputs over GOOSE.
 - .6 The relay shall support file transfer protocol TFTP and file transfer through 61850.
 - .7 The relay shall support multiple time synchronization sources such as IRIG-B, IEEE 1588, and SNTP(2) with the ability to configure priority for the time sources and dynamically switch based on availability of each source.
 - .8 The relays shall provide two copper/fiber optic Ethernet ports with two modes of operation – fail over mode or independent mode.

- .9 The relays shall support networks for IEC62439/ parallel redundancy protocol.
 - .10 The relays shall have an option for Wi-Fi (IEEE 802.11 b/g/n) connectivity to configure settings and retrieve operational records.
 - .11 A front panel universal serial bus port shall provide connectivity to configure settings and retrieve operational records.
 - .12 The relay shall provide a user definable memory map.
 - .13 The relay shall support Modbus connectivity to slave devices to gather data.
- .6 Relay Configuration/Setting File Management
- .1 Setting the entire relay from only a single setting file shall be supported.
 - .2 Entire relay settings (not only communication related but also protection and control functional settings) shall be part of the same single setting file.
 - .3 The relay shall be configured through the IEC 61850-6 standard based on the Configured IED Description (CID in XML) format file only.
 - .4 There shall be only a single relay setting (i.e. CID based XML format) file which can be directly uploaded into the device. This means there is no intermediate conversion of any proprietary setting file formats which requires managing multiple settings files for just one relay.
 - .5 The relay shall be able to receive single configuration/setting files from any third party tool (not only from a vendor specific proprietary relay configuration tool).
- .7 Front-Panel Visualization
- .1 The user interfaces shall provide a large color LCD front panel display and navigation keys.
 - .2 The front panel shall have color LCDs to display up to six configurable SLD, 12 control objects, 15 status, and 15 metering objects with a provision to control the breaker, online metering, and status information.
 - .3 The front panel shall be capable of displaying measured values, calculated values, I/O status, device status, target messages, events, motor learned data, and configured relay settings.
 - .4 The front panel shall have support for breaker and switch control through the SLD and pushbuttons with select-before-operate mechanism.
 - .5 The front panel shall have user-programmable LEDs and pushbuttons.
 - .6 The relay shall provide up to 36 configurable annunciation indicators like an annunciator panel to monitor and reset alarms through the front panel.
 - .7 The relay shall provide configurable 20 soft pushbuttons that are controlled from the front panel of the relay.
 - .8 The relay shall provide ten programmable home pages.

- .8 Monitoring and Diagnostics
 - .1 The relay shall provide a motor health report retrievable via the communication ports that provides a snapshot of the motor operating and diagnostic information. The report shall include information pertaining to device, status, trip summary, motor operating history, motor starting learned data, motor start records, and motor stopping/tripping. In addition, the relay shall provide a minimum of six motor start records with a sampling rate of 100 ms and a record length of 60 seconds.
 - .2 The relay shall provide advanced motor diagnostics for detection of broken rotor bar faults based on coherent demodulation utilizing voltage and current.
 - .3 The relay shall provide advanced motor diagnostics for detection of stator turn to turn faults.
 - .4 The relay shall provide advanced motor diagnostics for detection of roller bearing faults.
 - .5 The relay shall provide advanced motor diagnostics for detection of mechanical faults related to foundation looseness, eccentricity, and misalignment.
 - .6 The relay shall provide breaker health monitoring features including:
 - .1 Breaker close and breaker open times, trip/close circuit monitoring, spring charging time, per-phase arcing current, and trip counters.
 - .7 The relay shall record its exposure to temperature, humidity, and surge. In addition, a report shall be retrievable via the communication ports on the minimum/maximum average of those recorded values. The relay shall provide environmental awareness statistics that trends temperature, humidity, and surge pulses.
 - .8 The relay shall provide information on the power factor of the protected device (55).
 - .9 The relay shall provide up to 64 digital channels and up to 16 analog channels of oscillography at a sampling rate of 128 samples per cycle.
 - .10 The relay shall provide configurable event records - with a record of the last 1024 events, time tagged with a resolution of one ms.
 - .11 The relay shall store all its recorded data in non-volatile memory.
 - .12 The relay shall provide a separate data logger function which shall record a maximum of 16 analog channels with a settable sampling rate of one cycle, one second, 30 seconds, one minute, 15 minutes, 30 minutes, or one hour including a trigger source of sample, min, max, mean.
 - .13 The current metering accuracy shall be at +/- 0.25 percent of the reading for up to two times the rated secondary current and +/- one percent for above that.
 - .14 The voltage metering accuracy shall be at +/- 0.5 percent of the reading from 15 to 208V.
 - .15 The power metering accuracy shall be at +/- one percent of the reading.

- .16 The frequency metering accuracy shall be typically at one millihertz accuracy level.
- .9 Hardware
 - .1 The protection relay shall provide analog input systems that can reproduce up to 46 times CT rating RMS symmetrical. The relay shall execute protection related main algorithms at eight times per power system cycle.
 - .2 The relay shall have conformal coated electronic board assemblies for harsh environment deployment.
 - .3 Microprocessor based protective relays shall employ IPC Class 3 printed circuit boards, i.e., IPC Class 610-3.
 - .4 The relay shall have a draw-out construction to facilitate testing, maintenance, and interchange flexibility.
 - .5 The relay shall provide a field swappable (i.e. removable) power supply module.
 - .6 The relay shall have a scan rate of 128 samples per power system cycle for DI and provide less than one millisecond time stamp resolution for state changes.
 - .7 The relay shall provide an operating temperature range of minus 40 degrees Celsius to plus 60 degrees Celsius and be tested per IEC 60068 for 16-hour operation between minus 40 degrees Celsius and plus 85 degrees Celsius.
 - .8 The relay shall provide an optional sensitive ground input to detect a minimum primary ground current of 0.5A.
 - .9 The relay shall support at a minimum ten DO and 14 DI.
 - .10 The relay shall provide built-in trip coil and close coil supervision.
 - .11 The DI should be capable of accepting wet or dry input signals. In cases where an external wetting voltage is used, the voltage threshold shall be software selectable for 24V, 48V, 125V, and 250V DC sources.
 - .12 The relay contacts should be rated for a minimum of 10A continuous.
 - .13 The relay shall support 7 dcmA outputs, 4 dcmA inputs.
 - .14 The relay shall provide support for up to 13 RTD inputs for temperature based protection, an ability to detect open and shorted RTDs, and configurable voting using two or three RTDs. In addition, the relay shall support 100 Ohm Nickel, 120 Ohm Nickel, 100 Ohm Platinum, or 10 Ohm Copper RTDs.
 - .15 The relay shall have integrated arc flash protection with support for up to four Arc flash sensors.
- .10 Security
 - .1 The relay shall provide an option for RBAC with three roles such as observer for accessing operational data, operator for start-stop of the motor, and administrator for configuring the relay.
 - .2 The relay shall provide an option for password complexity.

- .3 The relay shall provide an option for local device level authentication and for remote server authentication using RADIUS.
- .4 The relay shall provide optional support for SYSLOG to publish security related events.
- .5 The relay shall support SFTP.
- .6 Security setting reports must include the following events with time stamp.
- .7 Failed authentication:
 - .1 User lock out.
 - .2 Setting changes.
 - .3 Login.
 - .4 Logout.
 - .5 RADIUS server unreachable.
 - .6 Clear event/transient/fault records.
 - .7 The relay shall provide SSH tunneling connection.
- .11 Service and Support
 - .1 Warranty: The relay shall include a ten-year warranty for all Material and workmanship defects.
- .12 Approved Products
 - .1 GE Multilin 869.
 - .2 Or approved equal in accordance with B7 of the Tender.

2.2 INSTRUMENT TRANSFORMERS

- .1 Instrument transformers: in accordance with Section 26 22 19 - Control and Signal Transformers.

2.3 RELAYS

- .1 Relays: to Section 26 29 03 - Control Devices.

2.4 EQUIPMENT IDENTIFICATION

- .1 Provide general equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.5 WARNING SIGNS

- .1 Provide warning signs in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.6 SOURCE QUALITY CONTROL

- .1 Contract Administrator to witness standard FAT of complete controller assembly prior to shipment including comprehensive operation of contactors, relays, interlocks, and controls in accordance with E9 of the Tender.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 MPR shall be securely mounted to the face of the switchgear door. Existing opening shall be made larger to accommodate new MPR.
- .2 MPR shall be configured as per the short circuit coordination study which will be provided by the Contract Administrator.
 - .1 The Contractor shall request the short circuit coordination study after award of the Contract.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests in accordance with manufacturer's instructions.
- .3 Examine switchgear assembly to ensure components are dry and clean.
- .4 Operate switches and contactors to verify correct functioning.
- .5 Simulate instrument transformer and transducer signal sources of protective relays and check relays for correct operation, calibration, and settings.
- .6 Perform simulated starting and stopping sequences of contactors and relays with connections to supply and motor isolated.

END OF SECTION

Approved: 2011-12-31

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittals.
- .3 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CSA C13-M83, Instrument Transformers.

1.3 DEFINITIONS

- .1 "PT" means potential transformer.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for control and signal transformers and include product characteristics, performance criteria, physical size, finish, and limitations.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide submittals in accordance with Section 01 78 00 - Closeout Submittals.
- .2 O&M Manuals:
 - .1 Include control and signal transformers for incorporation into manual.

1.6 MAINTENANCE MATERIALS

- .1 Provide spare parts in accordance with Section 01 78 00 – Closeout Submittals and Part 2 of this section.
- .2 Provide one spare set of fuses of each type and rating used per facility.
- .3 Provide PT spare parts quantities as listed below:

DESCRIPTION	PRODUCT LINE	PART	SPARE PARTS
Potential Transformer	GE	PT3	3

Part 2 Products

2.1 POTENTIAL TRANSFORMERS (PT)

- .1 PT to CAN3-C13, dry type for indoor use with the following characteristics:
 - .1 Accuracy class: 0.3W
 - .2 Rated frequency: 60 Hz
 - .3 Basic impulse level: 60 kV
 - .4 Voltage ratio: 4160:120 or 2400:120 as indicated on the Drawings.
 - .5 Phases: 3 or 1 as indicated on the Drawings.
 - .6 Rating: 600VA, or larger, as required.
- .2 PT primary and secondary sides fused with separate fuse blocks, ampacity as required.
- .3 Approved Product: GE PT3 or approved equal in accordance with B7 of the Tender.

2.2 MOUNTING BRACKETS

- .1 PT with channel type mounting brackets.
- .2 Fabricate brackets and channels from electro-galvanized code gauge steel.

Part 3 Execution

3.1 INSTALLATION

- .1 Install instruments in existing equipment and ensure accessibility.
- .2 Ensure adequate spacing between PT installed on each phase.
- .3 Provide equipment identification as per Section 26 05 00 - Common Work Results for Electrical.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

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

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittals.
- .3 Section 26 05 00 - Common Work Results for Electrical.
- .4 Section 26 28 21 - Moulded Case Circuit Breakers.

1.3 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA C22.2 No.29, Panelboards and enclosed Panelboards.

1.4 DEFINITIONS

- .1 “**kA**” means kiloamps

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Include electrical detail of panel, branch breaker type, quantity, ampacity, and enclosure dimension.

1.6 CLOSEOUT SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 78 00 - Closeout Submittals.
- .2 O&M Manuals:
 - .1 Panelboard product data.

Part 2 Products

2.1 PANELBOARDS

- .1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.
 - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand and related arc flash rating.
- .2 600 V panelboards: bus and breakers rated for 18 kA (symmetrical) interrupting capacity or as indicated.

- .3 250 V panelboards: bus and breakers rated for 10 kA (symmetrical) interrupting capacity or as indicated.
- .4 Panelboard width to be less than 230 mm.
- .5 Integral SPD.
- .6 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .7 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated on Drawings.
- .8 Two keys for each panelboard and key panelboards alike.
- .9 Copper bus with neutral of same ampere rating as mains.
- .10 Mains: suitable for bolt-on breakers.
- .11 Trim with concealed front bolts and hinges.
- .12 Trim and door finish: baked grey enamel.
- .13 Approved model: Square D MVP NQ series or approved equal in accordance with B7 of the Tender.

2.2 BREAKERS

- .1 Breakers: to Section 26 28 21 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Lock-on devices for fire alarm clock outlet, emergency, door supervisory, intercom, stairway, exit, and night light circuits.
- .4 Provide and install a minimum of two extra single pole 15 A breakers per panelboard.

2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Complete circuit directory with typewritten legend showing location and load of each circuit.

Part 3 Execution

3.1 INSTALLATION

- .1 Surface mount panelboards to match existing panelboard installations as required by Code or as indicated.
- .2 Connect loads to circuits.
- .3 Connect neutral conductors to common neutral bus with respective neutral identified.

- .4 Measure load current on each phase and adjust phase loading for a balanced system.

END OF SECTION

Approved: 2011-06-30

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CSA C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CAN/CSA C22.2 No.42.1, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .3 CSA C22.2 No.55, Special Use Switches.
 - .4 CSA C22.2 No.111, General-Use Snap Switches (Bi-national standard, with UL 20).

Part 2 Products

2.1 GENERAL

- .1 Switches, receptacles, and cover plates from one manufacturer throughout Work.

2.2 SWITCHES

- .1 20 A, 120 V, single pole, double pole, three-way, four-way switches to: CSA C22.2 No.55 and CSA C22.2 No.111.
- .2 Manually-operated specification grade AC switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 Ivory toggle.
- .3 Toggle operated locking fully rated for tungsten filament and fluorescent lamps, and up to 80 percent of rated capacity of motor loads.
- .4 Acceptable manufacturer:
 - .1 Hubbell or approved equal in accordance with B7 of the Tender.

2.3 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA C22.2 No.42 with following features:

- .1 Specification grade.
- .2 Heavy duty nylon face with steel reinforcing plate in centre.
- .3 Suitable for No. 10 AWG for back and side wiring.
- .4 Break-off links for use as split receptacles.
- .5 Eight back wired entrances, four side wiring screws.
- .6 Triple wipe contacts and riveted grounding contacts.
- .2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:
 - .1 Heavy duty nylon face with steel reinforcing place in centre.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Four back wired entrances, two side wiring screws.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Acceptable manufacturer:
 - .1 Hubbell 8200, 8210, or approved equal in accordance with B7 of the Tender.

2.4 COVER PLATES

- .1 Cover plates for wiring devices to: CSA C22.2 No.42.1.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.
- .4 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.

Part 3 Execution

3.1 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

- .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
- .3 Cover plates:
 - .1 Install suitable common cover plates where wiring devices are grouped.
 - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials for moulded-case circuit breakers.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittals.

1.3 REFERENCE STANDARDS

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

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Include time-current characteristic curves for breakers with ampacity of 90A and over or with interrupting capacity of 22,000 A symmetrical RMS and over at system voltage.

1.5 MAINTENANCE MATERIALS

- .1 Provide spare parts in accordance with Section 01 78 00 – Closeout Submittals and Part 2 of this section.
- .2 Provide minimum two (2) spare 15A circuit breakers per provided panel.

Part 2 Products

2.1 BREAKERS GENERAL

- .1 Moulded-case circuit breakers and circuit breakers to CSA C22.2 No. 5.
- .2 Circuit breakers shall be constructed using glass reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- .3 Circuit breakers shall have an over center, trip free, toggle operating mechanism which shall provide quick-make, quick-break contact action. The circuit breaker shall have common tripping of all poles.
- .4 Moulded case circuit breakers shall be bolt-on, quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees Celsius ambient.

- .5 Breakers to be mounted using manufacturer approved breaker mounting accessories.
- .6 Common-trip breakers: with single common handle for multi-pole applications.
- .7 Branch circuit breakers shall have a minimum interrupting capacity as indicated on the Drawings. Breakers shall have the same interrupting rating as that indicated for the panelboard, on the panelboard schedules. Series rated breakers will not be accepted.
- .8 Moulded case circuit breakers shall operate automatically by means of trip element devices to provide inverse time current tripping.
- .9 The circuit breaker handle shall reside in a tripped position between on and off to provide local trip indication. Circuit breaker escutcheon shall be clearly marked on and off.
- .10 Protective devices shall be suitable for use with 75°C or greater wire insulation systems and Canadian Electrical Code 75°C conductor ampacity.
- .11 The maximum ampere rating, CSA standards with applicable voltage systems and corresponding interrupting ratings, shall be clearly marked on the face of the circuit breaker.
- .12 Circuit breakers shall be factory sealed, with an installed hologram quality mark and shall have a date code on the face of the circuit breaker.
- .13 All equipment and components must be supplied through a manufacturer approved distribution channel. Equipment shall be supported, guaranteed, and traceable through the equipment manufacturer channels. Equipment procured from an unauthorized third party will be rejected.
- .14 Breakers shall be manufacturer approved, tested, and CSA approved for use within the panelboard or distribution equipment that it is installed within.
- .15 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
 - .1 Trip settings on breakers with adjustable trips to range from three to eight times current rating.
- .16 Circuit breakers to have minimum symmetrical RMS interrupting capacity rating matching the panelboard or switchboard containing breaker as required per the short circuit coordination study which will be provided by the Contract Administrator.
 - .1 The Contractor shall request the short circuit coordination study after award of the Contract.

2.2 THERMAL MAGNETIC BREAKERS [DESIGN A]

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

2.3 MAGNETIC BREAKERS [DESIGN B]

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

2.4 SOLID STATE TRIP BREAKERS [DESIGN D]

- .1 Moulded case circuit breaker to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time, instantaneous tripping for phase and ground fault short circuit protection.

Part 3 Execution

3.1 INSTALLATION

- .1 Install circuit breakers as indicated.
- .2 Circuit breakers to match existing panels.
- .3 Set adjustable trip settings according to the short circuit coordination study provided by Contract Administrator.
 - .1 The Contractor shall request the short circuit coordination study after award of the Contract.

END OF SECTION

Approved: 2011-06-30

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittals.
- .3 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CSA C22.2 No.14-, Industrial Control Equipment.
- .2 NEMA® standard
 - .1 NEMA ICS 1, Industrial Control and Systems: General Requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for control devices and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Shop Drawings:
 - .1 Include schematic, wiring, and interconnection diagrams.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures and Section 01 78 00 - Closeout Submittals.
- .2 O&M Manuals:
 - .1 Submit operation and maintenance data for control devices for incorporation into manual.

1.5 MAINTENANCE MATERIALS

- .1 Provide one spare plug-in type relay for each panel in which new relays are installed.

Part 2 Products

2.1 AC CONTROL RELAYS

- .1 Control relays: to CSA C22.2 No.14.

- .2 Fixed contact plug-in type: general purpose heavy duty with two poles.
- .3 Coil rating: 120 V or 24 VDC as specified.
- .4 Contact rating: 240 V, 2 A.

2.2 RELAY ACCESSORIES

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

2.3 OILTIGHT LIMIT SWITCHES

- .1 Snap action type: fork, roller, rod, lever, wobble stick, top, side, push actuator, CSA type 4 enclosure.
- .2 Contact rating: 240 V, 2 A.

2.4 SOLID STATE TIMING RELAYS

- .1 Construction: AC and DC operated electronic timing relay with solid-state timing circuit to operate output contact.
- .2 Operation: on-delay or off-delay.
- .3 Potentiometer: self-contained to provide time interval adjustment.
- .4 Supply voltage: 24 VDC or 120 VAC 60 Hz.
- .5 Temperature range: minus 20 degrees Celsius to plus 60 degrees Celsius.
- .6 Output contact rating: maximum voltage 300 V AC or DC.
- .7 Current: [NEMA ICS 1] A.
- .8 Timing ranges: minimum 0.1 seconds, maximum five minutes.

2.5 CONTROL AND RELAY PANELS

- .1 CSA Type 12 sheet steel enclosure with hinged padlockable access door, accommodating control equipment, labels, as indicated, factory installed, and wired to identified terminals.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of conditions: verify that conditions of substrate previously installed under other sections or contracts are acceptable for control devices installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform the Contract Administrator of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

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

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time, and check out operation of section.
- .3 Upon completion of sectional test, undertake group testing.
- .4 Check out complete system for operational sequencing.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Supply, install, and commissioning of a complete SCADA system and PLC upgrade for each station as shown on the Drawings and as specified herein.
- .2 Component subsystems of the SCADA system and PLC upgrade will include, but are not limited to, the following:
 - .1 SCADA host servers.
 - .2 SCADA thin and thick clients.
 - .3 Station fibre optic network ring.
 - .4 PLC and RIO modules.
 - .5 Pump and motor condition monitoring modules.
 - .6 EIO fibre optic network ring.
 - .7 Primary elements and transmitters.
 - .8 Final control elements.
 - .9 Instrumentation cabling.
 - .10 Instrumentation power supplies.
 - .11 Conduit and cable tray.
 - .12 All other items shown or implied on the Drawings and described herein.
- .3 Where packaged, stand-alone control systems are supplied by others, provide cabling to connect to the required remote monitoring and/or control functions. Provide end-to-end commissioning of all required remote monitoring and/or control functions. Assist in ensuring the correct functionality of any equipment supplied by others.

1.2 RELATED SECTIONS

- .1 Part E - Specifications.
- .2 Section 01 33 00 – Submittal Procedures.
- .3 Section 01 61 00 - Common Product Requirements.
- .4 Section 01 74 00 – Cleaning.
- .5 Section 01 78 00 – Closeout Submittals.
- .6 Section 07 84 00 – Fire Stopping.
- .7 Section 26 05 00 - Common Work Results for Electrical.
- .8 Division 29 - Instrumentation and Control.

1.3 REFERENCE STANDARDS

- .1 This division contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section, and those of the listed documents, the requirements of this section prevail.

□

- .1 IEEE 100, Dictionary of Electrical and Electronic Terms.
 - .2 ISA S5.4, Instrument Loop Diagrams.
 - .3 ISA S18.1, Annunciator Sequences and Specifications.
 - .4 ISA S51.1, Process Instrumentation Terminology.
 - .5 NEMA 250, Enclosures for Industrial Controls and Systems.
 - .6 NEMA ICS 1, General Standards for Industrial Control and Systems.
 - .7 NEMA ICS 2, Industrial Control Devices, Controllers, and Assemblies.
 - .8 NFPA 70, National Electrical Code (NEC).
 - .9 SAMA PMC 17-10, Bushings and Wells for Temperature Sensing Elements.
 - .10 UL 1012, Power Supplies.
- .2 City of Winnipeg Water and Waste Department Electrical Design Guide.
<https://winnipeg.ca/waterandwaste/pdfs/dept/ElectricalDesignGuide.pdf>

1.4 DRAWING AND SPECIFICATIONS

- .1 Refer to Part E – Specifications of the Tender, Division 1 - General requirements, and Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform all operations as designated by the NMS according to the methods prescribed, complete with all necessary labour and incidentals.
- .3 Treat any item or subject omitted from Division 29 - Instrumentation and Control or Drawings, but which is mentioned or reasonably specified in other NMS divisions' or Drawings and pertains to the instrumentation and control system, as being integral to the overall system. Provide such specified items or subjects.
- .4 Provide all minor items and Work not shown or specified but which are reasonably necessary to complete the Work.

1.5 DEFINITIONS

- .1 Interpret specialized terms not explicitly defined herein in accordance with ISA-S51.1, NEMA-ICS-1, ANSI/IEEE-Std-100, and The Communications Standard Dictionary, by Martin H. Weik.
- .2 “**DP**” means Decentralized Peripherals.
- .3 “**ELV**” means Extra-low Voltage.
- .4 “**IE**” means Instrumentation Earth.
- .5 “**LV**” means low voltage and is used to refer to anything 1000 V or less.
- .6 “**PE**” means Protective Earth.
- .7 “**PA**” means Process Automation.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Provide rated assembly prior to installation of fire stop.

□

- .2 Location Drawings:
 - .1 Indicate in plan and/or elevation views where the instrument elements are physically located. These Drawings are provided to assist the Contractor in estimating the amount of cable and ducting required.
- .3 Testing and Calibration
 - .1 Submit forms in accordance with Items 3.11 and 3.12.
- .4 Nameplates and Labels:
 - .1 Submit lamacoid nameplate list.

1.7 QUALITY ASSURANCE

- .1 Qualifications: The instrumentation Subcontractor shall be a firm normally engaged and fully competent in the type of Work described in Division 29 - Instrumentation and Control. The firm shall have been continuously and successfully engaged in this business for at least five years.
 - .1 Qualified journeyman instrument mechanics that are familiar with the devices being installed shall perform all instrument hook-ups, calibrations, and checkouts.
 - .2 Qualified journeyman electricians shall perform all control wiring installation and connections.
- .2 Employ a competent supervisor and all necessary licensed tradesmen to complete the Work in the required time.
- .3 Arrange and install products to fit properly into designated building spaces.
- .4 Install products in accordance with the recommendations and ratings of the product manufacturers.

1.8 CLOSEOUT SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures and Section 01 78 00 - Closeout Submittals.
- .2 O&M Manuals:
 - .1 Standard Details:
 - .1 Provide a reference for installation, operation, and other instructions pertinent to a particular device.
 - .2 Calibration Methods and Records:
 - .1 Provide a printed copy of all factory calibration methods and records for instrumentation devices. Provide a printed copy of calibration methods and records after Site installation for all instrumentation devices.

1.9 PERMITS, FEES, CODES, RULES, AND INSPECTIONS

- .1 Comply with all laws, ordinances, rules, regulations, codes, and orders of all Authorities Having Jurisdiction relating to this Work.

- .2 Comply with all rules of the Electrical Safety Act of the Province, CSA Standards, and the applicable building codes, whether specifically shown on Drawings or not.
- .3 Submit to the Electrical Inspection Department and Supply Authority the necessary number of Drawings and Specifications for examination and approval prior to commencement of Work.
- .4 The Contractor to acquire permits and pay associated fees in accordance with Part C - General Conditions of the Tender.
 - .1 The Contractor to obtain all permits for each Site.
- .5 The Contractor to provide Drawings and Specifications required by the Electrical Inspection Department and Supply Authority at no cost.
- .6 Notify the Contract Administrator of changes required by the Electrical Inspection Department prior to making changes.
- .7 Furnish certificates of acceptance from Authorities Having Jurisdiction on completion of Work to the Contract Administrator.

1.10 SITE AREA CLASSIFICATIONS

- .1 Classification of Pumping Station Areas
 - .1 Control Room: Ordinary (NEMA 1 equipment rating required).
 - .2 Electrical Room: Ordinary (NEMA 1 equipment rating required).
 - .3 Pump Floor: Ordinary (NEMA 12 equipment rating required).
 - .4 Basement or Crawl Space: Ordinary (NEMA 12 equipment rating required).
 - .5 Chlorine Room: Category 2 (NEMA 4X equipment rating required).

1.11 DELIVERY, STORAGE, HANDLING, AND PROTECTION

- .1 Deliver, store, and handle Materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 All instrumentation primary elements, control components, panels, etc. shall be placed in a secure, dry, heated storage building.
- .3 Maintain the space temperature above 10 degrees Celsius and the space relative humidity below 50 percent.
- .4 Perform a preliminary examination upon delivery to ensure that:
 - .1 All instrumentation and control components supplied for the Work under this section comply with the requirements stated in the instrument specification sheets.
 - .2 All instrumentation and control components supplied by others, to be connected to instrumentation and control components comply with the requirements stated in the Contract Documents.
 - .3 Itemize all non-conformities noted above and forward them to the Contract Administrator.

- .4 Do not install primary elements or other sensitive equipment until construction is sufficiently completed to provide an "operating condition" environment. Notify the Contract Administrator prior to installing any equipment of this type.
- .5 Ensure that covers where required are properly installed on all equipment. Provide all covers, padding, guards, etc. as required to guard any equipment against damage.
- .6 Return all damaged equipment to the supplier for total corrective repairs. If deemed necessary by the Contract Administrator, the damaged equipment shall be replaced with new product.
- .5 Use all means necessary to protect the products included in this division before, during, and after installation, and to protect products and installed Work of all other trades.
- .6 Any damage to the products and/or installed Work shall be repaired or replaced by the Contractor at no additional cost to the City and to the approval of the Contract Administrator.
- .7 Remove advertising labels from all products installed that have such labels attached. Identification or CSA labels are not to be removed.
- .8 Remove dirt, rubbish, grease, etc. resulting from Work performed under this division from all surfaces.

Part 2 Products

2.1 GENERAL

- .1 Refer to the requirements of Division 1 - General Requirements.
- .2 Selected Products
 - .1 Provide products and Materials that are new and free from all defects.
 - .2 The design has been based on the use of the first named product where multiple products have been listed.
- .3 Quality of Products
 - .1 All products provided to be CSA and/or ULC approved where applicable.
 - .2 If products specified are not CSA approved, obtain approval of the relevant provincial regulatory authority. Pay all applicable charges levied and make all modifications required for approval.
- .4 Uniformity of Manufacture
 - .1 Unless otherwise specifically called for in the NMS, uniformity of manufacture is to be maintained for similar products throughout the Work.
- .5 Use of Products during Construction
 - .1 Any equipment used for temporary or construction purposes is to be approved by the Contract Administrator. Clean and restore to "as new" condition all equipment prior to the time of facility closeout.

2.2 INSTRUMENTATION

- .1 General
 - .1 Instruments and installation methods to be suitable for the environmental conditions in which they are to be installed.
 - .2 Determine where injurious conditions may be expected to occur and make proper provision to protect the instruments to ensure their proper and reliable operation.

2.3 IDENTIFICATION

- .1 Refer to City of Winnipeg Water and Waste Department Electrical Design Guide for general identification requirements as well as Section 26 05 00 - Common Work Results for Electrical.
 - .1 The Contract Administrator will provide an overall lamacoid list indicating equipment that requires labels as well as a draft loop tag number. This list is for reference only and the Contractor shall submit lamacoid labels to the Contract Administrator for review.
 - .2 Provide 3 mm thick lamacoid nameplates with 6 mm black lettering on white background prior to Site commissioning. Identify the loop tag number (where applicable) and the device name, function, and instrument range or setpoint value on the nameplate.
 - .3 Provide nameplates for each device on or within the panels and enclosures. Nameplates shall be white lamacoid with black lettering, a minimum of 25 mm x 75 mm in size with up to three lines of 5 mm lettering. Securely fasten nameplates and situate them in a visible location.
 - .4 Where it is not possible to attach a lamacoid nameplate to a field instrument component, provide the component with a stainless steel metal tag firmly wired to the device and identified with the loop tag number.
 - .5 Identify all wires where they terminate at the marshalling panels, junction boxes, and field devices with a heat shrink sleeve with machine printed labelling.
 - .6 Clearly mark all panels, pull boxes, junction boxes, etc. to indicate the nature of service.
 - .7 Provide neatly typed circuit directories for panel power distribution systems to indicate loops or devices powered by the circuit and the fuse size.
 - .8 Identify all exposed control conduits at all pull box locations, where the conduits enter or leave a room, and 5 m on center throughout the room. This shall apply to conduits above removable ceilings. Use Thomas & Betts TY-RAP 5532-M labels for conduit identification or approved equal in accordance with B7 of the Tender.
 - .9 For direct current wiring, use black for positive and white for negative.
 - .10 For thermistor wiring to motors, use red and blue coloured insulated wire.

Part 3 Execution

3.1 COORDINATION WITH OTHER DIVISIONS

- .1 Examine the Drawings and Specifications and become fully familiar the Work. Before commencing Work, obtain a ruling from the Contract Administrator on any conflicting issues between NMS divisions. No compensation will be made for any costs arising from conflicts not identified before the Work has commenced.
- .2 Coordinate the Work to be performed under this section with Division 26 - Electrical installing equipment to ensure that there are no conflicts.
- .3 Install anchors, bolts, pipe sleeves, hanger inserts, etc. required in ample time to prevent delays to other installation Work.
- .4 Lay out the Work and equipment with due regard to architectural, structural, and mechanical features. Architectural and structural Drawings take precedence over electrical Drawings regarding locations of walls, doors, and equipment.
- .5 Structural members shall not be cut without prior approval of the Contract Administrator.
- .6 Examine previously constructed Work and notify the Contract Administrator of any conditions which prejudice the proper completion of this Work.

3.2 SEPARATION OF SERVICES

- .1 Maintain separation between the electrical wiring system, piping, ductwork, and the instrumentation cables so that each system is isolated (except at approved connections to such systems) to prevent galvanic corrosion. In particular, contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is unacceptable.
- .2 Do not support wiring from pipes, ductwork, etc. Hangers for suspended ceilings are not to be used for the support of wiring.
- .3 Classifications of Circuits
 - .1 The circuit categorization shall of first priority follow CEC with respect to separation for electrical safety and the following shall apply with respect to electro-magnetic compatibility:

Very Noisy	High voltage circuits and their associated grounding
	High current (>200 A) LV circuits.
	Harmonic-rich LV circuits
	DC circuits: un-suppressed or above 50 V
Noisy	Low current class two (2) circuits
	Medium power pulsed or radio frequency circuits
Indifferent	ELV digital status circuits
	Intrinsically safe circuits
	Telecommunications circuits
	Fire alarm and emergency lighting circuits (note that some fire alarm circuits may fall into the category of signal circuits).
	Any other emergency, shutdown, or high integrity circuit (e.g. toxic gas alarm).
Sensitive	Analogue signal circuits
	Data communication circuits

Very Sensitive	Low level voltage and current signals (e.g. from instrument sensors).
-----------------------	---

.4 Separation of Circuits

- .1 This section relates to the running of cables carrying differing types of circuits in close proximity to one another and to other services. Sensitive circuits shall normally be run in overall shielded cable. Very sensitive circuits shall normally be run in individually twisted pair shielded cable.
- .2 For cables sharing the same support/containment system, the following shall provide guidance to minimize extraneous interference:

Segregation between Circuits	Very Noisy	Noisy	Indifferent	Sensitive	Very Sensitive
Very Noisy	Thermal grouping as per CE Code	150 mm	300 mm	300 mm	300 mm
Noisy	150 mm	Thermal grouping as per CE Code	150 mm	150 mm	150 mm
Indifferent	300 mm	150 mm	Separation of Circuit types	100 mm	100 mm
Sensitive	300 mm	150 mm	100 mm	Touching	50 mm
Very Sensitive	300 mm	150 mm	100 mm	50 mm	Touching

3.3 WIRE AND CABLE

- .1 Refer Division 26 – Electrical.

3.4 CONTROL WIRING COLOUR IDENTIFICATION

- .1 Colour Codes

Conductor Purpose	Colour
Power, 120/208/240 VAC Supply	Black
Power, 120/208/240 VAC Neutral	White
Power, 24 VDC Supply (+)	Blue
Power, 24 VDC Common (-, or 0VDC)	Brown
Discrete Control AC	Red
Discrete Control DC	Blue
Intrinsically Safe	IS (light) Blue
Protective Earth (PE)	Green
Signal Ground/Instrumentation Earth (IE)	Green/Yellow

3.5 NETWORK CABLE – JACKET COLOUR

- .1 Colour Codes

Cable Purpose	Colour
Fibre Optic	Orange
Ethernet, CAT5E or CAT6	Blue

Cable Purpose	Colour
Profibus DP	Purple
Profibus PA, Non-Intrinsically Safe	Black
Profibus PA, Intrinsically Safe	Light Blue
Modbus/RTU (serial)	Grey

3.6 EQUIPMENT CONNECTIONS

- .1 Prior to the connection of signal wiring to process control and instrumentation devices, check the device voltage rating and polarity for compatibility with the corresponding loop and/or schematic diagram. Where device and circuit characteristics are found to be incompatible, the connections are not to be made. Report the condition immediately to the Contract Administrator.
- .2 All control wiring diagrams illustrate typical control circuits applicable to the type of equipment specified. Control circuits may vary with different manufacturer's equipment. Verify all control circuits with the manufacturers of the equipment and make any corrections to the control wiring diagrams that may be required.

3.7 WIRING TO EQUIPMENT SUPPLIED BY OTHER DIVISIONS

- .1 Equipment supplied by the City or by other divisions, that have external or field mounted control devices, are to be installed, wired, and commissioned by this division.

3.8 INSTRUMENT MOUNTING STANDS

- .1 Supply and install instrumentation mounting stands as required. Stands are to be either floor or wall mounted. The mounting stands are to be fabricated from aluminum.
 - .1 Any stands required in chlorine areas are to be fabricated from galvanized steel.
- .2 Supply and install protective drip shields for any exterior stand-mounted instrumentation equipment. Drip shields are to extend 50 mm past the front and side faces of the equipment. Drip shields are to be fabricated from aluminum.

3.9 SEALING OF WALL AND FLOOR OPENINGS

- .1 All penetrations shall be sealed in accordance with Section 07 84 00 – Fire Stopping.
- .2 Seal all conduit and cable entries passing through walls of buildings, through partition walls separating electrical rooms from other areas, through fire separations, and through floors above grade.
- .3 Seal openings after all wiring entries have been completed.
- .4 Sealing Material shall be fire resistant and shall not contain any compounds that could chemically affect the wiring jacket or insulating Material.
- .5 Cable penetrations through fire separations, if required, are to be sealed.
- .6 Submit Shop Drawing for rated assembly prior to installation of fire stop.

3.10 TAGGING STANDARDS FOR DEVICES AND WIRING

- .1 Tag all devices, wires, and I/O using the assigned loop, equipment, or device tag name. Where tag naming and numbering is not specified, the Contract Administrator will provide naming and numbering that is consistent with the City of Winnipeg Water and Waste Department Electrical Design Guide.

3.11 TESTING OF INSTRUMENTATION LOOPS

- .1 After all devices within a loop have been connected, check the loop for correct functioning and interaction with other loops, where applicable. Provide written notice to the Contract Administrator when the loops are going to be tested so that the tests may be witnessed at the Contract Administrator's discretion.
- .2 Check the operation of final control elements such as solenoid valves, actuators, etc. by manual control before checking with automatic control.
- .3 Check and simulate all alarms and shutdown functions.
- .4 Test all tubing for leaks in compliance with ISA RP7.1. Isolate all instruments when tubing is being tested to protect against over pressure.
- .5 Perform tests and record results on the test data forms that are included in this section. Develop additional and/or more detailed test forms as necessary to suit more complex instrumentation.
- .6 Sign and date all test reports. Submit the test reports to the Contract Administrator within five Business Days of testing.

3.12 CALIBRATION

- .1 Instruments are to be factory pre-calibrated. Verify calibration after installation for all instruments installed under these Specifications. Provide a printed record of the factory calibration parameters for "smart" devices.
- .2 Prior to calibration, completely program all "smart" transmitters including entries of the appropriate range and tag number. Provide a printed record of smart device serial numbers against their assigned tag number with all programmed parameters.
- .3 Calibrate all instruments to an accuracy of 0.5 percent of full range, or to the manufacturer's stated accuracy of the instrument whenever an accuracy of 0.5 percent is not achievable.
- .4 Prior to instrument installation, perform the following applicable calibration for each instrument and its associated signal conditioning equipment:
 - .1 Calibrate online analyzers with known samples.
 - .2 Calibrate equipment per manufacturer guidelines.

3.13 COMMISSIONING

- .1 Commission each facility in accordance with E10 of the Tender.

3.14 TRAINING

- .1 Provide training to the City personnel in the operation, care, and maintenance of system, system equipment, and components in accordance with E11 of the Tender.

3.15 CLEANING

- .1 Progress cleaning: clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Leave Work are clean at the end of each day.
- .2 Final cleaning: upon completion, remove surplus Materials, rubbish, tools, and equipment in accordance with Section 01 74 00 - Cleaning.

3.16 TEST FORMS

Form No.	Title
.1 ITR	Instrument Test Report
.2 LCR	Loop Check Report

LOOP CHECK REPORT

- CHECKED OUT OK
- NOT APPLICABLE
- FURTHER ACTION REQUIRED

	INSTRUMENT TAG NO.							
LOOP NO.								
SHEET NO.								
P & I DWG. NO.								
INSTALLATION COMPLETE								
Primary Element								
Impulse Lines								
Block and Drain Valves								
Air Supply/Filter/Reg.								
Wiring								
Tracing/Insulation/Housing								
Mounting and Location								
PLC/SCADA I/O & Status								
CALIBRATED								
Impulse Lines Press. Tested								
LOOP CHECKED								
Element To Receiver								
X Mtr. to Receiver								
X Mtr./Trans. to Receiver								
X Mtr./Trans. to Switches								
Switches to Annunciator								
Interlocking Circuit								
Controller to Valve								
Controller Action D or R								

REMARKS:

READY FOR START-UP

DATE: _____

Installed by: _____

Checked by: _____

INSTRUMENT TEST REPORT

SYSTEM: _____

SERVICE: _____ TAG NO. _____

LOCATION: _____

MAKE: _____ MODEL: _____

SERIAL NO.: _____ CSA: _____

ELEMENT: _____ RANGE: _____

DESIGN SETTING/RANGE: _____ CONTACT TO: _____ ON: _____

SIGNAL IN: _____ OUT: _____ ASSOCIATED INSTRUMENT: _____

INSTRUMENT CONDITION: _____ CONFORM TO SPEC: _____

PROJECT NO.: _____ DATA SHEET: _____

TEST METHOD	TEST 1				TEST 2			
	INPUT		OUTPUT		INPUT		OUTPUT	
PROCESS	INC.	DEC.	INC.	DEC.	INC.	DEC.	INC.	DEC.
TEST POINT 1								
TEST POINT 2								
TEST POINT 3								
TEST POINT 4								
TEST POINT 5								
COMMENTS								
GRAPHS								

TESTED BY: _____ CHECKED BY: _____

DATE: _____ DATE: _____

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 Suppliers, equipment, products, and execution must meet all requirements detailed in Section 29 05 00 - Common Work - Instrumentation and Control.
- .2 Local control stations shall be supplied to house local control switches, push buttons, and indicator lights associated with field devices (valves, drives, etc.). The control stations shall be located in close proximity to their associated devices. Where a group of devices are located within close proximity to each other, the local controls may be combined into a single common local control panel. Line of sight must be maintained between all devices and the respective local controls.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 29 05 00 - Common Work - Instrumentation and Control.
- .3 Division 26 - Electrical.

1.3 REFERENCE STANDARDS

- .1 NEMA® Standard
- .2 ANSI

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Provide Shop Drawings for all new enclosures to be used.

Part 2 Products

2.1 GENERAL

- .1 Unless otherwise specified, provide outside finishes on all enclosures in ANSI 61 Grey.
- .2 The enclosures must be suitable for carrying the weight of the equipment mounted inside the panel and on the doors without any warpage.

2.2 ENCLOSURES

- .1 Provide Electrical NEMA Type 12 enclosures for ordinary locations.
- .2 Provide Electrical NEMA Type 4X enclosures for Category 1 and 2 locations.

2.3 WIRING AND ACCESSORIES

- .1 Provide wiring inside the enclosures according to the following specifications:

- .1 Control wiring to be a minimum of #16 AWG tinned stranded copper; insulation rated at 600 V.
- .2 Wiring for power distribution shall be a minimum of #12 AWG tinned stranded copper; insulation rated at 600 V.
- .3 Install cables in accordance with the requirements of Division 26 - Electrical.
- .2 Wiring systems with different voltage levels or types shall be suitably segregated within the panel, according to relevant electrical codes.
- .3 Run all wiring in enclosed plastic wireways such as Panduit or approved equal in accordance with B7 of the Tender. Size all wireways so that the total cross sectional area of the insulated wire and cable does not exceed 40 percent of the cross sectional area of the wire way.
- .4 Provide a minimum clearance of 50 mm between wireways and any point of wire termination.
- .5 Terminate all wiring, incoming and outgoing, at terminal strips mounted inside the enclosure. Identify each terminal strip with a terminal strip number, defined as follows:
 - .1 Wire identification to use the connected field device tag name with the wire's corresponding end device terminal number appended to it.
 - .2 Identify every joint and/or terminal of the above wire run with the same identifier until the wire meets another tagged device, at which point the wire identifier will change to use the new device name and terminal number.
 - .1 For example, pressure transmitter PIT-M1500-1 located in the field has a 1 PR-TPSH cable connected to it. The wire identifiers for the pair of wires would be M1500-1 from the terminal blocks in the control panel.
 - .3 Identify spare wires by using the cable tag, wire number, and an "-SP" suffix.
 - .4 Arrange wiring on terminal blocks such that all internal panel wiring terminates on the inboard side of the terminal blocks and all external wiring terminates on the outboard side.
- .6 Provide sufficient terminals in order to avoid not more than two wires are connected under the same terminal. Provide 20 percent spare terminal capacity at each terminal block assembly for each type of terminal block (fused, non-fused, etc.).

2.4 PANEL GROUNDING

- .1 Provide a ground system for the instrumentation circuits.
- .2 Provide grounding lugs for each panel, suitable for termination of up to #2 AWG copper grounding conductor.
- .3 Firmly bond all panel-mounted devices on or within the panels to ground. Provide supplementary bonding conductors for backpanels and doors. Attach a separate bonding conductor to all devices that are not firmly fastened to the panels with screws for such devices as case mounted instruments, meters, etc.

Part 3 Execution

3.1 MOUNTING HEIGHTS

- .1 Unless otherwise specified or a conflict exists, mount all panels, starters, and disconnects 2000 mm to top of cover.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Division 26 - Electrical.

1.2 REFERENCES STANDARDS

- .1 CSA International
 - .1 CSA-C22.2 No. 214, Communications Cables (Bi-National standard with UL 444).
 - .2 CSA-C22.2 No. 232, Optical-Fibre Cables.
- .2 TIA
 - .1 TIA-455, General requirements for standard test procedures for optical fibers, cables, transducers, sensors, connecting and terminating devices, and other fiber optic components.
 - .2 TIA-526, Standard Test Procedures for Fiber Optic Systems.
 - .3 TIA-568.0, Generic Telecommunications Cabling for Customer Premises
 - .4 TIA-569, Telecommunications Pathways and Spaces.
 - .5 TIA-606, Administration Standard for Telecommunications Infrastructure.
 - .6 TIA-607, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
 - .7 TIA-758, Customer-Owned Outside Plant Telecommunications Infrastructure Standard.
 - .8 TIA-862, Building Automation Systems Cabling Standard.
 - .9 TIA-1005, Telecommunications Infrastructure Standard for Industrial Premises.
 - .10 TIA-1152, Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling.
 - .11 TIA TSB-140, Telecommunications Systems Bulletin – Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems.
 - .12 TIA-598, Optical Fiber Cable Color Coding.

1.3 DEFINITIONS

- .1 “**ACR-F**” means Attenuation to Crosstalk Ratio Far-End.
- .2 “**ACR-N**” means Attenuation to Crosstalk Ratio Near-End.
- .3 “**dB**” means Decibel.
- .4 “**ELTCTL**” means Equal Level Transverse Conversion Transfer Loss.
- .5 “**LC connector**” means Lucent Connector.
- .6 “**NEXT**” means Near-End Crosstalk.

- .7 “**OLTS**” means optical loss test set.
- .8 “**OTDR**” means optical time domain reflectometer.
- .9 “**PS ACR-N**” means Power Sum Attenuation to Crosstalk Ratio Near-End.
- .10 “**PS NEXT**” means Power Sum Near-End Crosstalk.
- .11 “**TCL**” means Transverse Conversion Loss.
- .12 “**TIA**” means Telecommunications Industry Association.
- .13 “**TSB**” means Technical Systems Bulletin.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide product data sheets for cable testing:
 - .1 Provide sample test data sheets and information with respect to test instrumentation to be used as described in 3.6.6 and 3.8.10.
 - .2 Provide fibre-optic cable test results.
 - .3 Provide Category 6 cable test results.

1.5 INSPECTION

- .1 Provide adequate notice to the Contract Administrator in order that all cable installations can be inspected prior to energizing equipment.

1.6 STANDARDS

- .1 All wire and cable shall be CSA approved.

Part 2 Products

2.1 TPSH

- .1 TPSH shall be constructed as follows:
 - .1 Two copper conductors, stranded, minimum #18 AWG, PVC insulated, twisted in nominal intervals of 50 mm.
 - .2 Insulated for 600 V, 90 degrees Celsius.
 - .3 100 percent coverage aluminum foil or tape shield.
 - .4 Separate bare stranded copper drain wire, minimum #18 AWG.
 - .5 Overall flame retardant PVC jacket to CSA-C22.2.
 - .6 The entire cable assembly to be suitable for pulling in conduit or laying in cable tray.
 - .7 Interlocked aluminum armour and outer PVC jacket.
 - .8 Shaw Type 1751-CSA or Belden equivalent or approved equal in accordance with B7 of the Tender.

- .2 Where multi-conductor TPSH cables are called for, each pair shall be individually shielded, continuous number coded, and the cable assembly shall have an overall shield and overall flame retardant PVC jacket.

2.2 RTD AND MULTI CONDUCTOR SHIELDED CABLE

- .1 RTD cables shall be CSA approved and shall be constructed as follows:
 - .1 Three or more copper conductors, stranded, minimum # 18 AWG.
 - .2 PVC insulated for 600 V.
 - .3 100 percent coverage aluminum foil or tape shield.
 - .4 Separate bare stranded copper drain wire.
 - .5 Interlocked aluminum armour and outer PVC jacket.
 - .6 Overall flame retardant PVC jacket to CSA-C22.2.

2.3 TECK CABLES

- .1 As per Division 26 - Electrical.

2.4 WIRE

- .1 As per Division 26 - Electrical.

2.5 CATEGORY 6 COMMUNICATION CABLE

- .1 Category 6 cable shall be CSA approved and constructed as follows:
 - .1 Four bonded pairs, solid stranded, #24 AWG.
 - .2 Interlocked aluminum armour.
 - .3 Rip cord.
 - .4 PVC inner and outer jackets.
 - .5 ULC verified to Category 6.
 - .6 Insulated for 300 V.
 - .7 Shielded.
 - .8 FT4 Fire rating.

2.6 FIBRE OPTIC CABLE

- .1 Fibre optic cable shall be CSA approved and constructed as follows:
 - .1 6-strand multimode 50/125µ 10 Gig fibre cable.
 - .2 12-strand multimode 50/125µ 10 Gig fibre cable.
 - .3 24-strand multimode 50/125µ 10 Gig fibre cable.
- .2 Interlocked aluminum armour.
- .3 FT4 Fire rating.
- .4 Terminated using duplex LC connectors.

Part 3 Execution

3.1 ANALOG SIGNALS

- .1 Use TPSH cable for all low level analog signals such as 4-20 mA, pulse type circuits 24 VDC and under, and other signals of a similar nature.
- .2 Use RTD cable for connections between RTDs and transmitters or control system RTD inputs.

3.2 DIGITAL SIGNALS

- .1 Use TPSH cable for all low level input (24 V and below) and output signals to the control system.

3.3 INSTRUMENT POWER

- .1 Use wire and conduit for power to instruments, for 120 V signals, other than those mentioned above and as otherwise indicated on the Drawings. Use stranded wire and cable to supply power to instruments.

3.4 INSTALLATION

- .1 Install instrumentation cables in conduits or cable trays. Use a minimum of 300 mm and a maximum of 1000 mm length of liquid tight flexible conduit to connect the field sensors to the conduit.
- .2 At each end of the run, leave sufficient cable length for termination.
- .3 Do not make splices in any of the instrumentation cable runs.
- .4 Cable shields shall be terminated on insulated terminals and carried through to the extent of the cable.
- .5 Ground cable shields at one end only. Unless otherwise specified, ground the shields at the PLC control panel.
- .6 Protect all conductors against moisture during and after installation.

3.5 CATEGORY 6 INSTALLATION

- .1 Follow the manufacturer's guidelines for minimum bend radius and tension.
- .2 Provide 1 m coil of slack to enable the possibility of future changes for balanced twisted-pair cabling.
- .3 All installations and terminations shall be performed by personnel certified by cable manufacturer or experienced in Category 6 cable installation.

3.6 CATEGORY 6 TESTING

- .1 Perform all Category 6 cable testing to TIA-568 standards.
- .2 Testing must be performed by trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof. These certificates may have been issued by any of the following organizations or an equivalent organization:
 - .1 Manufacturer of the connectors or cable.

- .2 Manufacturer of the test equipment used for the field certification.
- .3 Training organizations.
- .3 Category 6 cable testing instrument:
 - .1 Level III accuracy in accordance with TIA-1152.
 - .2 Independent verification of accuracy.
- .4 Each cabling link shall be in tested for:
 - .1 Wire Map.
 - .2 Length.
 - .3 Propagation Delay.
 - .4 Delay Skew.
 - .5 DC Loop Resistance – recorded for information only.
 - .6 DC Resistance Unbalance – recorded for information only.
 - .7 Insertion Loss.
 - .8 NEXT.
 - .9 PS NEXT.
 - .10 ACR-N – recorded for information only.
 - .11 PS ACR-N – recorded for information only.
 - .12 ACR-F.
 - .13 PS ACR-F.
 - .14 Return Loss.
 - .15 TCL – recorded for information only.
 - .16 ELTCTL – recorded for information only.
- .5 Reconnect or re-install and retest as necessary to correct excessive variations.
- .6 Before commencing testing, submit sample test data sheets and information with respect to test instrumentation to be used.

3.7 FIBRE OPTIC CABLE INSTALLATION

- .1 Install all fibre optic cabling to manufacturer's instructions.
- .2 Follow the manufacturer's guidelines for minimum bend radius and tension.
- .3 Provide 1 m coil of slack to enable the possibility of future changes for fibre optic cabling.
- .4 All installations and terminations shall be performed by personnel certified by cable manufacturer or experienced in fibre optic cable installation.
- .5 Install cabling in a neat and professional manner using best industry practice.
- .6 Equipment shall not be connected directly to backbone fibre optic cables.
- .7 Tie wraps shall not be used for cable suspension.
- .8 Fibre strands must be routed at the patch panel in such a manner to ensure signal transmission will not be adversely affected.

- .9 The Contractor shall not exceed the maximum pull-tension rating of the fibre cables during installation.
- .10 The minimum bend radius of the fibre cables shall not be exceeded during installation.
- .11 Protect all cables from mechanical damage during installation.
- .12 Fibre optic cables to be installed in a star topology where indicated on the Drawings.

3.8 FIBRE OPTIC CABLE TESTING

- .1 Fibre optic cable testing to be in accordance with TIA-455, TIA-526, and TIA-568.
 - .1 Fibre optic cable test includes testing the attenuation and polarity of the installed cable with an OLTS and the installed condition of the cabling system and its components with an OTDR. The condition of the fibre end faces shall also be verified.
 - .2 Testing shall be performed on each cabling link (connector to connector).
 - .3 Testing shall be performed on each cabling channel (equipment to equipment).
- .2 All tests shall be documented including OLTS dual wavelength attenuation measurements and OTDR traces with event tables as well as OTDR maps.
- .3 Testing must be performed by trained technicians who have successfully attended an appropriate training program, which includes testing with an OLTS and an OTDR and have obtained a certificate as proof thereof. These certificates may have been issued by any of the following organizations or an equivalent organization:
 - .1 Manufacturer of the fiber optic cable and/or the fiber optic connectors.
 - .2 Manufacturer of the test equipment used for the field certification or representative.
 - .3 Equivalent training organization.
- .4 Fibre optic cable testing instrument:
 - .1 The field-test instrument shall be within the calibration period recommended by the manufacturer.
 - .2 OLTS
 - .1 Multimode optical fiber light source:
 - .1 Provide dual LED light sources with central wavelengths of 850 nm (+/-30 nm) and 1300 nm (+/-20 nm). VCSEL sources are not permitted per TIA-526-14.
 - .2 Output power of -20 dBm minimum.
 - .3 The launch shall meet the Encircled Flux launch requirements of TIA 526-14.
 - .4 The test reference cords must demonstrate an insertion loss ≤ 0.15 dB when mated against each other.
 - .2 Power meter:

- .1 Provide 850 nm, 1300 nm, 1310 nm, and 1550 nm wavelength test capability.
- .2 Power measurement uncertainty of +/- 0.25 dB.
- .3 OTDR
 - .1 Multimode OTDR:
 - .1 Wavelengths of 850 nm (+/- 10 nm) and 1300 nm (+ 35 nm / - 15 nm).
 - .2 Event dead zones not to exceed 0.7 m at 850 nm and 1300 nm.
 - .3 Attenuation dead zones not to exceed 2.5 m at 850 nm and 4.5 m at 1300 nm.
 - .4 Distance range not less than 9,000 m.
 - .5 Dynamic range at least 28 dB for 850 nm and 30 dB at 1300 nm.
 - .6 Allow bi-directional testing without moving the OTDR to the far end.
 - .4 Fiber Microscope
 - .1 Field of view 420 μ m x 320 μ m
 - .1 Video camera systems are preferred.
 - .2 Camera probe tips that permit inspection through adapters are required.
 - .5 Integrated OLTS, OTDR, and fiber microscope
 - .1 Test equipment that combines into one instrument an OLTS, an OTDR and a fiber microscope may be used.
- .5 OLTS testing:
 - .1 Multimode links shall be tested in one direction at 850 nm and 1300 nm in accordance with TIA-526-14, with an Encircled Flux compliant launch.
 - .2 Testing shall not include any active devices or passive devices within the link or channel other than cable, connectors, and splices, i.e. link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.
 - .3 The link attenuation shall be calculated as specified in TIA-568.
 - .4 Maximum allowable connector loss = 0.75 dB.
 - .5 Maximum allowable splice loss = 0.3 dB.
- .6 OTDR testing:
 - .1 Fiber links shall be tested at these wavelengths for anomalies and to ensure uniformity of cable attenuation, connector insertion loss, and reflectance.
 - .1 Multimode: 850 nm and 1300 nm.
 - .2 Reflective events (connections) shall not exceed:
 - .1 0.75 dB in optical loss when bi-directionally averaged.
 - .2 -35 dB Reflectance for multimode connections.
 - .3 Non-reflective events (splices) shall not exceed 0.3 dB.

- .7 Magnified end face inspection:
 - .1 Fibre connections shall be visually inspected for end face quality.
 - .2 Scratched, pitted, or dirty connectors shall be diagnosed and corrected.
- .8 Length measurement:
 - .1 The length of each fiber shall be measured using an OLTS or OTDR and be recorded.
- .9 Polarity testing:
 - .1 Paired duplex fibers in multi-fiber cables shall be tested to verify polarity in accordance with TIA 568.0. The polarity of the paired duplex fibers shall be verified using an OLTS.
- .10 Before commencing testing, submit sample test data sheets, and information with respect to test instrumentation to be used.

3.9 CONDUCTOR TERMINATIONS

- .1 All equipment supplied shall be equipped with terminal blocks to accept conductor connections.
- .2 Instrumentation conductors, where terminated at equipment terminals other than clamping type terminal blocks, shall be equipped with Burndy-YAE-2 or STA-KON or approved equal in accordance with B7 of the Tender, self-insulated, locking type terminators, sized as required to fit conductors and screw terminals.

3.10 CABLE TESTING

- .1 Test all conductors for opens, shorts, or grounds. Resistance values shall not be less than those recommended by the cable manufacturer.

3.11 IDENTIFICATION

- .1 Identify all instrumentation cables.
- .2 Identify each conductor with wire numbers using a machine printed Raychem TMS heat shrink wire marker or approved equal in accordance with B7 of the Tender.

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 Equipment, products, and execution must meet all requirements detailed in Section 29 05 00 - Common Work - Instrumentation and Control.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittals.
- .3 Division 26 - Electrical.
- .4 Section 26 29 03 - Control Devices.
- .5 Section 29 05 00 - Common Work - Instrumentation and Control.

1.3 DEFINITIONS

- .1 “**DIP**” means Dual in-line package.
- .2 “**LED**” means light emitting diode.
- .3 “**RSTP**” means Rapid Spanning Tree Protocol.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Provide product data sheet for Ethernet switches and routers.
 - .2 Provide product data sheet for Ethernet UTP converter.
 - .3 Provide product data sheet for LTE cellular modems.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 78 00 - Closeout Submittals.
- .2 O&M Manuals:
 - .1 Ethernet switch, Ethernet UTP converter and cellular modem product data and itemized part numbers.

1.6 MAINTENANCE MATERIALS

- .1 Provide spare parts in accordance with Section 01 78 00 – Closeout Submittals and Part 2 of this section.
- .2 Where fused terminal blocks are installed, provide 10 spare terminal block style fuses per control panel.
- .3 Provide one spare Ethernet UTP Converter.

- .4 Provide Managed Ethernet Switch and Cellular Modem spare parts quantities as listed below:

DESCRIPTION	PRODUCT LINE	PART	SPARE PARTS
Network Switch - MCP	Siemens Ruggedcom	RX1510	1
Network Switch - LCP	Siemens Ruggedcom	RS900G	3
Network Switch - Rack Mount	Siemens Ruggedcom	RST2228	1
LTE Cellular Modem	Siemens Ruggedcom	RM1224	1

1.7 REFERENCE STANDARDS

- .1 CSA Group
- .1 CAN/CSA-C22.2 NO. 60950-1-07 Information Technology Equipment – Safety – Part 1: General Requirements
- .2 Institute of Electrical and Electronics Engineers (IEEE)
- .1 IEC 61000-6-2 Electromagnetic Compatibility (EMC) – Part 6-2: Generic Standards – Immunity for Industrial Environments

Part 2 Products

2.1 MISCELLANEOUS PANEL DEVICES

- .1 Managed Ethernet Switches and Routers
- .1 To CAN/CSA-C22.2 NO. 60950-1-07 and IEC 61000-6-2 Standards.
- .2 Siemens RUGGEDCOM RS900G or approved equal in accordance with B7 of the Tender.
- .1 Mounting: DIN rail.
- .2 Power Supply: 120 V.
- .3 Fibre Optic Connector: LC
- .1 1000 Mb/s FX Data Speed.
- .4 Copper Connector: RJ45
- .1 10/100 Mb/s TX Data Speed.
- .5 Rapid Spanning Tree Protocol (RSTP) support for the station fibre optic loop and EIO fibre optic loop.
- .6 Provide Ethernet Switches with the ports listed below for the locations listed below:

FACILITY	PANEL	NAME	1000 FX PORTS	100 FX PORTS	1000 TX PORTS	100 TX PORTS
Deacon	CP-D21	NSW-D021	2			8
Deacon	LCP-3	NSW-D003	2			8
Deacon	LCP-4	NSW-D004	2			8
Deacon	LCP-5	NSW-D005	2			8
Deacon	UV Master PLC CP	NSW-D810	2			8
Hurst	LCP-11	NSW-M011	2			8

FACILITY	PANEL	NAME	1000 FX PORTS	100 FX PORTS	1000 TX PORTS	100 TX PORTS
Hurst	LCP-12	NSW-M012	2			8
Hurst	LCP-14	NSW-M014	2			8
Hurst	LCP-15	NSW-M015	2			8
Hurst	LCP-16	NSW-M016	2			8
Hurst	LCP-17	NSW-M017	2			8
MacLean	LCP-21	NSW-M021	2			8
MacLean	LCP-22	NSW-M022	2			8
MacLean	LCP-23	NSW-M023	2			8
MacLean	LCP-25	NSW-M025	2			8
MacLean	LCP-26	NSW-M026	2			8
McPhillips	LCP-1	NSW-M001	2			8
McPhillips	LCP-2	NSW-M002	2			8
McPhillips	LCP-3	NSW-M003	2			8
McPhillips	LCP-4	NSW-M004	2			8
McPhillips	LCP-5	NSW-M005	2			8
McPhillips	LCP-6	NSW-M006	2			8
Shoal Lake	PL-57	NSW-P057	2			8
Shoal Lake	PL-59	NSW-P059	2			8
Tache	LCP-1	NSW-M001	2			8
Tache	LCP-2	NSW-M002	2			8
Tache	LCP-3	NSW-M003	2			8

.3 Siemens RUGGEDCOM RST2228 or approved equal in accordance with B7 of the Tender.

.1 Mounting: 19" rack mount.

.2 Power Supply: 120 V.

.3 Fibre Optic Connector: LC

.1 1000/10000 Mb/s Data Speed.

.4 Copper Connector: RJ45

.1 10/100/1000 Mb/s Data Speed.

.5 RSTP support for the station fibre optic loop and EIO fibre optic loop.

.6 Provide Ethernet Switches with the ports listed below for the locations listed below:

FACILITY	PANEL	NAME	1000 FX PORTS	100 FX PORTS	1000 TX PORTS	100 TX PORTS
Deacon	NP-D801	NSW-D801	4		24	
McPhillips Backup Control Room	Server Rack	NSW-S800	4		24	
Shoal Lake	NP-H800	NSW-H800	4		24	
Shoal Lake	NP-S800	NSW-S800	4		24	

FACILITY	PANEL	NAME	1000 FX PORTS	100 FX PORTS	1000 TX PORTS	100 TX PORTS
WTP	WTP-1	NSW-B800-1	4		24	
WTP	WTP-1	NSW-B800-2	4		24	

- .4 Siemens RUGGEDCOM RX1510 or approved equal in accordance with B7 of the Tender.
 - .1 Mounting: DIN rail.
 - .2 Power Supply: 120 V.
 - .3 Fibre Optic Connector: LC
 - .1 1000 Mb/s Data Speed.
 - .4 Copper Connector: RJ45
 - .1 10/100/1000 Mb/s Data Speed.
 - .5 RSTP support for the station fibre optic loop and EIO fibre optic loop.
 - .6 Provide Ethernet Switches with the ports listed below for the locations listed below:

FACILITY	PANEL	NAME	1000 FX PORTS	100 FX PORTS	1000 TX PORTS	100 TX PORTS
Hurst	Main Control Panel	NSW-M800	2	6		12
MacLean	Main Control Panel	NSW-M800	2	6		12
McPhillips	Main Control Panel	NSW-M800	2	6		12
Tache	Main Control Panel	NSW-M800	2	6		12

- .2 Cellular Modem
 - .1 Industrial 4G LTE Cellular Modem.
 - .2 Power Supply: 24 VDC.
 - .3 Mounting: DIN rail.
 - .4 Data Interface: 10/100 TX Ethernet.
 - .5 External Antenna
 - .6 Product: Siemens RUGGEDCOM RM1224 or approved equal in accordance with B7 of the Tender.
- .3 Ethernet UTP Converter
 - .1 Data Interface: 10/100 TX Ethernet.
 - .2 Data Rate: DIP-switch selectable 10/100Mbps.
 - .3 Transmission Distance: 914m at 10Mbps or 305m at 100Mbps.
 - .4 LED Indicators: Operating Power, Ethernet Link, Extended Link.
 - .5 Ethernet Connectors: RJ-45.
 - .6 Extended Link Connectors: RJ-45.
 - .7 Must be compatible with existing ComNet rack.
 - .8 Four channel: ComNet CLFE4EOU or approved equal in accordance with B7 of the Tender.
 - .9 One channel: ComNet: CLFE1EOU or approved equal in accordance with B7 of the Tender.

- .4 Fibre Optic Termination Panel
 - .1 Wall mount termination panel.
 - .1 Single 24 fibre CCH Splice Cassette.
 - .2 Approved products: Corning SCH-01C or approved equal in accordance with B7 of the Tender.
 - .2 Rack mount termination panel.
 - .1 1U housing with minimum of two (2) CCH connector panels.
 - .2 2U housing with minimum of four (4) CCH connector panels.
 - .3 Larger termination housings as required to complete the Work.
 - .4 Approved products: Corning CLSSC-01U, Corning CLSSC-02U, or approved equal in accordance with B7 of the Tender.
- .5 Pilot Lights
 - .1 Provide LED transformer type pilot lights for extended lamp life, oil tight, push to test, complete with appropriate colour lenses.
 - .2 Normal colours used are:
 - .1 Run=red.
 - .2 Stop=green.
 - .3 Fault=amber.
 - .3 Refer to Division 26 - Electrical for additional information.
- .6 Terminals
 - .1 Provide strap screw type terminal blocks rated for 600 V.
 - .2 Identify each terminal block within an enclosure with a unique machine printed terminal block number. Cabinet chassis grounding terminal blocks to be identified by the electrical ground symbol.
 - .3 Connections to screw terminals to be locking fork tongue insulated crimp type wire connectors.
 - .4 Terminals to be Weidmuller or approved equal in accordance with B7 of the Tender. Where indicated on Drawings, install terminal blocks that match existing terminal block style.
 - .5 Provide a group of terminals for each of 120 VAC hot and neutral and 24 VDC positive and negative power. Distribution wiring to have a thermal magnetic circuit breaker upstream of all major blocks of loads, adequately sized to protect the connected load while not causing nuisance tripping.
 - .6 Provide Weidmuller or approved equal in accordance with B7 disconnect type terminal blocks for each load or loop powered from the marshalling panels.
 - .7 New terminal blocks shall be color coded as follows:
 - .1 Red = positive 24 VDC.
 - .2 Black = analog signal plus.
 - .3 White = analog signal common and VAC neutral.
 - .4 Grey = 120 VAC.
 - .5 Green = ground.

- .7 Control Relays
 - .1 Refer to Section 26 29 03 - Control Devices.
- .8 Nameplates
 - .1 Refer to Section 29 05 00 - Common Work - Instrumentation and Control.

Part 3 Execution

3.1 REFERENCES - GENERAL

- .1 Refer to Section 29 05 00 - Common Work - Instrumentation and Control.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 29 05 00 - Common Work - Instrumentation and Controls.

Part 2 Products

2.1 POWER SUPPLY AND CONDITIONING EQUIPMENT

.1 General

- .1 Provide all DC power supplies as required for all instrument circuits. All circuits are to be powered from the PLC control panels. Power supplies to be Hammond, G.F.C., Weidmuller or approved equal in accordance with B7 of the Tender, complete with an over-voltage protection module.
- .2 DC power supplies shall be fully redundant. Individual fault signals from each power supply shall be monitored by the PLC for alarming.
- .3 Unless otherwise required, all DC power supplies to be rated 28 VDC, adjustable plus or minus five percent, and set to provide 26.4 V on the panel direct current bus. Size the power supply for two times the connected load, minimum size is 2 amps.

2.2 NOISE SUPPRESSION

- .1 Provide SPD units in each new control panel to power AC instrumentation and control loads. Power conditioners are to be Square D, Eaton, Leviton or approved equal in accordance with B7 of the Tender.

Part 3 Execution

3.1 REFERENCES - GENERAL

- .1 Refer to Section 29 05 00 - Common Work - Instrumentation and Controls, Part 3.

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 Equipment, products, and execution must meet all requirements detailed in Section 29 05 00 - Common Work - Instrumentation and Controls.
- .2 Contractor shall supply all software, hardware, and labour to provide a fully functional and commissioned control system.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittals
- .3 Section 29 05 00 - Common Work - Instrumentation and Controls.

1.3 DEFINITIONS

- .1 “**GHZ**” means Gigahertz.
- .2 “**GbE**” means Gigabit Ethernet.
- .3 “**iSCSI**” means Internet Small Computer System Interface.
- .4 “**KVM**” means keyboard, video, and mouse.
- .5 “**NFS**” means Network File System.
- .6 “**OS**” means operating system.
- .7 “**SAS**” means Statistical Analysis System.
- .8 “**SD**” means Secure Digital.
- .9 “**SQL**” means structured query language
- .10 “**TB**” means Terabyte.
- .11 “**TFT**” means Thin Film Transistor.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data:
 - .1 Provide product data and data sheets for all equipment detailed in this section:
 - .1 High availability server cluster.
 - .2 Backup server.
 - .3 DR server.
 - .4 Thick clients.
 - .5 Thin clients.
 - .6 Engineering workstations.
 - .7 HMIs.

- .3 Shop Drawings:
 - .1 Include for all hardware and software components.
 - .2 Provide graphic layout screens and variable declarations.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 78 00 - Closeout Submittals.
- .2 O&M Manuals:
 - .1 Product data on the following equipment should be included:
 - .1 High availability server cluster.
 - .2 Backup server.
 - .3 DR server.
 - .4 Thick clients.
 - .5 Thin clients.
 - .6 Engineering workstations.
 - .7 HMIs.
 - .8 SAN storage.
 - .2 A list of all usernames and passwords used for all software. Organized by location, equipment, and software.
 - .3 Manufacturer’s manuals for all hardware and software.

1.6 MAINTENANCE MATERIALS

- .1 Provide spare parts in accordance with Section 01 78 00 – Closeout Submittals and Part 2 of this section.
- .2 Provide one spare Thick Client.
- .3 Provide two spare Thin Clients.
- .4 Provide HMI spare parts quantities as listed below:

DESCRIPTION	PRODUCT LINE	PART	SPARE PARTS
HMI 12.1" Screen	Schneider Harmony GTU	HMIDT642	2
HMI Base Unit	Schneider Harmony GTU	HMIG3U	2

Part 2 Products

2.1 SERVER HARDWARE

- .1 The SCADA system server hardware shall be as specified in the following section.
- .2 High Availability Server Cluster
 - .1 Three production vSphere ESXi Host servers shall be provided at the WTP and shall meet the following specifications:
 - .1 Dual socket.

- .2 16 cores per socket with hyper threading, effectively 32 cores per socket.
- .3 512 GB RAM.
- .4 Dual hot swap power supply.
- .5 Dual microSD drives (OS drive).
- .6 Fourteen 1GbE ports (management and VM):
 - .1 Two 1 GbE ports for management and vMotion VMKernel ports.
 - .2 Twelve 1 GbE ports for VMs port groups.
- .7 Approved product: HPE ProLiant DL380 G10 or approved equal in accordance with B7 of the Tender.
- .2 One SAN storage drive, 20 TB.
 - .1 Approved product: HPE MSA 2052 or approved equal in accordance with B7 of the Tender.
- .3 Backup Server shall meet the following specifications:
 - .1 One Veeam backup proxy server shall be provided at the WTP:
 - .1 Dual socket.
 - .2 Eight cores per socket with hyper threading, effectively 16 cores per socket.
 - .3 32 GB RAM.
 - .4 Dual hot swap power supply.
 - .5 Two 300GB 15K 12G SAS hard disk drives (OS drive).
 - .6 Six 1 GbE ports:
 - .1 Four 1 GbE ports for LAN.
 - .2 Two 1 GbE ports for iSCSI / NFS.
 - .7 Approved product: HPE ProLiant DL380 G10 or approved equal in accordance with B7 of the Tender.
- .4 DR Server shall meet the following specifications:
 - .1 One DR vSphere ESXi Host server shall be provided at the McPhillips Backup Control Room:
 - .1 Dual socket.
 - .2 16 cores per socket with hyper threading, effectively 32 cores per socket.
 - .3 512 GB RAM.
 - .4 Dual hot swap power supply.
 - .5 Dual microSD Drives (OS drive).
 - .6 24 1.2TB SAS hard disk drives.
 - .7 Six 1 GbE ports (management and VM):
 - .1 Two 1 GbE ports for management.
 - .2 Four 1 GbE ports for VMs port groups.
 - .8 Approved product: HPE ProLiant DL380 G10 or approved equal in accordance with B7 of the Tender.

2.2 SERVER SOFTWARE

- .1 The virtualization software shall be deployed on individual VM with multiple VMs hosted on individual servers. The VM servers will initially use the latest supported version of Microsoft Windows server as an OS. At the completion of the upgrade project, the server OS shall be upgraded to the latest version supported by the SCADA system.
- .2 Provide VMs as listed below:

VM	Function	OS	vCPU	Memory (GB)	Storage (GB)	Network (Gbps)
1	AD DNS 01	Microsoft Windows Server 2019	4	4	300	1
2	AD DNS 02	Microsoft Windows Server 2019	4	4	300	1
3	AD DNS 03	Microsoft Windows Server 2019	4	4	300	1
4	Galaxy Repository	Microsoft Windows Server 2019	4	16	500	1
5	Wonderware AOS1	Microsoft Windows Server 2019	4	16	300	1
6	Wonderware AOS2	Microsoft Windows Server 2019	4	16	300	1
7	InTouch for Terminal Services (TS1), Rockwell Thin Manager, InTouch Access Anywhere	Microsoft Windows Server 2019	4	16	300	1
8	InTouch for Terminal Services (TS2), Rockwell Thin Manager, InTouch Access Anywhere	Microsoft Windows Server 2019	4	16	300	1
9	Wonderware Historian	Microsoft Windows Server 2019	12	32	750	1
10	InTouch Access Anywhere Secure Gateway	Microsoft Windows Server 2019	4	16	500	1
11	vCenter Server Virtual Appliance	VMware vCenter Server 7.0	4	16	290	1
12	Veeam Backup and Replication Server	Microsoft Windows Server 2019	4	16	500	1
13	Wonderware Tier-2 Historian and On-Premise Insight	Microsoft Windows Server 2019	4	4	300	1
	Total		60	176	4940	13

- .3 Wonderware System Platform
 - .1 The SCADA system software applications and server deployment will be similar to the existing WTP SCADA system and shall be comprised of the following:

□

- .1 Wonderware IDE (as described in 2.2.3.2).
- .2 Wonderware Galaxy (as described in 2.2.3.3).
- .3 Wonderware AOS (as described in 2.2.3.4).
- .4 Wonderware Intouch View (as described in 2.2.3.5).
- .5 Wonderware Historian (as described in 2.2.3.6).
- .6 Wonderware Historian Client (as described in 2.2.3.7).
- .7 OI Servers (as described in 2.2.3.8).
- .8 Wonderware InTouch Access Anywhere (as described in 2.2.3.9).
- .9 Wonderware Tier-2 Historian (as described in 2.2.3.10).
- .10 Wonderware On-Premise Insight (as described in 2.2.3.11).
- .2 Wonderware IDE
 - .1 The Wonderware IDE is the integrated design and development tool from which all ArcestrA objects are configured and deployed to the target platforms. ArcestrA is the object based distributed architecture for the Wonderware SCADA system. The IDE is the user interface for the configuration of the application and is used to create/manage templates, create object instances, create graphics, and deploy engines and objects.
- .3 Wonderware Galaxy
 - .1 The Wonderware Galaxy is a SQL server database that contains the entire Wonderware System Platform SCADA application consisting of a collection of platforms (computers hosting application engines), engines (hosts of application and device integration objects), device integration objects (communication drivers to PLC systems), application object templates, object instances and attributes (transmitters, pumps, valves, etc.), and security. The Wonderware Galaxy server database is managed through the Wonderware IDE tool.
- .4 Wonderware AOS
 - .1 The Wonderware AOS is the host for ArcestrA objects including areas, device integration objects, application object instances, InTouch View engines, and InTouch View application objects. The AOS is essentially the runtime engine for the ArcestrA objects. The ArcestrA objects are distributed across platforms to balance the server computer resources.
- .5 Wonderware InTouch View
 - .1 The Wonderware InTouch View application is the host for InTouch applications managed within the Galaxy. InTouch is the container for ArcestrA graphics and provides the interface for the operations personnel to control and monitor the system.
- .6 Wonderware Historian
 - .1 The Wonderware historian is a SQL server database used to store time series data for latter retrieval. The configuration for the historian including tag names, storage intervals, and security is stored within a SQL database. The actual historical data is stored in flat files on a circular drive (first in – first out). Typically, there is

one historical data file per day and a new file is created whenever there is a change to the SQL database configuration.

- .7 Wonderware Historian Client
 - .1 The Wonderware historian client is a set of tools used for retrieval of the time series data stored on the circular drive. Analysis tools include trending, Microsoft Word and Microsoft Excel add-in for reports, SQL query client, and web reporting.
- .8 OI Servers
 - .1 OI Server objects are used for communication from the SCADA system to smart devices. This includes PLCs as well as other networked devices such as smart motor control centres, smart instruments, MPR, PMCM systems, or other software systems.
- .9 Wonderware InTouch Access Anywhere
 - .1 The Wonderware Access Anywhere shall be used to provide secure access to remotely view the running InTouch application using web browser on the City corporate network. Access Anywhere shall be installed in the SCADA network and the Access Anywhere Secure Gateway shall be installed in a DMZ between the SCADA network and the corporate network
- .10 Wonderware Tier-2 Historian Tier-2
 - .1 The Wonderware Tier-2 Historian shall be used for data replication for access from the City corporate network.
- .11 Wonderware On-Premise Insight
 - .1 On-Premise Insight shall be used for reporting on historical data from the City corporate network.
- .4 Rockwell Thin Client Manager
 - .1 To remotely and securely deliver software to the operator workstations, two software packages shall be used:
 - .1 Microsoft Windows Terminal Services (as described in 2.2.4.2).
 - .2 Rockwell ThinManager (as described in 2.2.4.3).
 - .2 Microsoft Windows Terminal Services
 - .1 The server will be configured as a remote desktop session host for thin clients as remote desktop connection clients.
 - .3 ThinManager
 - .1 ThinManager is used as a content management and delivery system which sends content from a server to a ThinManager Ready or ThinManager Compatible device. ThinManager is also used to define sources, configure devices, and regulate user access. For use in this project, ThinManager will be used to connect the Microsoft Windows terminal servers at the WTP to their respective thin clients.

2.3 THICK CLIENT

- .1 Hardware
 - .1 Thick client workstations are located at each facility to allow the operators to connect to the RDS SCADA system. Each new thick client shall require:
 - .1 One computer with minimum:
 - .1 4 GHz processor.
 - .2 Dual core processor.
 - .3 16 GB RAM.
 - .4 1 TB hard drive.
 - .5 Four USB ports.
 - .6 Two 10/100 Ethernet ports.
 - .7 Two video ports.
 - .2 Two monitors with a minimum size of 24 inch and resolution of 1920x1080 pixels.
 - .3 One standard keyboard.
 - .4 One standard mouse.
- .2 Software
 - .1 Operating System
 - .1 The thick clients shall utilize a Microsoft Windows OS. The latest version supported by the SCADA system at the time of installation and at Substantial Performance shall be used.
 - .2 Backup active directory DNS.
 - .2 Wonderware
 - .1 InTouch View for System Platform
 - .1 The Wonderware software package InTouch View for System Platform shall be installed locally on the thick client workstations and connection to the Microsoft Windows terminal services server will not be required for operation.
 - .2 AOS
 - .1 The thick clients located at each facility shall be configured as AOSs for the ArchestrA objects located locally. This will include object instances such as pumps, valves, and transmitters as well as OI servers. This will enable the ability to provide local control in the event of a failure of the servers and/or loss of both the primary and backup communication networks.
 - .2 The AOS shall also provide local storage of historical data during a loss of both the primary and backup communication networks. Upon restoration of the communication network the AOS will automatically populate the historian with the spooled data.

- .3 OI Servers
 - .1 Local thick clients shall be configured with OI Server objects to be used for communication from the SCADA system to smart devices. Smart devices includes PLCs as well as other networked devices such as smart motor control centres, smart instruments, MPRs, PMCM systems, or other software systems.
- .4 Historian Client
 - .1 Local thick clients will be configured with Historian Client for analysis tools include trending, Microsoft Word and Microsoft Excel add-in for reports, SQL query client, and web reporting.

2.4 THIN CLIENT

- .1 Hardware
 - .1 Thin clients shall be provided with the following minimum specifications:
 - .1 Thin client computer:
 - .1 Rockwell ThinManager compatible hardware.
 - .2 2 GHz processor.
 - .3 4 GB RAM.
 - .4 Four USB ports.
 - .5 One Ethernet port.
 - .6 Two video ports.
 - .2 Two monitors with a minimum size of 24" and resolution of 1920x1080 pixels.
 - .3 One standard keyboard.
 - .4 One standard mouse.
- .2 Software
 - .1 The only required software on the thin clients is the Rockwell ThinManager firmware. This firmware is downloaded from the ThinManager server once it is connected and serves as the OS of the thin client. ThinManager connects the thin client to the Microsoft Windows terminal services server and the security accounts.

2.5 ENGINEERING WORKSTATIONS

- .1 Hardware
 - .1 The Engineering Workstations are used for software development for engineers at the WTP and McPhillips Backup Control Room DR centre. Each new Engineering Workstation shall require the following:
 - .2 One computer with a minimum:
 - .1 4 GHz, processor.
 - .2 16 GB RAM.
 - .3 1 TB hard drive.

- .4 Four USB ports.
- .5 Two 10/100/1000 Ethernet ports.
- .6 Windows 10 or newer if supported.
- .3 Two monitors with a minimum size of 24" and a resolution of 1920x1080 pixels.
- .4 One standard keyboard.
- .5 One standard mouse.
- .2 Software:
 - .1 Operating System
 - .1 The engineering workstations shall utilize a Microsoft Windows OS. The latest version supported by the SCADA system at the time of installation and at Substantial Performance shall be used.
 - .2 Backup active directory DNS.
 - .3 Wonderware InTouch view for system platform.
 - .4 Historian client.
 - .5 Wonderware IDE.

2.6 HMI

- .1 The HMI shall be a high performance modular panel with the following specifications:
 - .1 Touch screen.
 - .2 Screen size: 12.1".
 - .3 Resolution: 1,024 x 768 pixels.
 - .4 Colours: 16 M.
 - .5 Single Touch: sliding, scrolling.
 - .6 Multi-touch: zooming, double touch.
 - .7 Acceptable manufacture: Schneider Harmony GTU, Magellis HMIDT642 or approved equal in accordance with B7 of the Tender.
- .2 The processor box shall have the following specifications:
 - .1 CUP: RISC, 600 MHz.
 - .2 Vijeo Designer configuration software.
 - .3 24 VDC.
 - .4 Two RJ45 Ethernet ports.
 - .5 Two USB ports.
 - .6 Ethernet Modbus TCP/IP.
 - .7 Acceptable manufacture: Schneider Harmony GTU, HMIG3U or approved equal in accordance with B7 of the Tender.
- .3 Software:
 - .1 Programming and configuration software for the HMI terminal shall be Schneider Electric's Vijeo Designer HMIDT642 or approved equal in accordance with B7 of the Tender.

- .4 HMI to be mounted in control panels as indicated.
- .5 Provide 1 GB SD memory card.

Part 3 Execution

3.1 INSTALLATION

- .1 Install the SCADA hardware according to manufacturer's instruction and as detailed in the Drawings.
- .2 Connect video, keyboard, and mouse ports to existing rack mounted KVM switches for each SCADA server.
- .3 Configure SCADA hardware and software as detailed in the Appendix C - Process Control Narrative.
 - .1 The Contractor will submit draft virtualization graphics to the Contract Administrator for approval.
- .4 All networking hardware to be grounded according to manufacturer's guidelines.
- .5 Install HMIs according to manufacturer's guidelines in locations detailed in the Drawings.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 29 05 00 - Common Work - Instrumentation and Control.

1.2 RTU I/O INDEX

- .1 Existing PLC wiring schematics, loop diagrams, and P&IDs can be found in Appendix C - Process Control Narrative, Appendix D - PLC Wiring Schematics and Loop Drawings (Existing), and Appendix E – Process and Instrumentation Diagram Drawings (Existing). Exported documentation of the existing PLC I/O indices can be found in the Appendix F – PLC Configuration, I/O List, and Program Logic (Existing). These appendices are intended to serve as an aid for determining the cabling and programming requirements for the Work specified in this division.
- .2 The new PLC I/O points shown in the Drawings, and summarized in the following spreadsheet, shall be added into the PLC logic.

Part 2 Products

- .1 Not used

Part 3 Execution

- .1 Not used

END OF SECTION

PLC I/O INDEX

RECORD NO.	REV. NO.	TAG NAME	DESCRIPTION			P&ID DRAWING	ENG. UNITS	I/O SPECIFICATION									
								SCALE		ALARMS		PLC CABINET	TYPE	ADDRESS	RACK (1-#)	SLOT (1-#)	POINT (0-#)
								LOW	HIGH	LOW	HIGH						
DEACON																	
0000	0	PMCM-D003	LCP-3 REDUNDANCY POWER MODULE OK	LCP-3 PUMP AND MOTOR CONDITION MONITORING UNIT	-	-	-	-	ON	OFF	LCP-3	DI	%I14	2	6	5	
0001	0	PMCM-D004	LCP-4 REDUNDANCY POWER MODULE OK	LCP-4 PUMP AND MOTOR CONDITION MONITORING UNIT	-	-	-	-	ON	OFF	LCP-4	DI	%I14	2	6	5	
0002	0	PMCM-D005	LCP-5 REDUNDANCY POWER MODULE OK	LCP-5 PUMP AND MOTOR CONDITION MONITORING UNIT	-	-	-	-	ON	OFF	LCP-5	DI	%I14	2	6	5	
HURST																	
0003	0	PMCM-M011	LCP-11 REDUNDANCY POWER MODULE OK	LCP-11 PUMP AND MOTOR CONDITION MONITORING UNIT	-	-	-	-	ON	OFF	LCP-11	DI	%I16	2	7	7	
0004	0	PMCM-M012	LCP-12 REDUNDANCY POWER MODULE OK	LCP-12 PUMP AND MOTOR CONDITION MONITORING UNIT	-	-	-	-	ON	OFF	LCP-12	DI	%I16	2	7	7	
0005	0	PMCM-M014	LCP-14 REDUNDANCY POWER MODULE OK	LCP-14 PUMP AND MOTOR CONDITION MONITORING UNIT	-	-	-	-	ON	OFF	LCP-14	DI	%I16	2	7	7	
0006	0	PMCM-M015	LCP-15 REDUNDANCY POWER MODULE OK	LCP-15 PUMP AND MOTOR CONDITION MONITORING UNIT	-	-	-	-	ON	OFF	LCP-15	DI	%I16	2	7	7	
0007	0	PMCM-M016	LCP-16 REDUNDANCY POWER MODULE OK	LCP-16 PUMP AND MOTOR CONDITION MONITORING UNIT	-	-	-	-	ON	OFF	LCP-16	DI	%I16	2	7	7	
0008	0	PMCM-M017	LCP-17 REDUNDANCY POWER MODULE OK	LCP-17 PUMP AND MOTOR CONDITION MONITORING UNIT	-	-	-	-	ON	OFF	LCP-17	DI	%I16	2	7	7	
0009	0	PIT-M1500-1	DISCHARGE HEADER PRESSURE	HURST RPS DISCHARGE HEADER	1-0650M-P0013-001	PSI	0	150	50	100	HURST-MCP	AI	%IW33	2	1	0	
0010	0	PIT-M1500-2	DISCHARGE HEADER PRESSURE	HURST RPS DISCHARGE HEADER	1-0650M-P0013-001	PSI	0	150	50	100	HURST-MCP	AI	%IW34	2	1	1	
0011	0	PIT-M1501-1	DISCHARGE HEADER PRESSURE	HURST RPS DISCHARGE HEADER	1-0650M-P0013-001	PSI	0	150	50	100	HURST-MCP	AI	%IW35	2	1	2	
0012	0	PIT-M1501-2	DISCHARGE HEADER PRESSURE	HURST RPS DISCHARGE HEADER	1-0650M-P0013-001	PSI	0	150	50	100	HURST-MCP	AI	%IW36	2	1	3	
0013	0	LSH-M5422-2	STATION FLOOD LOCKOUT 2	HURST RPS STATION FLOOD LOCKOUT	1-0650M-P0019-001	-	-	-	ON	OFF	HURST-MCP	DI	%I36	2	5	4	
MACLEAN																	
0014	0	PMCM-M021	LCP-21 REDUNDANCY POWER MODULE OK	LCP-21 PUMP AND MOTOR CONDITION MONITORING UNIT	-	-	-	-	ON	OFF	LCP-21	DI	%I16	2	7	7	
0015	0	PMCM-M022	LCP-22 REDUNDANCY POWER MODULE OK	LCP-22 PUMP AND MOTOR CONDITION MONITORING UNIT	-	-	-	-	ON	OFF	LCP-22	DI	%I32	1	7	7	
0016	0	PMCM-M023	LCP-23 REDUNDANCY POWER MODULE OK	LCP-23 PUMP AND MOTOR CONDITION MONITORING UNIT	-	-	-	-	ON	OFF	LCP-23	DI	%I16	2	7	7	
0017	0	PMCM-M025	LCP-25 REDUNDANCY POWER MODULE OK	LCP-25 PUMP AND MOTOR CONDITION MONITORING UNIT	-	-	-	-	ON	OFF	LCP-25	DI	%I16	2	7	7	
0018	0	PMCM-M026	LCP-26 REDUNDANCY POWER MODULE OK	LCP-26 PUMP AND MOTOR CONDITION MONITORING UNIT	-	-	-	-	ON	OFF	LCP-26	DI	%I32	1	7	7	
0019	0	PIT-M1500-1	DISCHARGE HEADER PRESSURE	MACLEAN RPS DISCHARGE HEADER	1-0630M-P0009-001	PSI	0	150	50	100	MACLEAN-MCP	AI	%IW27	2	1	0	
0020	0	PIT-M1500-2	DISCHARGE HEADER PRESSURE	MACLEAN RPS DISCHARGE HEADER	1-0630M-P0009-001	PSI	0	150	50	100	MACLEAN-MCP	AI	%IW28	2	1	1	
0021	0	PIT-M1501-1	DISCHARGE HEADER PRESSURE	MACLEAN RPS DISCHARGE HEADER	1-0630M-P0009-001	PSI	0	150	50	100	MACLEAN-MCP	AI	%IW29	2	1	2	
0022	0	PIT-M1501-2	DISCHARGE HEADER PRESSURE	MACLEAN RPS DISCHARGE HEADER	1-0630M-P0009-001	PSI	0	150	50	100	MACLEAN-MCP	AI	%IW30	2	1	3	
0023	0	LSH-M5900-2	STATION FLOOD LOCKOUT 2	MACLEAN RPS STATION FLOOD LOCKOUT	1-0630M-P0012-001	-	-	-	ON	OFF	MACLEAN-MCP	DI	%I20	2	3	3	
MCPHILLIPS																	
0024	0	PMCM-M001	LCP-1 REDUNDANCY POWER MODULE OK	LCP-1 PUMP AND MOTOR CONDITION MONITORING UNIT	-	-	-	-	ON	OFF	LCP-1	DI	%I32	1	7	7	
0025	0	PMCM-M002	LCP-2 REDUNDANCY POWER MODULE OK	LCP-2 PUMP AND MOTOR CONDITION MONITORING UNIT	-	-	-	-	ON	OFF	LCP-2	DI	%I16	2	7	7	
0026	0	PMCM-M003	LCP-3 REDUNDANCY POWER MODULE OK	LCP-3 PUMP AND MOTOR CONDITION MONITORING UNIT	-	-	-	-	ON	OFF	LCP-3	DI	%I40	1	8	7	
0027	0	PMCM-M004	LCP-4 REDUNDANCY POWER MODULE OK	LCP-4 PUMP AND MOTOR CONDITION MONITORING UNIT	-	-	-	-	ON	OFF	LCP-4	DI	%I16	2	7	7	
0028	0	PMCM-M005	LCP-5 REDUNDANCY POWER MODULE OK	LCP-5 PUMP AND MOTOR CONDITION MONITORING UNIT	-	-	-	-	ON	OFF	LCP-5	DI	%I32	1	7	7	
0029	0	PMCM-M006	LCP-6 REDUNDANCY POWER MODULE OK	LCP-6 PUMP AND MOTOR CONDITION MONITORING UNIT	-	-	-	-	ON	OFF	LCP-6	DI	%I16	2	7	7	
0030	0	PIT-M1500-1	DISCHARGE HEADER PRESSURE	MCPHILLIPS RPS DISCHARGE HEADER	1-0640M-P0009-001	PSI	0	150	50	100	MCPHILLIPS-MCP	AI	%IW27	2	1	0	
0031	0	PIT-M1500-2	DISCHARGE HEADER PRESSURE	MCPHILLIPS RPS DISCHARGE HEADER	1-0640M-P0009-001	PSI	0	150	50	100	MCPHILLIPS-MCP	AI	%IW28	2	1	1	
0032	0	PIT-M1501-1	DISCHARGE HEADER PRESSURE	MCPHILLIPS RPS DISCHARGE HEADER	1-0640M-P0009-001	PSI	0	150	50	100	MCPHILLIPS-MCP	AI	%IW29	2	1	2	
0033	0	PIT-M1501-2	DISCHARGE HEADER PRESSURE	MCPHILLIPS RPS DISCHARGE HEADER	1-0640M-P0009-001	PSI	0	150	50	100	MCPHILLIPS-MCP	AI	%IW30	2	1	3	
0034	0	LSH-M5900-2	STATION FLOOD LOCKOUT 2	MCPHILLIPS RPS STATION FLOOD LOCKOUT	1-0640M-P0012-001	-	-	-	ON	OFF	MCPHILLIPS-MCP	DI	%I97	2	11	0	
SHOAL LAKE																	
0035	0	PMCM-P057	PL-57 REDUNDANCY POWER MODULE OK	PL-57 PUMP AND MOTOR CONDITION MONITORING UNIT	-	-	-	-	ON	OFF	PL-17	DI	%I102	1	4	5	
0036	0	PMCM-P059	PL-59 REDUNDANCY POWER MODULE OK	PL-59 PUMP AND MOTOR CONDITION MONITORING UNIT	-	-	-	-	ON	OFF	PL-17	DI	%I85	1	3	4	
TACHE																	
0037	0	PMCM-M001	LCP-1 REDUNDANCY POWER MODULE OK	LCP-1 PUMP AND MOTOR CONDITION MONITORING UNIT	-	-	-	-	ON	OFF	TACHE-MCP	DI	%I53	2	7	4	
0038	0	PMCM-M002	LCP-2 REDUNDANCY POWER MODULE OK	LCP-2 PUMP AND MOTOR CONDITION MONITORING UNIT	-	-	-	-	ON	OFF	TACHE-MCP	DI	%I54	2	7	5	
0039	0	PMCM-M003	LCP-3 REDUNDANCY POWER MODULE OK	LCP-3 PUMP AND MOTOR CONDITION MONITORING UNIT	-	-	-	-	ON	OFF	TACHE-MCP	DI	%I55	2	7	6	
0040	0	LSH-M5900-2	STATION FLOOD LOCKOUT 2	TACHE RPS STATION FLOOD LOCKOUT	1-0660M-P0004	-	-	-	ON	OFF	TACHE-MCP	DI	%I27	2	4	2	

Part 1 General

1.1 RELATED SECTIONS

.1 Section 29 05 00 – Common Work - Instrumentation and Control.

1.2 INSTRUMENT INDEX

.1 The following spreadsheet gives an itemized list of the instrumentation included as part of this Work.

Part 2 Products

.1 Not used

Part 3 Execution

.1 Not used

END OF SECTION

INSTRUMENTATION INDEX

RECORD NO.	REV. No.	LOOP NUM.	TAG NAME	DESCRIPTION		POWER SUPPLY	CALIBRATED RANGE	MOUNTING	SUPPLIED BY	INSTALLED BY	COMMENTS	SPEC. DATA SHEET
				INSTRUMENT TYPE	SERVICE							
1	0	500	PIT-M1500-1	PRESSURE TRANSMITTER	HURST DISCHARGE HEADER	24 VDC	4 - 20 mA	INTEGRATED	CONTRACTOR	CONTRACTOR	-	I-102
2	0	500	PIT-M1500-2	PRESSURE TRANSMITTER	HURST DISCHARGE HEADER	24 VDC	4 - 20 mA	INTEGRATED	CONTRACTOR	CONTRACTOR	-	I-102
3	0	501	PIT-M1501-1	PRESSURE TRANSMITTER	HURST DISCHARGE HEADER	24 VDC	4 - 20 mA	INTEGRATED	CONTRACTOR	CONTRACTOR	-	I-102
4	0	501	PIT-M1501-2	PRESSURE TRANSMITTER	HURST DISCHARGE HEADER	24 VDC	4 - 20 mA	INTEGRATED	CONTRACTOR	CONTRACTOR	-	I-102
5	0	422	LSH-M5422-2	FLOAT SWITCH	HURST STATION FLOOD LOCKOUT	120 VAC/24 VDC	N/A	HANGING	CONTRACTOR	CONTRACTOR	-	I-101
6	0	500	PIT-M1500-1	PRESSURE TRANSMITTER	MACLEAN DISCHARGE HEADER	24 VDC	4 - 20 mA	INTEGRATED	CONTRACTOR	CONTRACTOR	-	I-102
7	0	500	PIT-M1500-2	PRESSURE TRANSMITTER	MACLEAN DISCHARGE HEADER	24 VDC	4 - 20 mA	INTEGRATED	CONTRACTOR	CONTRACTOR	-	I-102
8	0	501	PIT-M1501-1	PRESSURE TRANSMITTER	MACLEAN DISCHARGE HEADER	24 VDC	4 - 20 mA	INTEGRATED	CONTRACTOR	CONTRACTOR	-	I-102
9	0	501	PIT-M1501-2	PRESSURE TRANSMITTER	MACLEAN DISCHARGE HEADER	24 VDC	4 - 20 mA	INTEGRATED	CONTRACTOR	CONTRACTOR	-	I-102
10	0	900	LSH-M5900-2	FLOAT SWITCH	MACLEAN STATION FLOOD LOCKOUT	120 VAC/24 VDC	N/A	HANGING	CONTRACTOR	CONTRACTOR	-	I-101
11	0	500	PIT-M1500-1	PRESSURE TRANSMITTER	MCPHILLIPS DISCHARGE HEADER	24 VDC	4 - 20 mA	INTEGRATED	CONTRACTOR	CONTRACTOR	-	I-102
12	0	500	PIT-M1500-2	PRESSURE TRANSMITTER	MCPHILLIPS DISCHARGE HEADER	24 VDC	4 - 20 mA	INTEGRATED	CONTRACTOR	CONTRACTOR	-	I-102
13	0	501	PIT-M1501-1	PRESSURE TRANSMITTER	MCPHILLIPS DISCHARGE HEADER	24 VDC	4 - 20 mA	INTEGRATED	CONTRACTOR	CONTRACTOR	-	I-102
14	0	501	PIT-M1501-2	PRESSURE TRANSMITTER	MCPHILLIPS DISCHARGE HEADER	24 VDC	4 - 20 mA	INTEGRATED	CONTRACTOR	CONTRACTOR	-	I-102
15	0	901	LSH-M5901-2	FLOAT SWITCH	MCPHILLIPS STATION FLOOD LOCKOUT	120 VAC/24 VDC	N/A	HANGING	CONTRACTOR	CONTRACTOR	-	I-101
16	0	901	LSH-M5901-2	FLOAT SWITCH	TACHE STATION FLOOD LOCKOUT	120 VAC/24 VDC	N/A	HANGING	CONTRACTOR	CONTRACTOR	-	I-101

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 PLC controllers, I/O sub-systems, and HMIs shall be housed in existing control panels as indicated. General requirements for the control panels are defined in Section 29 10 01 - Enclosures.
- .2 Coordinate and cooperate with other contractors, suppliers, and the City's representatives during system programming, start-up, and commissioning of the complete control system and associated field devices and wiring.
- .3 Provide complete PLC programming, start-up, and commissioning.

1.2 RELATED SECTIONS

- .1 Part E - Specifications.
- .2 Section 01 33 00 - Submittal Procedures.
- .3 Section 01 78 00 - Closeout Submittals.
- .4 Section 29 05 00 - Common Work - Instrumentation and Control.
- .5 Section 29 10 01 - Enclosures.

1.3 DEFINITIONS

- .1 **"MBTCP"** means Modbus Transmission Control Protocol

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit the following product data and Shop Drawings:
 - .1 PLC rack layouts.
 - .2 PLC racks.
 - .3 PLC rack expansion kit.
 - .4 PLC processors.
 - .5 PLC power supply.
 - .6 PLC fibre optic repeater.
 - .7 PLC quick wiring adapters.
 - .8 PLC I/O card data sheets.
 - .9 PLC network card data sheets.
 - .10 Quantum PLC RIO drop.
 - .11 Quantum PLC fibre optic repeater.
- .3 Test results:
 - .1 Submit loop test results for all I/O points. Sample test form can be found in Section 29 05 00 - Common Work - Instrumentation and Control.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 78 00 - Closeout Submittals.
- .2 O&M Manuals:
 - .1 PLC product data and itemized part numbers.
 - .2 PLC rack layout Shop Drawings.
 - .3 Loop test results.

1.6 MAINTENANCE MATERIALS

- .1 Provide spare parts in accordance with Section 01 78 00 – Closeout Submittals and Part 2 of this section.
- .2 PLC spare parts quantities listed below:

DESCRIPTION	PRODUCT LINE	PART	SPARE PARTS
PLC Rack - 4 Slot	Schneider Modicon M580	BME XBP 0400	3
PLC Rack - 8 Slot	Schneider Modicon M580	BME XBP 0800	5
PLC Rack - 12 Slot	Schneider Modicon M580	BME XBP 1200	3
PLC Rack Expansion Kit	Schneider Modicon M580	BMX XBE 2005	3
PLC Power Supply	Schneider Modicon M580	BMX CPS 3500	8
PLC Hot Standby Processor	Schneider Modicon M580	BME H58 6040	2
PLC Processor	Schneider Modicon M580	BME P58 6040	2
PLC Network Card	Schneider Modicon M580	BME NOC 0301	2
PLC Remote IO Card	Schneider Modicon M580	BME CRA 312 10	2
PLC Fibre Optic Repeater	Schneider Modicon M580	BMX NRP 0200	2
PLC Analog Input Card 4PT	Schneider Modicon M580	BMX AMI 0410	6
PLC Analog Output Card 2PT	Schneider Modicon M580	BMX AMO 0210	6
PLC Discrete Input Card 120VAC, 16PT	Schneider Modicon M580	BMX DAI 1604	12
PLC Discrete Input Card 24VDC, 16PT	Schneider Modicon M580	BMX DDI 1602	3
PLC Discrete Input Card 24VDC, 32PT	Schneider Modicon M580	BMX DDI 3202K	1
PLC Discrete Relay Output Card 24VDC / 120VAC, 8PT	Schneider Modicon M580	BMX DRA 0805	10
PLC Discrete Output Card 24VDC, 16PT	Schneider Modicon M580	BMX DDO 1602	1
Quantum PLC Remote IO Drop	Schneider Modicon M580	140 CRA 312	1
Quantum PLC Fibre Optic Repeater	Schneider Modicon M580	140 NRP 321 00	1

Part 2 Products

2.1 PROGRAMMABLE LOGIC CONTROLLER

- .1 General
 - .1 Where existing PLCs are to be replaced, new PLC equipment shall be based on the Schneider Modicon M580 hardware platform or approved equal in accordance with B7 of the Tender.

□

- .2 Where new PLC cards are to be added to existing PLC racks, PLC cards must be compatible with the existing PLC rack.
- .3 Provide all necessary racks, power supplies, cables, communication cards, and accessories to provide a complete and functioning system.
- .4 Communication protocol for the PLC processor network to be Modbus TCP (MBTCP).
- .5 I/O signal voltage and I/O channels to match existing PLC cards for use with wiring adapters as indicated.
 - .1 For clarity, it is intended that wiring adapters will be used to interface new PLC cards with existing PLC wiring in order to minimize the amount of re-wiring required.
- .2 New Schneider Modicon M580 PLC Equipment
 - .1 PLC Rack
 - .1 X-bus and dual Ethernet.
 - .2 4, 8, or 12 slot as indicated and as required.
 - .1 BME XBP 0400.
 - .2 BME XBP 0800.
 - .3 BME XBP 1200.
 - .4 Or approved equal in accordance with B7 of the Tender.
 - .3 Rack extender kits as indicated and as required.
 - .1 BMX XBE 2005 or approved equal in accordance with B7 of the Tender.
 - .2 PLC Power Supply
 - .1 Source: 120 VAC.
 - .2 Power output: 36 W.
 - .3 BMX CPS 3500 or approved equal in accordance with B7 of the Tender.
 - .3 PLC Processor
 - .1 Redundant PLC Processor.
 - .1 Complete with 490NAC0100 HSBY RJ45 SFP socket (hot standby copper adapter).
 - .2 BME H58 6040 or approved equal in accordance with B7 of the Tender.
 - .2 Standard PLC Processor
 - .1 BME P58 6040 or approved equal in accordance with B7 of the Tender.
 - .4 24 VDC Sink Discrete Input Card
 - .1 24 VDC.
 - .2 16 channel.
 - .3 BMX DDI 1602 or approved equal in accordance with B7 of the Tender.
 - .5 120 VAC Discrete Input Card

- .1 120 VAC.
- .2 16 channel.
- .3 BMX DAI 1604 or approved equal in accordance with B7 of the Tender.
- .6 24 VDC Sink High Density Discrete Input Card
 - .1 24 VDC.
 - .2 32 channel.
 - .3 BMX DDI 3202K or approved equal in accordance with B7 of the Tender.
- .7 Relay Discrete Output Card
 - .1 24 VDC relay.
 - .2 8 channel.
 - .3 BMX DRA 0805 or approved equal in accordance with B7 of the Tender.
- .8 24 VDC Discrete Output Card
 - .1 24 VDC.
 - .2 16 channel.
 - .3 BMX DDO 1602 or approved equal in accordance with B7 of the Tender.
- .9 Analogue Input Card
 - .1 4-20 mA.
 - .2 4 channel.
 - .3 BMX AMI 0410 or approved equal in accordance with B7 of the Tender.
- .10 Analogue Output Card
 - .1 4-20 mA.
 - .2 2 channel.
 - .3 BMX AMO 0210 or approved equal in accordance with B7 of the Tender.
- .11 Ethernet Communication Card
 - .1 BME NOC 0301 or approved equal in accordance with B7 of the Tender.
- .12 Performance EIO Drop Card
 - .1 BME CRA 312 10 or approved equal in accordance with B7 of the Tender.
- .13 Fibre Optic Repeater
 - .1 For use with multimode optical fibre.
 - .2 BMX NRP 0200 or approved equal in accordance with B7 of the Tender.
- .3 New Quantum PLC cards
 - .1 Ethernet EIO Drop Card.

- .1 140 CRA 312 00 or approved equal in accordance with B7 of the Tender.
- .2 Fibre Optic Repeater.
 - .1 140 NRP 312 00 or approved equal in accordance with B7 of the Tender.
- .4 Quick Wiring Adapters
 - .1 For use with 24 VDC Sink Discrete Input card (BMX DDI 1602), Relay Discrete Output card (BMX DRA 0805), and 24 VDC Discrete Output card (BMX DDO 1602).
 - .1 990XSM00206
 - .2 For use with Analogue Input card (BMX AMI 0410).
 - .1 990XSM00208
 - .3 For use with Analogue Output card (BMX AMO 0210).
 - .1 990XSM00212
 - .4 For use with 120 VAC Discrete Input card (BMX DAI 1604).
 - .1 990XSM00213
 - .5 Or approved equal in accordance with B7 of the Tender.

Part 3 Execution

3.1 INSTALLATION

- .1 Install the hardware in accordance with the foregoing requirements to satisfy the performance requirements defined in this and other NMS divisions.
- .2 Cooperate with other contractors, suppliers, the City, and the Contract Administrator to commission and start-up the system as defined herein.

3.2 FAT

- .1 Perform FAT for each facility in accordance with E9 of the Tender.

3.3 COMMISSIONING AND START-UP TESTING

- .1 Commission and perform start-up testing for each facility in accordance with E10 of the Tender.

3.4 TRAINING

- .1 Provide training to the City personnel in the operation, care, and maintenance of system, system equipment, and components in accordance with E11 of the Tender.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 PMCM unit to monitor vibration, acceleration, and temperature sensors installed in pumps and motors.
- .2 New PMCM unit to be compatible with existing vibration, acceleration, and temperature sensors.
- .3 Provide PMCM hardware, configuration, start-up, and commissioning required to read correct values from existing sensors and interface into new PLC ModbusTCP Ethernet network.

1.2 RELATED SECTIONS

- .1 Part E - Specifications.
- .2 Section 01 33 00 - Submittal Procedures.
- .3 Section 01 78 00 - Closeout Submittals.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data and Shop Drawings:
 - .1 PMCM rack layouts.
 - .2 PMCM rack and module data sheets.
 - .3 Sensor wiring and configuration parameters.
- .3 Test results:
 - .1 Submit loop test results for all I/O points. Sample test form can be found in Section 29 05 00 - Common Work - Instrumentation and Control.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 78 00 - Closeout Submittals.
- .2 O&M Manuals:
 - .1 PMCM product data sheet and parts list.
 - .2 List of usernames and passwords organized by location and panel.
 - .3 Documented PMCM parameter settings, configuration, and program.
 - .4 Shop Drawings:
 - .1 PMCM wiring schematic.

1.5 MAINTENANCE MATERIALS

- .1 Provide spare parts in accordance with Section 01 78 00 – Closeout Submittals and Part 2 of this section.

.2 Provide PMCM spare parts quantities as listed below:

DESCRIPTION	PRODUCT LINE	PART	SPARE PARTS
PMCM System Rack	Emerson AMS 6500 ATG	A6500-SR	1
PMCM System Rack with Front Terminal Connectors	Emerson AMS 6500 ATG	A6500-FR	1
PMCM Communications Card	Emerson AMS 6500 ATG	A6500-CC	1
PMCM Temperature Measurement Card	Emerson AMS 6500 ATG	A6500-TP	5
PMCM Universal Measurement Card	Emerson AMS 6500 ATG	A6500-UM	5
PMCM Relay Card	Emerson AMS 6500 ATG	A6500-RC	2
PMCM Redundant Power Supply	Emerson AMS 6500 ATG	A6068	2

Part 2 Products

2.1 PMCM

.1 General

- .1 New PMCM equipment shall be based on the Emerson AMS6500 ATG hardware platform or approved equal in accordance with B7 of the Tender.
- .2 Provide all necessary racks, power supplies, cables, measurement cards, communication cards, and accessories to provide a complete and functioning system.
- .3 PMCM unit must be network compatible with the ability to transfer information over ModbusTCP Ethernet.

.2 PMCM Equipment

.1 PMCM System Rack

- .1 Six or 11 slot as indicated on plans:
 - .1 Emerson A6500-SR (for 11 slot).
 - .2 Emerson A6500-FR (for 6 slot).
 - .3 Or approved equal in accordance with B7 of the Tender.
- .2 Accessible terminal blocks for connection of sensors. Terminal blocks accessible from the back with door-mounted rack or from the front with surface mounted rack.

.2 PMCM Redundant Power Supply

- .1 Two 120 VAC/24 VDC power supplies.
- .2 One 24 VDC redundancy module.
- .3 Safety Extra Low Voltage 24 V.
- .4 DIN rail mount.
- .5 Monitoring dry contact output for PLC.
- .6 Emerson A6068 or approved equal in accordance with B7 of the Tender.

.3 Vibration/Acceleration Measurement Card

□

- .1 Shall work with existing vibration, velocity, and acceleration sensors as well as:
 - .1 Hall-effect sensors, piezoelectric sensors, and eddy current measuring chains.
- .2 Minimum two channels per card.
- .3 Emerson A6500-UM or approved equal in accordance with B7 of the Tender.
- .4 Temperature/Process Measurement Card
 - .1 Shall work with existing RTDs:
 - .1 2, 3, and 4-wire RTDs.
 - .2 Must be capable of interfacing with process input signals:
 - .1 0 to 10 V
 - .2 0 to 20 mA
 - .3 4 to 20 mA
 - .3 Minimum four (4) channels per card:
 - .4 Emerson A6500-TP or approved equal in accordance with B7 of the Tender.
- .5 Communication Card
 - .1 Communication with the PMCM system via ModbusTCP Ethernet communication card shall allow measurement monitoring, and warning and alarm set point adjustment.
 - .2 RJ45 Ethernet connection.
 - .3 Password protection available.
 - .4 Failure of communication card must not cause loss of protection functionality of the PMCM rack.
 - .5 Emerson A6500-CC or approved equal in accordance with B7 of the Tender.
- .6 Relay Output Card
 - .1 Software programmable relay card:
 - .1 Including: boolean operators, timers, flip flops, flags, voting, and internal alarms.
 - .2 Contacts rated for 24 VDC.
 - .3 Outputs available in both normally-open and normally-closed configuration.
 - .4 Emerson A6500-RC or approved equal in accordance with B7 of the Tender.
- .3 PMCM Monitoring Software
 - .1 PMCM Monitoring Software shall be capable of showing:
 - .1 Overall vibration values.
 - .2 Probe gap voltage.
 - .3 Amplitude and phase value.
 - .4 Alarm status.
 - .5 Sensor status.

- .6 Shaft rotation speed.
- .7 Live measurement values.
- .8 Live trend data.
- .9 Live time waveform.
- .10 Live frequency spectrum.
- .11 Live phase.
- .12 Module health information
- .2 Approved Product: Emerson Machine Studio or approved equal in accordance with B7 of the Tender.

Part 3 Execution

3.1 INSTALLATION

- .1 Install the hardware in accordance with the foregoing requirements to satisfy the performance requirements defined in this and other NMS divisions.
 - .1 Follow manufacturer's installation specifications.
- .2 Cooperate with other contractors, suppliers, the City and the Contract Administrator to commission and start-up the system as defined herein.
- .3 Record sensor configuration data in the existing Bentley Nevada system prior to construction.
- .4 Record warning and alarm parameters for all sensors in the existing Bentley Nevada system prior to construction.
- .5 Configure the new system sensor, warning, and alarm parameters to match existing.
- .6 Install the software in accordance with the foregoing requirements to satisfy the performance requirements defined in this and other NMS divisions.
 - .1 Follow manufacturer's installation specifications.

3.2 FAT

- .1 Perform FAT for each facility in accordance with E9 of the Tender.

3.3 COMMISSIONING AND START-UP TESTING

- .1 Commission and perform start-up testing for each facility in accordance with E10 of the Tender.

3.4 TRAINING

- .1 Provide training to the City personnel in the operation, care, and maintenance of system, system equipment, and components in accordance with E11 of the Tender.

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 The Work includes the provision of all instrument specification sheets.
- .2 Refer to Section 29 05 00 - Common Work – Instrumentation and Control.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittals.
- .3 Section 29 05 00 - Common Work – Instrumentation and Control.
- .4 Section 29 40 21 - Instrumentation Index.

1.3 REFERENCE STANDARDS

- .1 ISA Standard S20.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide instrument specification data sheets to itemize detailed As-Built information regarding the specification of instruments included as part of this Work for each instrument supplied. The datasheets already included in this section list specific minimum requirements for particular applications.
 - .2 Use forms in accordance with the ISA Standard S20 as a template for the preparation of the specification datasheets.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide Submittals in accordance with Section 01 78 00 – Closeout Submittals.
- .2 O&M Manual:
 - .1 Submit manufacturer’s instrumentation specification data sheets.

Part 2 Products

1.1 GENERAL

- .1 Refer to the following specification sheets.

INSTRUMENT SPECIFICATION NUMBER: I-101

DEVICE: Float Switch

TAG: Refer to Instrument Index, Section 29 40 21 – Instrumentation Index.

TYPE: Float Switch

SERVICE: Water

SIZE AND MATERIAL: Size and material to match existing

OUTPUT: One normally-open and one normally-closed contact

CONTACT RATING: 2 A, 120 VAC/24 VDC

ENCLOSURE: NEMA 4X

MANUFACTURER AND MODEL: Flygt ENM-10 or approved equal in accordance with B7 of the Tender.

INSTRUMENT SPECIFICATION NUMBER: I-102

DEVICE: Pressure Transmitter

TAG: Refer to Instrument Index, Section 29 40 21 - Instrumentation Index.

SERVICE: Potable Water

PROCESS CONNECTIONS: 1/2" NPT

RANGE: Refer to Instrument Index, Section 29 40 21- Instrumentation Index.

INACCURACY: ±1% of span or lower

OUTPUT: 4 to 20 mA DC into 500 OHM load

POWER SUPPLY: Loop powered 24 VDC

CONSTRUCTION: 316 Stainless Steel

ELECTRONIC ENCLOSURE: EEMAC/NEMA 4X

LOCAL DISPLAY: Unit mounted LCD Display

MANUFACTURER AND MODEL: Siemens Sitrans or approved equal in accordance with B7 of the Tender.

END OF SECTION