City of Saint John

TENDER No. 2023-085304T

Equipment Installation - Thermal Interconnect

Issue Date: October 10, 2023

City of Saint John

Contract Specifications

TENDER NO.

2023-085304T

City of Saint John

CONTRACT SPECIFICATIONS

FOR

TENDER NO.

2023-085304T

OCTOBER 2023

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DIVISION 1 – PROJECT DESCRIPTION

PROJECT DESCRIPTION

1.1 GENERAL DESCRIPTION

The work consists generally of providing pre-purchased equipment installations and hydronic piping to interconnect the Market Square hydronic heating loop to the Canada Games Aquatic Centre hydronic heating loop. The goal of the project is to re-purpose waste energy from the Market Square at the Canada Games Aquatic Centre through pool water heating, building heating and domestic cold water preheat.

This contractor is responsible for receipt of pre-purchased equipment (provided by City of Saint John), which will be delivered to the Canada Games Aquatic Centre and shall be received, moved, installed and commissioned by this contractor. Controls work will be provided by the City of Saint John. Please reference the technical specifications and drawings for further detail on contract requirements.

1.2 CONTRACT DOCUMENTS

a) General Specifications, City of Saint John, New Brunswick, with all applicable Divisions as listed in the Table of Contents of the Contract Specifications.

b) Contract Specifications,
Tender No.: 2023-085304T

Contract: Thermal Interconnect – Market Square and Aquatic Centre
City of Saint John, New Brunswick

c) List of Drawings

M-1 Canada Games Aquatic Center Basement Level – Mechanical New Work
M-2 Market Square Level 8.4 Mechanical Room – Mechanical New Work
M-3 Details and Schedules
M-4 Schematic
E-1 Canada Games Aquatic Center Basement Level – Electrical New Work
E-2 Market Square Level 8.4 – Electrical New Work
E-3 Electric Panel Schedules
E-4 Single Line Diagram

1.3 AUTHORIZED ENQUIRIES CONTACT

All inquiries during the procurement phase of this project shall be referred to:
Chris Roberts, SCMP, CPPB
City of Saint John
175 Rothesay Avenue, Saint John, NB
supplychainmanagement@saintjohn.ca

City of Saint John

CONTRACT SPECIFICATIONS

DIVISION 2

INSTRUCTIONS TO TENDERERS AND TENDERING PROCEDURES

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DIVISION 2 – INSTRUCTIONS TO TENDERERS AND TENDERING PROCEDURES

INSTRUCTIONS TO TENDERERS AND TENDERING PROCEDURES

2.1 TRADE TREATIES AND TENDERING POLICY

2.1.01 Internal Trade Agreements

Tenderers should note that the within procurement is subject to trade agreements including the Canadian Free Trade Agreement and the Atlantic Procurement Agreement and the Agreement on Opening Public Procurement for Quebec and NB.

2.1.02 Tendering Policy

Tenderers should note that the within Procurement shall conform with The City of Saint John "Tendering Policy for Construction Contracts" which is attached hereto as Appendix "A".

2.2 MATERIAL DISCLOSURES

2.2.01 General

The City makes the following material disclosures with respect to this Request for Tender. While the City has used considerable efforts to ensure the accurate representation of all information in this Request for Tender, including these material disclosures, such information is supplied solely as a guideline for Tenderers. The City does not warrant or guarantee the accuracy of such information, nor is such information necessarily comprehensive or exhaustive. Nothing in this Request for Tender is intended to relieve Tenderers of the obligation to form their own opinions and reach their own conclusions with respect to the matters addressed in this Request for Tender.

2.2.02 Permits Required for Project

Except as stated otherwise in the Tender Document, any and all permits and approvals required by the Authorities having jurisdiction, and arrangements for all inspections of the Work by these Authorities shall be obtained and paid for by the Contractor. The cost of such approvals, permits and inspection shall be included in the Tender Price.

2.2.03 Deemed Examination and Acceptance

Tenderers should note that by submission of a Tender they will be deemed to have examined and accepted the Specifications and Drawings, visited the site, and informed themselves as to existing conditions and limitations.

2.2.04 Availability of Services

The Tenderer shall ascertain from the relevant Authorities the availability of services, including, but not limited to, electricity, sewer, water, telephone, natural gas and transportation to the project and shall ascertain what prior notice each Authority will require for the installation of the service to the project.

2.2 MATERIAL DISCLOSURES (Cont'd)

2.2.05 Tax

a) Tenderers are advised to make special note of all applicable tax procedures.

b) The City is required to pay the Harmonized Sales Tax (HST).

c) The total tendered amount shall include the appropriate taxes on all labour, material and equipment to be incorporated into the Work.

d) Tenderers shall submit their Tenders on the basis that the total amount of the Tender shall include all taxes for which the City is liable.

e) Any increase or decrease in costs to the Tenderer due to the changes in such taxes and duties, after the date of the Tender Closing, shall increase or decrease the value of the Contract accordingly.

2.2.06 Performance Guarantees Required Prior to Contract Execution

Within five (5) Working Days following the City's notice of selection, the selected Tenderer shall provide the City with the required Performance Guarantees being a Performance Bond and a Labour and Material Payment Bond, each at fifty percent (50%) of the Tender Price covering the faithful performance of the full Contract. The bonds shall be in favour of *The City of Saint John* and show *The City of Saint John* as obligee; Unless specified elsewhere within the tender documents, the Performance Bond and the Labour and Material Payment Bond shall be in the form prescribed by regulation pursuant to the *Construction Remedies Act*. The Performance Bond and the Labour and Material Payment Bond shall be issued and be compliant with the requirements of the *Construction Remedies Act* whether the value of the Contract is less than the amount of prescribed pursuant to section 83(1) and 83(2) and 84(1) of the *Construction Remedies Act*.

2.2.07 Insurance

Tenders should refer to Division 6 (section 6.8) for details regarding insurance requirements. (available on the City's website).

2.2 MATERIAL DISCLOSURES (Cont'd)

2.2.08 WorkSafeNB Certificate and Business Corporations Act Certificate

a) New Brunswick Tenderers shall provide to the City a WorkSafeNB certificate which confirms proper registration and good standing with WorkSafeNB and a *Business Corporations Act* Certificate which confirms proper registration with the Province of New Brunswick - Corporate Affairs (of which the Contractor must be in good standing) within five (5) Working Days following the City's notice of selection.

b) Out-of-province Tenderers shall provide to the City a WorkSafeNB certificate which confirms proper registration and good standing with WorkSafeNB or a letter or certificate issued under the equivalent applicable legislation in the province of origin of the Tenderer confirming extension of coverage from said legislation to the Province of New Brunswick for the term of the Contract. Subject to paragraph c), out-of-province Tenderers shall also provide a *Business Corporations Act* Certificate which confirms proper registration with the Province of New Brunswick - Corporate Affairs (of which the Contractor must be in good standing) within five (5) Working Days following the City's notice of selection.

c) Tenderers from Nova Scotia may submit the appropriate *Business Corporations Act* Certificate from the Province of Nova Scotia.

2.2.09 New Brunswick Construction Safety Association

If the total Tender Price for the work, inclusive of HST, is two hundred and fifty thousand dollars ($250,000.00) or more, Tenderers shall supply a Letter of Good Standing under the Certificate of Recognition Program from the New Brunswick Construction Safety Association. Out-of-Province Tenderers shall supply an equivalent from the Tenderer's Province of origin acceptable to the Engineer.

2.2.10 Timetable for Completion of the Work

The Substantial Completion of the Work is March 31, 2024.

2.3 SCHEDULE FOR THE TENDER PROCESS

Issue Date of Request for Tender	Tuesday, October 10, 2023
Pre-Bid Site Visit	Wednesday, October 18, 2023, 3:00:00 pm, ADT
Deadline for Enquiries	Tuesday, October 24, 2023, 4:00:00 pm, ADT
Deadline for Issuing Addenda	Wednesday, October 25, 2023, 4:00:00 pm, ADT
Tender Closing	Tuesday, October 31, 2023, 2:30:00 pm, ADT

The Schedule for the Tender Process is tentative only and may be changed by the City in its sole discretion at any time prior to Tender Closing.

2.4 TENDER DOCUMENTS

2.4.01 Tender Documents to be Obtained in Prescribed Manner

Tender Documents shall be obtained from the City of Saint John's website under "Tenders and Proposals".

2.5 COMMUNICATIONS AFTER ISSUANCE OF TENDER

2.5.01 Tenderers to Review Tender Documents

Tenderers shall promptly examine all Tender Documents and:

a) shall report any errors, omissions or ambiguities; and
b) may direct enquiries or seek additional information

in writing by email before the Deadline for Enquiries to the Authorized Enquiries Contact as set out below. No such communications are to be directed to anyone other than the Authorized Enquiries Contact.

Authorized Enquiries Contact

Chris Roberts, SCMP, CPPB
Procurement Manager
City of Saint John
Email:
supplychainmanagement@saintjohn.ca

It is the Tenderer's responsibility to seek clarification from the City on any matter it considers unclear. The City shall not be responsible for any misunderstanding on the part of the Tenderer concerning this Tender or its process.

The City intends to confirm receipt of a Tenderer's communication by way of an email in reply. If a Tenderer has not received a reply, the Tenderer may wish to resend its communication as the lack of reply may have resulted from a technical problem. The City is under no obligation to respond to enquiries or provide additional information but may do so at its sole discretion.

2.5 COMMUNICATIONS AFTER ISSUANCE OF TENDER (Cont'd)

2.5.02 Email Communication

The following provisions shall apply to any communications with the Authorized Enquiry Contact or the Designated Alternate Contact by email where such email communication or delivery is permitted by the terms of this Tender:

a) The City does not assume any risk or responsibility or liability whatsoever to any Tenderer:

(i) for ensuring that any email system being operated for the City is in good working order, able to receive transmissions, or is not engaged in receiving other transmissions such that a Tenderer's transmission cannot be received;

(ii) if a permitted email communication or delivery is not received by the City, or is received in less than its entirety, within any time limit specified by this Tender; and

(iii) for any error that may occur in the submission of communications or enquiries.

b) All permitted communications submitted by a Tenderer by email to the Authorized Enquiries Contact or the Designated Alternate Contact shall be deemed to have been received on the dates and times indicated on the Authorized Enquiry Contact's or the Designated Alternate Contact's email system

2.5.03 Addenda: Responses to Enquiries and Amendments or Clarifications to Tender Documents

The City may, in its sole and absolute discretion, through the Authorized Enquiry Contact or the Designated Alternate Contact, respond to enquiries and/or amend the Tender Documents before Tender Closing.

Written Addenda are the only means of responding to enquiries or amending the Tender Documents. Only the Authorized Enquiry Contact or the Designated Alternate Contact, and no other employee or agent of the City, is authorized to respond to enquiries and amend the Tender Documents by issuing an Addendum.

Responses to enquiries, changes, clarifications or corrections prepared and circulated by the City form part of the Tender Documents and will be issued as Addenda. Responses will be made in writing and distributed by email to all Tenderers who are registered on the City's official bidders list in accordance with the procedure outlined in section 2.4.01 b) above, as of the date the response is prepared by the City. Each Addendum will contain a signature page(s) which each Tenderer is required to sign and include with its Tender submission. While the City will make reasonable efforts to deliver each Addendum to all Tenderers, it makes no guarantee of timely delivery of any Addendum to any Tenderer.

2.5.03 Addenda: Responses to Enquiries and Amendments or Clarifications to Tender Documents (Cont'd)

The City will not identify the source of the question in the response. If a Tenderer requests that an enquiry be treated as confidential, the City, in its sole discretion, will either treat the enquiry or any reply as confidential or inform the Tenderer that it will not respond to the enquiry unless the Tenderer withdraws in writing its request that the enquiry be treated as confidential.

Orally communicated information shall not be binding upon the City. Information offered from sources other than the Authorized Enquiry Contact or the Designated Alternate Contact with regard to the content, intent or interpretation of this Tender is not official, may be inaccurate and should not be relied on in any way, by any Tenderer, for any purpose.

2.6 SUBMISSION OF TENDER

2.6.01 Location of Tender Box for the Submission of Tender

City of Saint John
175 Rothesay Avenue, 1st Floor
Saint John, New Brunswick

2.6.02 Tenders Must be Submitted Only in the Prescribed Manner

a) Tenders must be submitted in the prescribed *Form of Tender* together with the prescribed *Schedule of Quantities and Unit Prices*. The *Form of Tender* and the *Schedule of Quantities and Unit Prices* shall be filled out in ink or typewritten and bear the signature in longhand.

b) Tenderers must submit one completely filled out original *Form of Tender* signed by an authorized representative and should include the following information written on the outside of the sealed envelope:

(i) Tender No.: 2023-085104T

(ii) Title of Work: Thermal Interconnect – Market Square and Aquatic Centre

(iii) The full legal name and return address of the Tenderer; and

(iv) Tender Closing date and time.

c) Each Tender shall be accompanied by a Tender (Bid) Bond or certified cheque in the amount of ten percent (10%) of the Tender Price.

d) Each Tender must be sealed and be addressed to the attention of the Purchasing Agent, City of Saint John, 1st Floor, 175 Rothesay Avenue, Saint John, New Brunswick E2J 2B4.

e) All Tenders shall include a surety consent letter or agreement to bond as per the requirements in the Form of Tender.

2.6 SUBMISSION OF TENDER (Cont'd)

2.6.03 Contingency Allowance

The Tender Price shall include the contingency allowance as specified in the *Schedule of Quantities and Unit Prices*, to cover additional costs that may occur during the execution of the Contract attributed to approved additional work not originally contemplated. No part of this allowance shall be expended without the written direction of the Engineer, and any part not so expended shall be deducted from the contingency allowance.

2.6.04 Tenders Must be Placed in the Tender Box Before Tender Closing

It is the responsibility of each Tenderer to ensure that its Tender is placed in the Tender Box before Tender Closing. Tenders submitted by fax or by any other electronic transmission will not be considered.

Tenders submitted after Tender Closing will be deemed late, Disqualified and returned to the Tenderer unopened. For the purpose of calculating time, the City clock at the location of the Tender Box shall govern.

The City is not responsible for any Tender that has not been placed in the Tender Box by the Tenderer. The City assumes no responsibility for improperly addressed or delivered Tenders, Tenders that are left outside of the Tender Box, or sent by electronic transmission.

2.6.05 Amending or Withdrawing Tender Prior to Tender Closing

At any time prior to Tender Closing, a Tenderer may amend or withdraw a submitted Tender by placing an amending letter signed by the person who signed the Tender in a sealed envelope in the Tender Box before the Tender Closing.

The amending letter should clearly specify that the Tenderer intends to withdraw its Tender or, in the case of an amendment, clearly indicate the part of the Tender that the amending letter is intending to replace. In the case of a unit price contract, the amending letter shall show the revision to the Tender Price. In the case of a lump sum contract, the amending letter shall state the amount to be added or subtracted from the Tender Price.

The sealed envelope should clearly state the full legal name of the Tenderer, as well as the Tender No., Title of Work, and Tender Closing date and time as stated in section 2.6.02 b).

Amending letters that are left outside of the Tender Box, or sent by mail, by facsimile, electronically, or by other means will not be considered.

2.6.06 Tenderers Shall Bear the Costs of Preparing and Submitting a Tender

Under no circumstances will the City be responsible for a Tenderer's costs of preparing or submitting a Tender.

2.6 SUBMISSION OF TENDER (Cont'd)

2.6.07 Tenders in English

All Tenders are to be in English only. Any Tenders that are not entirely in the English language may be disqualified.

2.6.08 Tender Acceptance Period

Tenders submitted before Tender Closing shall remain open to acceptance in the form submitted by the Tenderer for a period of sixty (60) calendar days after Tender Closing. Failure of the Tenderer to keep the Tender open for sixty (60) calendar days will result in the enforcement of the Tender (Bid) Bond or the cashing of the certified cheque submitted in lieu of the Tender (Bid) Bond pursuant to section 2.6.02 c).

2.6.09 Tender Documents Incorporated Into Tender

By submission of a Tender, a Tenderer is deemed to have accepted and incorporated all the instructions and terms and conditions contained in the Tender Documents into its Tender. Submission of a Tender shall also confirm that the Tenderer is satisfied as to the correctness and sufficiency of the Tender, the Tender Price and the prices entered in the *Schedule of Quantities and Unit Prices*.

2.7 AMENDMENT OR WITHDRAWAL OF TENDER POST TENDER CLOSING

2.7.01 No Amendment Post Tender Closing

No Tenderer is permitted to amend or withdraw its Tender after Tender Closing. A Tenderer who discovers an error in the Tender after Tender Closing may leave the Tender as is or request permission from Common Council to withdraw its Tender. A request to withdraw a Tender after Tender Closing must be delivered, along with the reasons for the request, to the City Clerk for consideration by Common Council within twenty-four (24) hours of Tender Closing.

2.7.02 Withdrawal Requests

Common Council, in its sole discretion, will decide whether or not to grant the withdrawal request based on the information supplied by the Tenderer and a recommendation from City staff. Where Common Council, in its sole discretion, decides to not allow the withdrawal, Common Council may require the Tenderer to perform the Contract or forfeit the Tender (Bid) Bond or the certified cheque submitted in lieu thereof pursuant to section 2.6.02 c).

2.8 TENDER EVALUATION PROCESS

2.8.01 Delivery of Tender Box to Tender Opening Room

Immediately following Tender Closing, the Purchasing Agent shall deliver the Tender Box to the tender opening room where it will be opened by the Tender Opening Committee. **Tenderers who are on the official bidders list shall receive a Microsoft Teams invitation to view the opening online.**

2.8.02 Tender Opening Process

All Tenders shall be removed from Tender Box, opened, evaluated pursuant to Section 2.8.03, then read and recorded by the Tender Opening Committee in public at the Tender Opening Location. The Tender Opening Committee shall open each Tender individually. Tenders submitted by Tenderers who are not registered on the City's official bidders list according to the procedure outlined in section 2.4.01 b) will not be evaluated. The Tender Opening Committee will conduct the evaluation of the Tenders in two stages.

2.8.03 Stage 1: Evaluation of Mandatory Requirements

Stage 1 will consist of a review to determine which Tenders comply with all of the mandatory requirements. Tenders which do not comply with all of the mandatory requirements set out below, shall be Disqualified and not evaluated further.

Tenders shall be deemed as not complying with the mandatory requirements where:

a) The Tender is not in a sealed envelope which bears on its face the full legal name and address of the Tenderer, the Tender number, Title of Work and Tender Closing date and time.

b) The Tender is illegible or its pricing terms or conditions cannot be understood by the Tendering Opening Committee.

c) Where it is a Tender for more than one item and where it is required that all items be bid, there is a failure to bid an item or it does not contain a unit price or extended total of all items to be bid.

d) The Tender contains a bid on an item not included in the *Schedule of Quantities and Unit Prices*.

e) The Tender does not contain the total tender price, the unit prices or the fixed price written in words or does not have the words "dollars" and, where applicable, "cents" set out in the written total tender price, unit prices or fixed price on the *Schedule of Quantities and Unit Prices*.

f) The Tender is not accompanied by the required Tender (Bid) Bond or certified cheque pursuant to section 2.6.02 c).

g) The Tender does not include a fully completed prescribed Form of Tender, signed by an authorized agent, which bears the Tenderer's corporate seal, pursuant to section 2.6.02 a) and Division 4.

2.8.03 Stage 1: Evaluation of Mandatory Requirements (Cont'd)

h) The Tender does not include all required documents specified in the Form of Tender, does not comply with the provisions of the Tender Documents, or does not include the signature page(s) of all addenda issued to the Tenderers signed by the Tenderer.

i) The Form of Tender contains a change in price that is not initialed by the person signing the Form of Tender.

j) The Tender contains an unsolicited alternative or a qualification to the terms of the Tender Documents.

k) Where a Tenderer submits more than one Tender in response to the Request for Tender, all such Tenders shall be Disqualified.

Tenders which are Disqualified by the Tender Opening Committee will be returned to the Tenderer at the address contained in the Tender or in person if the Tenderer is present at the Tender Opening. Tender Prices of Disqualified Tenders will not be announced at the Tender Opening.

2.8.04 Stage 2: Evaluation of Tender Price

Stage 2 will consist of a recording of the Tender Prices by the Tender Opening Committee.

2.8.05 Selection of the Successful Tenderer

At the conclusion of Stage 1 and Stage 2 of the evaluation process and, subject to the approval of selection by Common Council and the reserved rights of the City, the selected Tenderer will enter into the Contract, as set out in the Tender Documents.

2.9 NOTICE OF SELECTION AND EXECUTION OF CONTRACT

2.9.01 Selection of Tenderer

Notice of selection by the City to the selected Tenderer will be in writing. Within five (5) Working Days following the City's notice of selection, the Tenderer shall provide to the City:

a) those items listed at section 6.8.04 ("Insurance Policies and Certificates");

b) an executed Form of Agreement (Division 5); and

c) the required Performance Guarantees pursuant to section 2.2.06

This provision is solely to the benefit of the City and may be waived by the City at its sole discretion.

2.9 NOTICE OF SELECTION AND EXECUTION OF CONTRACT (Cont'd)

2.9.02 Over-Budget Bids

If the Tender Price of the lowest compliant Tender exceeds the City's project budget or the Engineer's estimate for the Project, the City may proceed with negotiations with the lowest compliant Tenderer. Said negotiations shall be conducted within a prescribed timeframe to identify changes in scope and/or quantities of work, in exchange for a corresponding bid price reduction. Where the City and lowest compliant Tenderer establish acceptable changes and a corresponding bid price reduction, those changes shall be documented as post-bid addendum.

Any such negotiations or resulting recommendations shall be conditional and subject to the approval of Common Council and, in accordance with the Limitation of Liability and Waiver set out in section 2.12 below, there shall be no liability resulting from any failure to award a contract.

Where acceptable changes and a corresponding bid price reduction cannot be successfully negotiated with the lowest compliant Tenderer, the City may proceed with a new tender call at a later date.

2.9.03 Failure to Enter Into the Contract

In addition to all of the City's other remedies, such as the enforcement of the Tender (Bid) Bond, if a selected Tenderer fails to execute the Contract, or satisfy any of the applicable conditions set out above at section 2.9.01 within five (5) Working Days of the notice of selection, the City may, in its sole and absolute discretion and without incurring any liability rescind the selection of the Tenderer and proceed with the selection of the next lowest compliant Tenderer.

2.10 CONFIDENTIAL INFORMATION AND MEDIA COMMUNICATIONS

2.10.01 Tenderer's Confidential Commercial Information

The City is committed to an open and transparent Tendering Process while understanding the Tenderers' need for protection of confidential commercial information. To assist the City in meeting this commitment, Tenderers will cooperate and extend all reasonable accommodation to this endeavour.

2.10.02 Tenderer Not to Communicate With Media and Public

To ensure that all public information generated about the Work is fair and accurate, and will not inadvertently or otherwise influence the outcome of the Tendering Process, all public information generated in relation to the Work, including communications with the media and the public, must be coordinated with, and is subject to the prior approval of, the City.

2.10.02 Tenderer Not to Communicate With Media and Public (Cont'd)

Tenderers will notify the City of requests for information or interviews from the media.

Tenderers will ensure that all of the Tenderers' Subcontractors and others associated with the Tenderer comply with the foregoing requirements.

2.11 RESERVED RIGHTS

The City reserves the right to:

a) Reject an unbalanced Tender. For the purpose of this section, an unbalanced tender is a tender containing a unit price which deviates substantially from, or does not fairly represent reasonable and proper compensation for the unit of work bid or one that contains prices which appear to be so unbalanced as to adversely affect the interests of the City. The City reserves the right to use tenders submitted in response to this Request for Tender or for other like or similar work as a guideline in determining if a bid is unbalanced.

b) Amend or modify the scope of the Work, and/or cancel or suspend the Tender award, at any time for any reason;

c) Require Tenderers to provide additional information after the Tender Closing to support or clarify their Tender;

d) Not accept any or all Tenders;

e) Not accept a Tender from a Tenderer who is itself, or whose principals, owners or directors are also principals, owners or directors of another entity which is, involved in litigation, arbitration or any other similar proceeding against the City;

f) Reject any or all Tenders without any obligation, compensation or reimbursement to any Tenderer or any of its team members;

g) Withdraw this Request for Tender and cancel or suspend the Tendering Process;

h) Extend, from time to time, any date, any time period or deadline provided in this Tender (including, without limitation, the Tender Closing), upon written notice to all Tenderers;

i) Assess and reject a Tender on the basis of:

   (i) information provided by references;

   (ii) the Tenderer's past performance on previous contracts;

   (iii) the information provided by a Tenderer pursuant to the City exercising its clarification rights under this Tendering Process;

   (iv) the Tenderer's experience with performing the type and scope of work specified including the Tenderer's experience as a general contractor;

   (v) other relevant information that arises during this Tendering Process

2.11 RESERVED RIGHTS (Cont'd)

j) Waive formalities and accept Tenders which substantially comply with the requirements of this Request for Tender;

k) Verify with any Tenderer or with a third party any information set out in a Tender;

l) Disqualify any Tenderer whose Tender contains misrepresentations or any other inaccurate or misleading information;

m) Disqualify any Tenderer who has engaged in conduct prohibited by the Tender Documents;

n) Disqualify any Tenderer who is guilty of an offence listed in Schedule C of the New Brunswick Regulation 2014-93 under the Procurement Act;

o) Disqualify any Tenderer for documented significant or persistent deficiencies in fulfilling or performing a substantive requirement or obligation under a prior contract or contracts. The disqualification for past performance shall be conducted in accordance with sections 64 thru 81 of the New Brunswick Regulation 2014-93 under the Procurement Act;

p) Make changes, including substantial changes, to the Tender Documents provided that those changes are issued by way of addenda in the manner set out in these Instructions to Tenderers;

q) Select any Tenderer other than the Tenderer whose Tender reflects the lowest cost to the City;

r) Cancel this Tendering Process at any stage, for any reason;

s) Cancel this Tendering Process at any stage and issue a new Request for Tender for the same or similar deliverables;

t) Accept any Tender in whole or in part; or

u) Accept a Tender which contains the following errors:

(i) error in mathematics – whether this involves the extension of a unit price or an error in addition, the mistake will be corrected and the correct total will be used for evaluation purposes and will be binding on the Tenderer.

(ii) conflict between the written and numerical bid prices. In all cases, the total bid price will be corrected to reflect the written bid price, whether lump sum or unit price.

(iii) failure to include the contingency allowance in the total Tender Price. If the contingency allowance was not included in the addition, the Tender Price shall be corrected to reflect its inclusion.

and these reserved rights are in addition to any other express rights or any other rights which may be implied in the circumstances and the City shall not be liable for any expenses, costs, losses or any direct or indirect damages incurred or suffered by any Tenderer or any third party resulting from the City exercising any of its express or implied rights under this Request for Tender.

2.11 RESERVED RIGHTS (Cont'd)

By submitting a Tender, the Tenderer authorizes the collection by the City of the information set out at paragraph 2.11 i) in the manner contemplated in that subparagraph.

2.12 LIMITATION OF LIABILITY AND WAIVER

Each Tenderer, by submitting a Tender, agrees that:

a) Neither the City nor any of its employees, agents, advisors or representatives will be liable, under any circumstances, for any Claim arising out of this Tendering Process including but not limited to costs of preparation of the Tender, loss of profits, loss of opportunity or for any other Claim; and

b) The Tenderer waives any Claim for any compensation of any kind whatsoever, including Claims for cost of preparation of the Tender, loss of profit or loss of opportunity by reason of the City's decision to not accept the Tender submitted by the Tenderer, to award a Contract to any other Tenderer or to cancel this Tendering Process, and the Tenderer shall be deemed to have agreed to waive such right or Claim.

2.13 INVOICES

a) In light of the requirements of Section 169 of the *Excise Tax Act*, R.S.C. 1985,c. E-15, and amendments thereto, the selected Tenderer shall provide to the City properly documented invoices with all requests for payments. This includes a government issued business number and the amount of tax included on the invoice.

b) Failure to provide properly documented invoices may result in delays in processing payments or outright rejection of the payment request.

City of Saint John

APPENDIX 'A'

TENDERING POLICY FOR CONSTRUCTION CONTRACTS

City of Saint John

TENDERING POLICY FOR CONSTRUCTION CONTRACTS

PREAMBLE

Whereas the City of Saint John seeks to duly represent the public interest in the management of its public tendering process for construction contracts;

And whereas taxpayers/ratepayers have the right to expect the benefits of free and open competition, that is, the best goods and services at the lowest possible prices;

And whereas municipal tendering should duly respect the place of other stakeholders, including vendors and contractors, in the process;

And whereas the values of integrity, effectiveness, due process and efficiency must be inherent in the process;

Common Council establishes this tendering policy for construction contracts.

POLICY AND APPLICABLE STATUTES

Persons and/or companies that submit tenders for construction contracts are deemed to have understood and agreed to the requirements of this policy and all applicable tender documentation, as well as all applicable Municipal by-laws and Federal or Provincial statutes. Applicable federal and provincial statutes include, but are not limited to: the *Canada Competition Act*; the *New Brunswick Procurement Act*; *Construction Remedies Act*; *Local Governance Act* and the amendments thereto.

APPLICATION OF POLICY

The City of Saint John seeks to optimize fair, open and independent competition for municipal construction work and to afford interested and qualified contractors the opportunity to seek the business.

This policy has been established for construction contracts valued in excess of $100,000 (before HST). The procedures detailed herein shall apply to all publicly advertised tender calls issued on behalf of the City of Saint John for construction contracts, but do not apply to publicly advertised tenders for the supply of goods and/or services or to invited bids or calls for proposal.

The following divisions of tender specifications for construction contracts form part of this policy: *Instruction to Tenderers and Tendering Procedures* (Division 2); *Form of Tender* (Division 4); and *Form of Agreement* (Division 5).

PUBLIC NOTICE OF TENDER/TENDER ADVERTISEMENT

A public notice of tender shall be issued for all construction contracts valued in excess of one hundred thousand dollars ($100,000). The notice shall state the contract number, a brief description, the date and the time for the closing of tenders, the location of the locked box for receipt of tenders, and the date, time and location of the tender opening.

TENDER DOCUMENTATION

The following documentation shall be provided to those persons or companies who wish to submit a tender, at an appropriate cost as determined by the Chief City Engineer:

1. Division 1: *Project Description* – as determined by the Chief City Engineer or a designate;

2. Division 2: *Instruction to Tenderers and Tendering Procedures* – forming part of this policy;

3. Division 3: *Particular Specifications* - as determined by the Chief City Engineer or a designate;

4. Division 4: *Form of Tender* - forming part of this policy, and including a Certificate of Independent Tender Determination;

5. Division 5: *Form of Agreement* - forming part of this policy;

6. A notice that Division 6: *General Administration of Contract* and Division 7: *Construction of Municipal Services* of the General Specifications apply to all contracts, and that it is the responsibility of the tenderer to familiarize itself with the provisions in Divisions 6 and 7, as well as those of any other division in the General Specifications determined by the Chief City Engineer or a designate to be applicable to the contract; and

7. Applicable contract drawings, as determined by the Chief City Engineer or a designate.

TENDER PROCESSING

Tenders shall be received and processed in accordance with the provisions set out in Division 2: *Instruction to Tenderers and Tendering Procedures*.

TENDER OPENING COMMITTEE

A tender opening committee is hereby established, consisting of a chairman and two members, as follows:

Chair:	*Purchasing Agent or a designate*
Member:	*Chief City Engineer or a designate*
Member:	A member of staff designated by the City Manager

The committee shall proceed in accordance with the provisions set out in Division 2.

TENDER REJECTION AND AWARD OF CONTRACT

The City of Saint John reserves the right to reject any or all tenders, or to accept a tender other than the lowest tender and to accept the tender deemed to be in its best interests, based on evaluation of relevant criteria, including quality, service and price.

Common Council shall make the decision as to whether or not a contract shall be awarded and to whom it will be awarded.

GENERAL SPECIFICATIONS

The Chief City Engineer may, from time to time, revise the technical provisions of the General Specifications to reflect changes in technology, methods or construction industry practices.

City of Saint John

CONTRACT SPECIFICATIONS

DIVISION 3

PARTICULAR SPECIFICATIONS

OCTOBER 2023

Division 01 - General Requirements

Division 23 - Heating, Ventilating, and Air-Conditioning (HVAC)

Division 25 - Integrated Automation (By City of Saint John)

Division 26 - Electrical

Drawings

M-1 CANADA GAMES AQUATIC CENTER BASEMENT LEVEL – MECHANICAL NEW WORK

M-2 MARKET SQUARE LEVEL 8.4 MECHANICAL ROOM – MECHANICAL NEW WORK

M-3 DETAILS AND SCHEDULES

M-4 SCHEMATIC

E-1 CANADA GAMES AQUATIC CENTER BASEMENT LEVEL – ELECTRICAL NEW WORK

E-2 MARKET SQUARE LEVEL 8.4 – ELECTRICAL NEW WORK

E-3 ELECTRIC PANEL SCHEDULES

E-4 SINGLE LINE DIAGRAM

END OF SECTION

Part 1 General

1.1 GENERAL

.1 All articles in this Section are "Project Specific General Requirements". Refer also to front-end documents.

1.2 SUMMARY OF WORK

.1 This contract includes the supply of all plant, labour, materials and equipment necessary to complete the tender package.

.1 Contract method: Stipulated Sum.

.2 Owner's occupancy: Carry out work in manner to keep disruption of normal building activities minimized.

.2 Note: It is the intent that a Mechanical Contractor will act as the General Contractor and coordinate all other trades as required. Errors and omissions by sub-trades will be the responsibility of the Mechanical General Contractor. The work under this Contract includes, but is not limited to the following:

.1 General:

.1 Mechanical General Contractor is responsible for receipt of pre-ordered equipment (provided by City of Saint John). Equipment will be delivered to the Canada Games Aquatic Centre and shall be received, moved, installed and commissioned by the Mechanical General Contractor. Coordinate with the City Project Coordinator for shipment dates of equipment. All equipment has been stipulated to arrive on site prior to February 16th, 2024. The pre-ordered equipment is demonstrated on the drawings and consists of:

.1 High Temperature Heat Pump (HTHP-1)

.2 Circulator Pumps (10 such)

.3 Heat Exchangers (3 such)

.2 Provide all labour and materials to perform the work as indicated on the drawings and as described herein to the best standards of the industry and in accordance with Local Authority Having Jurisdiction requirements.

.3 Obtain all licenses, permits and approvals to perform the work under this contract.

.4 Provide protection of building, equipment and systems from all work performed under this contract.

.5 Provide all cutting and patching for work performed under this contract. Repair damaged surfaces and finishes to match existing.

.6 Provide for clean-up of all areas during and at the completion of work.

.7 Building will be occupied during regular working hours. Therefore, all work shall be executed in such a manner as to provide minimum interference with the use of the existing premises by the occupants and provide maximum safety of the occupants during the work period.

.8 Provide for identification of all new piping and equipment. Contractor to follow existing building nomenclature and standard.

.9 Provide all training, start-up reporting and close-out documentation.

.10 Provide user training and Operations and Maintenance Manuals.

.11 All work shall be done in accordance with all codes and standards related to the work being executed under this contract, including but not limited to:

- .1 National Building Code of Canada (NBC) – 2015.
- .2 National Plumbing Code of Canada (NPC) – 2015.
- .3 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standards.
- .4 Sheet Metal and air Conditioning Contractors (SMACNA) Standards.
- .5 National Fire Protection Association (NFPA) Standards and Fire Codes.

.12 Provide and install new piping, circulator pumps, heat exchangers, as indicated on drawings.

.13 This contractor to coordinate shut-downs required to complete the work.

.14 Provide power wiring, transformers and all other devices to power new control devices. Provide all required modifications to the electrical systems (i.e. including relays, transducers, contactors, transformers, switches, etc.) to make all control systems a complete operational package.

.15 Provide Testing, Adjusting and Balancing.

.16 Provide commissioning of all new equipment and systems, user training and updated operations and maintenance manuals.

.17 Owner will occupy premises during entire construction for execution of normal operations. Cooperate with Owner in scheduling operations to minimize conflict and to facilitate Owner usage.

.18 Work generating excessive noise to be completed outside the normal operation of the building.

.19 Connect all new mechanical equipment as indicated on drawings.

.20 Contractor responsible to provide all hydronic heating system draining and re-filling to perform the work. Provide hydronic system start-up as per specification.

.21 Provide all electrical power work for the new chiller, and new circulation pumps installation.

.22 Relocate all control devices, control junction box, cabinets, etc. in conflict with new piping and equipment installation.

.23 Relocate all lighting, electrical junction boxes, cabinets, etc. in conflict with new piping and equipment installation.

.24 Controls work shall be provided by the City of Saint John. Mechanical contractor responsible for providing thermal wells in piping as indicated on drawings to facilitate installation of controls work by the City.

1.3 SUBMITTALS

.1 This section must be coordinated with Section 01 00 02 - STANDARD GENERAL REQUIREMENTS for additional requirements regarding submittals procedures and information required.

.2 Consultant must stamp (received/date) all shop drawings, product data or any documentation requiring review upon arrival to his office. All documentation shall be reviewed, stamped, marked up as required and returned to the contractor at the latest, 10 working days after reception of the documents.

1.4 PROJECT COORDINATION

.1 Coordinate progress of the work, work schedules, submittals, use of site, temporary controls and access/control of site for heavy lifting.

.2 Schedule verification of site dimensions, shop drawing review and ordering of materials before work commences on site so that no delays will occur.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 New Brunswick Occupational Health and Safety Act.

.2 Canadian Hazardous Products Act.

1.2 CONTRACTOR QUALIFICATIONS

.1 Certificate of Recognition (COR) Program: The contractor shall for all projects with a tender value greater than $100,000.00 maintain a valid Letter of Good Standing in the New Brunswick Construction Safety Association (NBCSA) COR Program, or alternatively;

.1 Provide evidence of COR status from other member associations of the Canadian Federation of Construction Safety Associations using the NBCSA Reciprocal Process, or;

.2 Provide evidence of an audited construction safety program certified by an independent agency.

.1 Submit audited construction safety program 7 days prior to tender closing date for review and approval to SNB Buildings Construction at:

Constructionquestions@snb.ca

.2 Acceptance of an audited construction safety program certified by an independent agency will be at the discretion of the Engineer-Architect.

.3 Bidders are responsible to obtain approval for their construction safety program prior to placing their bid.

.3 Tenders without an approved “Construction Safety Certification” program at tender opening will be rejected for all projects with a value greater than $100,000.00.

.4 The Contractor shall maintain a valid COR until project Final Completion.

1.3 SUBMITTALS

.1 Make submittals in accordance with Section 01 00 02 - STANDARD GENERAL REQUIREMENT and Section 01 00 01 – PROJECT SPECIFIC GENERAL REQUIREMENTS.

.2 When requested by the Engineer-Architect, provide copies of the following:

.1 Site-specific hazard assessment.

.2 Contractor's safety policy.

.3 Provide name of person designated as Health and Safety Supervisor.

.4 Provide copies of accident and incident reports.

.5 Submit valid copy of Contractor's Worksafe NB coverage prior to commencement of Work.

.6 Submit copies of reports or directions issued by Federal, Provincial and Municipal health and safety inspectors.

.7 Provide Material Safety Data Sheets (MSDS) for controlled products specified by the regulations made under the Hazardous Materials Act.

1.4 COMPLIANCE REQUIREMENTS

.1 Comply with the latest version of the NB Occupational Health and Safety Act and Regulations. Refer to the WSNB Website under Policy and legal for the most up to date versions.

.1 Employers must ensure:

.1 They are in compliance with the Act and Regulations.

.2 Their employees are made aware of the rights and responsibilities within the act and Regulations and comply with the Act and regulations.

.3 That work at the place of employment is competently supervised.

1.5 AUTHORITY HAVING JURISDICTION

.1 The OHS Act is enforced by Worksafe NB.

1.6 SAFETY ASSESSMENT

.1 Perform site-specific safety hazard assessment related to project.

1.7 PROJECT CONDITIONS

.1 Refer to related technical specification sections for remediation procedures associated with hazardous materials.

1.8 SAFETY REQUIREMENTS

.1 Be responsible for Health and Safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.

.2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable Federal, Provincial and Local statutes, regulations, and ordinances.

1.9 ENVIRONMENTAL REQUIREMENTS

.1 Comply with the requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding the use, handling, storage and disposal of hazardous materials, and regarding the labelling and provision of MSDS data sheets.

1.10 MEETINGS

.1 Schedule and administer Health and Safety meetings in accordance with Section 01 00 02 - STANDARD GENERAL REQUIREMENTS and Section 01 00 01 – PROJECT SPECIFIC GENERAL REQUIREMENTS.

.2 Notify the nearest office of Worksafe NB to allow for a Commission representative at the project Start-Up Meeting.

1.11 HEALTH AND SAFETY SUPERVISOR

.1 Designate an employee who, in addition to their regular duties, will act as Health and Safety Supervisor, and be;

.1 Responsible for implementing, enforcing and monitoring health and safety provisions.

1.12 POSTING OF DOCUMENTS

.1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of New Brunswick.

1.13 CORRECTION OF NON-COMPLIANCE

.1 Immediately address health and safety non-compliance issues identified by Worksafe NB, Engineer-Architect, Federal, Provincial and Municipal health and safety inspectors.

.2 Provide Engineer-Architect with written reports of action taken to correct non-compliance of health and safety issues identified.

.3 Engineer-Architect may stop Work if non-compliance of health and safety regulations is not corrected. Delay claims will not be accepted for this matter.

1.14 BLASTING

.1 Blasting or other use of explosives is not permitted without prior receipt of written approval by Engineer-Architect.

1.15 POWDER ACTUATED DEVICES

.1 Use powder actuated devices only after receipt of written permission from Engineer-Architect.

END OF SECTION

Part 1 General

1.1 REFERENCES AND CODES

.1 Perform Work in accordance with National Building Code of Canada (NBC) 2005 including amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.

.2 Meet or exceed requirements of:

.1 Contract documents.

.2 Specified standards, codes and referenced documents.

1.2 HAZARDOUS MATERIAL DISCOVERY

.1 Asbestos: demolition of spray or trowel-applied asbestos is hazardous to health. Stop work immediately when material resembling spray or trowel-applied asbestos is encountered during demolition work. Notify City of Saint John Representative.

.2 PCB: Polychlorinated Biphenyl: stop work immediately when material resembling Polychlorinated Biphenyl is encountered during demolition work. Notify – City of Saint John Representative.

.3 Mould: stop work immediately when material resembling mould is encountered during demolition work. Notify – City of Saint John Representative.

1.3 BUILDING SMOKING ENVIRONMENT

.1 Smoking is not permitted in City of Saint John buildings.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 INSPECTION

.1 Refer to Standard Construction Documents – Version 2008.

.2 Allow City of Saint John Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.

.3 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by City of Saint John Representative's instructions, or law of Place of Work.

.4 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.

1.2 INDEPENDENT INSPECTION AGENCIES

.1 Provide equipment required for executing inspection and testing by appointed agencies.

.2 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.

.3 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by City of Saint John Representative at no cost to City of Saint John Representative. Pay costs for retesting and re-inspection.

1.3 ACCESS TO WORK

.1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.

.2 Co-operate to provide reasonable facilities for such access.

1.4 PROCEDURES

.1 Notify appropriate agency and City of Saint John Representative in advance of requirement for tests, in order that attendance arrangements can be made.

.2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.

.3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.5 REJECTED WORK

.1 Refer to Standard Construction Contract Documents – Version 2008.

.2 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by City of Saint John Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.

.3 Make good other Contractor's work damaged by such removals or replacements promptly.

.4 If in opinion of City of Saint John Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, City of Saint John Representative, will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by City of Saint John Representative.

1.6 REPORTS

.1 Submit 4 copies of inspection and test reports to City of Saint John Representative.

.2 Provide copies to subcontractor of work being inspected or tested and/or manufacturer or fabricator of material being inspected or tested.

1.7 EQUIPMENT AND SYSTEMS

.1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Temporary utilities.

1.2 RELATED SECTIONS

.1 Section 01 52 00 - Construction Facilities.

.2 Section 01 56 00 - Temporary Barriers and Enclosures.

1.3 INSTALLATION AND REMOVAL

.1 Provide temporary utilities controls in order to execute work expeditiously.

.2 Provide all temporary lighting or other such utilities.

.3 Remove from site all such work after use.

1.4 ELECTRICAL SUPPLY

.1 The owner will supply electricity for construction purposes at no cost to the Trade Contractor.

1.5 FIRE PROTECTION

.1 Provide and maintain temporary fire protection equipment during performance of work.

.2 Burning rubbish and construction waste materials is not permitted on site.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Construction Access.

.2 Elevators.

.3 Site Storage.

.4 Construction Office.

1.2 RELATED SECTIONS

.1 Section 01 14 00 - Work Restrictions.

.2 Section 01 51 00 - Temporary Utilities.

.3 Section 01 56 00 - Temporary Barriers and Enclosures.

1.3 INSTALLATION AND REMOVAL

.1 Provide construction facilities in order to execute work expeditiously.

1.4 SCAFFOLDING

.1 Provide and maintain scaffolding, ramps, ladders, work platforms, swing staging, platforms, temporary stairs, all other temporary services required to execute the work.

1.5 HOISTING

.1 Provide all cranes required for moving materials and equipment.

.2 Hoisting equipment to be operated by qualified operators.

1.6 ELEVATORS

.1 Elevators in existing buildings may be used, with prior written permission from the Owner, for access and moving of construction materials and equipment. The use of elevators in existing buildings shall be coordinated with the Construction Manager who will co-ordinate this with the Owner. In most cases the Trade Contractor's use of the elevator will be restricted to specified hours throughout the day. The Trade Contractor is responsible for the safe use of the elevator and protecting all finishes.

.2 Provide protective coverings for finish surfaces of cars and entrances.

.3 Interior of elevators shall be lined with plywood to act as protection against damage and shall remain in place for the duration of the project. Trade Contractor to remove plywood cladding once all renovations are complete.

1.7 SITE STORAGE / LOADING

.1 Confine work and operations of employees to areas within the Agreement documents. Do not unreasonably encumber premises with products.

.2 As there is limited storage area in the area of work, provide just in time delivery of materials.

.3 Do not load or permit to load any part of work with a weight or force that will endanger the work.

.4 As necessary, the Trade Contractor shall provide their own storage and means of securing the storage facilities, and shall carry all necessary insurances for any storage facility used as well as the contents stored in the trailer and on the grounds.

1.8 EQUIPMENT, TOOL AND MATERIALS STORAGE

.1 Provide and maintain, in a clean and orderly condition, lockable weatherproof storage of tools, equipment and materials.

1.9 SANITARY FACILITIES

.1 For work in existing buildings an existing washroom will be available for use by the Trade Contractor and workers. The Consultant will designate the washroom to be used. This facility must be kept clean by the Trade Contractor at all times. The washing of paint brushes, mixing of grout and other non personal hygiene activities in the washroom is strictly prohibited. Such non personal hygiene operations shall be carried out in a janitor's room designated by the Consultant.

1.10 FIRST AID

.1 Provide such equipment as required by the Occupational Health and Safety Act, to supply first aid service to anyone who may be injured on the work site. In case of serious injury or death, report the accident immediately to the proper authorities and to the Consultant and the Owner.

.2 Trade Contractor assigned Supervisor (site representative) to provide First Aid training certificate to the Consultant.

1.11 CONSTRUCTION ACCESS AND TRAFFIC MAINTENANCE

.1 Construction access to the work areas within existing building for workmen and delivery of materials will be designated by the Owner and/or Construction Manager. No other existing exits or entrances shall be used by workers for access or for delivery of materials.

.2 The Trade Contractor to conduct construction operations with minimum interference to adjacent roadways, sidewalks and access facilities in general and shall keep such areas free from materials, debris and equipment at all times.

.3 The Trade Contractor shall not close or obstruct existing roadways, sidewalks, parking areas or delivery points and to not place or store materials or park cars on same.

.4 The Trade Contractor shall obtain approval of his proposed haul routes from the Owner.

.5 Haul routes to be kept clean and free of dust.

.6 The Trade Contractor shall cooperate in all ways with the Owner and/or Construction Manager in all matters concerning necessary interference with normal operation of the Owner’s facilities. Minimizing disruption of normal building operation and vehicular movements around city properties is an essential requirement of the in undertaking the work.

.7 It is the requirement of the Trade Contractor to provide items such as but not limited to signage, traffic barriers, personnel barriers, to fully notify building occupants of all construction activities.

1.12 CONSTRUCTION PARKING

.1 Parking will be permitted on site provided it does not disrupt performance of Work.

.2 Provide and maintain adequate access to Owner's facility.

.3 Coordinate and cooperate with Owner to determine suitable parking areas.

.4 Clean access areas where used by Contractor's equipment.

.5 Repair and bring back to pre-existing conditions areas used for parking.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Barriers.

.2 Environmental Controls.

.3 Traffic Controls.

.4 Fire Routes.

1.2 RELATED SECTIONS

.1 Section 01 51 00 - Temporary Utilities.

.2 Section 01 52 00 - Construction Facilities.

1.3 REFERENCES

.1 Canadian Standards Association (CSA).

1.4 INSTALLATION AND REMOVAL

.1 Provide temporary controls in order to execute work expeditiously.

.2 Remove from site all such work after use.

1.5 GUARD RAILS AND BARRICADES

.1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs.

.2 Provide barricades to isolate work areas from public areas.

.3 Provide as required by governing authorities, or the Owners Safety Officer, as indicated.

1.6 FLOOR BARRICADES AND SIGNAGE (WHEN WORKING IN PUBLIC AREAS)

.1 Provide a 24" x 32" Metal "A" frame sign with red graphics.

.2 Two signs shall be located at each Work area and in public spaces (both ends – e.g. hallways) or one sign at the entrance to a room where work is ongoing.

.3 Red/Yellow caution tape shall be applied from sign to walls to cordon off Work area from the public. Comply with requirements of the site safety manual.

.4 Trade Contractor shall have a pair of signs for each work crew.

.5 Where work is occurring in a room, the work signs shall be located at the entrance to the room.

1.7 DUST TIGHT SCREENS

.1 Provide dust tight screens or partitions to localize dust generating activities, and for protection of workers, finished areas of Work and public.

.2 Maintain and relocate protection until such work is complete.

1.8 ACCESS TO SITE

.1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for Owner's personnel access to facilities and Trade Contractor's access to Work.

1.9 PUBLIC TRAFFIC FLOW

.1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform Work and protect public.

1.10 FIRE ROUTES

.1 Maintain access to property including overhead clearances for use by emergency response vehicles.

1.11 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

.1 Protect surrounding private and public property from damage during performance of work.

.2 Be responsible for damage incurred.

1.12 PROTECTION OF BUILDING FINISHES

.1 Provide protection for finished and partially finished building finishes and equipment during performance of work.

.2 Provide necessary screens, covers, and hoardings.

.3 Be responsible for damage incurred due to lack of or improper protection.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Within text of each specification section, reference may be made to reference standards.

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

.3 If there is question as to whether products or systems are in conformance with applicable standards, City of Saint John Representative reserves the right to have such products or systems tested to prove or disprove conformance.

.4 Cost for such testing will be borne by City of Saint John Representative in the event of conformance with Contract Documents or by 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 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.

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

.4 Should disputes arise as to quality or fitness of products, decision rests strictly with City of Saint John Representative based upon requirements of Contract Documents.

.5 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.

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

1.3 AVAILABILITY

.1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify City of Saint John Representative of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.

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

1.4 STORAGE, HANDLING AND PROTECTION

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

.2 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.

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

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

.5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

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

.7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.

.8 Remove and replace damaged products at own expense and to satisfaction of City of Saint John Representative.

.9 Touch-up damaged factory finished surfaces to City of Saint John Representative's satisfaction. Use touch-up materials to match original. Do not paint over nameplates.

1.5 TRANSPORTATION

.1 Pay costs of transportation of products required in performance of 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 City of Saint John Representative in writing, of conflicts between specifications and manufacturer's instructions, so that City of Saint John Representative will establish course of action.

.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes City of Saint John Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

1.7 QUALITY OF WORK

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

.2 Do not employ anyone unskilled in their required duties. City of Saint John Representative reserves the right to require 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 City of Saint John Representative whose decision is final.

1.8 CO-ORDINATION

.1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.

.2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.9 CONCEALMENT

.1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.

.2 Before installation inform City of Saint John Representative if there is interference. Install as directed by City of Saint John Representative.

1.10 REMEDIAL WORK

.1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate 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 Work.

1.11 LOCATION OF FIXTURES

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

.2 Inform City of Saint John Representative of conflicting installation. Install as directed.

1.12 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.

1.13 FASTENINGS - EQUIPMENT

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

.2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.

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

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

1.14 PROTECTION OF WORK IN PROGRESS

.1 Prevent overloading of parts of building. Do not cut, drill or sleeve load bearing structural member, unless specifically indicated without written approval of City of Saint John Representative.

1.15 EXISTING UTILITIES

.1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, and/or building occupants and pedestrian and vehicular traffic.

.2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 LOCATION OF EQUIPMENT AND FIXTURES

.1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.

.2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.

.3 Inform City of Saint John Representative of impending installation and obtain approval for actual location.

.4 Submit field drawings to indicate relative position of various services and equipment when required by City of Saint John Representative.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

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

.2 Submit written request in advance of cutting or alteration which affects:

- .1 Structural integrity of elements of project.
- .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 Owner or separate contractor.

.3 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 Owner or separate contractor.
- .7 Written permission of affected separate contractor.
- .8 Date and time work will be executed.

1.2 MATERIALS

.1 Required for original installation.

1.3 PREPARATION

.1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.

.2 After uncovering, inspect conditions affecting performance of Work.

.3 Beginning of cutting or patching means acceptance of existing conditions.

.4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.

1.4 EXECUTION

.1 Execute cutting, fitting, and patching to complete Work.

.2 Fit several parts together, to integrate with other Work.

.3 Remove and replace defective and non-conforming Work.

.4 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.

.5 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.

.6 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.

.7 Restore work with new products in accordance with requirements of Contract Documents.

.8 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

.9 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material.

.10 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.

.11 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

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

.2 Copy will be returned with City of Saint John Representative comments.

.3 Revise content of documents as required prior to final submittal.

.4 Two weeks prior to Substantial Performance of the Work, submit to the City of Saint John Representative, 3 final copies of operating and maintenance manuals for review.

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

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

.7 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.

.8 Pay costs of transportation.

1.2 FORMAT

.1 Organize data as instructional manual.

.2 Electronic Media for final copies.

.3 When multiple sections are used correlate data into related consistent groupings. Identify contents of each section within electronic media - sections.

.4 Arrange content by systems, under Section numbers and sequence of Table of Contents.

.5 Provide dividing sections for each separate product and system, with typed description of product and major component parts of equipment.

.6 Text: manufacturer's printed data, or typewritten data.

1.3 CONTENTS - EACH VOLUME

.1 Table of Contents: provide title of project;

- .1 Date of submission; names.
- .2 Addresses, and telephone numbers of Contractor and sub-contractor with name of responsible parties.
- .3 Schedule of products and systems, indexed to content of volume.

.2 For each product or system:

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

.3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.

.4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

.5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.

1.4 AS-BUILTS AND SAMPLES

.1 Maintain, at site one record copy of:

.1 Contract Drawings.
.2 Specifications.
.3 Addenda.
.4 Change Orders and other modifications to Contract.
.5 Reviewed shop drawings, product data, and samples.
.6 Field test records.
.7 Inspection certificates.
.8 Manufacturer's certificates.

.2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.

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

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

.5 Keep record documents and samples available for inspection by City of Saint John Representative.

1.5 RECORDING ACTUAL SITE CONDITIONS

.1 Record information on set of black line opaque drawings, provided by City of Saint John Representative.

.2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.

.3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.

.4 Contract Drawings and shop drawings: mark each item to record actual construction, including:

.1 Measured depths of elements of foundation in relation to finish first floor datum.

.2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

.3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.

.4 Field changes of dimension and detail.

.5 Changes made by change orders.

.6 Details not on original Contract Drawings.

.7 References to related shop drawings and modifications.

.5 Specifications: mark each item to record actual construction, including:

.1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.

.2 Changes made by Addenda and change orders.

.6 Other Documents: maintain manufacturer's certifications required by individual specifications sections.

1.6 EQUIPMENT AND SYSTEMS

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

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

.3 Include installed colour coded wiring diagrams.

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

.5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

.6 Provide servicing and lubrication schedule, and list of lubricants required.

.7 Include manufacturer's printed operation and maintenance instructions.

.8 Include sequence of operation by controls manufacturer.

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

.10 Provide installed control diagrams by controls manufacturer.

.11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.

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

.13 Additional requirements: as specified in individual specification sections.

1.7 MATERIALS AND FINISHES

.1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.

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

.3 Additional Requirements: as specified in individual specifications sections.

1.8 SPARE PARTS

.1 Provide spare parts, in quantities specified in individual specification sections.

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

.3 Deliver to site; place and store.

.4 Receive and catalogue items. Submit inventory listing to City of Saint John Representative. Include approved listings in Maintenance Manual.

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

1.9 MAINTENANCE MATERIALS

.1 Provide maintenance and extra materials, in quantities specified in individual specification sections.

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

.3 Deliver to site; place and store.

.4 Receive and catalogue items. Submit inventory listing to City of Saint John Representative. Include approved listings in Maintenance Manual.

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

1.10 SPECIAL TOOLS

.1 Provide special tools, in quantities specified in individual specification section.

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

.3 Deliver to site; place and store.

.4 Receive and catalogue items. Submit inventory listing to City of Saint John Representative. Include approved listings in Maintenance Manual.

1.11 STORAGE, HANDLING AND PROTECTION

.1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.

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

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

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

.5 Remove and replace damaged products at own expense and to satisfaction of City of Saint John Representative.

1.12 GUARANTEE

.1 Guarantee the Work for a period of 1 year, from the date of interim/substantial acceptance by the City of Saint John Representative or for longer periods as called for in the Contract Documents.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

.1 Demonstrate scheduled operation and maintenance of equipment and systems to Owner's personnel two weeks prior to date of final inspection.

.2 Owner will provide list of personnel to receive instructions, and will co-ordinate their attendance at agreed-upon times.

.3 Demonstrate operation of Energy Management Control System, Stack economizer system and DHW heat exchanger systems.

1.2 QUALITY CONTROL

.1 When specified in individual Sections require manufacturer to provide authorized representative to demonstrate operation of equipment and systems, instruct Owner's personnel, and provide written report that demonstration and instructions have been completed.

1.3 SUBMITTALS

.1 Submittals: in accordance with Section 01 00 02 – Standard General Requirements.

.2 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for City of Saint John Representative's approval.

.3 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.

.4 Give time and date of each demonstration, with list of persons present.

1.4 CONDITIONS FOR DEMONSTRATIONS

.1 Equipment has been inspected and put into operation.

.2 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.5 PREPARATION

.1 Verify that conditions for demonstration and instructions comply with requirements.

.2 Verify that designated personnel are present.

1.6 DEMONSTRATION AND INSTRUCTIONS

.1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at scheduled agreed upon times, at the designated location.

.2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.

.3 Review contents of manual in detail to explain aspects of operation and maintenance.

.4 Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instructions.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 General requirements relating to commissioning of project's equipment and systems, specifying general requirements for static, start-up and functional performance verification and testing of components, equipment, sub-systems, systems, and integrated systems.

1.2 ABBREVIATIONS

.1 The following are common abbreviations used in this document:

A/E	Design Team Consultants
BOD	Basis of Design
CC	Controls Contractor
Cx	Commissioning
CxA	Commissioning Agent / Authority
EC	Electrical Contractor
FPT	Functional Performance Test
FPTF	Functional Performance Test Form
GC	General Contractor (or Prime Contractor)
MC	Mechanical Contractor
Mfr	Manufacturer
PC	Plumbing Contractor
OPR	Owner’s Project Requirements
RFI	Request for Information
SUF	Start-Up Form
SVF	Static Verification Form
TAB	Test and Balance Contractor

1.3 SCOPE OF WORK

.1 Provide material, tools, labour and supervision necessary to assist the CxA in the verification of commissioning of the equipment and systems as outlined in this and related Sections.

.2 Coordinate, cooperate, and harmonize efforts with the CxA.

.3 Commissioning shall be done in accordance with this and related Sections and the Commissioning Plan.

.4 Once the contractor’s commissioning is completed as outlined in the Contract Documents, provide material, tools, labour and supervision to verify in detail with the CxA that the equipment and systems have been commissioned in accordance with this and related Sections.

1.4 GENERAL

.1 Commissioning is a planned program of tests, procedures and checks systematically carried out on equipment, systems and integrated systems of the finished Project to verify that they meet the Owner's Project Requirements. Commissioning is performed after systems and integrated systems are completely installed, functional and the Contractor's responsibilities have been completed and approved.

.2 Objectives:

.1 Verify installed equipment, systems and integrated systems operate in accordance with the Owner's Project Requirements, the contract documents and design criteria and intent.

.2 Verify that O&M personnel have been fully trained in all aspects of the installed equipment and systems.

.3 Proper documentation relating to the commissioned equipment and systems are compiled and provided to the Owner.

.3 Contractor participates in the Cx process, operating equipment and systems, troubleshooting and making adjustments as required:

.1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be operated interactively with each other as intended in accordance with Contract Documents and design criteria.

.2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.

.4 Design Criteria: as per the Owner's Project Requirements or determined by designer. To meet the Project's functional and operational requirements.

1.5 COMMISSIONING OVERVIEW

.1 Pay costs associated with starting, testing, adjusting and relevant instruments and supplies required to perform duties outlined in this and related Sections.

.2 Cx activities supplement field quality and testing procedures described in relevant technical sections of the Contract Documents. Cx activities do not relieve the Contractor from the contractual requirements outlined in other specification sections of the Contract Documents. Cx activities do not circumvent or relieve the Contractor from warranty requirements, responsibilities or obligations.

.3 Cx is conducted in concert with other activities performed during various stages of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the Project is constructed and proven to operate satisfactorily under various weather, environmental and occupancy conditions to meet the functional and operational requirements. Cx activities include transfer of critical knowledge to facility operational personnel.

.4 Ensure all systems have been started, adjusted to design criteria, and are functionally operational, ready for independent testing. The CxA will not begin Functional Performance Testing until satisfied that all requirements have been met. The CxA reserves right to request inspection reports and sign-off from Contractor or Consultant that equipment and systems are ready for Functional Performance Testing.

.5 Employ experienced personnel for equipment start up and commissioning, who are able to interpret results of readings and tests, and report the system status in a clear and concise manner.

.6 Provide all equipment required to perform testing, balancing, and commissioning of systems. Calibrate instruments used in start-up; provide calibration certificates if requested by the CxA.

.7 Utilize equipment check certificates and other commissioning documents required by the CxA.

.8 Verify that equipment is installed in accordance with Contract Documents, and reviewed shop drawings. Sign and date Static Verification forms and Start-Up Forms.

.9 Do not start up equipment unless Static Verification forms have been completed and submitted.

.10 Commissioning will be considered complete once:

.1 Completed Cx documentation has been received, reviewed for suitability and approved by the CxA and the Owner.

.2 Equipment, components and systems have been commissioned and all issues have been addressed to the satisfaction of the Owner.

.3 O&M training has been completed.

1.6 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

.1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the non-functional system, including related systems as deemed required by the CxA to ensure effective performance.

.2 Costs for corrective work, additional tests and inspections to determine acceptability and proper performance of such items to be borne by the Contractor. Above costs to be in the form of progress payment reductions or hold-back assessments.

1.7 PRE-CX REVIEW

.1 Before Construction:

.1 Review contract documents, confirm in writing to CxA:

.1 Adequacy of provisions for Cx.

.2 Aspects of design and installation pertinent to success of Cx.

.2 During Construction:

.1 Co-ordinate provision, location and installation of provisions for Cx.

.3 Before start of Cx:

.1 Have completed Cx Plan up-to-date.

.2 Ensure installation of related components, equipment, sub-systems, and systems are complete.

.3 Fully understand Cx requirements and procedures.

.4 Understand completely design criteria and intent and special features.

.5 Submit complete start-up documentation to CxA and Owner for review.

.6 Have Cx schedule up-to-date.

.7 Ensure systems have been cleaned thoroughly.

.8 Complete TAB procedures on systems; submit TAB reports to CxA and Owner for review.

.9 Ensure "As-Built" system schematics are available.

.4 Inform CxA and Owner, in writing, of discrepancies and deficiencies on finished works.

1.8 CONFLICTS

.1 Report conflicts between requirements of this section and other sections to CxA, Owner and Design Consultants before start-up and obtain clarification.

.2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

1.9 COMMISSIONING DOCUMENTATION

.1 Contractor to provide cut sheets, shop drawings, installation and start-up checklists and O&M and troubleshooting procedures as requested by the CxA. CxA may request information prior to normal O&M manual submission process.

1.10 COMMISSIONING SCHEDULE

.1 General sequence of events:

.1 Equipment is not “temporarily” started until pre-start checklist items and all manufacturers’ pre-start procedures are completed and moisture, dust and other environmental and building integrity issues have been addressed.

.2 Functional testing is not begun until Static Verification, Pre-Functional, Start-Up and TAB is completed, for a given system (this does not preclude a phased approach).

.3 The controls system and equipment it controls are not functionally tested until all points have been calibrated and pre-functional testing is completed.

.4 TAB is not performed until the controls system has been sufficiently functionally tested and approved by the CxA for TAB work

.5 TAB is not performed until the envelope is completely enclosed and ceiling complete, unless the return are is ducted.

.2 Provide detailed Cx schedule as part of the construction schedule and in accordance with the Contract Documents.

.3 A general overview of activities is provided in the Cx Plan.

.4 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:

.1 Approval of Cx documentation and reports.

.2 Verification of reported results.

.3 Repairs, retesting, re-commissioning, re-verification.

.4 Training.

1.11 COMMISSIONING MEETINGS

.1 Purpose: to identify and resolve issues and monitor progress relating to Cx.

.2 Participate in and cooperate fully in the Cx meetings, chaired by the CxA.

.3 The CxA will convene an initial Cx meeting to:

.1 Review the Cx Plan and Cx schedule

.2 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.

.3 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.

.4 Review activities, requirements and expectations during the Cx process.

.4 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.

.5 Meetings will be chaired by CxA who will record and distribute minutes.

.6 Ensure subcontractors and relevant manufacturer representatives are present at initial and subsequent Cx meetings and as required.

1.12 STARTING AND TESTING

.1 Contractor assumes liabilities and costs for inspections. Include disassembly and re-assembly after approval, starting, testing and adjusting, and supply of testing equipment.

1.13 WITNESSING OF START-UP, TESTING AND BALANCING

.1 Provide 14 days' notice prior to commencement.

.2 Allow Cx team members to witness start-up, testing, adjusting and balancing procedures.

.3 CxA reserves the right to witness start-up and testing.

.4 Contractor to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

1.14 ACCESS TO THE SITE

.1 Allow CxA free access to the site for scheduled and un-scheduled visits, inspections and other Cx activities.

1.15 MANUFACTURER'S INVOLVEMENT

.1 Factory testing: Manufacturer to:

.1 Coordinate time and location of testing.

.2 Provide testing documentation for approval by Consultant.

.3 Arrange for Consultant to witness tests.

.4 Obtain written approval of test results and documentation from [Consultant before delivery to site.

.2 Obtain Manufacturer's installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Consultant and CxA:

.1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.

.2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.

.3 Integrity of warranties:

.1 Use manufacturers trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.

.2 Verify with manufacturer that testing as specified will not void warranties.

.4 Qualifications of manufacturer's personnel:

.1 Experienced in design, installation and operation of equipment and systems.

.2 Ability to interpret test results accurately.

.3 To report results in clear, concise, logical manner.

1.16 PROCEDURES

.1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.

.2 Conduct start-up and testing and Cx in following distinct phases:

.1 Included in delivery and installation:

.1 Verification of conformity to specification, approved shop drawings and completion of Static Verification forms.

.2 Visual inspection of quality of installation.

.2 Start-up: follow accepted start-up procedures and complete Start-Up forms.

.3 Operational testing: document equipment performance.

.4 Conduct Functional Performance Testing in presence of CxA, including repetition of tests after correcting issues identified during initial FPT.

.5 Conduct fine-tuning as required by Consultants and CxA.

.3 Correct issues and obtain approval from Consultant and CxA after distinct phases have been completed and before commencing next phase.

.4 Document required tests on approved Cx forms.

.5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency, selected by the Owner. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:

.1 Minor equipment/systems: implement corrective measures approved by Consultant and Owner.

.2 Major equipment/systems:

.1 If evaluation report concludes that damage is minor, implement corrective measures approved by Consultant and Owner.

.2 If evaluation report concludes that major damage has occurred, Consultant and Owner shall reject equipment.

.1 Rejected equipment to be removed from site and replace with new.

.2 Subject new equipment/systems to specified start-up procedures.

1.17 START-UP DOCUMENTATION

.1 Assemble start-up documentation and submit to Consultant and CxA for review and approval before commencement of Functional Performance Testing.

.2 Start-up documentation to include:

.1 Factory and on-site test certificates for specified equipment.

.2 Pre-start-up inspection reports.

.3 Signed installation/start-up check lists.

.4 Start-up reports,

.5 Step-by-step description of complete start-up procedures to permit Owner to repeat start-up at any time.

1.18 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

.1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.

.2 With assistance of manufacturer develop written maintenance program and submit to Consultant for approval before implementation.

.3 Operate and maintain systems for length of time required for commissioning to be completed.

.4 After completion of commissioning, operate and maintain systems until issuance of certificate of acceptance.

1.19 TEST RESULTS

.1 If start-up, testing and/or FPT produce unacceptable results, repair, replace or repeat specified starting, testing and/or FPT procedures until acceptable results are achieved.

.2 Provide manpower and materials. Assume all costs for re-commissioning.

1.20 START OF COMMISSIONING

.1 Notify Consultant and CxA at least 21 days prior to start of Cx.

.2 Start Cx after elements of building affecting start-up and FPT verification of systems have been completed.

1.21 INSTRUMENTS / EQUIPMENT

.1 Submit to Consultant and CxA for review and approval:

.1 Complete list of instruments proposed to be used.

.2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.

.2 Provide the following equipment as required:

.1 2-way radios.

.2 Ladders.

.3 Equipment as required to complete work.

1.22 PRE-REQUISITES FOR FUNCTIONAL PERFORMANCE TESTING

.1 Prerequisites for functional testing are as follows:

.1 All related equipment has been started up and start-up reports and pre-functional checklists are submitted and approved ready for functional testing.

.2 All control system functions for this and all interlocking systems are programmed and operable per contract documents, including final setpoints and schedules with debugging, loop tuning and sensor calibrations completed.

.3 Piping system flushing complete and required report approved.

.4 Water treatment system complete and operational.

.5 Vibration control report approved (if required).

.6 Test and balance (TAB) complete and approved for the air and hydronic systems.

.7 All A/E deficiency list items for the equipment specified are corrected.

.8 Functional test procedures have been reviewed and approved by installing contractor.

.9 Safeties and operating ranges reviewed by the CxA and the Contractor.

.10 Test requirements and sequences of operation provided.

.11 Schedules and setpoints provided.

.12 False loading equipment, system and procedures ready.

.13 Crankcase heaters have been on long enough for start-up.

.14 Sufficient clearance around equipment for servicing.

.15 Record of all values for pre-test setpoints changed to accommodate testing has been made and a check box provided to verify return to original values (control parameters, limits, delays, lockouts, schedules, etc.)

.16 Other miscellaneous checks of the pre-functional checklist and start-up reports completed successfully.

.17 Points verification report from Control Contractor has been provided.

1.23 COMMISSIONING FUNCTIONAL PERFORMANCE TESTING

.1 Carry out Cx:

.1 Under actual or accepted simulated operating conditions, over entire operating range, in all modes.

.2 On independent systems and interacting systems.

.2 Cx procedures to be repeatable and reported results are to be verifiable.

.3 Follow equipment manufacturer's operating instructions.

.4 EMCS trending to be available as supporting documentation for performance verification.

.5 Ensure all systems have been started, adjusted to design criteria, and are functionally operational, ready for independent testing. The CxA will not begin Functional Performance Testing until satisfied that all requirements have been met. The CxA reserves right to request inspection reports and sign-off from Contractor or Consultant that equipment and systems are ready for Functional Performance Testing.

1.24 WITNESSING COMMISSIONING

.1 CxA and Consultant to witness activities and verify results.

1.25 AUTHORITIES HAVING JURISDICTION

.1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.

.2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.

.3 Provide copies to CxA and Consultant within 5 days of test and with Cx report.

1.26 EXTRAPOLATION OF RESULTS

.1 Where Cx of weather, occupancy, or seasonal-sensitive equipment or systems cannot be conducted under near-rated or near-design conditions, extrapolate part-load results to design conditions when approved by CxA and Consultant in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

1.27 EXTENT OF VERIFICATION

.1 Provide manpower and instrumentation to verify reported results based on the sampling strategy outlined in the Project Specifications and the Commissioning Plan.

.2 Number and location to be at discretion of CxA.

.3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.

.4 Review and repeat commissioning of systems if inconsistencies found in more than 10% of reported results.

.5 Perform additional commissioning until results are acceptable to CxA, Consultant and Owner.

1.28 REPEAT VERIFICATIONS

.1 Assume costs incurred by CxA and Consultant for third and subsequent verifications where:

.1 Verification of reported results fail to receive Consultant's or CxA’s approval.

.2 Repetition of second verification again fails to receive approval.

.3 CxA deems Contractor's request for second verification was premature.

1.29 SUNDRY CHECKS AND ADJUSTMENTS

.1 Make adjustments and changes which become apparent as Cx proceeds.

.2 Perform static and operational checks as applicable and as required.

1.30 DEFICIENCIES, FAULTS, DEFECTS

.1 Correct deficiencies found during start-up and Cx to satisfaction of Consultant and CxA.

.2 Report problems, faults or defects affecting Cx to CxA and Consultant in writing. Stop Cx until problems are rectified. Proceed with written approval from Consultant.

1.31 O&M MANUALS

.1 Provide copy of O&M Manual for review by CxA, as requested.

1.32 WARRANTY PERIOD

.1 During the warranty period, required seasonal testing and other deferred testing is completed according to the Specifications. The CxA coordinates this activity. Contractor to cooperate fully with the CxA. Tests are executed and issues are corrected by the appropriate Sub-Contractors, witnessed by facilities staff and the CxA. Any final adjustments to the O&M manuals and as-builts due to the testing are to be made by the Sub-Contractor.

.2 At the discretion of the CxA, the CxA and the Contractor will return to the project approximately 10 months into the 12 month warranty period. During this visit(s) the CxA will review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal commissioning.

.3 Contractor to cooperate fully with CxA for Cx activities during the Warranty Period.

1.33 COMPLETION OF COMMISSIONING

.1 Upon completion of Cx leave systems in normal operating mode.

.2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.

.3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by the CxA and the Owner.

1.34 ACTIVITIES UPON COMPLETION OF COMMISSIONING

.1 When changes are made to baseline components or system settings established during Cx process, provide updated Cx form for affected item.

1.35 FINAL COMMISSIONING REPORT AND SYSTEMS MANUALS

.1 CxA responsible for completion of Commissioning Report and Systems Manual, as applicable.

.2 Contractor to cooperate fully and provide all documentation required by CxA to complete the Final Commissioning Report and System manuals.

1.36 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

.1 Supply, deliver, and document maintenance materials, spare parts, and special tools as specified in contract.

1.37 OCCUPANCY

.1 Cooperate fully with CxA during stages of acceptance and occupancy of facility.

1.38 INSTALLED INSTRUMENTATION

.1 Use instruments installed under Contract for TAB and FPT if:

.1 Accuracy complies with these specifications.

.2 Calibration certificates have been deposited with the CxA and the Consultant.

.2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

1.39 PERFORMANCE VERIFICATION TOLERANCES

.1 Application tolerances:

.1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within +/- 10% of specified values.

.2 Instrument accuracy tolerances:

.1 To be of higher order of magnitude than equipment or system being tested.

.3 Measurement tolerances during verification:

.1 Unless otherwise specified actual values to be within +/- 2 % of recorded values.

1.40 OWNER'S PERFORMANCE TESTING

.1 Performance testing of equipment or system by Owner, CxA or Consultant will not relieve Contractor from compliance with specified start-up and testing procedures.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Description of overall structure of the Commissioning Plan and roles and responsibilities of the Commissioning Team.

.2 Related Requirements:

.1 Section 01 91 13 General Commissioning Requirements.

.2 Section 01 91 33 Commissioning Forms.

.3 Section 01 91 41 Commissioning Training.

.4 Preliminary Commissioning Plan.

1.2 ABBREVIATIONS

.1 The following are common abbreviations used in this document:

A/E	Design Team Consultants
BOD	Basis of Design
CC	Controls Contractor
Cx	Commissioning
CxA	Commissioning Agent / Authority
EC	Electrical Contractor
FPT	Functional Performance Test
FPTF	Functional Performance Test Form
GC	General Contractor (or Prime Contractor)
MC	Mechanical Contractor
Mfr	Manufacturer
PC	Plumbing Contractor
OPR	Owner's Project Requirements
RFI	Request for Information
SUF	Start-Up Form
SVF	Static Verification Form
TAB	Test and Balance Contractor

1.3 GENERAL

.1 The Cx Plan aids the building design, construction and operations team in verifying that the project will meet the Owner's Project Requirements. It sets out the process and methodology for the successful commissioning of the project during the design and construction phases. The Cx Plan also acts as a communication tool to facilitate each team member's understanding of their roles and responsibilities in the commissioning process.

.2 The Cx Plan is a living document in that information is added and modified as the project progresses.

.3 The Cx Plan does not relieve the project team from contractual requirements outlined in the other specification sections of this project. The project specifications may include special testing requirements for equipment. These tests are mutually exclusive of the verification and functional procedures outlined in the Cx Plan.

.4 The Project Specifications will take precedence in the event of a contradiction or conflict between the Project Specification and the Cx Plan.

1.4 PURPOSE OF THE COMMISSIONING PLAN

.1 The purpose of the Cx Plan is to provide direction for the commissioning process during construction by:

.1 Outlining the organization, scheduling, allocation of resources, documentation, pertaining to the implementation of Cx.

.2 Communicating the responsibilities of the team members involved in Cx scheduling, activities, documentation requirements, and verification procedures.

.3 Setting out the deliverables relating to the process and administration of Cx.

.4 Describes the process for the verification of how the equipment and systems meet the Owner’s Project Requirements and the design intent.

.5 Producing a complete functional system prior to issuance of Certificate of Occupancy.

.6 Acting as a management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:

.1 Overview of Cx.

.2 General description of elements that make up Cx Plan.

.3 Process and methodology for successful Cx.

1.5 DEVELOPMENT OF FINAL CX PLAN

.1 The CxA is responsible for developing the preliminary and final Cx Plan.

.2 Cx Plan provided as part of the project specifications is preliminary only and is subject to change as project progresses.

.3 Cx Plan to be finalized by the CxA to take into account:

.1 Approved shop drawings and product data.

.2 Approved changes to contract.

.3 Contractor's project schedule.

.4 Cx schedule.

.5 Contractor's, Sub-Contractor's, suppliers' requirements.

.6 Project construction team's and Cx team's requirements.

.4 The CxA will provide a final commissioning plan prior to the start of the commissioning activities.

1.6 REFINEMENT OF CX PLAN

.1 During the construction phase, the CxA will revise, refine and update the Cx Plan to include:

.1 Changes resulting from Client program modifications.

.2 Approved design and construction changes.

1.7 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM

.1 The CxA will coordinate the commissioning process. The GC and all sub-contractors are expected to cooperate fully with the CxA.

.2 All members of the Cx Team will work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents.

.3 A general description of the commissioning roles is as follows:

.1 CxA:

.1 Reports to the Owner.

.2 Develops and updates the Commissioning Plan.

.3 Coordinates the Commissioning Process.

.4 Reviews commissioning documentation and other test reports for compliance with the Contract Documents. Commissioning documentation includes, but is not limited to SVF, SUF and FPTF.

.5 Prepares, oversees and documents Functional Performance Tests.

.6 Verifies that the systems are performing in accordance with Contract Documents.

.7 Develops General Training Plan and coordinates training.

.8 Prepares a final Commissioning Report, with the assistance of the Commissioning Team.

.2 GC:

.1 Facilitates and supports the Commissioning Process.

.2 Coordinates the response to RFIs throughout the commissioning process.

.3 Ensures that all subcontractors fulfill their commissioning responsibilities.

.4 Integrates Commissioning into the Construction Process and Schedule.

.5 Coordinates and provides Training.

.6 Includes the CxA on the distribution lists for project documents such as shop drawings and start-up reports.

.3 Subcontractors (MC, EC, PC, CC, TAB and others):

.1 Completes all required start-up and testing activities, as outlined in the project specifications, prior to commencement of the FPT by the CxA.

.2 Demonstrates proper system performance and perform the actual testing as designated by the Commissioning Team.

.3 Coordinates with manufacturers and suppliers to provide documentation requested by the Commissioning Team.

.4 Completes commissioning documentation as outlined in the Commissioning Plan.

.5 Conducts training and coordinates with Manufacturers.

.4 A/E:

.1 Develops Basis of Design document, project specifications and drawings.

.2 Provides clarification on the design intent to the Cx Team, as required.

.3 Responds to RFIs relating to the commissioning process.

.4 Reviews or inspects installed equipment and systems for compliance with the project specifications prior to commencement of the FPT by the CxA.

.5 Participates in the training process, as required.

.5 Owner and Owner's Representative:

.1 Develops the Owner's Project Requirements.

.2 Gives final approval of the Commissioning work.

.3 Coordinates the involvement of user representatives in the commissioning and training process.

1.8 OTHER CX PARTICIPANTS

.1 The General Contractor and Sub-contractors are expected to employ the following Cx participants to verify performance of equipment and systems, as required:

.1 Installation contractor/subcontractor:

.1 Equipment and systems except as noted.

.2 Equipment manufacturer: equipment specified to be installed and started by manufacturer.

.1 To include performance verification.

.3 Specialist subcontractor: equipment and systems supplied and installed by specialist subcontractor.

.4 Specialist Cx agency:

.1 Possessing specialist qualifications and installations providing environments essential to client's program but are outside scope or expertise of Cx specialists on this project.

.5 Owner: equipment for which the Owner is the specialist.

.2 Ensure that Cx participant:

.1 Could complete work within scheduled time frame.

.2 Available for emergency and troubleshooting service during first year of occupancy by user for adjustments and modifications outside responsibility of O&M personnel, including:

.1 Modify ventilation rates to meet changes in off-gassing.

.2 Changes to heating or cooling loads beyond scope of EMCS.

.3 Changes to EMCS control strategies beyond level of training provided to O M personnel.

.4 Redistribution of electrical services.

.5 Modifications of fire alarm systems.

.6 Modifications to voice communications systems.

.3 Provide names of participants to the CxA prior to starting date of Cx for review and approval.

1.9 COMMISSIONING PROCESS

.1 General overview of Commissioning Process is included in Project Specifications and Commissioning Plan.

.2 CxA to lead the Commissioning Team during through the Commissioning Process.

.3 Contractor and other Commissioning Team members shall cooperate fully with the CxA

1.10 EQUIPMENT AND SYSTEMS TO BE COMMISSIONED

.1 Commissioning and training for the following systems and equipment will be verified as part of the commissioning process. Multiple, identical pieces of non-life-safety or otherwise non-critical equipment may be functionally tested using a sampling strategy. The CxA will provide the sampling strategy as required:

.1 Pumps and circulators.

.2 Water to Water Heat Exchangers.

.3 Chillers.

.4 BAS and sequences associated with:

.1 New equipment listed above.

.2 Modifications to existing AHUs, and perimeter heating loop.

.5 TAB.

.6 Other systems as defined by the Commissioning Agent.

1.11 DELIVERABLES RELATING TO THE CX PROCESS

.1 Contractors to provide:

.1 Completed installation and pre-start-up checklists.

.2 Completed Static Verification Forms.

.3 TAB reports.

.4 Factory test reports.

.5 Reports for testing, inspections and quality control activities specified in the Contract Documents or request by the Design Engineer.

.6 Completed Start-up Forms.

.7 Completed Functional Performance Testing forms.

.8 Training Plans.

.9 O&M Manuals.

.10 Prescribed activities during warranty period.

.2 Contractors are to sign the documentation confirming that they conducted the testing required.

.3 Documentation is to be submitted to the CxA for review.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Commissioning forms to be completed for equipment, systems and integrated systems.

.2 Related Requirements:

.1 Section 01 91 13 - General Commissioning (Cx) Requirements.

.2 Section 01 91 31 - Commissioning Plan.

.3 Section 01 91 41 - Commissioning Training.

.4 Preliminary Commissioning Plan.

1.2 STATIC VERIFICATION FORMS

.1 Static Verification Forms compile gathered data on items of equipment produced by equipment manufacturer, includes nameplate information, performance requirements and other pertinent technical data.

.2 Prior to Start-up and Functional Performance Testing of equipment or systems, complete the Static Verification Forms related to systems and equipment and submit to Commissioning Authority for review and acceptance.

.3 Installer to sign forms after completion certifying that the information provided on the forms is correct and matches the equipment and systems installed. Forms will be required during Commissioning and will be included in the Commissioning Report at completion of project.

1.3 START-UP FORMS / INSTALLATION CHECKLISTS

.1 Include the following data:

.1 Product manufacturer's installation instructions and recommended checks.

.2 Special procedures as specified in relevant technical sections.

.3 Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.

.2 Equipment manufacturer's start-up forms and installation checklists are acceptable for use. Submit to Commissioning Authority for review and approval prior to use. As deemed necessary by Commissioning Authority, supplemental forms or additional data lists will be required for specific project conditions.

.3 Prior to Functional Performance Testing of equipment or systems, use checklists to verify equipment installation. Document checklist verifying checks have been made, indicate deficiencies and corrective action taken.

.4 Installer to sign checklists and/or forms upon completion, certifying stated checks and inspections have been performed. Return completed checklists and/or forms to Commissioning Authority for review and approval. Forms and checklists will be required during Commissioning and will be included in the Commissioning Report at completion of project.

1.4 FUNCTIONAL PERFORMANCE TEST FORMS

.1 FPT forms to be used for checks, running dynamic tests and adjustments carried out on equipment and systems to ensure correct and efficient operation, and that equipment and systems function independently and interactively with other systems as intended with project requirements.

.2 FPT forms include those developed by Contractor to record measured data and readings taken during functional testing procedures and those developed by the Commissioning Authority.

.3 Prior to Functional Performance Testing of integrated system, complete FPT forms of related systems and submit to Commissioning Authority for review and acceptance.

.4 Participants and Witnesses to the Functional Performance Testing to sign forms acknowledging their presence at the testing.

.5 Forms provide in electronic format will not require signatures. Commissioning Authority reserves the right to prepare separate attendance form for signature by all Participants and Witnesses.

1.5 SAMPLES OF COMMISSIONING FORMS

.1 Commissioning Authority will develop and provide to Contractor required project-specific Commissioning forms in hard copy or electronic format complete with specification data.

.2 A Preliminary Commissioning Plan and Commissioning Forms will be provided prior to commencement of commissioning.

1.6 CHANGES AND DEVELOPMENT OF NEW REPORT FORMS

.1 When additional forms are required, the Commissioning Authority will develop appropriate verification forms.

1.7 COMMISSIONING FORMS

.1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.

.2 Strategy for Use:

.1 Commissioning Authority provides Contractor project-specific Commissioning forms with Specification data included.

.2 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.

.3 Confirm operation as per design criteria and intent.

.4 Identify variances between design and operation and reasons for variances.

.5 Verify operation in specified normal and emergency modes and under specified load conditions.

.6 Record analytical and substantiating data.

.7 Verify reported results.

.8 Form to bear signatures of recording technician and reviewed and signed off by Commissioning Authority.

.9 Submit immediately after tests are performed.

.10 Report results in true measured SI unit values.

.11 Provide Commissioning Authority with originals of completed forms.

.12 Maintain copy on site during start-up, testing and commissioning period.

Part 2 Products

2.1 Not Used

.1 Not Used.

Part 3 Execution

3.1 Not Used

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Specifications for roles and responsibilities of Commissioning Training.

.2 Related Requirements:

.1 Training and Demonstration requirements from other Sections.

.2 Section 01 91 13 - General Commissioning (Cx) Requirements.

.3 Section 01 91 31 - Commissioning Plan.

.4 Section 01 91 33 - Commissioning Forms.

.5 Preliminary Commissioning Plan.

1.2 SCOPE OF WORK

.1 Provide sufficient time, material, labour and supervision for training associated with systems outlined in Section 01 91 31 Commissioning Plan and in accordance with the outline for instruction and training provided in the Commissioning Plan, as applicable.

1.3 TRAINEES

.1 Trainees: Personnel selected for operating and maintaining the facility, may include Property or Facility Manager, building operators, maintenance staff, security staff, and technical specialists as required.

.2 Trainees will be available for training during later stages of construction for purposes of familiarization with systems.

.3 Trainees may participate in functional performance testing as part of training activities.

1.4 INSTRUCTORS

.1 Mechanical and Electrical Design Consultants to provide instruction on the following:

.1 Descriptions of systems.

.2 Design philosophy, design criteria, and design intent.

.3 Interaction among systems during integrated operation.

.2 Contractor and certified factory-trained manufacturers' personnel to provide instruction on the following:

.1 Start-Up, operation, shut-down of equipment, components and systems once Functional Performance tests have been successfully completed.

.2 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.

.3 Instructions on servicing, maintenance and adjustment of systems, equipment and components.

.3 Contractor and equipment manufacturer to provide instruction on:

.1 Start-up, operation, maintenance and shut-down of equipment they have certified as installed, started up and once Functional Performance tests have been successfully completed.

1.5 TRAINING OBJECTIVES

.1 Training to be detailed and of duration to ensure:

.1 Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.

.2 Effective on-going inspection, measurements of system performance.

.3 Proper preventive maintenance, diagnosis and trouble-shooting.

.4 Ability to update documentation.

.5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

1.6 TRAINING MATERIALS

.1 Instructors to be responsible for content and quality.

.2 Training materials to include:

.1 "As-Built" Contract Documents.

.2 Operating Manual.

.3 Maintenance Manual.

.4 Management Manual.

.5 TAB and Functional Performance Test Reports.

.3 Owner, Project Manager and Commissioning Agent reserve the right to review and approve the training manuals.

.4 Training materials to be in a format that permits future training procedures to the same degree of detail.

.5 Provide sufficient handouts for all Trainees.

.6 Supplement training materials:

.1 Transparencies for overhead projectors.

.2 Multimedia presentations.

.3 Manufacturer's training videos.

.4 Equipment models.

1.7 SCHEDULING

.1 Include in the Commissioning Schedule time for training.

.2 Deliver training during regular working hours, training sessions to be 3 hours in length. Schedule sufficient sessions to cover all topics.

.3 Training to be completed prior to acceptance of facility.

1.8 RESPONSIBILITIES

.1 Be responsible for:

.1 Implementation of training activities,

.2 Coordination among instructors,

.3 Quality of training, training materials,

.2 Owner, Project Manager and Commissioning Agent reserve the right to evaluate training and materials.

1.9 TRAINING SESSIONS

.1 No training will take place without the Contractor submitting the following information to the Project Manager two (2) weeks in advance for review:

.1 Qualifications of Instructors

.2 Written agenda for the training session(s)

.3 Training manuals, tools, O&M Manuals and training handouts

.2 Training to include demonstrations by Instructors using the installed equipment and systems.

.3 Use of room with overhead or table mount projector and screen in concert with laptop computer containing control software, graphics sequences, etc. specific to the facility is considered a pre-requisite for effective demonstration and presentation of the materials herein.

.4 Upon completion of training, provide written report, signed by Instructors, witnessed by Owner, Project Manager and/or Commissioning Agent outlining:

.1 Time, Date and Location

.2 Name of Instructor(s)

.3 Topics of training

.4 List of Trainees

.5 Provide specialized training as specified in relevant Technical Sections of the construction specifications.

1.10 TRAINING CONTENT

.1 Training to include:

.1 Review of facility, occupancy profile and functional requirements.

.2 System philosophy, limitations and interaction of systems.

.3 Review of system layout, equipment, components and controls.

.4 Equipment and system start-up, operation, monitoring, servicing, maintenance, emergency and shut-down procedures.

.5 In depth review of EMCS or BAS sequences of operation.

.6 Trouble-shooting diagnosis.

.7 Interaction among systems during integrated operation.

.8 Review of O&M documentation emphasizing safe and proper operating requirements, preventative maintenance, special tools needed, spare parts inventory suggestions.

.9 Discussion on relative health and safety issues and solutions.

.10 Information concerning the warranties and their use and the location of all guarantees.

.11 Description of spare parts in stock and their service.

.12 Service contracts and protocols.

1.11 VIDEO-BASED TRAINING

.1 Manufacturer's videotapes to be used as training tool with Owner, Project Manager and/or Commissioning Agent review and written approval three (3) months prior to commencement of scheduled training.

.2 On-Site training videos:

.1 Videotape training sessions for use during future training, upon Owner request.

.2 To be performed after systems are fully commissioned.

.3 Organize into several short modules to permit incorporation of changes.

.3 Production methods to be of professional quality.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 This section covers items common to all sections of Divisions 23 & 25.

1.2 SCOPE OF WORK

.1 The work of this section includes all labour, materials, and equipment necessary for the installation complete of the mechanical systems shown on the drawings and described in these specifications.

.2 It is the requirement of this work to provide all systems complete, functioning in intended system operation, notwithstanding that every item necessarily required may not be specifically mentioned.

1.3 EQUIPMENT LIST

.1 Complete list of equipment and materials to be used on this project and forming part of tender documents including manufacturer's name, model number and details of materials, and submit for approval.

.2 Submit for approval within seven (7) days after award of contract.

1.4 SUBMITTALS

.1 Submittals: in accordance with Section 01 00 02 – Standard General Requirements.

.2 Submit Shop Drawings to Owner Representative for approval by the Consultant.

.3 Shop drawings to show:

- .1 Mounting arrangements.
- .2 Operating and maintenance clearances. eg. access door swing spaces.

.4 Shop drawings and product data accompanied by:

- .1 Detailed drawings of bases, supports, and anchor bolts.
- .2 Acoustical sound power data, where applicable.
- .3 Points of operation on performance curves.
- .4 Manufacturer to certify current model production.
- .5 Certification of compliance to applicable codes.

.5 Closeout Submittals:

- .1 Provide Operation and Maintenance Data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Manual approved by and final copies deposited with, Consultant before final inspection.
- .3 Operation data to include:
  - .1 Control schematics for systems including environmental controls.

.2 Description of systems and their controls.

.3 Description of operation of systems at various loads together with reset schedules and seasonal variances.

.4 Operation instruction for systems and component.

.5 Description of actions to be taken in event of equipment failure.

.6 Valve schedule and flow diagram.

.7 Colour coding chart.

.4 Maintenance data to include:

.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.

.2 Data to include schedules of tasks, frequency, tools required and task time.

.5 Performance data to include:

.1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.

.2 Equipment performance verification test results.

.3 Special performance data as specified.

.4 Testing, Adjusting and Balancing Reports as specified in Section 23 05 93 – Testing, Adjusting and Balancing for HVAC.

.6 Approvals:

.1 Submit two (2) hard copies and one (1) electronic PDF copy of draft Operation and Maintenance Manual to Owner Representative for approval. Submission of individual data will not be accepted unless directed by Owner Representative.

.2 Make changes as required and re-submit as directed by Owner Representative.

.7 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.8 Site records:

.1 Contractor shall obtain one (1) set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

.2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection.

.9 As-built drawings:

.1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of record drawings.

.2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).

.3 Submit to Owner Representative for approval and make corrections as directed.

.4 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

.5 Perform completed Testing, Adjusting and Balancing for HVAC using As-built Drawings.

1.5 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

.2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 30 –Health and Safety Requirements.

1.6 EQUIPMENT INSTALLATION

.1 In accordance with Manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

1.7 CLEARANCES

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment and components.

1.8 TRIAL USAGE

.1 Owner's Representative and Commissioning Agent may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Trial usage to apply to following equipment and systems:

.1 EMCS.

.2 Air Handling Units.

.3 Boilers and Water Heaters.

.4 Heat Pumps.

.5 Pumps.

.6 Fan Coils.

.3 Use of systems during construction:

.1 Use of mechanical systems during construction.

.2 Use of new and existing permanent heating and ventilating systems for supplying temporary heat or ventilation is permitted only under following conditions:

.1 Entire system is complete, commissioned, pressure tested, cleaned and flushed out.

.2 Specified water treatment system has been commissioned, water treatment is being continuously monitored.

.3 Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.

.4 There is no possibility of damage.

.5 Supply ventilation systems are protected by 60% filters, inspected daily, changed every 2 weeks or more frequently as required.

.6 Return systems have approved filters over openings, inlets and outlets.

.7 Systems will be:

.1 Operated as per Manufacturer's recommendations and instructions.

.2 Operated by Contractor.

.3 Monitored continuously by Contractor.

.8 Warranties and Guarantees are not relaxed.

.9 Regular preventive and other Manufacturer's recommended maintenance routines are performed by Contractor at own expense and under supervision of Owner Representative and Consultant.

.10 Refurbish entire system before static completion; clean internally and externally, restore to "as-new" condition and replace filters in air systems.

.3 Filters specified in this Section are over and above those specified in other Sections of this project.

1.9 PROTECTION OF OPENINGS

.1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

1.10 ELECTRICAL

.1 The Electrical Contractor is responsible for all power wiring over 120V and over required for operation of mechanical equipment and plant systems.

.2 Division 25 EMCS is responsible for all wiring required for controls systems, including obtaining 120V sources from the electrical system.

1.11 PREPARATION FOR FIRESTOPPING

.1 All fire stopping is to be performed by a qualified subcontractor.

.2 Contractor to identify all locations where mechanical penetrations are required through fire rated separations including type and sizing.

.3 Provide all required clearances between outside surface of pipe and inside surface of sleeve, core drilled hole or listed fire rated system.

1.12 EXISTING CONDITIONS

.1 Connect into existing systems at times coordinated with Owner.

.2 Request written approval ten (10) days minimum, prior to commencement of work.

.3 Be responsible for damage to existing plant by this work.

.4 Ensure daily clean-up of existing areas.

1.13 TESTS

.1 Give 48 hours' written notice of date for all tests.

.2 Insulate or conceal work only after testing and approval by Owner Representative.

.3 Conduct tests in presence of Owner Representative.

.4 Bear costs including retesting and making good.

.5 Equipment: test as specified in relevant sections.

.6 Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures or test medium.

1.14 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 – SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

1.15 DEMONSTRATION, OPERATING AND MAINTENANCE INSTRUCTIONS

.1 Where specified elsewhere in Divisions 23 and 25, Manufacturers to provide demonstrations and instructions.

.2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.3 Use operation and maintenance manual, as-built drawings and audio visual aids as part of instruction materials.

.4 Instruction duration time requirements as specified in appropriate sections. Provide minimum 8 hour instruction.

.5 When deemed necessary, Owner Representative will record these demonstrations on video tape for future reference.

1.16 INTERPRETATION OF PLANS AND SPECIFICATIONS

.1 These specifications are to be considered as an integral part of the plans which accompany them and neither the plans not the specifications shall be used alone. Any item which is omitted in one but which is reasonably implied in the other shall be considered properly and sufficiently specified and must, therefore, be provided by this Contractor.

.2 Misinterpretation of the plans or specifications shall not relieve this Contractor of responsibility; final interpretation of details and clauses remains with the Owner's Representative.

.3 Where uncertainty exists in the passing of pipes and location of equipment, the Consultant and or Owner Representative shall be consulted before work is started. Where such materials and equipment have been installed so as to cause interference with the inside treatment of the building, they shall be removed and relocated without additional cost to the Owner.

.4 The plans do not necessarily show all valves, duct offsets, access panels, connections, balancing fittings, bases, isolators, flexible connections, drains, etc., and this Contractor shall not avail himself of these obvious omissions, but shall install the work complete in essential details so that it will function properly, can be easily balanced and so that repairs and removal of equipment can easily be made.

.5 Building dimensions shall not be scaled from the plans but shall be obtained from on-site dimensions of the building. Any discrepancy between the drawings and the building shall be questioned before proceeding with any installation.

1.17 CO-OPERATION OF CONTRACTORS

.1 This Contractor shall become familiar with the work of other Contractors and in laying out and installing the work shall co-operate with the other Contractors, so as to facilitate the progress of the work as a whole and avoid interference or delays. Where interference exists, this Contractor shall notify the Owner Representative and the Consultant before installing the work. Any changes in the work or alterations of the Contractor's schedule of procedure required for such co-operation will not be considered as a claim for extra compensation.

.2 Due to the complexities of many sub-trades, and the restrictive space available in this project, it is required that all trades co-operate closely so as to install all systems in their allotted locations as indicated on the drawings, or coordination on site.

1.18 ERRORS AND OMISSIONS

.1 The drawings are not intended to show every item of accessory equipment, but the Contractor shall tender on and install all essential details to provide for efficiency of operation and ease of maintenance.

.2 Should this Contractor discover errors or discrepancies in the plans or specification, he shall refer the matter to the Consultant for change or clarification and shall not proceed with that portion of the work until advised by the Owner Representative to do so.

1.19 TESTING, ADJUSTING AND BALANCING (TAB)

.1 This Contractor shall provide labour and materials to verify calibration of all pressure and temperature devices. Provide support during commissioning and verification.

1.20 MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

.1 General:

.1 Electrical motors, drives and guards for mechanical equipment and systems.

.2 Supplier and installer responsibility indicated in Motor, Control and Equipment Schedule on Electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.

.3 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50V which are related to control systems specified in Divisions 23 and 25. Refer to Division 26 for quality of materials and workmanship.

.4 Motor shall be inverter duty rated for us with VFD's where required.

.2 Premium efficiency motor specifications TEFC Motors 1-200 HP:

.1 All motors furnished shall be designed, manufactured, and tested in accordance with the latest applicable standards of NEMA, ANSI, IEEE, and ASTM. As a minimum requirement, all motors shall conform to the latest applicable sections of NEMA Standard No. MG-1. Motors must meet or exceed CEE Premium Efficiency™ full load efficiencies.

The Consortium for Energy Efficiency (CEE), a national, non-profit public benefits corporation, promotes the manufacture and purchase of energy-efficient products and services.

.2 Per CEE Premium Efficiency™ Criteria, minimum efficiencies for TEFC motors shall be equal to or greater than those shown below:

HP	1200 RPM	1800 PM	3600 RPM
1	82.5	85.5	78.5
1.5	87.5	86.5	85.5
2	88.5	86.5	86.5
3	89.5	89.5	88.5
5	89.5	89.5	89.5
7.5	91.7	91.7	91.0
10	91.7	91.7	91.7
15	92.4	92.4	91.7
20	92.4	93.0	92.4

.3 Premium efficiency motor specifications ODP motors 1-200 HP:

.1 All motors furnished shall be designed, manufactured, and tested in accordance with the latest applicable standards of NEMA, ANSI, IEEE, and ASTM. As a minimum requirement, all motors shall conform to the latest applicable sections of NEMA Standard No. MG-1. Motors must meet or exceed CEE Premium Efficiency™ full load efficiencies. The Consortium for Energy Efficiency (CEE), a national, non-profit public benefits corporation, promotes the manufacture and purchase of energy-efficient products and services.

.2 Per CEE Premium Efficiency™ Criteria, minimum efficiencies for TEFC motors shall be equal to or greater than those shown below:

HP	1200 RPM	1800 PM	3600 RPM
1	82.5	85.5	80.0
1.5	86.5	86.5	85.5
2	87.5	86.5	86.5
3	89.5	89.5	86.5
5	89.5	89.5	89.5
7.5	91.7	91.0	89.5
10	91.7	91.7	90.2
15	92.4	93.0	91.0
20	92.4	93.0	92.4

1.21 BELT DRIVES

.1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.

.2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.

.3 For motors under 7.5 kW: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.

.4 For motors 7.5 kW and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.

.5 Correct size of sheave determined during commissioning.

.6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.7 Motor slide rail adjustment plates to allow for centre line adjustment.

.8 Supply one set of spare belts for each set installed in accordance with Division 01 – General Requirements.

1.22 DRIVE GUARDS

.1 Provide guards for unprotected drives.

.2 Guards for belt drives:

.1 Expanded metal screen welded to steel frame.

.2 Minimum 1.2 mm thick sheet metal tops and bottoms.
.3 38 mm dia. holes on both shaft centres for insertion of tachometer.
.4 Removable for servicing.

.3 Provide means to permit lubrication and use of test instruments with guards in place.

.4 Install belt guards to allow movement of motors for adjusting belt tension.-

.5 Guard for flexible coupling:

.1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
.2 Securely fasten in place.
.3 Removable for servicing.

.6 Unprotected fan inlets or outlets:

.1 Wire or expanded metal screen, galvanized, 19 mm mesh.
.2 Net free area of guard: not less than 80% of fan openings.
.3 Securely fasten in place.
.4 Removable for servicing.

1.23 THIRD PARTY COMMISSIONING VERIFICATION

.1 Contractors are required to complete the commissioning, field quality assurance, testing and/or performance verification as outlined in this specification.

Part 2 Products

2.1 MATERIALS

.1 Materials and products in accordance with Division 01 – General Requirements.

.2 Do verification requirements in accordance with Division 01 – General Requirements.

2.2 VOC LIMITS

.1 The purpose of this section is to reduce emissions of volatile organic compounds (VOCs) and to eliminate emissions of chloroform, ethylene dichloride, methylenechloride, perchloroethylene, and trichloroethylene from the application of adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers, or any other primers.

.2 This section applies to all commercial and industrial sales and applications of adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers, or any other primers, unless otherwise specifically exempted by this rule.

.3 Requirements:

.1 Unless otherwise specified in paragraph .2 a person shall not apply any adhesives, adhesive bonding primers, adhesive primers, or any other primer, which have a VOC content in excess of 250 g/L less water and less exempt compounds.

.2 A person shall not apply adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers, or any other primer, which have a VOC content in excess of the limits specified below:

.3 Limit*, Less Water and Less Exempt Compounds in Grams per Litre

Fig. 1

Architectural Applications	**Current VOC Limit**
Cove Base Adhesives	50
Multipurpose Construction Adhesives	70
Structural Glazing Adhesives	100
Single Ply Roof Membrane Adhesives	250

Fig. 2

Specialty Applications	**VOC Limits and Effective Dates****			
	Current VOC Limit	**1-1-05**	**7-1-05**	**1-1-07**
PVC Welding	**510**			
CPVC Welding	**490**			
ABS Welding	400		**325**	
Plastic Cement Welding	350	**250**		
Adhesive Primer for Plastic	650		**550**	
Computer Diskette Manufacturing	350			
Contact Adhesive	80			
Special Purpose Contact Adhesive	250			
Tire Retread	100			
Adhesive Primer for Traffic Marking Tape	150			
Structural Wood Member Adhesive	140			
Sheet Applied Rubber Lining Operations	850			
Top and Trim Adhesive	540			250

** The specified limits remain in effect unless revised limits are listed in subsequent columns.

.1 For adhesives, adhesive bonding primers, or any other primer not regulated by the above two tables and applied to the following substrates, the following limits shall apply:

Fig. 3

Substrate Specific Applications	**Current VOC Limit**
Metal to Metal	**30**
Plastic Foams	**50**
Porous Material (except wood)	**50**
Wood	**30**
Fiberglass	**80**

.2 If an adhesive is used to bond dissimilar substrates together the adhesive with the highest VOC content shall be allowed.

Fig. 4

Sealants	Current VOC Limit
Architectural	**250**
Marine Deck	760
Non-membrane Roof	300
Roadway	250
Single-Ply Roof Membrane	450
Other	420

Fig. 5

Sealant Primers	Current VOC Limit
Architectural **Non Porous** **Porous**	 **250** **775**
Modified Bituminous	500
Marine Deck	760
Other	**750**

* For low-solid adhesives or sealants the VOC limit is expressed in grams per liter of material as determined in paragraph .3; for all other adhesives and sealants, VOC limits are expressed as grams of VOC per liter of adhesive or sealant less water and less exempt compounds as determined in paragraph .4.

GRAMS OF VOC PER LITER OF MATERIAL is the weight of VOC per volume of material, to be used for a low-solids adhesive or sealant, and can be calculated by the following equation:

$$\text{Grams of VOC per Liter of Material} = \frac{W_s - W_w - W_{es}}{V_m}$$

Where: W_s = weight of volatile compounds, in grams
W_w = weight of water, in grams
W_{es} = weight of exempt compounds, in grams
V_m = volume of material, in liters

.4 GRAMS OF VOC PER LITER OF ADHESIVE OR SEALANT, LESS WATER AND LESS EXEMPT COMPOUNDS is the weight of VOC per combined volume of VOC and adhesive or sealant solids, and can be calculated by the following equation:

Grams of VOC per Liter of Adhesive or Sealant, Less Water and Less Exempt Compounds =

$$\frac{W_s - W_w - W_{es}}{V_m - V_w - V_{es}}$$

Where: W_s = weight of volatile compounds, in grams
W_w = weight of water, in grams

W_{es} = weight of exempt compounds, in grams
V_m = volume of material, in liters
V_w = volume of water, in liters
V_{es} = volume of exempt compounds, in liters

For adhesives or sealants that contain reactive diluents, the VOC content of the adhesive or sealant is determined after curing. The grams of VOC per liter of any adhesive or sealant, except a low solids adhesive or sealant shall be calculated by the following equation:

Grams of VOC per Liter of Adhesive or Sealant, Less Water and Less Exempt Compounds = $\frac{W_{rs} - W_{rw} - W_{res}}{V_{rm} - V_{rw} - V_{res}}$

Where:
W_{rs} = weight of volatile compounds not consumed during curing, in grams
W_{rw} = weight of water not consumed during curing, in grams
W_{res} = weight of exempt compounds not consumed during curing, in grams
V_m = volume of material prior to reaction, in liters
V_w = volume of water, in liters
V_{es} = volume of exempt compounds, in liters

2.3 PLENUM RATED WIRES AND CABLES

.1 Cables and electrical wires used for transmission of sound or data and that are not located in totally enclosed non-combustible raceway shall be FT6 rated.

Part 3 Execution

3.1 PAINTING REPAIRS AND RESTORATION

.1 Prime and touch up marred finished paintwork to match original.

.2 Restore to new condition, finishes which have been damaged.

3.2 CLEANING

.1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.3 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Division 01 – General Requirements and submit report as described in PART 1 - SUBMITTALS.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 – SUBMITTALS AND AS SPECIFIED RESPECTIVE SECTIONS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.4 PROTECTION

.1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Division 01 – General Requirements.

.2 Section 23 05 00 – Common Work Results for HVAC.

.3 Section 23 05 53 – Mechanical Identification.

.4 Section 23 08 02 – Cleaning and Start-up of Mechanical Piping Systems.

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Division 01 – General Requirements.

1.4 SUBMITTALS

.1 Submittals in accordance with Division 01 – General Requirements.

.2 Submit WHMIS MSDS – Material Safety data sheets in accordance with Division 01 – General Requirements and Section 23 05 00 – Common Work Results for HVAC. Indicate VOC's for all adhesives and solvents during application and curing.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 CONNECTIONS TO EQUIPMENT

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.2 CLEARANCES

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment and components.

3.3 DRAINS

.1 Install piping with grade in direction of flow except as indicated.

.2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.

.3 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.

.4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.4 AIR VENTS

.1 Install air vents at high points in piping systems.

.2 Install isolating valve at each automatic air valve.

.3 Install drain piping to approved location and terminate where discharge is visible.

3.5 DIELECTRIC COUPLINGS

.1 General: Compatible with system, to suit pressure rating of system.

.2 Locations: Where dissimilar metals are joined.

.3 NPS 2 and under: isolating unions or bronze valves.

.4 Over NPS 2: Isolating flanges.

3.6 PIPEWORK INSTALLATION

.1 Screwed fittings jointed with Teflon tape.

.2 Protect openings against entry of foreign material.

.3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.4 Assemble piping using fittings manufactured to ANSI standards.

.5 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main.

.1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.

.6 Install exposed piping, equipment and similar items parallel or perpendicular to building lines.

.7 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

.8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.9 Install, except where indicated, to permit separate thermal insulation of each pipe.

.10 Group piping wherever possible and as indicated.

.11 Ream pipes, remove scale and other foreign material before assembly.

.12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.13 Provide for thermal expansion.

.14 Valves:

.1 Install in accessible locations.
.2 Remove interior parts before soldering.
.3 Install with stems above horizontal position unless otherwise indicated.
.4 Valves accessible for maintenance without removing adjacent piping.
.5 Install globe valves in bypass around control valves.
.6 Use gate or ball valves at branch take-offs for isolating purposes except where otherwise specified.
.7 Install ball valves for glycol service.

.15 Check Valves:

.1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and elsewhere as indicated.
.2 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.

3.7 SLEEVES

.1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.

.2 Material: Schedule 40 black steel pipe.

.3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.

.4 Sizes: 6 mm minimum clearance between sleeve and un-insulated pipe or between sleeve and insulation.

.5 Installation:

.1 Concrete, masonry walls, concrete floors on grade: Terminate flush with finished surface.

.2 Other floors: Terminate 25 mm above finished floor.

.3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

.6 Sealing:

.1 Foundation walls and below grade floors: Fire retardant, waterproof non-hardening mastic.

.2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.

.3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.

.4 Ensure no contact between copper pipe or tube and sleeve.

3.8 ESCUTCHEONS

.1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.

.2 Construction: One piece type with set screws. Chrome or nickel plated brass or type 302 stainless steel.

.3 Sizes: Outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

3.9 PREPARATION FOR FIRESTOPPING

.1 Fire stopping by General Contractor. Sub-Contractor shall provide required clearance between outside surface of piping and inside surface of sleeve or core drilled hole for installation of fire stopping assembly by General Contractor.

.2 Un-insulated unheated pipes not subject to movement: No special preparation.

.3 Un-insulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging fire stopping material or installation.

.4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

3.10 FLUSHING OUT OF PIPING SYSTEMS

.1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

.2 Before start-up, clean interior of piping systems in accordance with requirements of Division 01 – General Requirements supplemented as specified in relevant sections of Mechanical Divisions.

.3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.11 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise Engineer and Commissioning Agent 48 hours' minimum prior to performance of pressure tests.

.2 Pipework: Test as specified in relevant sections of Mechanical Divisions.

.3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant sections of Mechanical Divisions.

.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.5 Conduct tests in presence of Engineer and Commissioning Agent.

.6 Pay costs for repairs or replacement, retesting and making good. Engineer and Commissioning Agent to determine whether repair or replacement is appropriate.

.7 Insulate or conceal work only after approval and certification of tests by Engineer and Commissioning Agent.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for thermometers and pressure gauges in piping systems.

1.2 RELATED SECTIONS

.1 Division 01 – General Requirements.

.2 Section 23 05 00 – Common Work Results for HVAC.

.3 Section 23 05 53 – Mechanical Identification.

1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME):

.1 ASME B40.100-05, Pressure Gauges and Gauge Attachments.

.2 ASME B40.200-08, Thermometers, Direct Reading and Remote Reading.

.2 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-14.4-M88, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.

1.4 SUBMITTALS

.1 Submittals in accordance with Division 01 – General Requirements.

.2 Submit Manufacturer printed shop drawings and product data in accordance with Division 01 – General Requirements.

.3 Submit manufacturer's product data for following items:

.1 Thermometers.

.2 Pressure gauges.

.3 Stop cocks.

.4 Wells.

.4 Submit WHMIS MSDS – Material Safety data sheets in accordance with Division 01 – General Requirements and Section 23 05 00 – Common Work Results for HVAC. Indicate VOC’s for all adhesives and solvents during application and curing.

1.5 HEALTH AND SAFETY

.1 Do construction occupational health and safety in accordance with Division 01 – General Requirements.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Division 01 – General Requirements.

Part 2 Products

2.1 GENERAL

.1 Design point to be at mid point of scale or range.

.2 Ranges:

.1 Chilled/Condenser Water: 0-80°C.

.2 Heating Water: 0-115°C.

2.2 DIRECT READING THERMOMETERS

.1 Industrial, variable angle type, liquid filled, 125 mm scale length: to CAN/CGSB14.4 and ASME B40.200:

.1 Acceptable Material: Trerice, Winters, Weiss or approved alternate.

2.3 THERMOMETER WELLS

.1 Copper pipe: copper or bronze.

.2 Steel pipe: brass or stainless steel.

2.4 PRESSURE GAUGES

.1 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel bourdon tube having 0.5% accuracy full scale unless otherwise specified.

.1 Acceptable Material: Trerice, Winters, Weiss or approved alternate.

2.5 LOW TEMPERATURE HOT WATER (LTHW) AND GLYCOL Meters – APPLICATIONS 120°F AND BELOW

.1 Application:

.1 LTHW meters shall be used to measure LTHW and ethylene or propylene inhibitor glycol flowing through the piping within a building.

.2 Energy meter shall be complete with the flow sensor, remote transmitter, flow computer of the same manufacturer as the meter, and two remote RTD temperature sensors of the same manufacturer as the meter.

.3 The specific heat capacity of glycol shall be programmed as per the on-site system concentration.

.2 Approved Products:

.1 System A:

.1 Flow Sensor: ABB ProcessMaster.

.2 Flow Computer: ABB SM500.

.2 System B:

.1 Flow Sensor: Endress and Hauser Promag 400W with Modbus RTU option and HT PFA liner.

.2 Flow Computer: Endress and Hauser RH33.

.3 System C:

.1 Flow Sensor: Rosemount 8700 Series with HART to Modbus RTU gateway.

.2 Flow Computer: Rosemount flow computer 08800-0800-1110.

.4 System D:

.1 Flow Sensor: Foxboro Model 9700 Series with PFA liner and Model IMT31 flow transmitter.

.2 Flow Computer: Kessler-Ellis products Model ES-749.

.3 Electromagnetic Flow Sensor:

.1 Design Details:

.1 The LTHW flow sensor shall be inline, flanged, and electromagnetic.

.2 The LTHW flow sensor flanges shall be provided in ASME class 150 and class 300 where applicable.

.3 All circuits for inputs, outputs and power supply shall galvanically isolated from each other.

.4 The flow sensor shall be available for pipes of nominal diameter NPS ½ to NPS 12.

.5 The flow sensors shall be equipped with a high temperature PFA liner, suitable for LTHW and glycol.

.6 Sensor to be stainless steel.

.2 Measurements:

.1 Energy Flow.

.2 Energy Totalizer.

.3 Measurements shall be available in the following units:

.1 GJ.

.2 kW.

.3 BTU/hr.

.3 Accuracy:

.1 The flow sensor shall have the following maximum measured error within the sensor application ranges:

.1 Current output: ± 5 μA.

.2 Pulse output: ±0.5% o.r. ± 1 mm/s (±0.5% o.r. ± 0.04 in/s).

.4 Application Ranges:

.1 Fluid velocity: 0.01 to 10m/s.

.2 Flow Measurement up to 9600m^3/h.

.3 Turndown ratio 1000:1.

.4 Fluid Temperature up to 180°C (356°F). High temperature PFA liner, as a minimum, is required.

.5 Process pressures up to 40bar (580 psi).

.6 Conductivity of ≥5µS/cm.

.5 Communications:

.1 The flow sensor shall be capable of transmitting the following information to the metering system:

.1 Energy Flow.

.2 Energy Totalizer.

.2 The flow sensor shall pass totalized volume and instantaneous flow to the flow computer.

.3 A service port shall be accessible for in-situ configuration, commissioning and download.

.4 The flow sensor shall be capable of reporting device failure to the metering system.

.5 Reference schedule on drawing for remote transmitter mounting requirements. Provide a remote transmitter and connecting signal cable supplied by the manufacturer. Signal cable length to be verified on-site.

.6 Electrical Supply Voltage:

.1 120V, 1 Phase, 60 Hz.

.4 Flow Computer:

.1 Design Details:

.1 The flow computer shall be remotely mounted.

.2 Communications:

.1 The LTHW flow sensor shall pass required totalized energy, instantaneous energy, temperature and device health to the Metering Network.

.2 The flow computer shall be capable of communicating to the metering network using Modbus RTU (serial) communication protocol.

.3 A service port shall be accessible for in-situ configuration, commissioning and download.

.4 The flow sensor shall be capable of reporting device failure to the metering system.

.3 Display:

.1 The flow computer shall have a local display for access to instantaneous and totalized values.

.2 Local display to be remotely mounted from flow sensor for ease of access.

.4 Calculations:

.1 The remote flow computer shall be capable of calculating the following measurements as per IAPWS-IF97 ASME:

.1 Power.

.2 Volume.

.3 Density.

.5 Inputs and Outputs:

.1 The remote flow computer shall have the following inputs and characteristics:

.1 Current or pulse input:

.1 4 to 20mA / 0-10V signal or pulse/frequency input.

.2 Galvanically isolated.

.3 Accuracy 0.1% o.f.s.

.2 Current/RTD input:

.1 4 to 20mA or RTD signal.

.2 Galvanically isolated.

.3 0.1% Accuracy o.f.s.

.6 Alarms:

.1 The remote flow computer shall provide at least 2 customizable limit alarms.

.2 The flow computer shall have a fault mode where error values are transmitted over the communications bus if measurement error conditions exist.

.7 Electrical:

.1 Remote flow computer to be designed for low-voltage power: 100 to 230 VAC at 60 Hz.

.2 An overload protection unit is required for the power cable.

.3 Power consumption 15 VA.

.5 Remote Metering Head (Transmitter):

.1 Provide a remote transmitter where indicated.

.2 The remote transmitter shall be compatible with the meter (sensor) specified, and shall meet the meter requirements as specified above.

.3 Communications cables shall be factory supplied liquid tight flexible signal cable. Specify length as per size conditions (by Contractor).

.4 Remote transmitter shall be supplied with the appropriate hardware required for wall mounting.

.5 Remote transmitter shall be equipped with a minimum two line liquid crystal display and pushbuttons.

.6 Housing to be aluminum coated.

Part 3 Execution

3.1 GENERAL

.1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.

.2 Install between equipment and first fitting or valve.

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 THERMOMETERS

.1 Install in wells on piping. Provide heat conductive material inside well.

.2 Install in locations as indicated and on inlet and outlet of:

- .1 Heat exchangers.
- .2 Water heating and cooling coils.
- .3 Buffer tanks.

.3 Install wells as indicated for balancing purposes.

.4 Use extensions where thermometers are installed through insulation.

3.4 PRESSURE GAUGES

.1 Install in following locations:

- .1 Suction and discharge of pumps.
- .2 Upstream and downstream of PRV's.
- .3 Upstream and downstream of control valves.
- .4 Inlet and outlet of coils.
- .5 Inlet and outlet of liquid side of heat exchangers.
- .6 Outlet of boilers.
- .7 In other locations as indicated.

.2 Install gauge cocks for balancing purposes, elsewhere.

.3 Use extensions where pressure gauges are installed through insulation.

3.5 NAMEPLATES

.1 Install engraved lamicoid nameplates as specified in Section 23 05 53 - Mechanical Identification, identifying medium.

3.6 INSTALLATION OF SIGNAL TRANSMISSION CABLE

.1 Ground shielding at one point only.

.2 Protect against RF interference.

.3 Cross electrical cables, conduits at 90 degrees leaving at least 150 mm space between.

.4 Signal cable to be installed in liquid tight flex.

3.7 GROUNDING

.1 Provide grounding of transmitter and flow meter as per manufacturer's recommendation and installation instruction.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Bronze – valves and cast iron.

.2 Related Sections:

.1 Division 01 – General Requirements.

.2 Section 23 05 05 - Installation of Pipework.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME):

.1 ANSI/ASME B1.20.1-1983 (R2001), Pipe Threads, General Purpose (Inch).

.2 ANSI/ASME B16.18-2001, Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ANSI/ASME B16.1-2010, Cast Iron Pipe Flanges and Flanged Fittings.

.2 American Society for Testing and Materials International, (ASTM):

.1 ASTM B62-09, Specification for Composition Bronze or Ounce Metal Castings.

.2 ASTM B283-11, Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).

.3 ASTM B505/B505M-10, Specification for Copper-Base Alloy Continuous Castings.

.4 ASTM A49-01(2006), Specification for Heat-Treated Carbon Steel Joint Bars.

.5 ASTM A126-04 (2009), Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

.6 ASTM B62-09, Specification for Composition Bronze or Ounce Metal Castings.

.7 ASTM B85-10, Specification for Aluminum-Alloy Die Castings.

.8 ASTM B209-07, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):

.1 MSS-SP-25-2008, Standard Marking System for Valves, Fittings, Flanges and Unions.

.2 MSS-SP-80-2008, Bronze Gate Globe, Angle and Check Valves.

.3 MSS-SP-110-2010, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

.4 MSS SP-70-1998, Cast Iron Gate Valves, Flanged and Threaded Ends.

.5 MSS SP-71-2005, Grey Iron Swing Check Valves, Flanged and Threaded Ends.

.6 MSS SP-82-1992, Valve Pressure Testing Methods.

.7 MSS SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 SUBMITTALS

.1 Submittals in accordance with Division 01 – General Requirements.

.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Division 01 – General Requirements and Section 23 05 00 – Common Work Results for HVAC.

.1 Submit shop drawings and product data in accordance with Division 1 – General Requirements.

.2 Submit data for valves specified in this section.

.3 Closeout Submittals:

.1 Submit maintenance data for incorporation into manual in accordance with Division 01 – General Requirements.

1.4 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Division 01 – General Requirements.

1.5 DELIVERY STORAGE AND DISPOSAL

.1 Waste Management and Disposal:

.1 Separate and recycle waste materials in accordance with Division 01 – General Requirements.

1.6 MAINTENANCE

.1 Extra Materials:

.1 Furnish following spare parts:

.1 Valve seats: one for every 10 valves each size, minimum 1.

.2 Discs: one for every 10 valves, each size. Minimum 1.

.3 Stem packing: one for every 10 valves, each size. Minimum 1.

.4 Valve handles: 2 of each size.

.5 Gaskets for flanges: one for every 10 flanged joints.

Part 2 Products

2.1 MATERIALS - GENERAL

.1 Sustainable Requirements:

.1 Materials and resources in accordance with Division 01 – General Requirements.

.2 Valves:

.1 Except for specialty valves, to be single manufacturer.

.2 All products to have CRN registration numbers.

2.2 VALVES - BRONZE

.1 End Connections:

.1 Connection into adjacent piping/tubing:

.1 Steel pipe systems: Screwed ends to ANSI/ASME B1.20.1.

.2 Copper tube systems: Solder ends to ANSI/ASME B16.18.

.2 Gate Valves:

. 1 Requirements common to gate valves, unless specified otherwise:

.1 Standard specification: MSS SP-80.

.2 Bonnet: union with hexagonal shoulders.

.1 Connections: screwed with hexagonal shoulders.

.2 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.

.3 Packing: non-asbestos.

.4 Handwheel: non-ferrous.

.5 Handwheel Nut: bronze to ASTM B62.

.2 NPS 2 and under, rising stem, solid wedge disc, Class 125:

.1 Body: with long disc guides, screwed bonnet.

.2 Operator: Handwheel.

.3 NPS 2 and under, rising stem, solid wedge disc, Class 150:

.1 Body: with long disc guides, screwed bonnet.

.2 Operator: Handwheel.

.4 Acceptable material: Crane, Jenkins, Kitz or approved alternates.

.3 Globe Valves:

.1 Requirements common to globe valves, unless specified otherwise:

.1 Standard specification: MSS SP-80.

.2 Bonnet: union with hexagonal shoulders.

.3 Connections: screwed with hexagonal shoulders.

.4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.

.5 Stuffing box: threaded to bonnet with gland follower, packing nut, high-grade non-asbestos packing.

.6 Handwheel: non-ferrous.

.7 Handwheel Nut: bronze to ASTM B62.

.2 NPS 2 and under, composition disc, Class 125:

.1 Body and bonnet: screwed bonnet.

.2 Disc and seat: renewable rotating PTFE disc composition to suit service conditions, re-grindable bronze seat, loosely secured to bronze stem to ASTM B505.

.3 Operator: Handwheel.

.3 Angle valve, NPS 2 and under, composition disc, Class 150:

.1 Body and bonnet: union bonnet.

.2 Disc and seat: renewable rotating PTFE disc in slip-on easily removable disc holder having integral guides, re-grindable bronze seat, loosely secured to stem.

.3 Operator: Handwheel.

.4 Acceptable material: Crane, Jenkins, Kitz or approved alternate.

.4 Check Valves:

.1 Requirements common to check valves, unless specified otherwise:

.1 Standard specification: MSS SP-80.

.2 Connections: screwed with hexagonal shoulders.

.2 NPS 2 and under, swing type, bronze disc, Class 125:

.1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.

.2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: re-grindable.

.3 NPS 2 and under, vertical lift type, bronze disc, Class 125:

.1 Disc: rotating disc having guides top and bottom, disc guides, retaining rings.

.4 Acceptable material: Crane, Jenkins, Kitz or approved alternate.

.5 Ball Valves:

.1 NPS 2 and under:

.1 Body and cap: cast high tensile bronze to ASTM B62.

.2 Pressure rating: Class125, 860 kPa steam.

.3 Connections: solder ends.

.4 Stem: tamperproof ball drive.

.5 Stem packing nut: external to body.

.6 Ball and seat: replaceable hard chrome solid ball and Teflon seats.

.7 Stem seal: TFE with external packing nut.

.8 Operator: removable lever handle.

.2 Acceptable material: Crane, Jenkins, Kitz or approved alternate.

2.3 VALVES – CAST IRON

.1 Standard specifications:

.1 Gate valves: MSS SP-70.

.2 Globe valves: MSS SP-85.

.3 Check valves: MSS SP-71.

.2 Requirements common to valves, unless specified otherwise:

.1 Body, bonnet: cast iron to ASTM B209 Class B.

.2 Connections: flanged ends plain face to ANSI B16.1.

.3 Inspection and pressure testing: to MSS SP-82.

.4 Bonnet gasket: non-asbestos.

.5 Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for hand wheel nut.

.6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.

.7 Gland packing: non-asbestos.

.8 Handwheel: Die-cast aluminum alloy to ASTM B85 or malleable iron to ASTM A49. Nut of bronze to ASTM B62.

.9 Identification tag: with catalogue number, size, other pertinent data.

.3 Gate Valves:

.1 NPS 2 ½ -8, outside screw and yoke (OS&Y), bronze trim, solid wedge disc:

.1 Body and multiple-bolted bonnet: with full length disc guides designed to ensure correct re-assembly, yoke, yoke hub, yoke sleeve and nut. Class 125.

.2 Disc: solid offset taper wedge, bronze to ASTM B62 up to NPS 3, cast iron with bronze disc rings on other sizes, secured to stem through integral forged T-head disc-stem connection.

.3 Seat rings: renewable bronze screwed into body.

.4 Stem: manganese-bronze.

.5 Disc: solid offset taper all-cast iron, secured to stem through integral forged T-head disc-stem connection.

.6 Seat rings: integral with body.

.7 Stem: nickel-plated steel.

.8 Pressure-lubricated operating mechanism.

.9 Operator: Handwheel.

.2 Acceptable material: Crane, Jenkins, Kitz or approved alternate.

.4 Globe Valves:

.1 NPS 2 ½ - 10, OSY:

.1 Body: with multiple-bolted bonnet.

.2 WP: 860 kPa steam, 1.4 MPa CWP.

.3 Bonnet-yoke gasket: non-asbestos.

.4 Disc: bronze to ASTM B62, fully guided from bottom, securely yet freely connected to stem for swivel action and accurate engagement with disc.

.5 Seat ring: renewable, re-grindable, screwed into body.

.6 Stem: bronze to ASTM B62.

.7 Operator: Handwheel.

.2 Acceptable material: Crane, Jenkins, Kitz or approved alternate.

.5 Check Valves:

.1 Swing check valves, Class 125:

.1 Body and bolted cover: with tapped and plugged opening on each side for hinge pin. Flanged ends: plain faced with smooth finish.
.1 Up to NPS 16: cast iron to ASTM A126 Class B.
.2 Disc: rotating for extended life.
.1 Up to NPS 6: bronze to ASTM B62.
.3 Seat rings: renewable bronze to ASTM B62 screwed into body.
.4 Hinge pin, bushings: renewable bronze to ASTM B62.
.5 Disc: A126 Class B, secured to stem, rotating for extended life.
.6 Seat: cast iron, integral with body.
.7 Hinge pin: exelloy; bushings; malleable iron.
.8 Identification tag: fastened to cover.
.9 Hinge: galvanized malleable iron.

.2 Swing check valves, NPS 2 ½ - 8 Class 250:
.1 Body and bolted cover: cast iron to ASTM A126 Class B with tapped and plugged opening on each side for hinge pin.
.2 Flanged ends: 2 mm raised face with serrated finish.
.3 Rating: 250 psi steam; 500 psi CWP.
.4 Disc: rotating for extended life.
.1 Up to NPS 3: bronze to ASTM B61.
.5 Seat rings: renewable bronze to ASTM B61, screwed into body.
.6 Hinge pin, bushings: renewable, bronze to ASTM B61.
.7 Hinge: galvanized malleable iron.
.8 Identification tag: fastened to cover.

.3 Acceptable material: Crane, Jenkins, Kitz or approved alternate.

.6 Butterfly Valves:

.1 NPS 2-1/2 through NPS 6.
.1 Body: cast bronze per CDA-836 (85-5-5-5).
.2 Pressure rating: 2065-kPa CWP.
.3 Connections: copper tube dimensioned grooved ends.
.4 Disc: ductile iron per ASTM A536 with elastomer coating.
.5 Stem: integrally cast with disc.
.6 Stem Nuts: nickel plated 416 stainless steel.
.7 Operator: lever operator.
.8 Victaulic Series 608.

.7 Grooved End Butterfly Valves:

.1 Butterfly valves: in accordance with MSS-SP-67 Application: Isolating cells or section of multiple component equipment (e.g. multi-section coils, multi-cell cooling towers):
.1 NPS2” and over: Grooved ends: Victaulic # 300 Masterseal.

.2 300 Psi WOG / 2068 kPa and be both bi-directional and dead end service capable to full rated pressure. Ductile iron body with blow –out proof stainless steel stems and nickel coated ductile iron disc. Seat shall be "EPDM" and have a full 360* continuous contact with the seating surface.

.3 Valve Operators: (Lever) or (Gear).

Part 3 Execution

3.1 INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.

.2 Remove internal parts before soldering.

.3 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

3.2 VERIFICATION

.1 Verification requirements in accordance with Division 01 – General Requirements.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Concrete housekeeping pads, hangers and supports for mechanical piping, ducting and equipment.

.2 Related Sections:

.1 Division 01 – General Requirements.

.2 Section 23 05 05 – Installation of Pipework.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM):

.1 ASTM A125-1996 (R2007), Specification for Steel Springs, Helical, Heat-Treated.

.2 ASTM A307-10, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.3 ASTM A563-07a, Specification for Carbon and Alloy Steel Nuts.

.2 Factory Mutual (FM).

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Material Safety Data Sheets (MSDS).

.4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS):

.1 MSS SP58-2009, Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 ANSI/MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.

.3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.

.5 Underwriter's Laboratories of Canada (ULC).

1.3 SYSTEM DESCRIPTION

.1 Design Requirements:

.1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

.2 Base maximum load ratings on allowable stresses prescribed by MSS SP58.ASME B31.1 or

.3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

.4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

.5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

1.4 SUBMITTALS

.1 Submittals: in accordance with Division 01 – General Requirements.

.2 Submit shop drawings and product data for following items:

.1 Bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

.3 Quality assurance submittals: submit following in accordance with Division 01 – General Requirements.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.4 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual Division 01 – General Requirements.

1.5 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Division 01 – General Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Division 01 – General Requirements and Section 23 05 00 – Common Work Results for HVAC.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 01 – General Requirements.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Division 01 – General Requirements.

2.2 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.3 PIPE HANGERS

.1 Finishes:

.1 Pipe hangers and supports: galvanized after manufacture.

.2 Use hot dipped galvanizing process.

.3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.

.2 Upper attachment structural: suspension from lower flange of I-Beam:

.1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.

.1 Rod: 13 mm.

.2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, to MSS-SP58 and MSS-SP69.

.3 Upper attachment structural: suspension from upper flange of I-Beam:

.1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, to MSS SP69.

.2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut.

.4 Upper attachment to concrete:

.1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.

.2 Concrete inserts: wedge shaped body with knockout protector plate to MSS SP69.

.5 Shop and field-fabricated assemblies:

.1 Trapeze hanger assemblies.

.2 Steel brackets.

.6 Hanger rods: threaded rod material to MSS SP58:

.1 Ensure that hanger rods are subject to tensile loading only.

.2 Provide linkages where lateral or axial movement of pipework is anticipated.

.7 Pipe attachments: material to MSS SP58:

.1 Attachments for steel piping: carbon steel galvanized.

.2 Attachments for copper piping: copper plated black steel.

.3 Use insulation shields for hot pipework.

.4 Oversize pipe hangers and supports.

.8 Adjustable clevis: material to MSS SP69, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

.1 Ensure "U" has hole in bottom for riveting to insulation shields.

.9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.

.10 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.

.1 Finishes for steel pipework: galvanized.

.2 Finishes for copper, glass, brass or aluminum pipework: galvanized, with formed portion plastic coated or epoxy coated.

.11 Acceptable materials: Grinnell, E. Myatt & Co., Erico.

2.4 RISER CLAMPS

.1 Steel or cast iron pipe: galvanized carbon steel to MSS SP58, type 42.

.2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.

.3 Bolts: to ASTM A307.

.4 Nuts: to ASTM A563.

.5 Acceptable materials: Grinnell, E. Myatt & Co., Erico.

2.5 INSULATION PROTECTION SHIELDS

.1 Insulated cold piping:

.1 64 kg/m^3 density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

.2 Insulated hot piping:

.1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.

2.6 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Division 05 - Metals.

2.7 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

.1 Provide templates to ensure accurate location of anchor bolts.

2.8 HOUSE-KEEPING PADS

.1 Provide templates to ensure accurate location and size of pads.

.2 House keeping pads by General Contractor.

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 datasheet.

3.2 INSTALLATION

.1 Install in accordance with:

.1 Manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

.1 Install on piping systems at pumps, fans and as indicated.

.3 Clamps on riser piping:

.1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.

.2 Bolt-tightening torques to industry standards.

.3 Steel pipes: install below coupling or shear lugs welded to pipe.

.4 Cast iron pipes: install below joint.

.4 Clevis plates:

.1 Attach to concrete with 4 minimum concrete inserts, one at each corner.

.5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

.6 Use approved constant support type hangers where:

.1 Vertical movement of pipework is 13 mm or more.

.2 Transfer of load to adjacent hangers or connected equipment is not permitted.

3.3 HANGER SPACING

.1 Plumbing piping: to Canadian Plumbing Code and authority having jurisdiction.

.2 Fire protection: to applicable fire code.

.3 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.

.4 Copper piping: up to NPS 1/2: every 1.5 m.

.5 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.

.6 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.1 m	1.8 m
1-1/2	2.7 m	2.4 m
2	3.0 m	2.7 m
2-1/2	3.6 m	3.0 m
3	3.6 m	3.0 m
3-1/2	3.9 m	3.3 m
4	4.2 m	3.6 m
5	4.8 m	
6	5.1 m	
8	5.7 m	

.7 Pipework greater than NPS 12: to MSS SP69.

3.4 HANGER INSTALLATION

.1 Install hanger so that rod is vertical under operating conditions.

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.5 HORIZONTAL MOVEMENT

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

.2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

.1 Adjust hangers and supports:

.1 Ensure that rod is vertical under operating conditions.

.2 Equalize loads.

.2 Adjustable clevis:

.1 Tighten hanger load nut securely to ensure proper hanger performance.

.2 Tighten upper nut after adjustment.

.3 C-clamps:

.1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

.4 Beam clamps:

.1 Hammer jaw firmly against underside of beam.

3.7 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Division 01 – General Requirements.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

.4 Applicable Systems: Vibration Isolation.

.3 Verification requirements in accordance with Division 01 – General Requirements.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

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

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.

.2 CAN/CGSB-24.3-92, Identification of Piping Systems.

.2 National Fire Protection Association (NFPA):

.1 NFPA 13-2010, Standard for the Installation of Sprinkler Systems.

1.3 SUBMITTALS

.1 Product Data:

.1 Submittals: in accordance with Division 01 – General Requirements.

.2 Product data to include paint colour chips, other products specified in this section.

1.4 QUALITY ASSURANCE

.1 Quality assurance submittals: submit following in accordance with Division 01 – General Requirements.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Division 01 – General Requirements and Section 23 05 00 – Common Work Results for HVAC.

.2 Indicate VOC/s for all adhesives and solvents during application and curing.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Division 01 – General Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 01 – General Requirements.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Division 01 – General Requirements.

2.2 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers raised or recessed.

.3 Information to include, as appropriate:

.1 Equipment: manufacturer's name, model, size, serial number, capacity.

.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.3 SYSTEM NAMEPLATES

.1 Colours:

.1 Hazardous: red letters, white background.

.2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

.2 Construction:

.1 3 mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

.1 Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

.2 Use maximum of 25 letters/numbers per line.

.4 Locations:

.1 Terminal cabinets, control panels: use size #5.

.2 Equipment in Mechanical Rooms: use size #9.

2.4 EXISTING IDENTIFICATION SYSTEMS

.1 Apply existing identification system to new work.

.2 Where existing identification system does not cover for new work, use identification system specified this section.

.3 Before starting work, obtain written approval of identification system from City of Saint John Representative and Engineer.

2.5 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:

.1 Propane: to CSA/CGA B149.1 and authority having jurisdiction.

.2 Sprinklers: to NFPA 13.

2.6 IDENTIFICATION OF PIPING SYSTEMS

.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.

.2 Pictograms:

.1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.

.3 Legend:

.1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.

.4 Arrows showing direction of flow:

.1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.

.2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.

.3 Use double-headed arrows where flow is reversible.

.5 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

.2 Length to accommodate pictogram, full length of legend and arrows.

.6 Materials for background colour marking, legend, arrows:

.1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.

.2 Other pipes: pressure sensitive vinyl with protective over-coating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150°C and intermittent temperature of 200°C.

.7 Colours and Legends:

.1 Where not listed, obtain direction from City of Saint John Representative.

.2 Colours for legends, arrows: to following table:

Background colour:	**Legend, arrows:**
Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background colour marking and legends for piping systems:

Contents	**Background colour marking**	**Legend**
Chilled Water Return	Green	CH WTR. RETURN
Chilled Water Supply	Green	CH WTR. SUPPLY
Condenser Water Return	Green	COND. WTR. RETURN
Condenser Water Supply	Green	COND. WTR. SUPPLY

2.7 IDENTIFICATION DUCTWORK SYSTEMS

.1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.

.2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

2.8 CONTROLS COMPONENTS IDENTIFICATION

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

2.9 LANGUAGE

.1 Identification in English

2.10 VOC LIMITS

.1 Refer to Section 23 05 00 – Common Work Results for HVAC.

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 datasheet.

3.2 TIMING

.1 Provide identification only after painting specified Division 09 - Finishes has been completed.

3.3 INSTALLATION

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

.2 Provide ULC and or CSA registration plates as required by respective agency.

3.4 NAMEPLATES

.1 Locations:

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

.2 Standoffs:

.1 Provide for nameplates on hot and/or insulated surfaces.

.3 Protection:

.1 Do not paint, insulate or cover.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

.2 Adjacent to each change in direction.

.3 At least once in each small room through which piping or ductwork passes.

.4 On both sides of visual obstruction or where run is difficult to follow.

.5 On both sides of separations such as walls, floors, partitions.

.6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.

.7 At beginning and end points of each run and at each piece of equipment in run.

.8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification easily and accurately readable from usual operating areas and from access points.

.1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 FIELD QUALITY CONTROL

.1 Verification requirements in accordance with Division 01 – General Requirements.

3.7 CLEANING

.1 Proceed in accordance with Division 01 – General Requirements.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Thermal insulation for piping and piping accessories in commercial type applications.

.2 Related Sections:

.1 Division 01 – General Requirements.

.2 Division 23 – Common Work Results for HVAC.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):

.1 ASHRAE Standard 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).

.2 American Society for Testing and Materials International (ASTM):

.1 ASTM B209M-04, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.

.2 ASTM C335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.4 ASTM C533-2004, Calcium Silicate Block and Pipe Thermal Insulation.

.5 ASTM C547-2003, Mineral Fiber Pipe Insulation.

.6 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB):

.1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.

.4 Department of Justice Canada (Jus):

.1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.

.2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

.3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Material Safety Data Sheets (MSDS).

.6 Manufacturer's Trade Associations:

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).

.7 Underwriters' Laboratories of Canada (ULC):

.1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.3 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings

.4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

.8 Model National Energy Code of Canada for Buildings, 1997.

1.3 DEFINITIONS

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - will mean "not concealed" as specified.

.2 TIAC ss:

.1 CRF: Code Rectangular Finish.

.2 CPF: Code Piping Finish.

1.4 SUBMITTALS

.1 Submittals: in accordance with Division 01 – General Requirements.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01 – General Requirements. Include product characteristics, performance criteria, and limitations.

.1 Submit required copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 01 – General Requirements. Indicate VOC’s for all adhesives and solvents during application and curing.

.3 Shop Drawings:

.1 Submit shop drawings in accordance with Division 01 – General Requirements.

.4 Quality assurance submittals: submit following in accordance with Division 01 – General Requirements.

1.5 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: Specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, member of TIAC.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Division 01 – General Requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Division 01 – General Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Storage and Protection:

.1 Protect from weather, construction traffic.

.2 Protect against damage.

.3 Store at temperatures and conditions required by manufacturer.

.3 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 01 – General Requirements.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Division 01 – General Requirements.

2.2 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.3 INSULATION

.1 Mineral fibre specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket:

.1 Mineral fibre: to CAN/ULC-S702 and ASTM C547.

.2 Maximum "k" factor: to CAN/ULC-S702.

.4 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section):

.1 Mineral fibre: to CAN/ULC-S702 and ASTM C547.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/ULC-S702 and ASTM C547.

2.4 INSULATION SECUREMENT

.1 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.

.2 Contact adhesive: quick setting.

.3 Canvas adhesive: washable.

.4 Tie wire: 1.5 mm diameter stainless steel.

.5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

2.5 CEMENT

.1 Thermal insulating and finishing cement:

.1 Hydraulic setting or Air drying on mineral wool, to ASTM C449/C449M.

2.6 VAPOUR RETARDER LAP ADHESIVE

.1 Water based, fire retardant type, compatible with insulation.

2.7 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.8 OUTDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: fibrous glass, untreated 305 g/m^2.

2.9 JACKETS

.1 Polyvinyl Chloride (PVC):

.1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.

.2 Colour: White.

.3 Minimum service temperatures: -20°C.

.4 Maximum service temperature: 65°C.

.5 Moisture vapour transmission: 0.02 perm.

.6 Fastenings:

.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.

.2 Tacks.

.3 Pressure sensitive vinyl tape of matching colour.

.7 Special requirements:

.1 Outdoor: UV rated material at least 0.5 mm thick.

.2 Canvas:

.1 220 and 120 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Lagging adhesive: compatible with insulation.

.3 Colour: see insulation schedule.

.3 Aluminum Jacket (Exterior Piping):

.1 Pipe insulation aluminum jacket to ASTM B209.

.2 Thickness: 0.5 mm.

.3 Finish: Stucco Embossed.

.4 Jointing: Longitudinal and Circumferential slip joints with 50 mm laps, seal all joints with weatherproof sealant.

.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory attached protective liner.

.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing. Seal all jacket seams.

2.10 WEATHERPROOF CAULKING FOR JACKETS INSTALLED OUTDOORS

.1 Caulking to: Division 07.

2.11 VOC LIMITS

.1 Refer to Section 23 05 00 – Common Work Results for HVAC.

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 datasheet.

3.2 PRE-INSTALLATION REQUIREMENT

.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.

.2 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturer’s instructions and this specification.

.3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes:

.1 Install hangers, supports outside vapour retarder jacket.

.5 Supports, Hangers:

.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

.1 Application: at expansion joints, valves, primary flow measuring elements and flanges and unions at equipment.

.2 Design: to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

.3 Insulation:

.1 Insulation, fastenings and finishes: same as system.

.2 Jacket: PVC.

3.5 INSTALLATION OF ELASTOMERIC INSULATION

.1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints.

.2 Provide vapour retarder as recommended by manufacturer.

3.6 PIPING INSULATION SCHEDULES

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 TIAC Code: A-1:

.1 Securements: SS bands at 300 mm on centre.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code 1501-H.

.3 TIAC Code: C-2 with vapour retarder jacket:

.1 Insulation securements: SS bands at 300 mm on centre.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code: 1501-C.

.4 Thickness of insulation as listed in following table:

.1 Run-outs to individual units and equipment not exceeding 4000 mm long.

.2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	Temp °C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)						
			Run out	to 1	1 1/4 to 2	2 1/2 to 4	5 to 6	8 & over	Jacket Colour
Domestic HWS /HWR, CWS/CWR with vapour retarder		A-1	25	25	25	25	25	25	White/ Aluminum

Note: exterior piping to be 50mm.

.5 Finishes:

.1 Exposed indoors: PVC jacket.

.2 Exposed in mechanical rooms: PVC jacket.

.3 Concealed, indoors: canvas on valves, fittings. No further finish.

.4 Outdoors: water-proof aluminum ABS jacket.

.5 Installation: to appropriate TIAC code CRF/1 through CPF/5.

.6 Steam and condensate: canvas jacket.

3.7 FIELD QUALITY CONTROL

.1 Verification requirements in accordance with Division 01 – General Requirements.

3.8 CLEANING

.1 Proceed in accordance with Division 01 – General Requirements.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.

.2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 QUALIFICATIONS OF TAB PERSONNEL

.1 Submit names of personnel to perform TAB to Commissioning Agent and Engineer within 90 days of award of contract.

.2 Provide documentation confirming qualifications, successful experience.

.3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:

.1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2002.

.2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems - 1998.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing - 2002

.4 Recommendations and suggested practices contained in the TAB Standard: mandatory.

.5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.

.6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

.7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.

.8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.

.1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.

.2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.3 PURPOSE OF TAB

.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads

.2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 EXCEPTIONS

.1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction and Commissioning Agent.

1.5 CO-ORDINATION

.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

.3 Coordinate with Controls Contractor for Control Set Point Requirements.

1.6 PRE-TAB REVIEW

.1 Review contract documents before project construction is started and confirm in writing to City of Saint John Representative and Engineer adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to City of Saint John Representative and Engineer in writing proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7 START-UP

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

.2 Follow special start-up procedures specified elsewhere in Division 23.

1.8 OPERATION OF SYSTEMS DURING TAB

.1 Operate systems for length of time required for TAB and as required by City of Saint John Representative and Engineer for verification of TAB reports.

1.9 START OF TAB

.1 Notify Commissioning Agent and Engineer 7 days prior to start of TAB.

.2 Start TAB when building is essentially completed, including:

.1 Installation of ceilings, doors, windows, other construction affecting TAB.

.2 Application of weather stripping, sealing, and caulking.

.3 Pressure, leakage, other tests specified elsewhere Division 23.

.4 Provisions for TAB installed and operational.

.3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:

.1 Proper thermal overload protection in place for electrical equipment.

.2 Liquid systems:

.1 Flushed, filled, vented.

.2 Correct pump rotation.

.3 Strainers in place, baskets clean.

.4 Isolating and balancing valves installed, open.

.5 Calibrated balancing valves installed, at factory settings.

.6 Chemical treatment systems complete, operational.

1.10 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:

.1 Hydronic systems: plus or minus 10%.

1.11 ACCURACY TOLERANCES

.1 Measured values accurate to within plus or minus 2% of actual values.

1.12 INSTRUMENTS

.1 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.2 Calibrate within 3 months of TAB. Provide certificate of calibration to Commissioning Agent and Engineer.

1.13 SUBMITTALS

.1 Submit, prior to commencement of TAB:

.1 Proposed methodology and procedures for performing TAB if different from referenced standard.

.2 Sustainable Design:

.1 Submit product data/MSDS sheets for VOC emitting materials which clearly identify the actual VOC emissions, for compliance with LEED.

.2 Adhesives, Sealants, Paints and Coatings must conform to low VOC standards in accordance with Division 01 - General Requirements.

1.14 PRELIMINARY TAB REPORT

.1 Submit for checking and approval of City of Saint John Representative and Engineer, prior to submission of formal TAB report, sample of rough TAB sheets. Include:

.1 Details of instruments used.

.2 Details of TAB procedures employed.

.3 Calculations procedures.

.4 Summaries.

1.15 TAB REPORT

.1 Format in accordance with referenced standard.

.2 TAB report to show results in SI units and to include:

.1 Project record drawings.

.2 System schematics.

.3 Submit required copies of TAB Report to City of Saint John Representative and Engineer for verification and approval, in English in D-ring binders, complete with index tabs.

1.16 VERIFICATION

.1 Reported results subject to verification by Commissioning Agent and Engineer.

.2 Provide personnel and instrumentation to verify up to 30% of reported results.

.3 Number and location of verified results as directed by Commissioning Agent and Engineer.

.4 Pay costs to repeat TAB as required to satisfaction of City of Saint John Representative and Engineer.

1.17 SETTINGS

.1 After TAB is completed to satisfaction of City of Saint John Representative and Engineer, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.

.2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.18 COMPLETION OF TAB

.1 TAB considered complete when final TAB Report received and approved by City of Saint John Representative and Engineer.

1.19 LIQUID SYSTEMS

.1 Do TAB of the following systems, equipment and controls:

.1 New Pumps.

.2 New Circuit Balancing Valve for HX-CH1-00.

1.20 OTHER TAB REQUIREMENTS

.1 General requirements applicable to work specified this paragraph:

.1 Qualifications of TAB personnel: as for air systems specified this section.

.2 Quality assurance: as for air systems specified this section.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Related Sections:

.1 Section 01 91 13 – Commissioning and Training.

.2 Section 23 08 02 – Cleaning and Start-up of Mechanical Piping Systems.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM):

.1 ASTM E202-10, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.3 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS

.1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

1.4 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)

.1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.

.2 When systems are operational, perform following tests:

.1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.

.2 Verify performance of hydronic system circulating pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.

.1 Pump operation.

.2 Heat Exchanger operation

.3 Stack economizer loops operation.

1.5 HYDRONIC SYSTEM CAPACITY TEST

.1 Perform hydronic system capacity tests after:

.1 TAB has been completed

.2 Verification of operating, limit, safety controls.

.3 Verification of primary and secondary pump flow rates.

.4 Verification of accuracy of temperature and pressure sensors and gauges.

.2 Calculate system capacity at test conditions.

.3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.

.4 When capacity test is completed, return controls and equipment status to normal operating conditions.

.5 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.

.6 Heating system capacity test:

.1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:

.1 Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures to ensure that coils are not subjected to freezing conditions) or

.2 Reducing space temperature by turning of heating system for sufficient period of time before starting testing.

.2 Test procedures:

.1 Open fully heat exchanger, heating coil and radiation control valves.

.2 With boilers on and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.

1.6 REPORTS

.1 In accordance with Division 01 – Commissioning Sections: Reports, supplemented as specified herein.

1.7 TRAINING

.1 In accordance with Division 01 – Commissioning Sections.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Procedures and cleaning solutions for cleaning mechanical piping systems.

.2 Related Sections:

.1 Section 23 08 01 – Performance Verification Mechanical Piping Systems.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM):

.1 ASTM E202-10, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01 – General Requirements. Include product characteristics, performance criteria, and limitations.

.2 Quality assurance submittals: submit following in accordance with Division 01 – General Requirements.

.1 Instructions: submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Division 01 – General Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Division 01 – General Requirements.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 01 – General Requirements.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Division 01 – General Requirements.

2.2 CLEANING SOLUTIONS

.1 Tri-sodium phosphate: 0.40 kg per 100 L water in system.

.2 Sodium carbonate: 0.40 kg per 100 L water in system.

.3 Low-foaming detergent: 0.01 kg per 100 L water in system.

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 datasheet.

3.2 CLEANING HYDRONIC AND STEAM SYSTEMS

.1 Timing: systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.

.2 Cleaning Agency:

.1 Retain qualified water treatment specialist to perform system cleaning.

.3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist.

.4 Cleaning procedures:

.1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:

.1 Cleaning procedures, flow rates, elapsed time.

.2 Chemicals and concentrations used.

.3 Inhibitors and concentrations.

.4 Specific requirements for completion of work.

.5 Special precautions for protecting piping system materials and components.

.6 Complete analysis of water used to ensure water will not damage systems or equipment.

.5 Conditions at time of cleaning of systems:

.1 Systems: free from construction debris, dirt and other foreign material.

.2 Control valves: operational, fully open to ensure that terminal units can be cleaned properly.

.3 Strainers: clean prior to initial fill.

.4 Install temporary filters on pumps not equipped with permanent filters.

.5 Install pressure gauges on strainers to detect plugging.

.6 Report on Completion of Cleaning:

.1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.

.7 Hydronic Systems:

.1 Fill system with water, ensure air is vented from system.

.2 Fill expansion tanks 1/3 to 1/2 full, charge system with compressed air to at least 35 kPa (does not apply to diaphragm type expansion tanks).

.3 Use water metre to record volume of water in system to +/- 0.5%.

.4 Add chemicals under direct supervision of chemical treatment supplier.

.5 Closed loop systems: circulate system cleaner at 60°C for at least 36 h. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.

.6 Flush velocity in system mains and branches to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.

.7 Add chemical solution to system.

.8 Establish circulation, raise temperature slowly to 60°C minimum. Circulate for 12 h, ensuring flow in all circuits. Remove heat and continue to circulate until temperature is below 38°C. Drain as quickly as possible. Refill with clean water. Circulate for 6 h at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).

3.3 START-UP OF HYDRONIC SYSTEMS

.1 After cleaning is completed and system is filled:

.1 Establish circulation and expansion tank level, set pressure controls.

.2 Ensure air is removed.

.3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.

.4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.

.5 Clean out strainers repeatedly until system is clean.

.6 Commission water treatment systems as specified in Section 23 25 00 - HVAC Water Treatment Systems.

.7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.

.8 Repeat with water at design temperature.

.9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.

.10 Bring system up to design temperature and pressure slowly over a 48 hour period.

.11 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.12 Adjust pipe supports, hangers, springs as necessary.

.13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.

.14 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.

.15 Check operation of drain valves.

.16 Adjust valve stem packings as systems settle down.

.17 Fully open balancing valves (except those that are factory-set).

.18 Check operation of over-temperature protection devices on circulating pumps.

.19 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

3.4 FIELD QUALITY CONTROL

.1 Verification requirements in accordance with Division 01 – General Requirements.

3.5 CLEANING

.1 Proceed in accordance with Division 01 – General Requirements.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Materials and installation for steel piping, valves and fittings for hydronic systems in building services piping.

.2 Related Sections.

.1 Division 01 – General Requirements.
.2 Section 23 05 05 - Installation of Pipework.
.3 Section 23 05 23 - Valves – Bronze and Cast Iron.
.4 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
.5 Section 23 08 01 - Performance Verification of Mechanical Piping Systems.
.6 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME):

.1 ASME B16.1-98, Cast Iron Pipe Flanges and Flanged Fittings.
.2 ASME B16.3-98, Malleable Iron Threaded Fittings.
.3 ASME B16.5-03, Pipe Flanges and Flanged Fittings.
.4 ASME B16.9-01, Factory-Made Wrought Buttwelding Fittings.
.5 ASME B18.2.1-03, Square and Hex Bolts and Screws (Inch Series).
.6 ASME B18.2.2-87 (R1999), Square and Hex Nuts (Inch Series).

.2 American Society for Testing and Materials International, (ASTM):

.1 ASTM A47/A47M-99 (2009), Standard Specification for Ferritic Malleable Iron Castings.
.2 ASTM A53/A53M-10, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
.3 ASTM A536-84 (2009) e1, Standard Specification for Ductile Iron Castings.
.4 ASTM B61-08, Standard Specification for Steam or Valve Bronze Castings.
.5 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
.6 ASTM E202-10, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.

.3 American Water Works Association (AWWA):

.1 AWWA C111-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 Canadian Standards Association (CSA International):

.1 CSA B242-05, Groove and Shoulder Type Mechanical Pipe Couplings.

.2 CAN/CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau).

.5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS):

.1 MSS-SP-70-98, Cast Iron Gate Valves, Flanged and Threaded Ends.

.2 MSS-SP-71-97, Cast Iron Swing Check Valves Flanged and Threaded Ends.

.3 MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.

.4 MSS-SP-85-02, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.3 SUBMITTALS

.1 Submit shop drawings in accordance with Division 01 – General Requirements.

.2 Closeout Submittals.

.1 Provide maintenance data for incorporation into manual in accordance with Division 01 – General Requirements.

.2 Submit required copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 01 – General Requirements. Indicate VOC's for adhesives and solvents during application and curing.

1.4 QUALITY ASSURANCE

.1 Health and Safety.

.1 Do construction occupational health and safety in accordance with Division 01 – General Requirements.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal.

.1 Separate waste materials for reuse and recycling in accordance with Division 01 – General Requirements.

1.6 MAINTENANCE

.1 Extra Materials:

.1 Provide following spare parts:

.1 Valve seats: one for every ten valves, each size. Minimum one.

.2 Discs: one for every ten valves, each size. Minimum one.

.3 Stem packing: one for every ten valves, each size. Minimum one.

.4 Valve handles: two of each size.

.5 Gaskets for flanges: one for every ten flanges.

Part 2 Products

2.1 PIPE

.1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:

.1 To NPS6: Scheduled 10.

2.2 PIPE JOINTS

.1 NPS2 and under: screwed fittings with lead-free pipe dope.

.2 NPS2-1/2 and over: welding fittings and flanges to CAN/CSA W48.

.3 Roll grooved: standard coupling to CSA B242.

.4 Pipe thread: taper.

.5 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.

.6 Roll grooved coupling gaskets: type EPDM.

.7 Acceptable Roll Grooved System: Victaulic or approved equal.

2.3 FITTINGS

.1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.

.2 Pipe flanges and flanged fittings:

.1 Cast iron: to ASME B16.1, Class 125.

.3 Butt-welding fittings: steel, to ASME B16.9.

.4 Unions: malleable iron, to ASTM A47/A47M and ASME B16.3.

.5 Fittings for roll grooved piping: ductile iron to ASTM A536.

2.4 VALVES

.1 Connections:

.1 NPS2 and smaller: screwed ends.

.2 NPS2.1/2 and larger: grooved ends.

.2 Gate valves: Application: Isolating equipment, control valves, pipelines:

.1 NPS2 and under:

.1 Mechanical Rooms: Class 125, rising stem, solid wedge disc as specified Section 23 05 23 - Valves – Bronze and Cast Iron.

.2 Elsewhere: Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23 - Valves – Bronze and Cast Iron.

.2 NPS21/2 and over:

.1 Mechanical Rooms: rising stem, solid wedge disc, bronze trim, as specified Section 23 05 23 - Valves – Bronze and Cast Iron.

.1 Operators: Handwheel.

.2 Elsewhere: Non-rising stem, solid wedge disc, bronze trim, as specified Section 23 05 23 - Valves – Bronze and Cast Iron.

.1 Operators: Handwheel.

.3 Globe valves: to Application: Throttling, flow control, emergency bypass:

.1 NPS2 and under:

.1 Mechanical Rooms: with PTFE disc, as specified Section 23 05 23 - Valves – Bronze and Cast Iron.

.2 Elsewhere: Globe, with composition disc, as specified Section 23 05 23 - Valves – Bronze and Cast Iron.

.4 Balancing, for TAB:

.1 Sizes: Calibrated balancing valves, as indicated on drawings.

.5 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23 - Valves - Bronze.

.6 Swing check valves: to MSS-SP-71.

.1 NPS2 and under:

.1 Class 125, swing, with composition disc, as specified Section 23 05 23 - Valves – Bronze and Cast Iron.

.2 NPS21/2 and over:

.1 Grooved ends: as specified Section 23 05 23 - Valves – Bronze and Cast Iron.

.7 Ball valves:

.1 NPS2 and under: as specified Section 23 05 23 - Valves – Bronze and Cast Iron.

Part 3 Execution

3.1 PIPING INSTALLATION

.1 Install pipework in accordance with Section 23 05 05 - Installation of Pipe Work.

3.2 CLEANING, FLUSHING AND START-UP

.1 In accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.

3.3 TESTING

.1 Test system in accordance with Section 23 05 00 - Common Work Results for HVAC.

.2 For glycol systems, retest with propylene glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves.

3.4 BALANCING

.1 Balance water systems to within plus or minus 10% of design output.

.2 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 The supply and installation of Hydronic Specialties Equipment.

.2 Related Sections:

.1 Division 01 – General Requirements.

.2 Section 23 08 01 - Performance Verification Mechanical Piping Systems.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME):

.1 ASME-04, Boiler and Pressure Vessel Code.

.2 American Society for Testing and Materials, (ASTM):

.1 ASTM A47/A47M-2009, Specification for Ferritic Malleable Iron Castings.

.2 ASTM A278M-01 (2006), Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (345 degrees C).

.3 ASTM A516/A516M-10, Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.

.4 ASTM A536-84 (2009) e1, Specification for Ductile Iron Castings.

.5 ASTM B62-09, Specification for Composition Bronze or Ounce Metal Castings.

.3 Canadian Standards Association (CSA International):

.1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.

1.3 SUBMITTALS

.1 Submittals in accordance with Division 01 – General Requirements.

.2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets in accordance with Division 01 – General Requirements.

.1 Submit shop drawings and product data in accordance with Division 01 – General Requirements.

.2 Indicate on product data expansion tanks, air vents, separators, valves, strainers, heat exchanger and low loss header.

.3 Indicate VOC’s for all adhesives and solvents during application and curing.

.3 Closeout Submittals:

.1 Submit maintenance data in accordance with Division 01 – General Requirements.

1.4 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Division 01 – General Requirements.

1.5 DELIVERY STORAGE AND DISPOSAL

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Division 01 – General Requirements.

Part 2 Products

2.1 MATERIAL

.1 Sustainable Requirements:

.1 Materials and resources in accordance with Division 01 – General Requirements.

2.2 AUTOMATIC AIR VENT

.1 Standard float vent: brass body and NPS 1/8 connection and rated at 620 kPa working pressure.

.2 Industrial float vent: cast iron body and NPS 1/2 connection and rated at 860 kPa working pressure.

.3 Float: solid material suitable for 115°C working temperature.

.4 Acceptable material: Bell & Gossett, Armstrong, Taco, Watts or approved alternate.

2.3 PIPE LINE STRAINER

.1 NPS 1/2 to 2: bronze body to ASTM B62, screwed connections, Y pattern.

.2 NPS 2 1/2 to 12: cast iron body to ASTM, Class 30 flanged connections.

.3 Blowdown connection: NPS 1.

.4 Screen: stainless steel with 1.19 mm perforations.

.5 Working pressure: 860 kPa.

.6 Acceptable material: Watts, Jenkins, Crane.

Part 3 Execution

3.1 GENERAL

.1 Install as indicated and to manufacturer's recommendations.

.2 Run drain lines and blow off connections to terminate above nearest drain.

.3 Maintain proper clearance to permit service and maintenance.

.4 Should deviations beyond allowable clearances arise, request and follow City of Saint John Representative's and Engineer's directive.

.5 Check shop drawings for conformance of all tappings for ancillaries and for equipment operating weights.

3.2 STRAINERS

.1 Install in horizontal or down flow lines.

.2 Ensure clearance for removal of basket.

.3 Install ahead of each pump.

.4 Install ahead of each automatic control valve larger than NPS 1 and as indicated.

3.3 AIR VENTS

.1 Install at high points of systems.

3.4 EXPANSION TANKS

.1 Adjust expansion tank pressure to suit design criteria.

.2 Install lock shield type valve at inlet to tank.

3.5 VERIFICATION

.1 Verification requirements in accordance with Division 01 – General Requirements.

3.6 PRESSURE SAFETY RELIEF VALVES

.1 Run discharge pipe to terminate above nearest drain.

3.7 SUCTION DIFFUSERS

.1 Install on inlet to pumps having suction size greater than 50.

3.8 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 01 - Performance Verification of Mechanical Piping Systems, supplemented as specified herein.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Division 01 – General Requirements.

.2 Section 23 05 00 – Common Work Results for HVAC.

.3 Hydronic Pumps as per Schedule on the drawings will be supplied to the site by City of Saint John for installation by this Contractor.

1.2 REFERENCES

.1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE):

.1 Standard 90.1-2001 Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 Electrical Equipment Manufacturers Advisory Council (EEMAC).

.3 Canadian Standards Association (CSA International):

.1 CAN/CSA-B214-01, Installation Code for Hydronic Heating Systems.

.4 National Electrical Manufacturers Association (NEMA):

.1 NEMA MG 1-2003, Motors and Generators.

1.3 SUBMITTALS

.1 Submittals in accordance with Division 01 – General Requirements.

.2 Submit Manufacturer printed shop drawings and product data in accordance with Division 01 – General Requirements.

.3 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.

.4 Submit product data of pump curves for review showing point of operation.

.5 Indicate piping, valves and fittings shipped loose by packaged equipment supplier, showing their final location in field assembly.

.6 Provide maintenance data for incorporation into manual in accordance with Division 01 – General Requirements.

1.4 HEALTH AND SAFETY

.1 Do construction occupational health and safety in accordance with Division 01 – General Requirements.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Division 01 – General Requirements.

1.6 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Division 01 – General Requirements.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and resources in accordance with Division 01 – General Requirements.

2.2 EQUIPMENT

.1 Do component selection and sizing to: CAN/CSA-B214.

2.3 SPLIT COUPLED VERTICAL INLINE PUMP WITH INTEGRATED CONTROLS

.1 Design pump for variable flow applications and selected for hydraulic design conditions and minimum system pressure with sensorless load Demand Based Control.

- .1 Select hydraulic design conditions and minimum pressure with sensorless load control
- .2 For sensorless control the operating control curve shall be quadratic with adjustable minimum head setting.

.2 Meet or exceed energy saving requirements of ASHRAE 90.1-2010 by pump selection, based on optimum performance at part load, to save 70% of design flow energy at 50% part-load

.3 Design pumping units to UL STD 778 & CSA STD C22.2 No.108

.4 Design Stainless Steel Type 316 units to NSF/ANSI 61 & 372 Coupling: rigid self-aligning.

.5 Casing: Ductile iron ASTM A536 Grade 65-45-12, e-coated

- .1 Test casing to 150 % maximum working pressure.
- .2 Ensure casing is radially split to allow for removal of rotating element without disturbing pipe connections.
- .3 Cast iron casing wetted surfaces shall be e-coated to prevent seizing of impeller to casing after periods of inactivity.
- .4 Drill and tap casing for gauge ports on both suction and discharge connections.
- .5 Drill and tap casing at lowest point for drain port.

.6 Impeller: To ASTM A743 CF8M, Stainless Steel Type 316, fully enclosed and dynamically balanced to ANSI G6.3 and fitted to shaft with key. Use two-plane balancing when installed impeller diameter is less than 6 times impeller width.

.7 Pump Shaft: Split-coupled: Stainless steel to ASTM A582/A582M, Grade 416.

.8 Coupling: Rigid spacer type, high tensile aluminum.

- .1 Design coupling for easy removal on site to reveal space between pump and motor shaft.
- .2 Ensure revealed space is sufficient for removal of mechanical seal components without disturbing pump, controls or motor.
- .3 Include coupling guard.
- .4 Include lower seal chamber throttle bushing to ensure seals maintain positive cooling and lubrication.

.9 Flanges: To ANSI/ASME B16.5, Class 125

.10 Flush Line: 3/8 inch braided stainless steel complete with vent.

.11 Casing O-ring: EPDM.

.12 Mechanical Seal: Non-potable, Type AB2 outside balanced seal design and rated to 200°F maximum:

.1 Rotating face: Resin bonded carbon

.2 Stationary face: Sintered Silicon Carbide

.3 Seal rotating hardware: Stainless Steel

.4 Secondary / shaft seal elastomer: Viton®

.13 Motor: Permanent Magnet Motor: To IE5 efficiency:

.1 Horsepower: 7.5 HP.

.2 Enclosure: TEFC.

.3 Efficiency: IE5 efficiency To IEC 60034-30-1

.4 Power supply: 575V, 3PH 60 Hertz

.14 Pump Control:

.1 Control: Integrated with UL type 12 minimum enclosure rating, sensorless controls complete with menu-driven graphical touchscreen interface.

.2 Provide near unity displacement power factor (cos Ø) without need for external power factor correction capacitors at all loads and speeds using VVC-PWM type integrated controls

.3 Incorporate DC link reactors for reduction of mains borne harmonic currents and DC link ripple current to increase DC link capacitor lifetime.

.4 Fit RFI filters as standard to ensure integrated controls meets low emission and immunity requirements.

.5 Protocol: BACnet™ MS/TP

.6 Sensorless override for BAS/BMS control signal.

.7 Enclosure: UL Type 12

.8 EMI/RFI Control: Integrated filter designed to DIN EN61800-3.

.9 Harmonic suppression: Equivalent 5% impedance AC line reactor) to mitigate harmonics to support IEEE 519 system requirements.

.10 Cooling: Fan cooled, surface cooling.

.11 Ambient working conditions: 14°F to +113°F, up to 3300 feet above sea level.

.12 Analog I/O: 2 inputs minimum, 1 output minimum. Output can be configured for voltage or current.

.13 Digital I/O: 2 inputs minimum, 2 outputs minimum. Outputs can be configured as inputs.

.14 Pulse inputs: 2 programmable minimum.

.15 Relay outputs: 2 programmable minimum.

.16 Communications ports: 1- RS485.

.17 One volt free contact.

.18 Auto alarm reset.

.15 Pump Motor and Controls Protection

.1 Motor phase to phase fault.
.2 Motor phase to ground fault.
.3 Loss of supply phase.
.4 Over voltage.
.5 Under voltage.
.6 Motor over temperature.
.7 Inverter overload.
.8 Over current

.16 Accessories

.1 Pipe Flanges: To ANSI/ASME B16.5, Class 150.
.2 Suction Diffuser: For ANSI Class 150 pipe flange and ANSI 125 pump flange
.3 Triple Duty Valve: Cast iron valve body, tight shut-off, spring -closure type silent non-slam check valve with effective throttling design capability.

.17 Acceptable Manufacturer: Armstrong Design Envelope Sensorless 4300, Bell & Gossett e-80SC, Wilo-Stratos GIGA or approved alternate.

2.4 PUMP SCHEDULE

.1 Refer to Drawings.

Part 3 Execution

3.1 INSTALLATION (By this Contractor)

.1 Do Work in accordance with CAN/CSA-B214.

.2 In line circulators: install as indicated by flow arrows. Support at inlet and outlet flanges or unions. Install with bearing lubrication points accessible.

.3 Ensure that pump body does not support piping or equipment. Provide stanchions or hangers for this purpose. Refer to manufacturer's installation instructions for details.

.4 Pipe drain tapping to floor drain, if required.

.5 Install volute venting pet cock in accessible location.

.6 Check rotation prior to start-up.

.7 Install pressure gauge test cocks.

3.2 START-UP (By City of Saint John)

.1 General:

.1 In accordance with Division 01 – Commissioning Sections; supplemented as specified herein.
.2 In accordance with Manufacturer's recommendations.

.2 Procedures:

.1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.
.2 After starting pump, check for proper, safe operation.

.3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.

.4 Check base for free-floating, no obstructions under base.

.5 Run-in pumps for 12 continuous hours.

.6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.

.7 Eliminate air from scroll casing.

.8 Adjust water flow rate through water-cooled bearings.

.9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.

.10 Adjust alignment of piping and conduit to ensure true flexibility at all times.

.11 Eliminate cavitation, flashing and air entrainment.

.12 Adjust pump shaft seals, stuffing boxes, glands.

.13 Measure pressure drop across strainer when clean and with flow rates as finally set.

.14 Replace seals if pump used to degrease system or if pump used for temporary heat.

.15 Verify lubricating oil levels.

3.3 PERFORMANCE VERIFICATION (PV)

.1 General:

.1 In accordance with Division 01 – Commissioning Sections: General Requirements, supplemented as specified herein.

.2 In accordance with Division 01 – General Requirements.

.3 In accordance with manufacturer's recommendations.

.2 Exclusions:

.1 This paragraph does not apply to small in-line circulators.

.3 Assumptions: these PV procedures assume that:

.1 Manufacturer's performance curves are accurate.

.2 Valves on pump suction and discharge provide tight shut-off.

.4 Multiple Pump Installations - Series and Parallel:

.1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.

.5 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.

.6 Commissioning Reports: In accordance with Division 01 – Commissioning Sections. Reports supplemented as specified herein. Reports to include:

.1 Record of point(s) of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.

.2 Report forms Division 01 – Commissioning Sections: Report Forms and Schematics.

.3 Pump performance curves (family of curves).

3.4 OPERATION REQUIREMENTS

.1 Operational requirements in accordance with Division 01 – General Requirements.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials, components, equipment and chemicals for installation of complete HVAC water treatment system.

.2 Related Sections:

.1 Division 01 – Commissioning Sections.

.2 Section 23 08 02 – Cleaning and Start-up of Mechanical Piping Systems.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME):

.1 ASME Boiler and Pressure Vessel Code, Section VII-2004.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Division 01 – General Requirements. Include product characteristics, performance criteria, and limitations.

.1 Submit required copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 01 – General Requirements. Indicate VOC's for adhesives and solvents during application and curing.

.2 Shop Drawings:

.1 Submit Manufacturer printed shop drawings in accordance with Division 01 – General Requirements.

.3 Quality assurance submittals: submit following in accordance with Division 01 – General Requirements.

.4 Closeout Submittals:

.1 Submit operation and maintenance data for incorporation into manual in accordance with Division 01 – General Requirements.

1.4 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Division 01 – General Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 23 05 00 – Common Work Results for HVAC.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Division 01 – General Requirements.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with Division 01 – General Requirements.

2.2 MANUFACTURER

.1 Equipment, chemicals, service provided by one supplier.

2.3 POT FEEDER

.1 Welded steel, pressure rating 860 kPa. Temperature rating: 90°C.

2.4 CHEMICAL FEED PIPING

.1 Resistant to chemicals employed. Pressure rating: 860 kPa.

2.5 WATER TREATMENT FOR HYDRONIC SYSTEMS

.1 Hot water heating system: pot feeder, 25 L, operating pressure 60 kPa.

.2 Glycol system: fill tank, operating pressure 860 kPa.

.3 Micron filter for each pot feeder:

.1 Capacity 2% of pump recirculating rate at operating pressure.

.2 Six (6) sets of filter cartridges for each type, size of micron filter.

2.6 CHEMICALS

.1 Provide 1 years supply.

2.7 TEST EQUIPMENT

.1 Provide one set of test equipment for each system to verify performance.

.2 Complete with carrying case, reagents for chemicals, specialized or supplementary equipment.

2.8 INHIBITED PROPYLENE GLYCOL

.1 Hydronic System to be filled with a pre-mixed glycol solution to provide freezing protection.

.1 Product: DOW – Dowfrost HD, 35% by Volume.

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 datasheet.

3.2 INSTALLATION

.1 Install HVAC water treatment systems in accordance with ASME Boiler Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.

.2 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.

3.3 CHEMICAL FEED PIPING

.1 Install crosses at changes in direction. Install plugs in unused connections.

3.4 CLEANING OF MECHANICAL SYSTEM

.1 Provide copy of recommended cleaning procedures and chemicals for approval by Engineer.

.2 Flush mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Use chemicals to inhibit corrosion of various system materials that are safe to handle and use.

.3 Examine and clean filters and screens, periodically during circulation of cleaning solution, and monitor changes in pressure drop across equipment.

.4 Drain and flush systems until alkalinity of rinse water is equal to make-up water. Refill with clean water treated to prevent scale and corrosion during system operation.

.5 Disposal of cleaning solutions approved by authority having jurisdiction.

3.5 WATER TREATMENT SERVICES

.1 Provide water treatment monitoring and consulting services for period of one year after system start-up. Service to include:

- .1 Initial water analysis and treatment recommendations.
- .2 System start-up assistance.
- .3 Operating staff training.
- .4 Visit plant every 5 days during period of operation and as required until system stabilizes, and advise on treatment system performance.
- .5 Provide necessary recording charts and log sheets for one year operation.
- .6 Provide necessary laboratory and technical assistance.
- .7 Provide clear, concise, written instructions and advice to operating staff.

3.6 FIELD QUALITY CONTROL

.1 Start-up:

- .1 Start up water treatment systems in accordance with manufacturer's instructions.

.2 Commissioning:

- .1 Commissioning Agency: to be installing water treatment sub-contractor.
- .2 Timing:
  - .1 After start-up deficiencies rectified.
  - .2 After start-up and before TAB of connected systems.

.3 Pre-commissioning Inspections: verify:

.1 Presence of test equipment, reagents, chemicals, details of specific tests performed, and operating instructions.

.2 Suitability of log book.

.3 Currency and accuracy of initial water analysis.

.4 Required quality of treated water.

.4 Commissioning procedures - applicable to Water Treatment Systems:

.1 Establish, adjust as necessary and record automatic controls and chemical feed rates.

.2 Monitor performance continuously during commissioning of connected systems and until acceptance of project.

.3 Establish test intervals, regeneration intervals.

.4 Record on approved report forms commissioning procedures, test procedures, dates, times, quantities of chemicals added, raw water analysis, treated water analysis, test results, instrument readings, adjustments made, results obtained.

.5 Establish, monitor and adjust automatic controls and chemical feed rates as necessary.

.6 Visit project at specified intervals after commissioning is satisfactorily completed to verify that performance remains as set during commissioning (more often as required until system stabilizes at required level of performance).

.7 Advise City of Saint John Representative and Engineer in writing on matters regarding installed water treatment systems.

.5 Commissioning procedures - Closed Circuit Hydronic Systems:

.1 Analyze water in system.

.2 Based upon an assumed rate of loss approved by Engineer, establish rate of chemical feed.

.3 Record types, quantities of chemicals applied.

.6 Training:

.1 Commission systems, perform tests in presence of, and using assistance of, assigned O&M personnel.

.2 Train O&M personnel in softener regeneration procedures.

.7 Certificates:

.1 Upon completion, furnish certificates confirming satisfactory installation and performance.

.8 Commissioning Reports:

.1 To include system schematics, test results, test certificates, raw and treated water analyses, design criteria, other data required by City of Saint John Representative and Engineer.

.9 Commissioning activities during Warranty Period:

.1 Check out water treatment systems on regular basis and submit written report to City of Saint John Representative and Engineer.

.3 Verification requirements in accordance with Division 01 – General Requirements.

3.7 CLEANING

.1 Proceed in accordance with Division 01 – General Requirements.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for piping and fittings used in HVAC heat exchangers.

.2 Related Sections:

.1 Section 01 35 30 – Health, and Safety Requirements.

.2 Section 01 45 00 - Quality Control.

.3 Section 01 78 00 - Closeout Submittals.

.4 Section 01 91 13 - General Commissioning (Cx) Requirements.

Note: Heat Exchanger and Maintenance Materials have been pre-purchased by City of Saint John and will be delivered to site for installation by this contractor.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME):

.1 ASME Boiler and Pressure Vessel Code.

.1 BPVC-VIII B-2004, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 1.

.2 BPVC-VIII-2 B-2004, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 2 - Alternative Rules.

.3 BPVC-VIII-3 B-2004, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 3 - Alternative Rules High Press Vessels.

.2 Canadian Standards Association (CSA International):

.1 CSA B51-03, Boiler, Pressure Vessel, and Pressure Piping Code.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Submittals in accordance with Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet for heat exchangers.

.2 Submit WHMIS MSDS in accordance with Hazardous Materials. Indicate VOC's for adhesive and solvents during application and curing.

.3 Shop Drawings:

.1 Submit shop drawings to indicate project layout including layout, dimensions of heat exchangers and system. Indicate following information:

.1 Manufacturers recommended clearances for tube withdrawal and manipulation of tube cleaning tools.

.2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Instructions: submit manufacturer's installation instructions.

.5 Manufacturers Field Reports: manufacturer's field reports specified.

.6 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

.1 Pre-Installation Meeting:

.1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations:

.1 Verify project requirements.

.2 Review installation conditions.

.3 Co-ordination with other building subtrades.

.4 Review manufacturer's installation instructions and warranty requirements.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 30 – Health, and Safety Requirements.

1.5 MAINTENANCE

.1 Maintenance Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Supply following spare parts:

.1 Head gaskets.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Construction/Demolition Waste Management and Disposal.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan (WMP).

.4 Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste in accordance with Waste Management Plan (WMP).

.5 Divert unused metal materials from landfill to metal recycling facility as approved by Project Manager.

Part 2 Products

2.1 PLATE AND FRAME HEAT EXCHANGER (Supplied by City of Saint John)

.1 Furnish a plate heat exchanger as manufactured and designed, completely assembled, inspected and tested to meet the thermal and hydraulic requirements of the schedule.

.2 The heat exchanger design shall be in fully accordance with the governing safety code: ASME, TSSA, PED.

.3 The individual heat transfer plates that shall be pressed from a single sheet of 304SS. The plate thickness shall be determined by the manufacturer to meet the design pressures and temperature. The plates shall be provided with a herringbone corrugation with a depth, spacing and thickness to meet a full differential pressure across the plate of 1.3 to 1.5 times the design pressure without deformation or failure.

.4 Each plate shall have a gasket made from nitrile, EPDM or other material that shall be compatible with all the operating fluids and rated for continuous service at the design temperature. The gasket cross section shall be tent shaped, resulting in better sealing with less compressive stress.

.5 Gaskets shall have vent grooves in the unused area of the plate to prevent intermixing of the fluids and to cause any leak by the gasket to be visually evident from outside the heat exchanger. The gasket groove in each plate shall be of the proper depth to contain 100% of the gasket profile.

.6 Gaskets, unless otherwise approved, shall be of the glue-free clip-on type that mechanically attach to a specific U-shaped hole at the outer edge of the plate. Gasket clips shall be visible from the outside to verify proper installation. Glue-free gaskets that wrap around the outer edge of the plate and can be damaged shall not be used. For certain applications, glued on gaskets may be acceptable.

.7 The pressure-retaining frame shall be designed and built to guarantee dependable operation and easy maintenance for the life of the heat exchanger. The frame shall be bolted together for ease of assembly and field installation. The unit covers shall be of sufficient uniform thickness and tightening bolt configuration to withstand all loadings.

.8 The covers and all other carbon steel parts shall be cleaned, prepared and painted. For heat exchangers that are 50” (1270 mm) or taller, the moveable cover shall be provided with a roller assembly to easily move it during assembly and plate inspection.

.9 The preferred connection arrangement is all four connections on the fixed front cover. Flow arrangement shall be vertical. A diagonal flow pattern is not acceptable. Connections shall be integral with the cover in either studded ANSI or NPT type to eliminate nozzle pipe loadings and leakage in the connection area.

.10 The carrying bars for the plates and tightening bolts shall be stainless steel or zinc-coated carbon steel for rust prevention and ease of maintenance. Painted surfaces are not acceptable.

.11 The frame and carrying bars shall be designed to allow for a plate expansion of at least 4% capacity while still providing maintenance space.

.12 All units are to be provided with an aluminum safety shield for personal protection and to protect the plates and gaskets from the elements.

.13 Acceptable Material: Armstrong, or approved equal.

Part 3 Execution (By this Contractor)

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 datasheet.

3.2 INSTALLATION

.1 General: install level and firmly anchored to supports in accordance with manufacturer's recommendations.

.2 Tube in shell heat exchangers: arrange piping so that tube bundle can be removed after disconnecting two unions or flanges adjacent to head and without disturbing other equipment and systems.

3.3 APPURTENANCES

.1 Install with safety relief valve piped to drain, vacuum breaker, steam trap and hose bib drain valve.

.2 Install thermometer wells with thermometers on inlet and outlet of secondary side.

.3 Install pressure gauge on steam inlet.

.4 Install thermometers and pressure gauges on each side of plate and from exchangers.

3.4 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its product[s], and submit written reports, in acceptable format, to verify compliance of work with Contract.

.2 Provide manufacturer's field services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with manufacturer's instructions.

.3 Schedule site visits to review work at stages listed:

.1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.

.2 Twice during progress of work at 25% and 60% complete.

.2 Upon completion of work, after cleaning is carried out.

.3 Obtain reports within 3 days of review and submit immediately to MCW CES Project Manager.

.4 Start-up:

.1 General: perform start-up operations as specified herein.

.2 Check heater for cleanliness on primary and secondary sides.

.3 Check water treatment system is complete, operational and correct treatment is being applied.

.4 Check installation, settings, operation of relief valves and safety valves.

.5 Check installation, location, settings and operation of operating, limit and safety controls.

.6 Check supports, seismic restraint systems.

.5 Performance Verification:

.1 General: perform performance verification as specified.

.2 Timing: only after TAB of hydronic systems have been successfully completed.

.3 Primary side:

.1 Measure flow rate, pressure drop, and either one steam pressure and temperature at heater inlet or two water temperature at heater inlet and outlet.

.2 Verify operation of steam traps. Measure temperature of condensate return at trap outlet.

.4 Control valve: verify proper operation without binding, slack in components. Measure steam pressure and temperature at control valve inlet.

.5 Secondary side:

.1 Measure flow rate, pressure drop and water temperature at heater inlet and outlet.

.2 Verify installation and operation of air elimination devices.

.6 Calculate heat transfer from primary and secondary sides.

.7 Simulate heating water temperature schedule and repeat above procedures.

.8 Verify settings, operation, safe discharge from safety valves and relief valves.

.9 Verify settings, operation of operating, limit and safety controls and alarms.

.10 Reports: Provide start-up reports.

3.5 CLEANING

.1 Perform cleaning operations in accordance with manufacturer's recommendations.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Semi-hermetic, direct drive, water-cooled rotary screw chillers with multiple compressors.

.2 Note: The heat recovery chiller and maintenance materials have been pre-purchased by the City of Saint John, and will be delivered to site for installation by this contractor.

1.2 SUBMITTALS

.1 Acceptable refrigerants on which chiller performance is based are HCFC-123 or HFC-134a. All proposals for chiller performance must include an AHRI approved selection for the specified refrigerants.

.2 Submit drawings indicating components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.

.3 Submit product data indicating rated capacities, weights, unit acoustics, specialties and accessories, electrical requirements and wiring diagrams.

.4 Submit manufacturer's installation instructions.

.5 Submit performance data indicating energy input versus cooling load output from 100 to 25 percent of full load with constant leaving condenser water temperature.

1.3 OPERATION AND MAINTENANCE DATA

.1 Include start-up instructions, operation data, maintenance data, controls, and accessories. Include trouble-shooting guide.

1.4 REGULATORY REQUIREMENTS

.1 Conform to AHRI Standard 550/590 for rating and certified testing of Water Chilling Packages using the Vapour Compression Cycle.

.2 Conform to UL 1995 - Standard for Heating and Cooling Equipment, Safety Standard. In the event the unit is not UL approved, the manufacturer shall, at manufacturer expense, provide for a field inspection by an UL representative to verify conformance to UL standards. If necessary, contractor shall perform modifications to the unit to comply with UL, as directed by the UL representative.

.3 Conform to ASME SECTION VIII Boiler and Pressure Vessel Code for construction and testing of unfired pressure vessels.

.4 Conform to ANSI/ASHRAE STANDARD 15 safety code for mechanical refrigeration.

.5 Unit shall bear the AHRI Certification Label for the specific type of water chiller as applicable.

.6 Chiller manufacturer shall provide LEED-NC EA Credit Calculation for each chiller utilizing the factors specified by the U.S. Green Building Council based upon equipment life of 23 years.

1.5 HANDLING

.1 Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

.2 Protect units from physical damage. Leave factory shipping covers in place until installation.

1.6 WARRANTY

.1 Provide a full parts warranty for one year from start-up or 18 months from shipment, whichever occurs first.

.2 A 5-year motor/transmission/compressor warranty shall be provided based upon the RPM of the compressor as follows:

Compressor RPM	**Warranty Term**
0 - 10,000	1 year from start-up
10,001 and above	5 years from start-up plus annual oil and refrigerant analysis

.3 Beginning at the expiration of the standard warranty, the original equipment owner shall be provided an optional extended (whole unit parts, whole unit labour, refrigerant, motor/transmission/compressor parts, motor/transmission/compressor labour) warranty.

.1 The warranty shall extend beyond the initial standard warranty up to the end of the (2 – 5) year.

.2 See extended warranties for additional warranty details.

.4 When start-up of the purchased equipment will be delayed beyond six months after shipment, an optional delayed start-up warranty shall be provided to postpone the commencement date of the standard parts warranty for up to one full year from the date of start-up. This will also defer the commencement of any additional purchased warranties. This warranty must be ordered before start-up.

1.7 MAINTENANCE SERVICE

.1 All inspections and service of units shall be accomplished by factory trained and authorized servicing technicians.

.2 All labour for leak checking the chiller according to the manufacturer's IOM and documentation must be included.

.3 In conjunction with and supporting Factory warranty OEM shall furnish complete factory authorized service and maintenance of Applied Chillers for 2 years from Date of Substantial Completion. All work shall be done by manufacturer's commercial warranty agent.

.4 OEM shall provide and report quarterly, semi-annual, and annual maintenance in compliance with or better than ASHRAE Standard 180-2008.

.5 Include maintenance items as recommended in manufacturer's operating and maintenance data.

.6 Submit copy of service call work orders and summary report to the City of Saint John Representative, including description of work performed, operating performance status and noted exceptions.

Part 2 Products

2.1 SUMMARY

.1 The contractor shall furnish and install rotary screw or centrifugal water chillers as shown and scheduled in the plans. The units shall be installed in accordance with this specification and produce the specified tonnage per the scheduled data in accordance with AHRI Standard 550/590. The unit shall be AHRI certified as applicable. Refer to ME schedules for capacities.

2.2 COMPRESSOR AND MOTOR

.1 Construct chiller using semi-hermetic helical rotary screw compressors with independent circuits:

.1 Statically and dynamically balance rotating parts.

.2 Provide oil lubrication system with oil charging valve and oil filter to ensure adequate lubrication during starting, stopping and normal operation.

.3 Provide compressor with automatic capacity reduction equipment consisting of capacity control slide valve (rotary). Compressor must start unloaded for soft start on motors.

.4 Provide crankcase heater and/or oil sump heater to evaporate refrigerant returning to crankcase during shut down. Energize heater when compressor is not operating.

.2 Chiller should be able to unload to 25 percent of full load tonnage with constant leaving condenser water temperature.

.3 The motor shall be semi-hermetic and liquid refrigerant cooled. Hot gas motor cooling is not acceptable. Open drives are not acceptable in positive pressure refrigerant systems (HFC-134a) due to the possibility of oil and refrigerant leaks at the shaft seal between the open motor and the compressor.

.4 Manufacturers with speed increasing transmissions that exceed 10,000 RPM compressor speeds shall annually inspect the gears and bearings. A report shall be forwarded to the owner each year over the first five years to confirm completion.

2.3 EVAPORATOR

.1 The evaporator shall be built in accordance with ANSI/ASHRAE 15- Safety Code for Mechanical Refrigeration. Design, test, and stamp evaporator refrigerant side for 200 psig (1379 kPa) working pressure in accordance with ANSI/ASME SEC VIII.

.2 Evaporator tubes shall be internally and externally enhanced. The tubes shall be securely supported at intermediate supports and physically expanded into both ends of the tube sheets. The evaporator tubes must also be removable from both ends to provide easy access for tube cleaning. The minimum evaporator tube wall thickness, root-to-root across the entire tube length shall be 0.025". It is unacceptable to provide this thickness at the intermediate supports only.

.3 Water boxes shall be designed for 150 psig maximum waterside working pressure and shall be flanged and gasketted for easy removal and access to the tubes. The water boxes shall have grooved-type water connections for easy field chilled water and condenser water connections and have proper orientation as referenced in the scheduled drawings.

.4 Adjustable or float type refrigerant metering devices and thermal expansion valves (TXV) shall be inspected and adjusted by the manufacturer annually for the first five years of operation to assure equivalent reliability to an electronic expansion valve (EXV) system. A written report shall be forwarded to the owner each year over the first five years to confirm completion of calibration.

.5 Units with multi-stage compressors shall incorporate an inter-stage flash vessel economizer in the refrigerant cycle.

.6 Factory insulation will be 3/4" insulation Armaflex II or equal (k=0.28) and cover the evaporator and motor housing. Factory installed foam insulation will be used on the suction line, liquid level sensor and oil return system assembly.

2.4 HEAT RECOVERY CONDENSER

.1 The water-cooled condenser shall be built in accordance with ANSI/ASHRAE 15 Safety Code for Mechanical Refrigeration. Design, test, and stamp condenser refrigerant side for 300 psig (2068 kPa) working pressure in accordance with ANSI/ASME SEC VIII.

.2 Condenser tubes shall be internally and externally enhanced. The tubes shall be securely supported at intermediate supports and physically expanded into both ends. The condenser tubes must also be removable from both ends to provide easy access for tube change outs or tube cleaning. The minimum condenser tube wall thickness, root-to-root across the entire tube length shall be 0.028". It is unacceptable to provide this thickness at the intermediate supports only.

.3 Water boxes shall be designed for 150 psig maximum waterside working pressure and shall be flanged and gasketted for easy removal and access to the tubes. The water boxes shall have grooved-type water connections for easy field chilled water and condenser water connections and have proper orientation as referenced in the scheduled drawings.

.4 Optimized compressors, oil cooler and high condenser temperature control panel allows for leaving condenser water temperatures up to 140°F (60°C). This option allows for entering condenser water temperatures above 95°F (35°C).

2.5 REFRIGERANT CIRCUIT

.1 All units shall have 2 independent refrigerant circuits, each with a separate single compressor. If manifolded compressors are provided on a circuit, then individual compressor warranties must be provided for each compressor on the circuit.

.2 Chiller shall be able to unload to 25% of capacity with AHRI relief and constant entering condenser water temperature.

.3 Chiller with water-cooled condenser.

.4 Provide for each refrigerant circuit:

.1 Suction service valve.
.2 Discharge service valve.
.3 Liquid line shutoff valve.
.4 Refrigerant pressure relief valves for low side and high side.
.5 Electronic expansion valve.
.6 Removable core filter.
.7 Charging port.
.8 Sight glass.
.9 Oil separator.

.5 The chiller shall be configured with relief valves on both the high pressure side and low pressure side of each refrigerant circuit.

2.6 CONTROLS

.1 The chiller(s) shall be controlled by a microprocessor-based, proportional and integral controller to show water and refrigerant temperatures, refrigerant pressures and diagnostics. A dedicated chiller control panel with a non-coded display is to be supplied with each chiller by the chiller manufacturer. The controller shall provide chiller capacity control in response to the leaving chilled water temperature.

.2 Digital communications to building automation system shall consist of a BACnet open standard communication protocol. BACnet shall be capable of communicating MS/TP using RS-485 hardware.

.3 The chiller control panel shall utilize an Adaptive Control Microprocessor which will automatically take action to prevent unit shutdown due to abnormal operating conditions associated with: evaporator refrigerant temperature, high condensing pressure and motor current overload.

.4 If the chiller runs in any of the abnormal operating conditions, the chiller will continue to run, in an unloaded state, and will continue to produce chilled water in an attempt to meet the cooling load. However, if the chiller reaches the trip-out limits, the chiller controls will take the chiller off line for protection, and a manual reset is required. Once the "near trip" condition is corrected, the chiller will return to normal operation and can then produce full load cooling.

.5 The chiller control panel shall provide control of chiller operation and monitoring of chiller sensors, actuators, relays, and switches. The panel shall be a complete system for stand-alone chiller control and include controls to safely and efficiently operate the chiller.

.6 Manufacturer shall provide a compressor that is capable of unloading to an infinite amount of positions in order to provide water temperature accuracy of +/- 0.5F°. In the event that the compressor unloads to finite steps, the manufacturer shall provide eight (8) or more steps of unloading on each compressor or provide hot gas bypass (HGBP).

.7 The chiller control panel is to be provided with the following digital type pressure readouts:

.1 Evaporator refrigerant pressure.

.2 Condenser refrigerant pressure.

.8 The front of the chiller control panel shall be capable of displaying the following clear language as standard:

.1 Entering and leaving evaporator water temperature.

.2 Entering and leaving condenser water temperature.

.3 Chilled water setpoint.

.4 Electrical 3 phase current limit and percent RLA setpoint.

.5 Electrical 3 phase amp draw.

.6 Chiller operating mode.

.7 Condenser refrigerant temperature.

.8 Elapsed time and number-of-starts counter.

.9 Chiller compressor run status relay.

.10 Diagnostics with time and date stamp.

.11 A relay output to start the condenser water pump and/or enable the cooling tower temperature controls.

.12 The control panel display shall identify the fault, indicate date, time, and operating mode at time of occurrence, and provide type of reset required and a help message. The historic diagnostic report shall display the last 20 diagnostics with their times and dates of occurrence.

.13 An analog input to control leaving chilled water temperature setpoint based upon a 4-20 mA or 0-10 VDC signal from a building automation system.

.14 An analog input to control chiller current limit setpoint based upon a 4-20 mA or 2-10 VDC signal from a building automation system.

.15 The chiller control panel shall output percent RLA via a 2-10 VDC signal.

.16 The chiller control panel shall output the power consumption for each compressor.

.17 A relay output that shall energize whenever an alarm is active.

.9 The chiller control panel shall provide a programmable soft load to prevent the chiller from achieving full capacity during the pulldown period by imposing a ramped current limit, or a temperature pulldown rate. Either can be adjusted to limit how fast the chiller can load after an initial start-up.

.10 The chiller control panel shall provide leaving chilled water temperature reset based upon return water temperature.

.11 The chiller shall have factory mounted and tested controls that provide dual chilled water setpoint control for ice-making application.

.12 The chiller control panel shall provide a chilled water pump output relay that closes when the chiller is given a signal to start.

.13 The chiller control panel shall have the ability to operate in variable evaporator flow applications. The chiller control must be able to operate with evaporator flow rate changes up to 10% during a 1 minute time period while maintaining 0.5°F water temperature accuracy. The chiller control must also be able to operate with evaporator flow rate changes up to 30% during a 1 minute time period while maintaining 2°F water temperature accuracy.

.14 The chiller control panel shall have the ability to control the leaving condenser fluid temperature setpoint through the user interface or via a 0-10 VDC signal from a building automation system.

2.7 STARTERS (LOW VOLTAGE)

.1 The motor starters shall be Wye-Delta. Motor starters shall have a UL 1995 enclosure. Enclosure shall be constructed of 14 gauge steel minimum.

.2 Starters shall be unit mounted with ventilating louvers.

.3 Motor starters shall include incoming line provisions for the number and size cables shown on the drawings. Incoming line lugs shall be copper mechanical type. Connection directly to the contactors is not permissible.

.4 Contactors shall be sized properly to the chiller full load and locked rotor currents. Contactors shall have double break main contacts with weld resistant silver cadmium faces. Auxiliary interlocks that interface with the control panel shall be low resistance having palladium silver contacts.

.5 Each motor starter shall include a control power transformer with fused primary and secondary. Current transformers of the proper size, ratio and burden capacity shall be provided to provide a signal to the control panel and optional devices. Control relays shall be provided within the motor starter to interface with the control panel.

.1 Factory installed control power transformer shall also be capable of providing 115V power for optional field-installed water regulating valve (water-cooled condenser only)

.6 Each starter shall include an advanced motor protection system incorporating electronic three phase overloads and current transformers. This electronic motor protection system shall monitor and protect against the following conditions:

.1 Three phase overload protection.
.2 Overload protection during start-up.
.3 Phase imbalance.
.4 Phase loss.
.5 Phase reversal.
.6 Low voltage.

.7 Under/over voltage protection (optional).

.7 Alternately the advanced motor protection system can be furnished in the chiller control panel.

.8 Each starter/control shall be designed and able to operate in temperatures up to 104°F (40°C).

.9 All field supplied wires, bus bars, and fittings shall be copper only.

.10 Provide in the starter panel:

.11 Choose only one of the following OR paragraphs:

.1 Mechanical Disconnect Switch - A non-fused disconnect switch shall be provided. The disconnect handles, both internal and external, shall be capable of being padlocked in the off position.

2.8 SOUND PACKAGE

.1 Chiller to be supplied with factory installed unit sound package.

.2 Certified acoustical performance to AHRI 575:

Octave Bands	63	125	250	500	1K	2K	4K	8K
Sound Pressure	64db	67db	77db	64db	69db	65db	55db	48db

Part 3 Execution

3.1 INSTALLATION (By this Contractor)

.1 Install in accordance with manufacturer's instructions.

.2 Provide for connection to electrical service. If oil pump is electric include the connection of the electrical to the oil pump.

.3 Provide elastomeric isolator to reduce vibration transmission.

.4 On units without unit mounted starters provide for connection of electrical wiring between starter and chiller control panel, oil pump, and purge unit.

.5 Furnish and install necessary auxiliary water piping for oil cooling units and purge condensers.

.6 Arrange piping for easy dismantling to permit tube cleaning.

.7 Provide piping from chiller relief valve to outdoors. Size as recommended by manufacturer.

.8 Proof of flow shall be provided by the equipment manufacturer, mechanically installed and electrically wired, at the factory of origin.

.9 The chiller shall be configured with forklift channels on the base of the unit to allow for a forklift to transport the unit at the jobsite.

3.2 MANUFACTURER'S FIELD SERVICES (Supplied by City of Saint John)

.1 OEM Start-up is performed by factory trained and authorized servicing technicians confirming equipment has been correctly installed and passes specification checklist prior to equipment becoming operational and covered under OEM warranty.

.1 Included OEM Factory Start-up:

.1 Centrifugal or Rotary Screw/Scroll Chillers.

.2 The manufacturer shall furnish complete submittal wiring diagrams of the package unit as applicable for field maintenance and service.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Methods and procedures for start-up, verification and commissioning, for building Energy Monitoring and Control System (EMCS) and includes:

.1 Start-up testing and verification of systems.

.2 Check out demonstration or proper operation of components.

.3 On-site operational tests.

.2 Related Sections:

.1 Section 01 00 01 – Project Specific General Requirements.

.2 Section 01 78 00 – Closeout Submittals.

.3 Section 01 79 00 – Demonstration and Training.

.4 Section 01 91 13 – General Commissioning (Cx) Requirements.

.5 Section 25 05 01 – EMCS: General Requirements.

1.2 DEFINITIONS

.1 Design Criteria: All pertinent information for the design, including key assumptions and limitations including such as temperature, occupancy, codes, references and indoor air quality.

.2 Design Intent: a detailed explanation of the ideas, concepts and criteria that are defined by the Owner to be important.

.3 PID – Proportional, Integral and Derivative.

1.3 CONTROLS VERIFICATION

.1 EMCS contractor shall test each point system, and sequence, and submit verification reports to satisfaction of City of Saint John Site Representative.

.2 Reports required:

.1 Point Verification Report.

.2 Above noted reports shall be submitted prior to interim inspection, or substantial performance.

1.4 DESIGN REQUIREMENTS

.1 Confirm with City of Saint John Site Representative that Design Criteria and Design Intents are still applicable.

.2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intents.

1.5 SUBMITTALS

.1 Submittals in accordance with Section 01 00 01 – Project Specific General Requirements.

.2 Final Report: submit report to City of Saint John Site Representative.

.1 Include measurements, final settings and certified test results.

.2 Bear signature of commissioning technician and supervisor

.3 Report format to be approved by City of Saint John Site Representative before commissioning is started.

.4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to City of Saint John Site Representative in accordance with Section 01 78 00 - Closeout Submittals.

.5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.6 CLOSEOUT SUBMITTALS

.1 Provide documentation, O&M Manuals, and training of O&M personnel for review by City of Saint John Site Representative before interim acceptance in accordance with Section 01 78 00 – Closeout Submittals.

1.7 CONTROL SYSTEM CHECKOUT AND TESTING

.1 Start-up Testing: All testing listed in this article shall be performed by the Contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the Owner's Representative is notified of system demonstration.

.2 The Contractor shall furnish all labour and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification.

.3 The mechanical design engineer shall reserve the right to use any piece of electrical equipment, device, or material for such reasonable lengths of time and at such times as he may require to make complete and thorough tests of same before the final completion and acceptance.

.4 Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.

.5 Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures per manufacturers' recommendations.

.6 Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.

.7 Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The Contractor shall check all control valves and automatic dampers to ensure proper action and closure. The Contractor shall make any necessary adjustments to valve stem and damper blade travel.

.8 Verify that the system operation adheres to the Sequences of Operation.

.9 Alarms and Interlocks:

.1 Check each alarm separately by including an appropriate signal at a value that will trip the alarm.

.2 Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.

.3 Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

.10 Mechanical deficiencies which may inhibit operation/control of the mechanical systems shall be brought to the attention of City of Saint John Site Representative.

1.8 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

.1 Demonstration:

.1 Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed its own tests.

.2 The tests described in this section are to be performed in addition to the tests that the contractor performs as a necessary part of the installation, start-up, and debugging process. The City of Saint John Site Representative will be present to observe and review these tests. The City of Saint John Site Representative shall be notified at least 10 days in advance of the start of the testing procedures.

.3 The demonstration process shall follow that approved in “Submittals”. The approved checklists and forms shall be completed for all systems throughout the demonstration.

.4 The contractor shall provide at least two persons equipped with two-way communication, and shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes.

.5 The purpose is to demonstrate the calibration, response, and action of every point/object and system. Any test equipment required to prove the proper operation shall be provided by and operated by the contractor.

.6 For facilities and buildings over 20,000 square feet, the contractor shall provide a controls representative on site for two days to assist City of Saint John testing and to be available to respond to telephone inquiries during the testing period. For other buildings, the controls representative is to be available to respond to telephone inquiries by City of Saint John during the test period.

.7 As each control input and output is checked, a log shall be completed showing the date, technician’s initials, and any corrective action taken or needed. This will form part of the “Point Verification Report”. Verification of all input/output points with regards to proper operation. City of Saint John Site Representative will inspect 100% of all points for physical installation, including conduit, wire, labels, connections, etc. City of Saint John Site Representative commissioning agent may choose to randomly inspect 50% of each point type for input/output response. Any failure will result in termination of inspection and future 100% inspections will be at the contractor’s cost.

.2 Optimization:

.1 For each 100 control points, or portion thereof, this Contractor shall provide 1 additional day (8 hr) of optimization programming as required by the Engineer.

.3 Final Acceptance:

.1 This phase shall consist of verifying to City of Saint John Site Representative that the deficiencies as identified during "Demonstration" have been rectified. If deficiencies are still found, the Contractor will have one week to correct them and costs for additional inspection shall be billed to the contractor.

.2 Demonstrate compliance with "System Performance".

.3 Demonstrate and simulate compliance with Sequences of Operation through all modes of operation.

.4 Demonstrate complete operation of Operator Interface.

.5 Additionally, the following items shall be demonstrated:

.1 DDC Loop Response. The contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop's response to a change in setpoint, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the setpoint, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the contractor.

.2 Optimum Start/Stop. The contractor shall supply a trend data output showing the capability of the algorithm. The hour-by-hour trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas.

.3 Operational logs for each system that indicate all setpoints, operating points, valve positions, mode, and equipment status shall be submitted to the City of Saint John Site Representative. These logs shall cover three 48-hour periods and have a sample frequency of not more than 10 minutes. The logs shall be provided in both printed and disk formats.

.4 A power failure for the building will be simulated and proper system operation and recovery observed.

.4 Any tests that fail to demonstrate the proper operation of the system shall be repeated at a later date. The Contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.

.5 **Point Verification Reports –** To be completed by the contractor and forwarded to the City of Saint John Site Representative prior to completing Demonstration. City of Saint John Site Representative will provide blank forms in Microsoft Excel format to the contractor as requested.

.6 The City of Saint John Representative will require testing, verification, of all commissioning for all points, and full simulation of all sequences. This contractor is to commit the necessary resources, manpower, and devices (example - radios) to allow City of Saint John Site Representative to complete commissioning.

.7 All software, database files, remote connection information and instruction must be provided to City of Saint John Site Representative 10 days in advance of inspections.

.8 All repeat testing and commissioning due to noncompliance to specification will be at the contractor's expense.

.9 All tests described in this specification shall have been performed to the satisfaction of both the City of Saint John Site Representative prior to the acceptance of the control system as meeting the requirements of completion. Any tests that cannot be performed due to circumstances beyond the control of the contractor may be exempt from the completion requirements if stated as such in writing by the City of Saint John Site Representative. Such tests shall then be performed as part of the warranty.

.10 The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved.

1.9 CLEANING

.1 The contractor shall clean up all debris resulting from its activities daily. The contractor shall remove all cartons, containers, crates, etc., under its control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.

.2 At the completion of work in any area, the contractor shall clean all of its work, equipment, etc., keeping it free from dust, dirt, and debris, etc.

.3 At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

1.10 THIRD PARTY COMMISSIONING

.1 Contractors are required to complete the commissioning, field quality assurance, testing and/or performance verification as outlined in this and subsequent sections.

.2 The Commissioning Authority will conduct third party commissioning verification. The following specification sections will also apply to the work to be performed under this and subsequent sections:

.1 Section 01 91 13 – General Commissioning (Cx) Requirements.

.2 Preliminary Commissioning Plan.

Part 2 Products

2.1 EQUIPMENT

.1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.

.2 Instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.

.3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 2 months prior to tests.

.4 Locations to be approved, readily accessible and readable.

.5 Application: to conform to ASHRAE Guideline 0-2005 – The Commissioning Process and Guideline 1.1 – 2007 – The HVAC Commissioning Process.

Part 3 Execution

3.1 PROCEDURES

.1 General: test installation of each system part after completion of mechanical and electrical hook-ups, to verify correct installation and function.

.1 Test each system independently and then in unison with other related systems.

.2 Commission each system using procedures prescribed by the City of Saint John Site Representative.

.3 Commission integrated systems using procedures prescribed by City of Saint John Site Representative.

.4 Debug Programming.

.5 Optimize operation and performance of systems by fine-tuning PID values and modifying programming as required.

.6 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

.2 Include following activities:

.1 Test and calibrate field hardware including stand-alone capability of each controller.

.2 Verify each analog to digital convertor.

.3 Test and calibrate each analog input using calibrated digital instruments.

.4 Test each binary input to ensure proper settings and switching contacts.

.5 Test each binary output to ensure proper operation and lag time.

.6 Test each analog output to ensure proper operation of controlled devices. Verify tight closure and signals.

.7 Test operating software.

.8 Test application software and provide samples of logs and commands.

.9 Debug software.

.10 Provide point verification list in table format including point identifier, point commissioning technician and City of Saint John Site Representative comments. This document will be used in final start-up testing.

.3 Demonstration: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of City of Saint John Site Representative and provide:

.1 Two technical personnel capable of re-calibrating field hardware and modifying software.

.2 Detailed daily schedule showing items to be tested and personnel available.

.3 City of Saint John Site Representative Acceptance signature to be on executive and applications programs.

.4 Demonstration testing is to be in accordance with the following conditions:

.1 Commissioning to commence during final start-up testing.

.2 O&M personnel may assist in commissioning procedures as part of training.

.3 Commissioning to be supervised by qualified supervisory personnel and City of Saint John Site Representative.

.4 Commission systems considered as life safety systems before affected parts of the facility are occupied.

.5 Operate systems as long as necessary to commission entire project.

.6 Monitor progress and keep detailed records of activities and results.

3.2 ADJUSTING

.1 Final adjusting: upon completion of commissioning as reviewed by City of Saint John Site Representative, set and lock devices in final position and permanently mark settings.

3.3 DEMONSTRATION

.1 Demonstrate to City of Saint John Site Representative operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Requirements and procedures for training program, instructors and training materials, for building Energy Monitoring and Control System (EMCS) Work.

.2 Related Sections:

.1 Section 25 05 01 - EMCS: General Requirements.

1.2 SUBMITTALS

.1 Submittals in accordance with Section 01 00 02 – Standard General Requirements, supplemented and modified by requirements of this Section.

.2 Submit training plan complete with hour-by-hour schedule including brief overview of content of each segment to City of Saint John Representative 30 days prior to anticipated date of beginning of training:

.1 List name of trainer, and type of visual and audio aids to be used.

.2 Show co-ordinated interface with other EMCS mechanical and electrical training programs.

.3 Submit training plan within one week following completion of controls testing and demonstration.

1.3 QUALITY ASSURANCE

.1 Provide competent trainers thoroughly familiar with aspects of EMCS installed in facility.

.2 City of Saint John Representative reserves the right to approve instructors.

1.4 INSTRUCTIONS

.1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of EMCS installed.

.2 Training is to be project specific.

1.5 TRAINING

.1 Contractor shall instruct Owners designated representatives on proper system use and maintenance, including set point changes, trending and simple program changes.

.2 Instructions shall be provided. Two – 4-hour day total at Owner’s request.

1.6 TRAINING MATERIALS

.1 Provide equipment, visual and audio aids, and materials for classroom training.

.2 Supply manual for each trainee, describing in detail data included in each training program.

.1 Review contents of manual in detail to explain aspects of operation and maintenance.

1.7 MONITORING OF TRAINING

.1 City of Saint John Representative to monitor training program and may modify schedule and content.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 TRAINING

.1 Provide a minimum of one onsite training class 8 hours in length during the construction period for personnel designated by the City of Saint John Representative.

.2 Train the designated staff of City of Saint John's Representative and Owner to enable them to:

.1 Day-to-day Operators:

.1 Proficiently operate the system.

.2 Understand control system architecture and configuration.

.3 Understand DDC system components.

.4 Understand system operation including DDC system control and optimizing routines (algorithms).

.5 Operate the workstation and peripherals.

.6 Log on and off the system.

.7 Access graphics, point/object reports, and logs.

.8 Adjust and change system setpoints, time schedules, and holiday schedules.

.9 Recognize malfunctions of the system by observation of the printed copy and graphical visual signals.

.10 Understand system drawings included in the Operation and Maintenance Manual.

.11 Understand the job layout and location of control components.

.12 Access data from DDC controllers.

.13 Operate portable operator's terminals.

.2 Advance Operators:

.1 Make and change graphics on the workstation.

.2 Create, delete, and modify alarms, including annunciation and routing of these.

.3 Create, delete, and modify point/object trend logs, and graph or print these.

.4 Create, delete, and modify reports.

.5 Add, remove, and modify system's physical points/objects.

.6 Create, modify, and delete programming.

.7 Add panels when required.

.8 Add operator interface stations.

.9 Create, delete, and modify system displays – both graphical and otherwise.

.10 Perform DDC system field checkout procedures.

.11 Perform DDC controller unit operation and maintenance procedures.

.12 Perform workstation and peripheral operation and maintenance procedures.

.13 Perform DDC system diagnostic procedures.

.14 Configure hardware including PC boards, switches, communication, and I/O points/objects.

.15 Maintain, calibrate, troubleshoot, diagnose, and repair hardware.

.16 Adjust, calibrate, and replace system components.

.3 System Managers/Administrators:

.1 Maintain software and prepare backups.

.2 Interface with job-specific, third-party operator software.

.3 Add new users and understand password security procedures.

.4 Provide course outline and materials as per Section 01 00 02 – Standard General Requirements. The trainer (s) shall provide one copy of training material per student.

.5 The trainer (s) shall be factory-trained instructors experienced in presenting this material.

.6 All Operation and Maintenance Manuals must be made available prior to training. Manuals will be a training tool, used during training sessions.

.7 List the name of the person conducting each session and the visual and audio aids employed.

.8 City of Saint John Representative may monitor the training program and reserves the right to modify the schedule, content, as well as replace instructors deemed unqualified.

END OF SECTION

Part 1 General

1.1 RELATED DOCUMENTS

.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 - General Requirements Specification Sections, apply to this Section.

.2 Related Sections:

.1 Section 01 91 13 – General Commissioning (Cx) Requirements.

1.2 SUMMARY

.1 This Section includes the EMCS (Energy Management Control System) equipment for HVAC systems and components, including open protocol control components for HVAC functions.

.2 The control system is existing Trane/Distech DDC System at the Canada Games Aquatic Centre and future controls at the Market Square will be AEM/Reliable. All new work to be compatible with the existing system.

.3 All further references within this section to the term “network”, unless specifically excepted, refers to the BACnet network between the DDC panels referenced within these specifications.

.4 Provide EMCS for all HVAC functions. Refer to schematics, floor plans, point list and sequence of operation.

.5 All graphics shall be displayed in English. Sequences of Operation for the purposes of programming shall be in English. Sequences of Operation for record documents shall be English.

.6 The work covered in the EMCS Controls Contract includes all new construction as indicated on drawings.

1.3 CODES AND STANDARDS

.1 All work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of the local, state, and federal authorities. Such codes, when more restrictive, shall take precedence over these plans and specifications. As a minimum, the installation shall comply with the current editions in effect 30 days prior to receipt of bids of the following codes:

.1 Canadian Electrical Code (CEC).
.2 Uniform Building Code (UBC).
.1 Section 403.3, Smoke Detection Group B Office Buildings and Group R, Division 1 Occupancies.
.2 Section 710.5, Wiring in Plenums.
.3 Section 1120, Detection and Alarm Systems.

.3 Uniform Mechanical Code (UMC).
.4 ASHRAE 135-2001.
.5 FCC Regulation, Part 15- Governing Frequency Electromagnetic Interference.
.6 Underwriters Laboratories UL916.

1.4 SYSTEM PERFORMANCE

.1 Performance Standards. The system shall conform to the following:

.1 Graphic Display. The system shall display a graphic with 20 dynamic points/objects with all current data within 10 seconds.
.2 Graphic Refresh. The system shall update a graphic with 20 dynamic points/objects with all current data within 10 seconds.
.3 Object Command. The maximum time between the command of a binary object by the operator and the reaction by the device shall be less than 2 seconds. Analog objects should start to adjust within 2 seconds.
.4 Object Scan. All changes of state and change of analog values will be transmitted over the high-speed Ethernet network such that any data used or displayed at a controller or workstation will have been current within the previous 2 seconds.
.5 Alarm Response Time. The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed 45 seconds.
.6 Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 1 second. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
.7 Performance. Programmable controllers shall be able to execute DDC PID control loops at a frequency of at least once per second. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
.8 Multiple Alarm Annunciation. All workstations on the network must receive alarms within 5 seconds of each other.
.9 Reporting Accuracy. The system shall report all values with an end-to-end accuracy equal to or better than those listed in Table 1.
.10 Stability of Control. Control loops shall maintain measured variable at setpoint within the tolerances listed in Table 2.

1.5 TABLE 1: Reporting Accuracy

Measured Variable	**Reported Accuracy**
Space Temperature	±0.5ºC [±1ºF]
Ducted Air	±0.5ºC [±1ºF
Outside Air	±1.0ºC [±2ºF]
Dewpoint	±1.5ºC [±3ºF]
Water Temperature	±0.5ºC [±1ºF]
Delta-T	±0.15ºC[±0.25ºF]
Relative Humidity	±5% RH
Water Flow	±5% of full scale
Airflow (measuring stations)	±5% of full scale
Air Pressure (ducts)	±25 Pa [±0.1 "W.G.]
Water Pressure	±2% of full scale *(see Note 2)*
Carbon Dioxide (CO_2)	±50 ppm
Note 1: For both absolute and differential pressure	
Note 3: Not including utility-supplied meters	

.3 TABLE 2: Control Stability and Accuracy

Controlled Variable	***Control Accuracy***	***Range of Medium***
Air Pressure	*±50 Pa [±0.2" w.g.]* *±3 Pa [±0.01" w.g.]*	*0-1.5 kPa [0-6" w.g.]* *-25 to 25 Pa [-0.1 to 0.1" w.g.]*
Airflow	*±10% of full scale*	
Temperature	*±0.5ºC [±1.0ºF]*	
Humidity	*±5% RH*	
Fluid Pressure	*±10 kPa [±1.5 psi]*	*0-1 kPa [1-150 psi]*
" " differential	*±250 Pa [±1.0" w.g.]*	*0-12.5 kPa [0-50"w.g.]*

1.6 SUBMITTALS

.1 Make submittals in accordance with Division 01 – General Requirements and Section 23 05 00 – Common Work Results for HVAC.

.1 Product Data: Include manufacturer printed technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and start-up instructions for each type of product indicated.

.2 Each control device labelled with setting or adjustable range of control.

.2 Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, and method of field assembly, components, and location and size of each field connection.

.1 Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
.2 Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
.3 Details of control panel faces, including controls, instruments, and labeling.
.4 Written description of sequence of operation.
.5 Schedule of dampers including size, leakage, and flow characteristics.
.6 Schedule of valves including close-off and flow characteristics.
.7 Trunk cable schematic showing programmable control unit locations and trunk data conductors.
.8 Listing of connected data points, including connected control unit and input device.
.9 System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
.10 System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.

.3 PIC/BIBB statement clarifying which BACnet objects and services are supported by each controller.

.4 ANSI / ASHRAE™ Standard 135-2001, BACnet PIC/BIBB Statement: Proof of Compliance Level 3 or higher is required to protect building owner by reducing future maintenance and expansion costs.

.5 Software and Firmware Operational Documentation: Include the following:

.1 Engineering, Installation, Operation and Maintenance manuals.
.2 Program Software Backup: On a flash drive, complete with data files.
.3 Device address list.
.4 Printout of software application and graphic screens.
.5 Licenses, guarantee, and warranty documents for all equipment and systems.

.6 Field Test Reports: Indicate and interpret test results for compliance with performance requirements and paragraph 1.8 of this section.

.7 Maintenance Data: For systems to include in maintenance manuals in accordance with Division 01 – General Requirements.

.8 Schedules:

.1 Within two weeks of contract award, provide a schedule of the work indicating the following:

.1 Intended sequence of work items.
.2 Start dates of individual work items.
.3 Duration of individual work items.
.4 Planned delivery dates for major material and equipment, and expected lead times.

.5 Milestones indicating possible restraints on work by other trades or situations.

.2 Provide monthly written status reports indicating work completed, revisions to expected deliver dates, etc. an updated project schedule shall be included.

.9 Qualification Data: For firms and persons specified in "Quality Assurance" Article.

.10 Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.

.11 Submit required copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Division 01 – General Requirements. Indicate VOC's for adhesives and solvents during application and curing.

.12 Letter signed by Controls Contractor indicating completion of System Commissioning, Demonstration and Training in accordance with Division 01 – Commissioning Sections.

1.7 QUALITY ASSURANCE

.1 Bids by wholesalers, distributors, mechanical contractors, ABCS, ACS, and non-franchised contractors shall not be acceptable.

.2 The installer shall have an established working relationship with the control system manufacturer, and be an authorized representative of the manufacturer at bid time.

.3 The installer shall have successfully completed control system manufacturers classes on the control system.

.4 The system manufacturer shall, as a minimum, manufacture and supply the Variable Air Volume Direct Digital Controller, Unitary Equipment Controller, Advanced Application Controller and Graphical User Interface.

.5 All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this.

.6 The Building Management System contractor shall have a full service facility within 50 km of the project that is staffed with engineers trained in Integrating Interoperable Systems and technicians fully capable of providing routine emergency maintenance service on all system components.

.7 Mechanical equipment manufacturers that are listed as approved to provide DDC type controls may submit a bid with factory mounted controls, and shall also provide a separate bid for their products less all controls, actuators, valve assemblies and sensors, which are specified to be provided by the BMS contractor.

.8 Electrical Components, Devices, and Accessories: Listed and labelled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

.9 Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."

.10 Comply with National Electric Code, UL-916 Energy Management Systems, ULC, FCC Part 15, subpart J, Class B Computing Devices.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities in accordance with Division 01 – General Requirements.

.3 Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste in accordance with Waste Management Plan.

1.9 CONTROLS VERIFICATION

.1 EMCS contractor shall test each point system, and sequence, and submit verification reports to satisfaction of Engineer and Commissioning Agent. No commissioning activities specified in Division 01 shall commence prior to submission of all reports noted in Paragraph1.8.2.

.2 Reports required:

.1 Point Verification Report.
.2 System Verification Report.
.3 Sequence Verification Report.
.4 Above noted reports shall be submitted prior to interim inspection, or substantial performance.

1.10 TRAINING

.1 Contractor shall instruct Owners designated representatives on proper system use and maintenance, including set point changes, trending and simple program changes.

.2 Instructions shall be provided. 2 – 4-hour days total, over 12-month period, in up to three phases, at Owner's request and in accordance with Section 01 91 13 – General Commissioning (Cx) Requirements.

1.11 PROJECT RECORD DOCUMENT

.1 Submit in accordance with Division 01 – General Requirements and Section 23 05 00 – Common Work Results for HVAC.

.2 Upon completion of installation, submit three copies of record (as-built) documents in accordance with Division 01 – General Requirements. The documents shall be submitted for approval prior to final completion and shall include:

.1 Project Record Drawings. These shall be as-built versions of the submittal shop drawings. One set of electronic files including DXF drawing files also shall be provided. Provide on a flash drive.

.2 Testing and Commissioning Reports and Checklists. Completed versions of all reports and checklists, along with all trend logs, used to meet the requirements of "Control System Demonstration and Acceptance".

.3 Operation and Maintenance (O & M) Manual. This shall include as-built versions of the submittal product data. In addition to the information required for submittals, the O & M manual shall include:

.1 Names, addresses, and 24-hour telephone numbers of Contractors installing equipment, and the control systems and service representatives of each.

.2 Operators Manual with procedures for operating the control systems, including logging on/off , alarm handling, producing point/object reports, trending data, overriding computer control, and changing setpoints and other variables.

.3 One set of Programming Manuals with a description of the programming language (including syntax), statement descriptions (including algorithms and calculations used), point/object database creation and modification, program creation and modification, and use of the editor.

.4 Engineering, Installation, and Maintenance Manual (s) that explain how to design and install new points/objects, panels, and other hardware; preventive maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.

.5 A listing and documentation of all custom software created using the programming language, including the setpoints, tuning parameters, and object database. One set of magnetic/optical media containing files of the software and database also shall be provided.

.6 One set of files containing all color graphic screens created for the project.

.7 A list of recommended spare parts with part numbers and suppliers.

.8 Complete original issue documentation, installation, and maintenance information for all third-party hardware provided, including computer equipment and sensors.

.9 Complete installation media for all software provided, including operating systems, programming language, operator workstation software, and graphics software.

.10 Licenses, guarantee, and warranty documents for all equipment and systems.

.11 Recommended preventive maintenance procedures for all system components, including a schedule of tasks inspection, cleaning, calibration, etc.), time between tasks, and task descriptions.

.12 System Drawings: Include all system as-built line drawings showing all interconnections of EMCS system hardware components and system layouts showing sensor locations, valves, dampers, fans, heating/cooling control coil control as per point list. Manuals are to include floor plan layouts for each building.

.13 Floor plans are to indicate location of all components (i.e. DDC Panels, Hydronic heater valves, duct dampers (outside mech. Room) sensors, exhaust fans, contactors, transducers, timers, etc. in addition to all built-up systems, indicated in block form (i.e. HRV, AHU, boilers, etc.) under EMCS control. Include routing of all network control wiring and major control wiring runs. Floor plan layouts are to be in AutoCAD format. Submit on 11 x 17" size for including in manual.

.14 All items on floor plans are to be labelled and all rooms to e numbered as per EMCS tender document sketches. Manuals shall include EMCS as-built control wiring schematics.

.4 Training Manuals: The Contractor shall provide a course outline and training manuals for all training classes at least six weeks prior to the first class. The Engineer may modify any or all of the training course outline and training materials to meet the needs of the Owner. Review and approval by the Engineer and Commissioning Agent shall be completed at least three weeks prior to the first class.

1.12 WARRANTY

.1 Provide standard warranty 12 months from approval date of substantial performance.

.2 EMCS Contractor shall perform all maintenance on installed equipment and software during the warranty period. Provide all personnel, vehicles, materials, and labour necessary.

.3 Warrant all work as follows:

.1 Labour and materials for the control system specified shall be warranted free from defects for a period of 12 months after final completion and acceptance. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the Owner. The Contractor shall respond to the Owner's request for warranty service within 24 hours during normal business hours.

.2 All work shall have a single warranty date, even when the Owner has received beneficial use due to an early system start-up. If the work specified is split into multiple contracts or a multi-phase contract, then each contract or phase shall have a separate warranty start date and period.

.3 At the end of the final start-up, testing, and commissioning phase, if equipment and systems are operating satisfactorily to the Engineer and Commissioning Agent, the Engineer and Commissioning Agent shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification. The date of acceptance shall be the start of warranty.

.4 Front end software, project-specific software, graphic software, database software, and firmware updates which resolve known software deficiencies as identified by the Contractor shall be provided at no charge during the warranty period and as per software purchasing agreement with the Hospital

.5 Exception: The Contractor shall be required to warrant reused devices. Contractor to bear necessary cost. The Contractor shall warrant all installation labour and materials.

1.13 COORDINATION

.1 Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

.2 Coordinate equipment from other divisions including "Motor Starters," and "Fire Alarm" to achieve compatibility with equipment that interfaces with those systems.

.3 Coordinate supply of conditioned electrical circuits for control units.

.4 Coordinate with the Owner's IT department on locations for UNC's, Ethernet communication cabling and TCP/IP addresses.

.5 Coordinate with TAB Contractor for Set Point Requirements.

1.14 OWNERSHIP OF PROPRIETARY MATERIAL

.1 All project developed software and documentation shall become the property of the owner. These include, but are not limited to project graphic images, record drawings, project database, project specific application programming code, and all other associated documentation

Part 2 Products

2.1 APPROVED MANUFACTURERS

.1 Manufacturers: Subject to compliance with requirements, provide products by the following pre-qualified manufacturer:

.1 Trane – Tracer (Canada Games Aquatic Centre)
.2 AEM – Reliable (Market Square)

Part 3 Execution

3.1 INSTALLATION

.1 Installation: to manufacturer’s recommendations.

3.2 MISCELLANEOUS REQUIREMENTS

.1 Air Handler devices shall be accessible.

3.3 WIRING AND RACEWAYS

.1 General: Provide copper wiring, plenum cable, and raceways as specified.

.2 All insulated wire to be copper conductors. UL labelled for 90C minimum service.

.3 Electrical work shall be in accordance with Canadian Electrical Code, latest edition, Electrical wiring, terminal blocks and other high voltage contacts shall be fully enclosed or properly guarded and marked to prevent accidental injury to personnel.

.4 All wiring in mechanical rooms and ceiling spaces shall be in accordance with the latest edition electrical code. Conformance with this code will be the responsibility of the Contractor.

.5 All wiring under this section shall be by this Contractor and shall include furnishing labour and miscellaneous material to make connections for all wiring related to the programmable controller.

.1 All wiring shall be concealed in cable tray or conduit from the stand-alone control panel to the ceiling space (as high as possible).
.2 Low voltage wiring shall not be run in conduit containing high voltage wiring.
.3 Communication or shielded control wiring shall be installed away from high voltage wiring where possible.
.4 Provide all power wiring in EMT conduit, coordinate with Section 26 05 00; 2.7, for colour coding.
.5 Identify each wire and cable in a permanent manner with wire numbers referenced to EMCS hardware address.
.6 Network (communication) wiring shall be run separately from other wiring.
.7 All control wiring to comply with manufacturers recommendations.
.8 Controls contractor to provide and install relays in motor starter's control circuit wiring as required, to allow EMCS control.
.9 Where there is a start/stop switch in place of a starter, the Contractor shall provide for manual override capability. S.A.C.P. LED modules with HOA switch are acceptable providing the manual starter label reads "Manual Override within S.A.C.P. #". (Lamicoid Label Required).
.10 All heating circulation pumps and AHU heating coil valves shall be wired for fail safe operation. (i.e. Heating controls to normally open position and outside air dampers fail to normally closed position).
.11 120V, 15A power to each control panel from distribution panel. Locking circuit breakers suppled and installed by Division 26.
.12 All networking and control device wiring to be continuous wire runs only, no splicing is permitted.
.13 All I/O wiring passing near or within the enclosure of a VFD will be shielded, with the shield terminated at the controller end.
.14 All I/O wiring will be suitably identified using adhesive wire-marker at the controller end.
.15 All I/O wiring within controller enclosure shall be neat and tidy and suitably bundled and strapped or contained in wire duct.
.16 All I/O wiring that requires a transition to a different conductor to meet electrical code requirement shall be executed using a terminal strip. Marret connections are not acceptable for any connection other than to connect low-voltage pigtails at the device end (e.g. Thermistors, 24 VAC/VDC transducers, actuators, etc.).
.17 Low voltage I/O wiring may be mixed together within a conduit.
.18 Power Wiring:
    .1 Provide power wiring and transformers and ground to each controller and transducer as per the manufacturer's specifications.
    .2 Each Building Controller will have its own dedicated power supply. No other controller or I/O device will be powered from this supply.
    .3 Custom Application Controllers may share a common power supply, but this supply will not be used for any other device (e.g. I/O devices).
    .4 Power wiring shall not be mixed with I/O wiring in a conduit.

3.4 TELEPHONE OR LAN INTERFACE

.1 Telephone or LAN interface to be provided to perform the following functions:
    .1 Interface between the EMCS and public phone lines – not required.

.2 Wiring to be in accordance with City of Saint John Standards.

3.5 EXAMINATION

.1 The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the Engineer for resolution before rough-in work is started.

.2 The Contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the Engineer for resolution before rough-in work is started.

.3 The Contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate or if any discrepancies occur between the plans and the Contractor's work, and the plans and the work of others – the Contractor shall report these discrepancies to the Engineer and shall obtain written instructions for any changes necessary to accommodate the Contractor's work with the work of others. Any changes in the work covered by this specification made necessary by the failure or neglect of the Contractor to report such discrepancies shall be made by and at the expense of this Contractor.

3.6 PROTECTION

.1 The Contractor shall protect all work and material from damage by its work or employees, and shall be liable for all damage thus caused.

.2 The Contractor shall be responsible for its work and equipment until finally inspected, tested, and accepted. The Contractor shall protect any material that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.7 COORDINATION

.1 Site:

.1 Where the mechanical work will be installed in close proximity to, or will interfere with work of other trades, the Contractor shall assist in working out space conditions to make a satisfactory adjustment. If the Contractor installs its work before coordinating with other trades, so as to cause any interference with work of other trades, the Contractor shall make the necessary changes in its work to correct the condition without extra charge.

.2 Coordinate and schedule work with all other work in the same area, or with work which is dependent upon other work, to facilitate mutual progress. Coordinate work in accordance with Division 01 – General Requirements.

.2 The Contractor shall furnish all tools necessary to interface to the control system for test and balance purposes.

.3 Coordination with controls specified in other sections or divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the Contractor as follows:

.1 Each supplier of controls product is responsible for the configuration, programming, start-up, and testing of that product to meet the sequences of operation described in this section.

.2 This Contractor shall coordinate and resolve any incompatibility issues that arise between the control products provided under this Section and those provided under other sections or divisions.

.4 Assist, to the extent required, the Commissioning Agent in the commissioning process in accordance with Section 01 91 13 – General Commissioning (Cx) Requirements.

3.8 GENERAL WORKMANSHIP

.1 Install equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.

.2 Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

.3 Install all equipment in readily accessible locations as defined by Chapter 1, Article 100, Part A of the National Electrical Code (NEC).

.4 All wiring shall be verified for its integrity to ensure continuity and freedom from shorts and grounds.

.5 All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.9 FIELD QUALITY CONTROL

.1 All work, materials, and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this specification.

.2 Contractor shall continually monitor the field installation for code compliance and quality of workmanship.

.3 Contractor shall have work inspected by local and provincial authorities having jurisdiction over the work.

3.10 WIRING INSTALLATION

.1 All control and interlock wiring shall comply with national and local electrical codes.

.2 All NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway per NEC.

.3 All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit).

.4 Where NEC Class 2 (current-limited) wires are in concealed and accessible locations including ceiling return air plenum, approved cables not in raceway may be used, provided that cables are UL listed for the intended application. For example, cables used in ceiling plenum shall e UL listed specifically for that purpose.

.5 All wiring in mechanical, electrical, or service rooms or where subject to mechanical damage shall be installed in raceway at levels below 3m.

.6 Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).

.7 Do not install wiring in raceway containing tubing.

.8 Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.

.9 All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.

.10 All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

.11 Maximum allowable voltage for control wiring shall be 120V. If only higher voltages are available, the Contractor shall provide step-down transformers.

.12 All wiring shall be installed as continuous lengths, with no splices permitted between termination points/objects.

.13 Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.

.14 Size of raceway and size and type of wire shall be the responsibility of the Contractor, in keeping with the manufacturer’s recommendation and NEC requirements, except as noted elsewhere.

.15 Include one pull string in each raceway 2.5 cm or larger.

.16 Use coded conductors throughout with different coloured conductors.

.17 Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.

.18 Conceal all raceways, except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 15 cm from high-temperature equipment (e.g., steam pipes or flues).

.19 Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.

.20 Adhere to Electrical Code requirements where raceway crosses building expansion joints.

.21 Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of all vertical raceways.

.22 The Contractor shall terminate all control and/or interlock wiring, and shall maintain updated (as-built) wiring diagrams with termination identified at the job site.

.23 Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 1 m in length and shall be supported at each end. Flexible metal raceway less than ½" electrical trade size shall not be used. In areas exposed to moisture including chiller and boiler rooms liquid-tight, flexible metal raceways shall be used.

.24 Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings (per code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

.25 FT6 wiring must be used where wires are run through a space used as a plenum. Controls wiring to meet manufacturers recommend installation guidelines.

3.11 COMMUNICATION WIRING

.1 The Contractor shall adhere to the items listed in the "Wiring Installation" Article in the specification.

.2 All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.

.3 Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.

.4 Maximum pulling, tension, and bend radius for cable installation as specified by the cable manufacturer shall not be exceeded during installation.

.5 Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.

.6 When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lightning arrestor shall be installed according to the manufacturer's instructions.

.7 All runs of communication wiring shall be un-spliced length when that length is commercially available.

.8 All communication wiring shall be labelled to indicate origination and destination data.

.9 Grounding of coaxial cable shall be in accordance with NEC regulations Article on Communications Circuits, Cable and Protector Grounding.

.10 Colour of Communication wiring to match Building Standards.

3.12 INSTALLATION OF SENSORS

.1 Install all sensors in accordance with the manufacturer's recommendations.

.2 Mount sensors rigidly and adequately for the environment within which the sensor operates.

.3 Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.

.4 All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.

.5 Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across duct. Each bend shall be supported with a capillary clip.

.6 Low limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 3 m of sensing element for each 1 m^2 of coil area.

.7 All pipe-mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.

.8 Install outdoor air temperature sensors on north wall complete with sun shield at designated location.

.9 Install outdoor air temperature sensors on north wall complete with sunshield.

3.13 ACTUATORS

.1 Mount and link control damper actuators per manufacturer's instructions.

.1 To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.

.2 Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.

.3 Provide all mounting hardware and linkages for actuator installation.

.2 Electric/Electronic:

.1 Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° available for tightening the damper seals. Actuators shall be mounted following manufacturer's recommendations.

.2 Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.

3.14 WARNING LABELS

.1 Permanent warning labels shall be affixed to all equipment which can be automatically started by the DDC system.

.1 Labels shall use white lettering (12-point type or larger) on a red background.

.2 Warning labels shall read as follows:

ATTENTION

This equipment is operated by an automatic control system and can start and stop at any time without warning. Switch the switch to the 'OFF' position before approaching.

.3 Approved Material: Bradly OEM/Equipment Labels Type: SS-3. 5X5-86201.

3.15 IDENTIFICATION OF HARDWARE AND WIRING

.1 All wiring and cabling, including that within factory-fabricated panels, shall be labelled at each end within 5 cm of termination with the information provided as sample.

Field Equipment Identification:

.1 To be as per laminated sample.

.2 To include the following:

- Scale/set-up range
- Panel (controller) address
- Point address
- Device Part #/Manufacture

.3 To be orange background.

.2 Permanently label or code each point/object of field terminal strips to show the instrument or item served.

.3 Identify control panels with minimum 1 cm letters on laminated plastic nameplates.

.4 Identify all other control components with permanent labels. All plug-in components shall be labelled such that removal of the component does not remove the label.

.5 Identify room sensors relating to terminal box or valves with nameplates.

.6 Manufacturers' nameplates.

.7 Identifiers shall match record documents.

3.16 CONTROLLERS

.1 Provide a separate controller for each AHU or other HVAC system. A DDC controller may control more than one system provided that all points/objects associated with the system are assigned to the same DDC controller. Points/objects used for control loop reset such as outside air or space temperature are exempt from this requirement.

.2 The primary sensor for all control loops must connect to the same panel containing the control loop output.

3.17 PROGRAMMING

.1 Provide sufficient internal memory for the specified sequences of operation and trend logging. There shall be a minimum of 25% of available memory free for future use.

.2 Point/object Naming: System point/object names shall be modular in design, allowing easy operator interface without the use of a written point/object index. Use the naming descriptors identified in the provided points list.

.3 Software Programming:

.1 Provide programming for the system and adhere to the sequences of operation provided. All other system programming necessary for the operation of the system, but not specified in this document, also shall be provided by the Contractor. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation. Use the appropriate technique based on the following programming types:

.1 Text-based:

.1 Must provide actions for all possible situations.

.2 Must be modular and structured.

.3 Must be commented.

.2 Graphic-based:

.1 Must provide actions for all possible situations.

.2 Must be documented.

.3 Parameter-based:

.1 Must provide actions for all possible situations.

.2 Must be documented.

.4 Programming Modifications: Contractor shall carry all cost for extra programming to be completed at Engineer and Commissioning Agent discretion. Provide labour on-site of a programmer for 8 hours per 100 points in contract, minimum of one 8 hour day. To be approved by City of Saint John Representative.

.4 Operator Interface:

.1 Standard Graphics. Provide graphics for all mechanical systems and floor plans of the building. This includes each hot water system, boiler, air handler, and all terminal equipment. Point/object information on the graphic displays shall dynamically update. Show on each graphic all input and output points/objects for the system. Show relevant calculated points/objects such as setpoints and any other objects that may be reasonably required by the operator to efficiently perform his duties.

.2 The Contractor shall provide all the labour necessary to install, initialize, start up, and troubleshoot all operator interface software and their functions as described in this section. This includes any operating system software, the operator interface database, and any third-party software installation and integration required for successful operation of the operator interface.

3.18 CONTROL SYSTEM CHECKOUT AND TESTING

.1 Start-up Testing: All testing listed in this article shall be performed by the Contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the Owner's Representative is notified of system demonstration and in accordance with Division 01 – Commissioning Sections.

.1 The Contractor shall furnish all labour and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification.

.2 Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.

.3 Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures per manufacturers' recommendations.

.4 Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.

.5 Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The Contractor shall check all control valves and automatic dampers to ensure proper action and closure. The Contractor shall make any necessary adjustments to valve stem and damper blade travel.

.6 Verify that the system operation adheres to the Sequences of Operation.

.7 Alarms and Interlocks:

.1 Check each alarm separately by including an appropriate signal at a value that will trip the alarm.

.2 Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.

.3 Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

.8 Mechanical deficiencies which may inhibit operation/control of the mechanical systems shall be brought to the attention of Engineer and Commissioning Agent.

3.19 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

.1 Demonstration:

.1 Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed its own tests.

.2 The tests described in this section are to be performed in addition to the tests that the Contractor performs as a necessary part of the installation, start-up, and debugging process and as specified in the "Control System Checkout and Testing" in this specification and Division 01 – Commissioning Sections.

.3 The Engineer and Commissioning Agent will be present to observe and review these tests. All parties shall be notified at least 10 days in advance of the start of the testing procedures.

.4 The demonstration process shall follow that approved in "Submittals". The approved checklists and forms shall be completed for all systems as part of the demonstration.

.5 The Contractor shall provide at least two persons equipped with two-way communication, and shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. The purpose is to demonstrate the calibration, response, and action of every point/object and system. Any test equipment required to prove the proper operation shall be provided by and operated by the Contractor.

.6 As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed. This will form part of the "Point Verification Report". Verification of all input/output points with regards to proper operation. Controls Contractor Construction Manager will inspect 100% of all points for physical installation, including conduit, wire, labels, connections, etc. The commissioning agent may choose to randomly inspect 50% of each point type for input/output response. Any failure will result in termination of inspection and future 100% inspections will be at the Contractor's Cost.

.7 Final Inspection shall consist of verifying to Engineer and Commissioning Agent that the deficiencies have been rectified.

.8 Demonstrate compliance with "System Performance".

.9 Demonstrate compliance with Sequences of Operation through all modes of operation.

.10 Demonstrate complete operation of Operator Interface.

.11 Additionally, the following items shall be demonstrated:

.1 DDC Loop Response. The Contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop's response to a change in setpoint, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the setpoint, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the Contractor.

.2 Optimum Start/Stop. The Contractor shall supply a trend data output showing the capability of the algorithm. The hour-by-hour trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas.

.3 Operational logs for each system that indicate all setpoints, operating points, valve positions, mode, and equipment status shall be submitted to the Engineer and Commissioning Agent. These logs shall cover three 48-hour periods and have a sample frequency of not more than 10 minutes. The logs shall be provided in both printed and disk formats.

.4 A power failure for the building will be simulated and proper system operation and recovery observed.

.12 Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The Contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.

.13 Point Verification Reports – To be completed by Subcontractor and forwarded to Engineer and Commissioning Agent prior to completing Final Inspection Demonstration. Engineer will provide blank forms in Microsoft Excel format to Subcontractor.

.14 Engineer and Commissioning Agent will require testing, verification, of all commissioning for all points, and full simulation of all sequences. This Contractor is to commit the necessary resources, manpower, and devices (i.e. Walkie-talkie) to allow all parties to complete commissioning.

.15 All software, database files and instruction must be provided to Engineer and Commissioning Agent 10 days in advance of inspections.

.16 Subcontractors failure to conform with any requirements of the "Checkout and Testing" process will require Subcontractor to pay all costs associated with redoing it.

.2 Acceptance:

.1 All tests described in this specification shall have been performed to the satisfaction of both Engineer and Commissioning Agent and Owner prior to the acceptance of the control system as meeting the requirements of Completion. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the Engineer and Commissioning Agent. Such tests shall then be performed as part of the warranty.

.2 The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1: "Submittals".

3.20 CLEANING

.1 The Contractor shall clean up all debris resulting from its activities daily in accordance with Division 01 – General Requirements. The Contractor shall remove all cartons, containers, crates, etc., under its control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.

.2 At the completion of work in any area, the Contractor shall clean all of its work, equipment, etc., keeping it free from dust, dirt, and debris, etc.

.3 At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.21 TRAINING

.1 Provide training in accordance with Division 01 – Commissioning Sections.

.2 Provide a minimum of one onsite training class 8 hours in length during the construction period for personnel designated by the Owner.

.3 Provide two additional training sessions at 6 and 12 months following building's turnover. Each session shall be 4 hours in length and must be coordinated with the building Owner.

.4 Train the designated staff of Owner's Representative and Owner to enable them to:

.1 Day-to-day Operators:

.1 Proficiently operate the system.

.2 Understand control system architecture and configuration.

.3 Understand DDC system components.

.4 Understand system operation including DDC system control and optimizing routines (algorithms).

.5 Operate the workstation and peripherals.

.6 Log on and off the system.

.7 Access graphics, point/object reports, and logs.

.8 Adjust and change system setpoints, time schedules, and holiday schedules.

.9 Recognize malfunctions of the system by observation of the printed copy and graphical visual signals.

.10 Understand system drawings, and Operation and Maintenance Manual.

.11 Understand the job layout and location of control components.

.12 Access data from DDC controllers and ASC.

.13 Operate portable operator's terminals.

.2 Advance Operators:

.1 Make and change graphics on the workstation.

.2 Create, delete, and modify alarms, including annunciation and routing of these.

.3 Create, delete, and modify point/object trend logs, and graph or print these.

.4 Create, delete, and modify reports.

.5 Add, remove, and modify system's physical points/objects.

.6 Create, modify, and delete programming.

.7 Add panels when required.

.8 Add operator interface stations.

.9 Create, delete, and modify system displays – both graphical and otherwise.

.10 Perform DDC system field checkout procedures.

.11 Perform DDC controller unit operation and maintenance procedures.

.12 Perform workstation and peripheral operation and maintenance procedures.

.13 Perform DDC system diagnostic procedures.

.14 Configure hardware including PC boards, switches, communication, and I/O points/objects.

.15 Maintain, calibrate, troubleshoot, diagnose, and repair hardware.

.16 Adjust, calibrate, and replace system components.

.3 System Managers/Administrators:

.1 Maintain software and prepare backups.

.2 Interface with job-specific, third-party operator software.

.3 Add new users and understand password security procedures.

.4 Provide course outline and materials as per "Submittals" Article in Part 1 of this specification. The instructor (s) shall provide one copy of training material per student.

.5 The instructor (s) shall be factory-trained instructors experienced in presenting this material.

.6 Classroom training shall be done using a network of controllers representative of the installed hardware.

.7 All Operation and Maintenance Manuals must be made available prior to training. Manuals will be a training tool, used during training sessions.

.8 List the name of the person conducting each session and the visual and audio aids employed.

.9 Engineer and Commissioning Agent may monitor the training program and reserves the right to modify the schedule, content, as well as replace instructors deemed unqualified.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Requirements and procedures for identification of Building Energy Monitoring and Control System (EMCS) devices such as: sensors; wiring; tubing; conduit; and equipment. This section covers requirements for nameplate materials, colours and lettering sizes.

.2 Related Sections:

.1 Section 01 00 02 – Standard General Requirements.

.2 Section 25 05 01 - EMCS: General Requirements.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International):

.1 CSA C22.1- The Canadian Electrical Code, Part I (latest edition), Safety Standard for Electrical Installations.

1.3 SYSTEM DESCRIPTION

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

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 00 02 – Standard General Requirements supplemented and modified by requirements of this Section.

.2 Submit samples to City of Saint John Representative for pre-approval. Include samples of nameplates, identification tags and list of proposed wording.

Part 2 Products

2.1 WARNING LABELS

.1 Permanent warning labels shall be affixed to all equipment which can be automatically started by the EMCS system.

.1 Labels shall use white lettering (12-point type or larger) on a red background.

.2 Warning labels shall read as follows:

C A U T I O N

This equipment is operating under automatic control and may start or stop at any time without warning. Switch disconnect to “Off” position before servicing.

.2 Permanent warning labels shall be affixed to all motor starters and all control panels which are connected to multiple power sources utilizing separate disconnects.

.1 Labels shall use white lettering (12-point type or larger) on a red background.

.2 Warning labels shall read as follows:

C A U T I O N

This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing.

2.2 IDENTIFICATION OF HARDWARE AND WIRING

.1 All wiring and cabling, including that within factory-fabricated panels, shall be labelled at each end within 5 cm of termination with the information provided as sample.

Field Equipment Identification: To be as per laminated sample.

.1 To include the following:

.1 Scale/set-up range

.2 Panel (controller) address

.3 Point address

.4 Device Part #/Manufacturer

.5 To be orange background.

.2 All pneumatic tubing shall be labelled at each end within 5 cm of termination with a descriptive identifier.

.3 Permanently label or code each point/object of field terminal strips to show the instrument or item served.

.4 Identify control panels with minimum 1 cm letters on laminated plastic nameplates.

.5 Identify all other control components with permanent labels. All plug-in components shall be labelled such that removal of the component does not remove the label.

.6 Identify room sensors relating to terminal box or valves with nameplates.

.7 Identifiers shall match record documents.

.8 Conduit:

.1 Colour code EMCS conduit. Confirm colour coding with City of Saint John Representative during project start-up meeting.

.2 Pre-paint box covers and conduit fittings as per City of Saint John Standards.

Part 3 Execution

3.1 NAMEPLATES AND LABELS

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

3.2 EXISTING PANELS

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Requirements and procedures for warranty and activities during warranty period for building Energy Monitoring and Control System (EMCS).

.2 Related Sections:

.1 Section 25 05 01 - EMCS: General Requirements.

1.2 WARRANTY

.1 Provide standard warranty twelve (12) months from approval date of substantial completion.

.2 EMCS Contractor shall perform all maintenance on installed equipment and software during the warranty period. Provide all personnel, vehicles, materials, and labour necessary.

.3 Warrant all work as follows:

.1 Labour and materials for the control system specified shall be warranted free from defects for a period of 12 months after the substantial completion date is accepted. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the Owner. The contractor shall respond to the Owner's request for warranty service within 24 hours during normal business hours.

.2 All work shall have a single warranty date, even when the Owner has received beneficial use due to an early system start-up. If the work specified is split into multiple contracts or a multi-phase contract, then each contract or phase shall have a separate warranty start date and period. In this case, each building will have separate warranty dates.

.3 At the end of the final start-up, testing, and commissioning phase, if equipment and systems are operating satisfactorily to the City of Saint John Representative, the City of Saint John Representative shall sign certificates certifying that the control system operation has been tested and accepted in accordance with the terms of this specification. The date of substantial completion shall be the start of warranty.

.4 Operator workstation software, graphic software, database software, and firmware updates which resolve known software deficiencies as identified by the contractor shall be provided at no charge during the warranty period.

.5 All firmware updates or functional enhancements associated with the above mentioned items must be provided during the warranty period. Written authorization by the Owner must, however, be granted prior to the installation of any of the above mentioned items.

.6 Exception: The contractor shall be required to warrant reused devices. Contractor to bear necessary cost. The contractor shall warrant all installation labour and materials.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Control devices integral to the Building Energy Monitoring and Control System (EMCS): transmitters, sensors, controls, switches, transducers, dampers, damper operators, valves, valve actuators, low voltage current transformers, variable frequency drives.

.2 Related Sections:

.1 Division 01 - General Requirements.

.2 Section 25 05 01 - EMCS: General Requirements.

1.2 REFERENCES

.1 American National Standards Institute (ANSI):

.1 ANSI C12.7-1993 (R1999), Requirements for Watthour Meter Sockets.

.2 ANSI/IEEE C57.13-1993, Standard Requirements for Instrument Transformers.

.2 American Society for Testing and Materials International, (ASTM):

.1 ASTM B148-97(03), Standard Specification for Aluminum-Bronze Sand Castings.

.3 National Electrical Manufacturer's Association (NEMA):

.1 NEMA 250-03, Enclosures for Electrical Equipment (1000 Volts Maximum).

.4 Air Movement and Control Association, Inc. (AMCA):

.1 AMCA Standard 500-D-98, Laboratory Method of Testing Dampers For Rating.

.5 Canadian Standards Association (CSA International):

.1 CSA-C22.1-02, Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations.

1.3 DEFINITIONS

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

1.4 EXISTING CONDITIONS

.1 Cutting and Patching: in accordance with Division 01 - General Requirements supplemented as specified herein.

.2 Repair surfaces damaged during execution of Work.

1.5 SUBMITTALS

.1 Sustainable Design:

.1 Submit product data/MSDS sheets for VOC emitting materials which clearly identify the actual VOC emissions.

Part 2 Products

2.1 GENERAL

.1 Control devices of each category to be of same type and manufacturer.

.2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant, assembly.

.3 Operating conditions: 0 – 32°C with 10 - 90% RH (non-condensing) unless otherwise specified.

.4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.

.5 Transmitters and sensors to be unaffected by external transmitters including walkie-talkies.

.6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

.7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.

.8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.

2.2 FIELD DEVICES

.1 Temperature Sensors:

.1 General:

.1 The following sensors shall apply to thermistor, and resistance temperature sensors as applicable:

.1 Sensing element to be hermetically sealed.

.2 Stem and tip construction to be copper.

.3 Sensors to have a time constant response of less than 3 seconds to a temperature chance of 10ºC.

.4 Sensors shall operate over the following ranges with the accuracies over the noted range of the sensor.

-50ºC to +50ºC, plus or minus 0.5ºC.

0ºC to +50ºC, plus or minus 0.25ºC.

0ºC to 25ºC, plus or minus 0.1ºC.

0ºC to 100ºC, plus or minus 1ºC.

.5 Immersion wells shall be of (stainless steel) materials. Heat transfer compound to be compatible with sensor. Unless noted otherwise, where an existing sensor or well is not available, a strap-on sensor will be acceptable.

.6 Immersion sensors shall be provided with a separable brass well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.

.7 Provide matched temperature sensors for differential temperature measurement.

.2 Temperature sensors shall be of the following types:

.1 General Purpose Duct Type: Suitable for insertion into air ducts at any angle, insertion length of 457 mm and 760 mm as noted on schedule or drawings.

.2 Spring-Loaded Thermowell Type: Spring-loaded construction with compression fitting for 20 mm NPT well-mounting. Lengths of 100 mm or 150 mm as noted.

.3 Averaging Duct Type: Continuous filament with Immersion length of 6000 mm minimum. Probe to be bent, at field installation time, to a minimum radius of 100 mm at any point along the probe length without degradation in performance. Averaging duct type to be used for all sensors between mixed air plenum and fan without exception and on downstream side of heat recovery coils.

.3 Double pole double throw (DPDT) relays control and status indication of alarms and/or electrical starters and equipment where shown on point schedule.

.1 Relay coils shall be rated for 120V or 24V. Where other voltages occur, provide transformer.

.2 Contacts rated at 5 amps at 130V AC.

.3 Relays to be plug-in type with termination base.

.4 Static pressure sensing unit, for fan systems shall be multi-point element with self-averaging manifold. Maximum pressure loss of 1.25 Pa at 609 m per minute. Accuracy of 1% of actual duct static.

.1 Output of 4-20 mA linear into maximum of 500 ohm load.

.2 Calibrated span: not greater than twice the static pressure at maximum flow.

.3 Accuracy: ± 2% of span.

.4 Repeatability: within 0.5% of output.

.5 Linearity: 1.5% of span.

.6 Deadband or Hysteresis: 0.1% of span.

.7 Must use shielded twisted pair from sensing device to S.A.C.P. Wiring shall be installed away from high voltage wiring.

.5 Current Transmitters:

.1 Supply and install where status points on equipment are required, unless otherwise noted.

.1 AC current transmitters will be self-powered combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 0-5vdc two-wire output. Unit ranges shall be 10A, 20A, 50A, 100A, 150A, and 200A full scale, internal zero and span adjustment, and ± 1% full scale accuracy at 500 ohm maximum burden.

.2 Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.

.3 Unit shall be split-core type for clamp-on installation.

.6 Relays (General):

.1 Control relays shall be UL Listed plug-in type with dust cover. Contact rating, configuration, and coil voltage suitable for application.

.2 Time delay relays shall be UL Listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable ± 200% (minimum) from setpoint shown on plans. Contract rating, configuration, and coil voltage suitable for application. Provide NEMA 1 enclosure when not installed in local control panel.

.7 Strap-On-Sensor:

.1 For non-intrusive pipe temperature sensing applications. Strap-On c/w stainless steel probe, min. 150 mm probe length, PT 100 or PT 1000 as required for systems.

.2 Temperature range to be selected for maximum systems temperature with 20% minimum safety factory. To be approved by Engineer.

Acceptable Products – Greystone, ACI, BAPI.

.8 Pressure Transducers:

.1 Transducer shall have linear output signal. Zero and span shall be field-adjustable.

.2 Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage.

.3 Water pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi. minimum. Transducer shall be complete with 1 – 5 VDC or 4 to 20 mA output, required mounting brackets and block and bleed valves.

.4 Water differential pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (differential pressure) and maximum static pressure shall be 300 psi.

Transducer shall be complete with 1 – 5 VDC or 4 to 20 mA output, required mounting brackets, and five-valve manifold.

Acceptable Products: Greystone, ACI, BAPI.

.9 Pressure Gauges:

.1 0 – 30 PSIG

.2 Acceptable Products: Greystone, ACI, BAPI.

Part 3 Execution

3.1 INSTALLATION

.1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

.2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.

.3 Temperature transmitters, humidity transmitters, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.

.4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.

.5 Fire stopping: provide space for fire stopping. Maintain fire rating integrity.

3.2 TEMPERATURE AND HUMIDITY SENSORS

.1 Stabilize to ensure minimum field adjustments or calibrations.

.2 Provide calibration report to Commissioning Agent noting all sensor field adjustments and calibrants.

.3 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.

.4 Outdoor installation:

.1 Protect from solar radiation and wind effects by non-corroding shields.

.2 Install in NEMA 4 enclosures.

.5 Duct installations:

.1 Do not mount in dead air space.

.2 Locate within sensor vibration and velocity limits.

.3 Securely mount extended surface sensor used to sense average temperature.

.4 Thermally isolate elements from brackets and supports to respond to air temperature only.

.5 Support sensor element separately from coils, filter racks.

.6 Averaging duct type temperature sensors.

.1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.

.2 Wire multiple sensors in series for low temperature protection applications.

.3 Wire multiple sensors separately for temperature measurement.

.4 Use software averaging algorithm to derive overall average for control purposes.

.7 Thermowells: install for piping installations.

.1 Locate well in elbow where pipe diameter is less than well insertion length.

.2 Thermowell to restrict flow by less than 30%.

.3 Use thermal conducting paste inside wells.

3.3 PANELS

.1 Arrange for conduit and tubing entry from top, bottom or either side.

.2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.

.3 Identify wiring and conduit clearly.

3.4 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES AND SENSORS

.1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.

.1 Protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Other Trades Sections:

.1 Section 25 05 01 – EMCS: General Requirements.

.2 Section 25 05 54 – EMCS: Identification.

1.2 BAS COORDINATION

.1 This Contractor shall meet with Manufacturer's representative who supplied the equipment to coordinate Work for this BACnet Interface Device and integration into the new DDC network.

.2 This Contractor shall discuss and confirm the BACnet integration and details of the proposed interface, including:

.1 PICS for BACnet equipment.

.2 Hardware and software object list using the object list in this section as a guide.

.3 Networking requirements including any network address range restrictions, bus communication speeds and any required network accessories.

.4 Communications and power wiring requirements for the gateway and ancillary equipment to be terminated into the BACnet Interface Device (valves, dampers, sensors, etc.).

.5 Equipment installation and mounting requirements if the device is not integral to the supplier's equipment.

.6 AutoCAD/PDF files to be used to create the BAS graphics.

.7 The purpose of this meeting shall be to insure there are no unresolved issues regarding the integration of these products into the BAS Device Network.

.3 Once this information is reviewed and approved, provide a formal submittal via the Shop Drawing process.

.4 Submittals for these products shall not be approved prior to the completion of this meeting.

.5 If the equipment supplier is providing a BACnet gateway device from an OEM supplier, both suppliers shall jointly warrant in writing that the gateway can successfully parse the proprietary protocol used by the packaged controls that come with the equipment.

.6 The BACnet Interface Device shall permit this Contractor to plot the BACnet objects into a graphic his non- UL Front End. This Contractor shall be able to monitor alarms and events and will be able to have control over objects as permitted by the supplier of the BACnet Interface Device(s).

1.3 SHOP DRAWINGS

.1 Provide product data sheets illustrating the equipment packaged controls interface(s) to be integrated with the BAS system device network. The Contractor/Equipment Supplier shall provide the following information in their Shop Drawing Submittals:

.1 Show the following BACnet interface wiring system components:

.1 Networking terminations: for example, indicate on the wiring diagram where the equipment supplier is terminating at an equipment outlet sometimes referred to as a "jack-in-the box".

.2 Field server/gateway devices: indicate wiring connection to Modbus equipment/controller interface.

.3 Indicate on the drawing wiring and termination responsibilities.

.2 Show how the Field Server/Gateway devices are to be installed and mounted if they are not integral to the supplier's equipment.

.3 Show how power wiring for the Field Server/Gateway and ancillary equipment is to be terminated into the BACnet Interface Device such as sensors, etc.

.4 Networking Diagrams should include the following:

.1 BACnet device address range restrictions.

.2 Bus communication speeds.

.3 Required network accessories.

.5 Product cut sheets for Local Control Panels (LCP), Field servers/Gateways devices and native BACnet devices to interface a piece of equipment to the network should include the following:

.1 Device BACnet Conformance Statements.

.2 Device BACnet BIBBS.

.3 Device BACnet PICS.

.4 Communications speeds.

.5 Communications protocols such as BACnet/IP, BACnet MS/TP etc.

.6 The BACnet Objects associated with equipment, are provided in the Specification. This list is provided as a minimum list of requirements however we understand that there are variations in Modbus listings depending on equipment options as required by the specification. Highlight the objects to be provided and if additional objects are available list these on a separate attachment. If some objects cannot be provided indicate the reason why they are not available.

.7 If using gateways provide details on the proprietary protocol used in the supplier's equipment and the BACnet protocol to which the proprietary points are being mapped.

.8 Hardware and Software object list table: use the object list in the specification as a guide. Show the object names for BACnet, Modbus register mapping numbers and names, SNVT's for LonMark or other identifiers. The reason this is required is that we provide this list to the BAS contractor so that they know how many objects are required for programming and what to expect when they discover the objects.

.9 Include shop drawings of the mechanical/electrical controller boards of the equipment to be integrated.

.10 Review the sequence of operation in the specification/drawings of the equipment to be provided. Some systems such as chillers, boilers and AHU's have interaction with external devices controlled by BAS and these external devices may need to be referenced in the shop drawing.

1.4 BACNET INTERFACE DEVICE TYPE

.1 This BACnet Interface Device shall be provided as:

.1 Single On-board BACnet Interface Device Type:

.1 This device is a single onboard BACnet interface device. Contractor is responsible for providing, installing, powering and networking this device.

Part 2 Products, Materials and Equipment

2.1 INTEGRATED AUTOMATION, GENERAL

.1 Each supplier of a controls product is responsible for the configuration, programming, start-up, and testing of that product to comply with the Control Sequences Standard.

2.2 GENERAL BACNET INTERFACE REQUIREMENTS

.1 If the equipment interface is a native BACnet device, all data shall be represented externally on the network as BACnet objects and services. The Controls Contractor shall also parse the alarms that are represented as AV and BV objects by the equipment interface.

.2 If the equipment interface is a Modbus, LonWorks, or proprietary device requiring a BACnet Gateway, the Division supplying the equipment shall provide a gateway to support mapping all the points from the device to BACnet AV and BV objects.

.3 Device data may be represented internally in the interface as SNVTs or proprietary points, but the data shall be represented externally on the network as BACnet objects and services. Device interfaces using LonWorks or Modbus are acceptable only on this basis.

.4 The interface shall support the following BACnet Interoperability Building Blocks (BIBBs):

.1 Data Sharing – Read Property - B (DS-RP-B).
.2 Data Sharing – Read Property Multiple - B (DS-RPM-B).
.3 Data Sharing – Write Property - B (DS-WP-B).
.4 Data Sharing – Write Property Multiple - B (DS-WPM-B).
.5 Alarm and Event - Notification Internal - B (AE-N-I-B).
.6 Alarm and Event - ACK - B (AE-ACK-B).
.7 Alarm and Event - Information - B (AE-INFO-B).
.8 Device Management - Dynamic Device Binding - B (DM-DDB-B).
.9 Device Management - Dynamic Object Binding - B (DM-DOB-B).
.10 Device Management – Device Communication Control - B (DM-DCC-B).
.11 Device Management – Time Synchronization - B (DM-TS-B).
.12 Device Management – UTC Time Synchronization - B (DM-UTC-B).
.13 Device Management – Re-initialize Device - B (DM-RD-B).
.14 Device Management - Restart - B (DM-R-B).

.5 The interface shall support the following Object types:

.1 Analog Input.
.2 Analog Output.
.3 Analog Value.
.4 Binary Input.
.5 Binary Output.
.6 Binary Value.
.7 Device.
.8 Multi-state Input.
.9 Multi-state Output.
.10 Multi-state Value.
.11 Trend Log.

.6 Support the required optional properties to comply with the Specification requirements and Control Sequences.

.7 All sensors and transmitters provided in the Work by the supplier shall meet the accuracy requirements outlined in Specification Section 25 30 02 – EMCS: Field Control Devices.

2.3 BACNET INTERFACE DEVICE GENERAL REQUIREMENTS

.1 The BACnet Interface Device supplier shall provide a BACnet/IP BACnet Interface Device complete with an Annex J router to support BACnet/IP to act as a client and/or server for all BACnet information from this system to the BAS System.

.2 The device shall have an open Ethernet port for connection to the DDC network infrastructure.

.3 The BACnet Interface Device shall be a product that is manufactured directly by the equipment supplier or may be an OEM product that is compatible with the equipment supplier:

.1 If the BACnet Interface Device supplier is providing a device from an OEM supplier, both suppliers shall jointly warrant in writing that the gateway can successfully parse the equipment protocol. Provide this information as a Shop Drawing.

.4 If the equipment interface is a native BACnet Interface Device, all objects must be represented externally on the network using BACnet objects and services:

.1 The exception is objects that are used by the supplier to configure the device or to assign administrative passwords or for use by qualified service personnel.

.5 If the equipment interface is a Modbus, LonWorks, or proprietary device requiring a BACnet gateway device, the Division supplying the equipment shall provide a gateway to support mapping all proprietary device points and their present values residing in the gateway device to BACnet AV and BV objects.

.6 The following shall apply to BACnet Interface Devices that are exposing objects in Life Safety devices (e.g., the Fire Alarm Panel):

.1 he BACnet Interface Device shall be a non-UUKL 864 listed device. The device shall present the BACnet objects in a non UUKL 864 manner. The device shall permit unidirectional communications only. The device shall permit this Contractor to plot the BACnet objects in his non-UL Front End, but this Contractor shall not be able to shut down or modify any values to any objects located in the BACnet Interface Device.

2.4 BACNET/IP INTERFACE REQUIREMENTS

.1 All equipment with packaged controls that provide a BACnet/IP interface shall include an Annex J router to support BACnet/IP to act as a client and/or server for all BACnet information from the supplied equipment to the BAS control device network.

.2 The interface shall have an open Ethernet 8P8C port for connection to the BAS system device network infrastructure using communications cabling that complies with the TIA/EIA 568-B standard.

.3 The interface shall operate at a minimum of 10 Mbps, full duplex.

2.5 BACNET MS/TP INTERFACE REQUIREMENTS

.1 All BACnet MS/TP interfaces shall operate as master devices on the BACnet MS/TP network.

.2 All equipment with packaged controls that provide a BACnet MS/TP interface shall have an opto-isolated EIA-485 termination block for connection of the communications cabling. All communications cabling shall only require a two-pair, twisted shielded pair, low capacitance cable following standard MS/TP wiring methods. Each MS/TP network segment shall support a total maximum cable length of 1,220 m (4,000 ft.).

.3 The BACnet MS/TP interface address shall be settable via DIP switch or software, with an address range of at least 0 to 31 per network segment. It shall be possible to connect up to 32 BACnet interfaces on any BACnet MS/TP network segment without requiring the use of repeaters.

.4 The BACnet MS/TP interface shall support network data rates of 9,600 bps, 19,200 bps, 38,400 bps, or 76,800 bps.

Part 3 Installation, Fabrication and Construction

3.1 BACNET INTERFACE DEVICE INSTALLATION AND COMMISSIONING: BACNET/IP REQUIREMENTS

.1 A BACnet/IP device provided in the Work shall meet the following requirements:

.1 BACnet/IP device shall include an Annex J B/IP router to support BACnet/IP to act as a client and/or server for all BACnet information from the supplied equipment to the BAS Device Network, which is considered a "directly connected network".

.2 The BAS Device Network is treated as a "remote network" that is reachable by communicating using BACnet/IP with a router supplied by others that serves the remote network.

.3 The BACnet/IP device shall come c/w a BBMD that will be configured to traverse IP subnets.

.4 The interface shall have an open Ethernet RJ-45 port for connection to the BAS system device network infrastructure using communications cabling that complies with the TIA/EIA 568-B standard.

.5 The interface shall operate at a minimum of 10 Mbps, full duplex.

.2 The supplier of the BACnet Interface Device shall provide the following:

.1 Configuration of the device with the assigned IP address.

.2 Connection of the network cable to the BACnet Interface Device.

.3 Providing details of the required alarms, schedules and trends as outlined in the Sequence of Operation.

.4 Creation and assignment of passwords and access levels within the device.

.5 Commissioning of the BACnet Interface Device with Commissioning Agent to the satisfaction of the City of Saint John Representative. The Work includes the following:

.1 Use the commissioning forms and procedures outlined in this Division.

.2 All network visible objects shall be commissioned.

.3 The process shall be overseen by Controls Engineers Representative.

.4 Allow 4 hours of on-site time for this Work.

.3 Creation of the Front End graphics based on information from the supplier of the BACnet Interface Device. The following minimums apply to this Section:

.1 Provide main graphical screen showing all objects. Graphical screen to be as per the heat flow schematic.

.2 Provide one master alarm graphic showing the Critical Alarms and all equipment fault alarms.

3.2 BACNET INTERFACE DEVICE INSTALLATION AND COMMISSIONING: BACNET/MS-TP REQUIREMENTS

.1 A BACnet MS/TP device provided in the Work shall meet the following requirements:

.1 The device shall:

.1 Operate as a master device on the BACnet MS/TP network.

.2 All equipment with packaged controls that provide a BACnet MS/TP interface shall have an opto- isolated EIA-485 termination block for connection of the communications cabling. All communications cabling shall only require a two-pair, twisted shielded pair, low capacitance cable following standard MS/TP wiring methods. Each MS/TP network segment shall support a total maximum cable length of 1,220 m (4,000 ft.).

.3 The BACnet MS/TP device address shall be settable via DIP switch or software, with an address range of at least 0 to 31 per network segment. It shall be possible to connect up to 32 BACnet interfaces on any BACnet MS/TP network segment without requiring the use of repeaters.

.4 The BACnet MS/TP device shall support network data rates of 9,600 bps, 19,200 bps, 38,400 bps, or 76,800 bps.

.2 The supplier of the BACnet Interface Device shall provide the following:

.1 Configuration of the device with the BACnet Interface Device ID that is unique to the BAS Device Network.

.2 Connection of the network cable to the BACnet Interface Device.

.3 Information on the baud rate used. Each BACnet MS/TP device shall be set to a fixed bit rate. Auto-bauding BACnet MS/TP device configuration will not be allowed.

.4 Providing details of the required alarms, schedules and trends as outlined in the Sequence of Operation.

.5 Creation and assignment of passwords and access levels within the device.

.6 Joint commissioning of the BACnet Interface Device with Commissioning Agent to the satisfaction of the City of Saint John Representative or the designated Commissioning Authority. The Work includes the following:

.1 Use the commissioning forms and procedures outlined in this Division.

.2 All network visible objects shall be commissioned.

.3 The process shall be overseen by Controls Engineer.

.4 Allow 4 hours of on-site time for this Work.

.3 This Contractor shall provide the following:

.1 Connect a shield wire to earth or device chassis at one point along the MS/TP bus prevent ground potential differences on the BAS Device Network.

.2 Each network segment shall be configured as a peer-to-peer token passing BACnet MS/TP network.

.3 A network drop from the Contractor's BACnet/IP Level 1/1A panel's MS/TP network to within 1 m (3 ft.) of the BACnet Interface Device location. Install and test this MS/TP connection per this Division.

.4 Joint commissioning the network connection to this Contractor's MS/TP network.

.5 Creating of the required alarms, schedules and trends as outlined in the Sequence of Operation. The following minimums apply to this Section:

.1 A minimum of 10 alarms or an alarm for each equipment fault. Two of which are considered critical.

.2 A minimum of 1 schedule.

.3 A minimum of 10 trends and 1 extended trend.

.4 Creation of the Front End graphics based on information from the supplier of the BACnet Interface Device. The following minimums apply to this Section:

.1 Provide main graphical screen showing all objects. Graphical screen to be as per the heat flow schematic.

.2 Provide one master alarm graphic showing the Critical Alarms and all equipment fault alarms.

3.3 BACNET INTERFACE SUPPLIER RESPONSIBILITY

.1 Supply a panel enclosure (tub) that is suitably sized for the BACnet interface and the required power supply, if supplied separately from the supplied equipment. Supply a separate low voltage power supply for the BACnet interface (if required).

.2 Supply any additional remote panels/equipment required to provide connectivity between the BACnet interface and the supplied equipment packaged controls.

.3 Each supplier of equipment with a BACnet interface is responsible for the configuration, programming, start- up, and testing of that product to comply with the requirements set out in the Specifications and Drawings for the Work. Create and assign passwords and access levels within the interface.

.4 If the equipment packaged controls has a native Modbus, LonWorks, or proprietary interface requiring a BACnet gateway, the equipment supplier shall verify that all proprietary equipment and interface data has been mapped to BACnet AV and BV Objects.

.5 The Controls Contractor shall produce graphics on the BAS system Front End that are visually similar to and emulate the functionality of the equipment local interface. The equipment supplier shall review the related Front End graphic(s) with the Controls Contractor to ensure that all local interface capabilities of the supplied equipment have been accurately reproduced on the Front End.

3.4 CONTROLS CONTRACTOR RESPONSIBILITY

.1 Install the panel enclosure for the BACnet interface and the required power supply as directed by the equipment supplier, if supplied separately from the supplied equipment. Mount the BACnet Interface Device in the panel enclosure as recommended by the Manufacturer.

.2 Supply and install line or low voltage power for the BACnet interface.

.3 Supply and install all communications lines between the BACnet interface and the supplied equipment packaged controls.

.4 Wire any additional remote panels/equipment required to provide connectivity between the BACnet interface and the supplied equipment packaged controls.

.5 Provide a Project Work Plan as a Shop Drawing that is specific to the networking requirements for connecting the BACnet device(s).

.6 Provide cost of equipment. Supplier/Representative to provide any required addressing modifications for a fully functional system.

.7 Provide all conduit, cabling, repeaters, switches, and termination of all communication cables to the supplied BACnet interfaces.

.8 Create all required Alarms, Schedules and Trends as outlined in the Specifications and Drawings for the Work.

.9 Create Front End graphics based on information from the supplier of the BACnet Interface Device:

.1 The Controls Contractor shall emulate the functionality of the supplied equipment local interface (e.g., annunciator panel, LCD display, GUI interface) at the BAS system Front End.

.2 The Front End graphics shall closely resemble the layout of the controls and display information available via the equipment local interface.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Narrative description of Sequence of Operation of each system.

1.2 GENERAL

.1 The following control strategies shall be applied to control the new equipment:

- .1 Market Square (AEM)
  - .1 Pumps CP-8A & CP-8B
  - .2 BTU meter
- .2 Canada Games Aquatic Centre (Trane)
  - .1 Pumps CP-1A, CP-1B, CP-2, CP-3, CP-4, CP-5, CP-6, CP-7
  - .2 Heat Pump Chiller HTHP-1

1.3 SEQUENCE OF OPERATION

.1 To follow.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Division 01 – General Requirements.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International) Latest Edition of the following:

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.2 CSA C22.2 No. 0-M91 (R2006), General Requirements.

.3 CAN3-C235-19 Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

.4 CSA Z462-21 Work Place Electrical Safety.

.2 Health Canada / Workplace Hazardous Materials Information System (WHMIS) Latest Edition of the following:

.1 Material Safety Data Sheets (MSDS).

.3 CAN/CSA-Z460-20 Control of Hazardous Energy – Lockout and Other Methods.

1.3 SCOPE OF WORK

.1 The work shall include all labour, materials and equipment necessary for the complete installation of the electrical systems shown on the drawings and described in these specifications.

.2 It is the requirement of this work to provide all systems completely functioning in intended system operation, notwithstanding that every item necessarily required may not be specifically mentioned.

1.4 DESIGN REQUIREMENTS

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard:

.1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.3 Language operating requirements: provide identification nameplates and labels for control items in English.

1.5 SUBMITTALS

.1 Submittals: in accordance with Division 01 – General Requirements.

.2 Submit requested documentation to Engineer.

.3 Product Data: submit WHMIS MSDS in accordance with Division 01 – General Requirements.

.4 All inquiries, shop drawings, requests for substitutions and similar items shall be submitted to the Engineer.

.5 Shop drawings:

.1 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.

.2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.

.3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.

.4 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.

.5 Submit required number of copies of drawings and specifications to authority having jurisdiction and to inspection authorities:

.1 If changes are required, notify Engineer of these changes.

.6 In addition to transmittal letter referred to in Division 01 – General Requirements: **Identify section and paragraph number.**

.7 Faxes are not acceptable for shop drawings. If sent by fax, they will not be reviewed.

.8 Do not begin fabrication until shop drawings have been reviewed by Consultant. Allow ten (10) working days for Consultant review.

.9 Consultant review of shop drawings does not relieve the contractor of the responsibility for co-ordination of field measurements required to complete the work.

.10 Contractor shall approve all shop drawings by signing and dating them prior to submitting to Consultant.

.6 Quality Control: in accordance with Division 01 – General Requirements:

.1 Provide CSA certified material.

.2 Where CSA certified material is not available, submit such equipment and material to authority having jurisdiction for approval before delivery to site.

.3 Pill testing of empty conduit system.

.4 Permits and fees: in accordance with General Conditions of contract.

.5 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Engineer.

.7 Manufacturer's Field Reports: submit to Engineer written report, within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

.8 As-Built Drawings:

.1 On a set of drawings, record all changes as work progresses. Incorporate all information issued in Addenda, Site Instructions and Change Orders and all changes in actual installation as a result of site conditions and coordination.

.2 Identify each drawing in lower right hand corner in letters at least 13 mm high as follows: AS-BUILT DRAWING This drawing has been revised to show electrical systems as installed, Name of Contractor, Signature of Contractor and Date.

.3 Submit to the General Contractor for approval and make all corrections as directed.

1.6 SUBSTITUTIONS

.1 It is the intent of these specifications to establish the required quality of materials. Where manufacturer's name, catalogue reference, data are used, it is done in order to establish the required quality, style, size or function. The decision as to suitability shall rest with the Engineer.

.2 Refer to Division 01 – General Requirements.

.3 All materials not meeting the standards as set down by these specifications shall not be allowed on the job site.

.4 Substitutions affecting the design will not be permitted. Additional costs to any other trade as a result of a change or substitution by this Contractor shall be borne by this Contractor.

.5 The listing of a manufacturer as acceptable does not imply acceptance of all products of that manufacturer and only products of that manufacturer and only products meeting the standards as set out in the specifications will be accepted.

.6 All requests for alternates must be submitted no later than five (5) working days prior to tender close.

.7 Faxes are not acceptable for request for alternates. If sent by fax, they will not be reviewed.

1.7 TEST REPORTS

.1 Submit certified test reports and certificates to Engineer from approved independent testing laboratories:

.1 Indicate compliance with specifications for specified performance characteristics and physical properties.

.2 Manufacturer's Field Services: submit copies of manufacturer's field inspection reports.

1.8 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for incorporation into operation and maintenance manual as per Division 01 – General Requirements.

.2 Include in Operation and Maintenance Data:

.1 Table of Contents.

.2 Names, addresses and telephone numbers of local suppliers for items included in Operation and Maintenance Manuals.

.3 Copy of reviewed Shop Drawings.

.4 Name and address of Electrical Contractor.

.5 Copy of all test certificates.

.6 Copy of all final panelboard schedules.

.7 Copy of signed transmittal verifying all maintenance materials turned over to the owner/user.

.8 Two (2) paper copies of drawings and specifications.

.9 Include details of design elements, component function and maintenance requirements to effectively operate, maintain or repair.

.10 Include technical data, product data, component illustrations, technical descriptions and parts list, wiring and schematic diagrams not considered proprietary, test and verification reports. Advertising or sales literature is not acceptable.

1.9 MAINTENANCE MATERIALS

.1 Provide maintenance materials in accordance with Division 01 – General Requirements and as indicated in respective specification sections.

1.10 FIRESTOPPING

.1 All fire stopping work is to be performed by the General Contractor.

.2 Electrical contractor shall coordinate all fire rated assembly penetrations with General Contractor.

.3 Electrical Contractor shall provide required clearances between outside surface of conduits and inside surface of sleeves, core drilled holes or listed fire rated systems.

1.11 ACCESS HATCHES

.1 All access doors shall be provided by individual trades, where required, and turned over to General Contractor. See Division 08 – Openings.

1.12 INTERPRETATION OF PLANS AND SPECIFICATIONS

.1 These specifications are to be considered as an integral part of the plans which accompany them and neither the plans nor the specifications shall be used alone. Any item which is omitted in one but which is reasonably implied in the other shall be considered properly and sufficiently specified and must, therefore, be provided by this Contractor.

.2 Drawings are diagrammatic. Building dimensions shall not be scaled from the Electrical plans.

.3 Any discrepancy between the drawings and the building shall be questioned before proceeding with any installation.

1.13 CO-OPERATION OF CONTRACTORS

.1 This Contractor shall become familiar with the work of other contractors and in lying out and installing the work shall co-operate with the other Contractors, so as to facilitate the progress of the work as a whole and avoid interference or delays.

Where interference exists, this Contractor shall notify the General Contractor and/or project manager and the engineer before installing the work. Any changes in the work or alterations of the Electrical Contractor's schedule required for such co-operation will not be considered as a claim for extra compensation.

.2 Due to the complexities of many sub-trades, and the restrictive space available in this project, it is required that all trades co-operate closely so as to install all systems in their allotted locations as indicated on the drawings, or as coordinated on site.

1.14 ERRORS AND OMISSIONS

.1 The drawings are not intended to show every item of accessory equipment, but the Contractor shall tender on and install all essential details to provide for efficiency of operation and ease of maintenance.

.2 Should this Contractor discover errors or discrepancies in the plans or specification, he shall refer the matter to the Engineer for change or clarification and shall not proceed with that portion of the work until advised by the Engineer to do so.

1.15 DELIVERY, STORAGE, AND HANDLING

.1 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: in accordance with Division 01 – General Requirements.

.2 Store and handle materials in accordance with Division 01 – General Requirements and manufacturer's written instructions.

1.16 SYSTEM START-UP

.1 Instruct operating personnel in operation, care and maintenance of systems, system equipment and components.

.2 The Contractor shall provide training with all systems. Sessions shall be broken into segments which will facilitate the training of individuals in the operation of this system. Operators Manuals and Users Guides shall be provided prior to the time of training. Segments shall as a minimum, consist of the following periods:

.1 Upon completion of the installation;

.2 After six weeks use of the system and;

.3 During the last month of the warranty period.

.4 All training shall be Bilingual.

1.17 PERMITS, FEES AND INSPECTION

.1 Submit to Electrical Inspection Department necessary number of drawings and specifications for examination and approval prior to commencement of work.

.2 Obtain an electrical work permit and pay associated fees.

.3 Notify Engineer of changes required by the Electrical Inspection Department.

.4 Contractor shall coordinate inspection date with Engineer and shall provide labour for access to all equipment for inspection. Such access shall imply removal of panel covers, opening of disconnect switches, junction/pull boxes, starters and luminaires, to confirm work method.

1.18 WARRANTY

.1 Warranty duration: 12 calendar months following Substantial Completion.

.2 Coverage: warrant against failure to perform to characteristics as specified.

.3 Manufacturer's warranty: submit manufacturer's warranty, for Engineer's acceptance.

1.19 RENOVATIONS

.1 Remove all redundant devices and wiring back to their source of supply.

.2 Contractor shall contact Facility Manager and user before demolition, and determine any material/equipment the school wishes to retain. Turn over to school, all devices, lighting, equipment, breakers, etc. removed during construction unless reused. All equipment which school refuses is to be removed from site.

.3 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding handling, storage and disposal of hazardous materials, such as ballasts containing PCB's in accordance with Section 01 00 01 – Project Specific General Requirements.

.4 Identify all new junction boxes on as-built drawings.

.5 Review demolition drawings carefully and relocate all devices, equipment, conduits, wiring interfering with construction.

.6 Extra payment will not be considered for removal or relocation of device, equipment or wiring in or on walls shown to be demolished on demolition drawings, whether specifically identified or not on Electrical Drawings.

.7 Where new drywall covers existing junction or pull box, install access hatch.

.1 Maintain wiring continuity for any existing branch circuits, or system wiring, which are interrupted due to removal of existing devices.

Part 2 Products

2.1 MATERIALS AND EQUIPMENT

.1 Provide material and equipment in accordance with Division 01– General Requirements.

.2 Material and equipment to be certified by an accredited certification organization and bear that organizations certification mark as evidence of having conformed to the appropriate Canadian Standards Association (CSA) Standards established under the provisions of the Canadian Electrical Code. Where CSA or ULC certified material and equipment are not available, obtain special approval from authority having jurisdiction, before delivery to site.

.3 Ensure labels are visible and readable after equipment is installed.

.4 Factory assemble electrical panels and component assemblies.

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

.2 Division 26 responsibility is as follows:

.1 Supply and installation of breakers and/or switches.

.2 Supply and installation of power feeder (conduit and wire) from panel to starter, from VFD to disconnect switch and from disconnect switch to motor.

.3 Supply and installation of disconnect switches at motors unless noted otherwise.

.4 Supply and installation of branch wiring to mechanical equipment as indicated on drawings.

.3 Control wiring and conduit is by Division 25 unless noted otherwise on electrical drawings.

2.3 WARNING SIGNS

.1 Warning Signs: in accordance with requirements of authority having jurisdiction, inspection authorities and Engineer.

.2 Signs, minimum size 178 x 254 mm.

2.4 WIRING TERMINATIONS

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

2.5 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two (2) coats of finish enamel:

.1 Paint outdoor electrical equipment "equipment" green finish to EEMAC Y1-1.

.2 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1.

.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

2.6 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with nameplates and labels as follows:

.1 Nameplates: 3 mm thick plastic engraving sheet, matt white finish face, black core, lettering accurately aligned and engraved into core, self-adhesive type.

.2 Sizes as follows:

NAMEPLATE SIZES

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

.3 Labels:

.1 Embossed plastic labels with 6 mm high letters unless specified otherwise.

.4 Wording on nameplates to be approved by Engineer prior to manufacture.

.5 Allow for minimum of twenty-five (25) letters per nameplate.

.6 Identification to be in French.

.7 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics. Label both box and cover.

.8 Disconnects, starters and contactors: indicate equipment being controlled and voltage. Terminal cabinets and pull boxes: indicate system and voltage.

.9 Panelboards and switchboards: name and electrical characteristics (voltage, phase, wire, bus capacity, interrupting capacity, circuit number and designation).

Example:

Panel HP – 125A 120/208 V – 3 PH – 4 W Fed from panel DA Circuit #2, 4, 6	Minimum interrupting capacity of breakers installed in this panel is to be not less than 10 KAIC

.10 Switch board and panels: indicate panel designation, amperage, voltage and interrupting rating.

.11 Transformers: indicate transformer designation, capacity, primary and secondary voltages.

.12 All power, switches, data and telephone outlets shall have a transparent identification permanently installed on coverplate.

2.7 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.1–18.

.4 Use colour coded wires in communication cables, matched throughout system.

2.8 CONDUIT AND CABLE IDENTIFICATION

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.3 Colours: 25 mm wide primary colour and ***20 mm*** wide auxiliary colour.

	Primary	**Auxiliary**
Controls	Brown	Orange
250 - 750V	Blue	

.4 Remaining electrical and communications conduits shall be color coded as per Facilities' Requirements/Standards.

.5 Provide identification of equipment, components, and assemblies specified, using materials suitable to withstand anticipated operating environment.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

.1 Confirm other related work is complete to receive work of this and related electrical sections.

.2 Commission electrical systems.

.3 Qualifications:

.1 Electricians: qualified, licensed electricians or apprentices in accordance with Provincial Act respecting manpower vocational training and qualifications.

.2 Apprentices: employees registered in provincial apprentices program permitted, under direct supervision of qualified licensed electrician, to perform specific tasks. Permitted activities determined based on level of training attained and demonstration of ability to perform specific duties.

.4 Contractor holding valid Master Electrical contractor licensed as issued by Province must oversee that work is being constructed.

.5 Contractor must be familiar with and adhere to the requirements of CAN Z462-21 at all times.

3.2 INSTALLATION

.1 Comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, MSDS, and product datasheets.

.2 Protect electrical equipment from dust and dirt. Plug or cap openings in conduit, fixtures and equipment during construction with Consultant approved materials.

.3 Conceal conduit in finished areas, unless otherwise authorized. Run exposed conduit parallel to building lines, and maintain maximum headroom.

.4 Install outlets, plates and other visible items parallel to building lines. Line up exposed raceways, parallel and at right angles to building walls, partitions, and ceilings.

.5 Set equipment and components plumb and level, accurate to position intended, and position hanger rods plumb.

3.3 NAMEPLATES AND LABELS

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

3.4 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete:

.1 Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 51 mm.

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

.4 Locate outlets in accordance with Section 26 05 32 – Outlet Boxes, Conduit Boxes and Fittings.

3.5 TESTING

.1 Provide advance notice to Consultant of proposed testing schedule.

.2 Perform tests at time of acceptance of work.

.3 Conduct and pay for field tests:

.1 Power distribution, including phase voltage, grounding and load balancing.

.2 Circuits originating from branch distribution panels.

.3 Motors, including sequenced operation.

.4 Lighting and lighting control.

.4 Perform tests in presence of Consultant:

.1 Provide instruments, meters, equipment and personnel required to conduct required tests.

.2 Test systems to verify operation as specified.

.5 Conduct di-electric tests, hi-pot tests, insulation resistance tests and ground continuity tests as required by nature of various systems and equipment.

.6 Perform the following tests on completed power systems:

.1 Control and switching: test circuits for correct operation of devices, switches and controls.

.2 Polarity tests: test circuits for correct operation of devices, switches and controls.

.3 Voltage tests: test voltage at last outlet of each circuit; maximum potential drop 2% on 120V, and 208V branch circuits, 3% on feeder circuits. Correct deficiencies.

.4 Phase balance: measure load on each phase at switchboards, splitter, distribution panel board and lighting and power panel board.

.1 Submit results to Consultant in writing.

.2 Re-arrange phase connections as necessary to balance load on each phase as instructed by Consultant.

.3 After marking such changes, submit revised drawings showing modified connections to Consultant.

.5 Supply voltage: measure line voltage of each phase at load terminals of main breakers and report results in writing to Engineer Consultant. Perform test with majority of electrical equipment in use.

.6 Motor loading: measure line current of each phase of motors with motor operating under load, and report results in writing to Consultant.

.1 Upon indications of imbalances or overloads, thoroughly examine electrical connections and rectify defective parts or wiring.

.2 If electrical connections are correct, report overloads due to defects in driven machines in writing to Consultant.

.7 Insulation resistance tests:

.1 Megger circuits, feeders and equipment up to 350V with a 500V instrument. Minimum insulation resistance shall be 0.5MΩ.

.2 Megger 350-600V circuits, feeders and equipment with a 1000V instrument. Minimum insulation resistance shall be 1.0MΩ.

.3 Check resistance to ground before energizing.

.8 Co-ordinate and carry out motor testing at same time as driven equipment is being tested. In addition to motor loading tests, provide labour and instruments to read and record motor load readings required to supplement tests on driven equipment through various load sequences, as required by driven equipment tests.

.7 General operations: energize and operate electrical circuit and item. Repair, alter, replace, test and adjust as necessary for a complete and operating electrical system.

.8 Provide labour, instruments, apparatus and pay expenses required for testing. Consultant reserves right to demand proof of accuracy of instruments used.

.9 Immediately prior to occupancy, test entire electrical system by performing loss and return of utility power test. Demonstrate operation of:

.1 High and low voltage service equipment and metering.

.2 Emergency lighting.

.3 Fire alarm, Public Address, Security Alarm / Door Access Control System, Video Surveillance System operation during power outage, including remote monitoring system.

.4 EMCS system shut down and auto restart, including re-stabilization of systems after power return. Attach report printouts as evidence of expected operation on systems.

.5 User equipment shut-down and auto-restart.

.10 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.11 Manufacturer's Field Services:

.1 Obtain written certificates from manufacturers verifying compliance of Work, in handling, installing, applying, protecting and cleaning of products for inclusion in operation and maintenance manuals.

.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 as indicated in respective specification sections.

3.6 TEST RESULTS

.1 Submit test results to Consultant for review.

.2 Testing methods and test results: to CSA, CEC and authorities having jurisdiction.

.3 Remove and replace conductors found damaged, with new materials.

.4 Provide required labour and tools, if during testing Consultant requests equipment be opened and removed from their housings to examine equipment, terminations and connections.

3.7 TRAINING

.1 Train operating personnel in operation, care and maintenance of electrical equipment and systems as indicated in paragraph 1.16.2 System Start-Up.

.2 Arrange and pay for manufacturer's factory service engineer to provide training. Ensure operating personnel are conversant with its care and operation.

.3 Obtain and submit written confirmation from operating personnel that satisfactory training has been received.

3.8 CLEANING

.1 Perform final cleaning of electrical equipment, systems and components.

3.9 DEMONSTRATION

.1 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.2 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

.3 Owner's Representative may record these demonstrations on video tape for future reference.

3.10 PROTECTION

.1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

3.11 CONTROL OF HAZARDOUS ENERGY

.1 Lock out and tag out all electrical and other equipment before performing work as per CAN/CSA-Z460-20.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for wire and box connectors.

1.2 RELATED SECTIONS

.1 Division 01 – General Requirements.

.2 Section 26 05 00 – Common Work Results for Electrical.

.3 Section 26 05 21 – Wires and Cables 0-1000V.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International) Latest Edition of the following:

.1 CAN/CSA-C22.2, No.18 (R2009), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.

.2 CSA C22.2 No.65 (R2008) Wire Connectors.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC) Latest Edition of the following:

.1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

Part 2 Products

2.1 MATERIALS

.1 Pressure type wire connectors to: CSA C22.2 No. 65-03, with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors to: CSA C22.2 No. 65-03, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Bushing stud connectors to: EEMAC 1Y-2 to consist of:

.1 Connector body and stud clamp for stranded, copper conductors.

.2 Clamp for stranded copper conductors.

.3 Stud clamp bolts.

.4 Bolts for copper conductors.

.5 Bolts for aluminum conductors.

.6 Sized for conductors as indicated.

.4 Clamps or connectors for flexible conduit, as required to: CAN/CSA-22.2 No. 18.1.

.5 Joints required in connecting all wiring up to and including # 8 are to be made using twist-on connectors.

.6 Joints for all other wiring shall be made using colour-keyed compression type connectors followed by a layer of CSA approved vinyl plastic tape.

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 datasheet.

3.2 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

.1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.

.2 Install fixture type connectors and tighten. Replace insulating cap.

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

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Division 01 – General Requirements.

.2 Section 26 05 00 – Common Work Results for Electrical.

.3 Section 26 05 20 - Wire and Box Connectors - 0 - 1000V.

.4 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

.1 CSA C22.2 No .0.3-09 (R2005), Test Methods for Electrical Wires and Cables Latest Edition.

Part 2 Products

2.1 BUILDING WIRES

.1 Conductors: solid for #10 AWG and smaller; stranded for #8 AWG and larger. **Minimum size: #12 AWG.** For longer runs use minimum: #10 (20-40 m); #8 (40-55 m) or #6 (>55 m) at 120 volt. On 600V circuits size to assure maximum 1.5% voltage drop.

.2 Conductors: size as indicated, with 600V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

.3 Neutral conductor insulated for 600V shall be continuous with no fuses, switches, or breaks of any kind.

.4 The voltage drop shall in no case exceed ***3%*** of the line volts for branch circuits.

.5 Voltage drop shall be calculated based on 80% of the circuit breaker current rating for all branch circuits unless noted otherwise.

.6 Voltage drop for motor branch circuits shall be calculated based on current equal to 80% of the ampacity of the branch circuit conductors.

.7 Branch circuit conductor sizes specified on drawings are the minimum required. Upsize branch circuit conductor sizes as required so that the voltage drop is less than the maximum value permitted.

2.2 TECK 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 Type: ethylene propylene rubber.

.2 Chemically cross-linked thermosetting polyethylene rated type RW90, 600V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: interlocking.

.6 Overall covering: thermoplastic polyvinyl chloride material.

.7 Fastenings:

.1 Channel type supports for two or more cables at 1.5 m centers.

.2 Threaded rods: 13 mm dia. to support suspended channels.

.8 Connectors:

.1 Watertight, approved for TECK cable.

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 datasheet.

3.2 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.

.2 Use vibration proof expanding spring wire connectors for No. 10 and smaller.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 32 – Outlet Boxes, Conduit Boxes and Fittings.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International):

.1 CSA C22.2 No.41-07, Grounding and Bonding Equipment.

Part 2 Products

2.1 CONNECTORS AND TERMINATIONS

.1 Copper compression connectors to CSA C22.2 as required sized for conductors.

Part 3 Execution

3.1 INSTALLATION

.1 Install, terminations, and splices in accordance with manufacturer's instructions.

.2 Bond and ground as required to CSA C22.2 No.41.

.3 Do not install more than three (3) connections per junction box unless specifically permitted by Engineer (in writing).

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Division 01 – General Requirements.

.2 Section 26 05 00 – Common Work Results for Electrical.

1.2 REFERENCES

.1 Canadian Standards Association, CSA C22.1–18, Canadian Electrical Code, Part 1.

Part 2 Products

2.1 EQUIPMENT

.1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.

.2 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size as indicated.

.3 Ground bus: copper, size as indicated, 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.

2.2 MANUFACTURERS

.1 Acceptable manufacturers: Burndy Corp., Erico Inc., Cadweld Div., Thomas & Betts (or approved equivalent).

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 datasheet.

3.2 INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding system including electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Make buried connections, and connections to conductive water main and grounding electrodes using copper welding by Thermit process.

.5 Use mechanical connectors for grounding connections to equipment provided with lugs.

.6 Soldered joints not permitted.

.7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.8 Connect building structural steel and metal siding to ground by welding copper to steel.

.9 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.10 Bond single conductor metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

.11 Install grounding conductors in conduit except where run in cable tray. Bond to EMT conduit.

.12 Ground secondary enclosures.

3.3 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list: Service equipment, transformers, duct systems, frames of motors, starters, control panels, building steel work, elevators, distribution panels, outdoor lighting.

.2 Where feeders over 100 A capacity pass through junction or pull boxes the ground continuity through the box shall be ensured by the use of grounding bushings and conductors sized in accordance with table 18 of CSA 22.1.

3.4 FIELD QUALITY CONTROL

.1 Verifications requirements in accordance with Division 01 – General Requirements.

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

.3 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Engineer and local authority having jurisdiction over installation.

.4 Perform tests before energizing electrical system.

.5 Disconnect ground fault indicator during tests.

3.5 CLEANING

.1 Proceed in accordance with Division 01 – General Requirements.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Division 01 – General Requirements.

.2 Section 26 05 00 – Common Work Results for Electrical.

Part 2 Products

2.1 SUPPORT CHANNELS

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

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 datasheet.

3.2 INSTALLATION

.1 Secure equipment to hollow or solid masonry, tile and plaster surfaces with nylon shields.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.4 Secure surface mounted equipment with twist clip fasteners to inverted T-bar ceilings. Ensure that T-bars are adequately supported to carry weight of equipment specified before installation.

.5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.6 Fasten exposed conduit or cables to building construction or support system using straps:

- .1 One-hole steel straps to secure surface conduits and cables 51mm and smaller.
- .2 Two-hole steel straps for conduits and cables larger than 51mm.
- .3 Beam clamps to secure conduit to exposed steel work.

.7 Suspended support systems:

- .1 Support individual cable or conduit runs with 10 mm dia. threaded rods and spring clips.
- .2 Support 2 or more cables or conduits on channels supported by 10 mm dia threaded rod hangers where direct fastening to building construction is impractical.

.8 For surface mounting of two or more conduits use channels at 1.5 m on centre 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 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.11 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Engineer.

.13 Install fastenings and supports as required for each type of equipment, cable and conduit, and in accordance with manufacturer's installation recommendations.

.14 Do not support conduit from other conduit.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Division 01 – General Requirements.

.2 Section 26 05 00 – Common Work Results for Electrical.

Part 2 Products

2.1 SPLITTERS

.1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Main and branch lugs and connection bars to match required size and number of incoming and outgoing conductors as indicated.

.3 At least three spare terminals on each set of lugs in splitters less than 400 A.

2.2 SPLITTER INSTALLATION

.1 Install splitters and mount plumb, true and square to the building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

2.3 JUNCTION AND PULL BOXES

.1 Welded steel construction with screw-on flat covers for surface mounting.

.2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

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 datasheet.

3.2 JUNCTION AND PULL BOXES INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Install pull boxes so as not to exceed 30 m of conduit run or 2-90° bends between pull boxes.

.3 Mount cabinets with top not higher than 1800 mm above finished floor.

.4 Maximum three (3) connections per junction box unless explicitly permitted by Engineer.

3.3 IDENTIFICATION

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

.2 Install size 2 identification labels indicating system name, voltage and phase.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Division 01- General Requirements.

.2 Section 26 05 00 – Common Work Results for Electrical.

1.2 REFERENCES

.1 CAN/CSA-C22.2 No. 18-98 (R2003) Outlet Boxes, Fittings and Associated Hardware.

.2 CSA-C22.1-2018 Canadian Electrical Code, Part 1.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1-2018.

.2 102 mm square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 SHEET STEEL OUTLET BOXES

.1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 51 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.

.2 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.

.3 102 mm square or octagonal outlet boxes for lighting fixture outlets.

.4 102 mm square outlet boxes with extension and plaster rings for voice and data outlets.

2.3 MASONRY BOXES

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

2.4 CONCRETE BOXES

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

2.5 CONDUIT BOXES

.1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles.

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 32 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

.5 EMT fittings to be steel set screw type.

2.7 IDENTIFICATION

.1 All boxes installed above finished ceilings and in interstitial levels shall have their covers color coded, as described in these specifications, and shall be labelled as to room number they serve.

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 datasheet.

3.2 INSTALLATION

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 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, and armored cable connections. Reducing washers are not allowed.

.5 All boxes shall be installed recessed/flush unless indicated otherwise.

.6 Install all outlet boxes in exterior walls with flexible vapour barrier and seal with caulking.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Division 01 – General Requirements.

.2 Section 26 05 00 – Common Work Results for Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA) Latest Edition of the following:

.1 CAN/CSA C22.2 No. 18.1-04 (R2009), Metallic Outlet Boxes.

.2 CAN/CSA C22.2 No. 18.3-04 (R2009), Hardware for the Support of Conduit, Tubing and Cable Fittings.

.3 CAN/CSA C22.2 No. 18.5-02 (R2007), Positioning Devices.

.4 CSA C22.2 No. 45.1-07, Electrical Rigid Metal Conduit – Steel.

.5 CSA C22.2 No. 45.2-07, Electrical Rigid Metal Conduit – Aluminum, Red Brass and Stainless Steel.

.6 CSA C22.2 No. 56-04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

.7 CSA C22. 2 No. 83.1-07, Electrical Metallic Tubing – Steel.

.8 CSA C22.2 No. 211.2-06, Rigid PVC (Un-plasticized) Conduit.

.9 CAN/CSA C22.2 No.227.3-05, Non-Metallic Mechanical Protection Tubing (NMPT), National Standard of Canada (February 2006).

Part 2 Products

2.1 CONDUITS

.1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83 – M 1985 (R003), with couplings.

.2 Flexible metal conduit and liquid-tight flexible conduit, complete with anti-short bushings: to CSA C22.2 No. 56-04, steel and liquid-tight flexible metal.

2.2 CONDUIT FASTENINGS

.1 One-hole steel straps to secure surface conduits 51 mm and smaller. Two hole steel straps for conduits larger than 51 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits at 1.5 m oc.

.4 Threaded rods, 6 mm diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

.1 Rain tight EMT connectors shall be used on "vertical" sections of conduit runs where terminating into tops of electrical equipment incorporating drip shields or hoods.

.2 Fittings: Use steel set screw connectors and fittings for EMT. Coating: same as conduit.

.3 Factory "ells" where 90 degree bends are required for 25 mm and larger conduits.

.4 Connectors for flexible conduit shall be set screw galvanized steel.

.5 Connectors for liquid tight flexible conduit shall be water tight, compression type galvanized steel.

.6 Threaded plastic or metal bushings to be installed on all EMT connectors sizes

35 mm and larger.

.7 Fittings: manufactured for use with conduit specified. Coating: same as conduit

2.4 FISH CORD

.1 Polypropylene.

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 datasheet.

3.2 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.

.3 EMT shall be installed as a complete system.

.4 Support of electrical systems raceway shall be independent of any type of suspended ceiling support rods, wires, etc. and mechanical piping or duct systems.

.5 Use electrical metallic tubing (EMT) for all work, unless otherwise indicated, for panelboard feeders, branch circuit wiring, fire alarm and communications, etc., where not installed underground unless specifically indicated otherwise. Provide a separate green ground for all conduit systems, including E.M.T.

.6 Flexible Metal Conduit:

.1 Use flexible metal conduit for connection to surface or recessed fluorescent fixtures.

.2 Flexible metal conduit permitted above T-bar ceilings, for drops to various fire alarm devices mounted on flush outlet boxes in finished ceiling. Minimum size of flexible conduit: 22 mm, Maximum length of drop: 1.5 m.

.7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment, furniture and transformers. Include a separate ground wire.

.8 Minimum conduit size for lighting and power circuits: 21 mm.

.9 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.10 Mechanically bend steel conduit over 22 mm dia.

.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. Do not use liquids to clean out conduits.

.14 Dry conduits out before installing wire.

.15 Securely fasten in place within 83 mm of each outlet box, junction box, cabinet, coupling or fitting, maximum spacing between supports as follows:

.1 1.5 m for 21 mm trade size conduit and smaller.

.2 2 m for 27 mm to 35 mm trade size conduit.

.3 3 m for 41 mm trade size and larger.

.16 Ground Wires:

.1 Provide a separate green ground wire in all conduit, including EMT.

3.3 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Run conduits in flanged portion of structural steel.

.3 Group conduits wherever possible on suspended or surface channels.

.4 Do not pass conduits through structural members except as indicated.

.5 Do not locate conduits less than 76 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

.6 Unless approved in writing by Engineer, surface conduits are acceptable only in electrical, communications and mechanical rooms.

3.4 CONCEALED CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

.3 Do not run conduits horizontally in walls and do not run conduit on inside of metal studs.

.4 Do not install conduits in terrazzo or concrete toppings.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for breaker type panelboards.

1.2 RELATED SECTIONS

.1 Division 01 – General Requirements.

.2 Section 26 05 00 – Common Work Results for Electrical.

.3 Section 26 28 21 - Moulded Case Circuit Breakers.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International) Latest Edition of the following:

.1 CSA C22.2 No.29–15 (R2019), Panelboards and Enclosed Panelboards.

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Section 26 05 00 – Common Work Results for Electrical.

.2 Drawings include electrical detail of panelboard, branch breaker type, quantity, ampacity and enclosure dimension, shown in the same layout as on panelboard schedules.

Part 2 Products

2.1 PANELBOARDS

.1 Panelboards: to CSA C22.2 No.29–15 (R2019) and product of one (1) 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.
.3 All provisional space shall be fully bussed and breaker ready.

.2 208V panelboards: bus and breakers rated for 10 kA rms (symmetrical) interrupting capacity minimum or as indicated.

.3 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.

.4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.5 Two (2) keys for each panelboard and key panelboards alike. Turn over keys to building Owner.

.6 Aluminum bus with neutral of same ampere rating as mains, unless noted otherwise.

.7 Mains: suitable for bolt-on breakers.

.8 Trim with concealed front bolts and hinges.

.9 Trim and door finish: baked grey enamel.

.10 Copper ground bus.

.11 Surface mounted panelboard shall be sprinkler proof.

2.2 BREAKERS

.1 Breakers: to Section 26 28 21 - Moulded Case Circuit Breakers.

.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

.3 Main breaker: separately mounted on top or bottom of panel to suit cable entry.

.4 Lock on devices for 10% of 15 to 30A breakers installed as indicated. Turn over unused lock on devices to Owner.

.5 Lock on devices for fire alarm, door supervisory, intercom, stairway, exit and night light circuits. Provide copy of receptacles of used breakers locked in operation and maintenance manuals.

2.3 EQUIPMENT IDENTIFICATION

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

.2 Nameplate for each panelboard Size 4 engraved as indicated.

.3 Nameplate for each circuit in distribution panelboards Size 2 engraved as indicated.

.4 Provide typewritten circuit directory, indicating location and load for each circuit. Circuit directories shall be written in English.

2.4 ACCEPTABLE MANUFACTURERS:

.1 Acceptable Manufacturers:

.1 Square D.
.2 Eaton.
.3 Siemens.

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 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Install surface mounted panelboards on plywood backboards or either fire retardant type or painted on all sides with fire retardant paint.

.3 Mount panelboards to height specified in Section 26 05 00 – Common Work Results for Electrical or as indicated.

.4 Connect loads to circuits.

.5 Connect neutral conductors to common neutral bus with respective neutral identified.

3.3 TESTS

.1 Test each branch breaker to verify that it controls the load indicated on the drawing and panel directory.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials for moulded-case circuit breakers.

1.2 RELATED SECTIONS

.1 Division 01 – General Requirements.

.2 Section 26 05 00 – Common Work Results for Electrical.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International) Latest Edition of the following:

.1 CSA-C22.2 No. 5-2 (R2007), 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 SUBMITTALS

.1 Submit Shop Drawings in accordance with Section 26 05 00 – Common Work Results for Electrical.

.2 Include time-current characteristic curves for breakers with ampacity of 100A and over.

Part 2 Products

2.1 BREAKERS GENERAL

.1 Moulded-case circuit breakers: to CSA C22.2 No. 5.

.2 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation.

.3 Common-trip breakers: with single handle for multi-pole applications.

.4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting:

.1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.

.5 Circuit breakers to have minimum symmetrical rms interrupting capacity rating to match panel or as indicated.

2.2 THERMAL MAGNETIC BREAKERS

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

2.3 ACCEPTABLE MATERIALS

.1 Breakers shall be compatible with existing panelboards or MCC's and shall meet the short circuit interrupting ratings as per existing distribution ratings.

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 Install circuit breakers as indicated.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

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

1.2 RELATED SECTIONS

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

1.3 REFERENCES

.1 Canadian Standards Association (CSA International) Latest Edition of the following:

.1 CAN/CSA C22.2 No.4-04 (R2009), Enclosed Switches.

.2 CSA C22.2 No.39-M 1987 (R2003), Fuse holder Assemblies.

1.4 SUBMITTALS

.1 Submit Shop Drawings in accordance with Section 26 05 00 – Common Work Results for Electrical.

Part 2 Products

2.1 DISCONNECT SWITCHES

.1 Fusible and non-fusible, heavy-duty horsepower rated disconnect switches to CAN/CSA C22.2 No.4, sized to match circuit ampacity and voltage, or as indicated.

.2 Provision for padlocking in off switch position by three locks.

.3 Mechanically interlocked door to prevent opening when handle is in ON position.

.4 Quick-make, quick-break action.

.5 ON-OFF switch position indication on switch enclosure cover.

.6 Enclosure: NEMA Type 1 or as indicated (weatherproof NEMA 4x).

2.2 EQUIPMENT IDENTIFICATION

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

.2 Indicate name of load controlled on size 4 nameplate.

2.3 ACCEPTABLE MANUFACTURERS

.1 Eaton

.2 Schneider

.3 Siemens.

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 Install disconnect switches complete with fuses, if applicable, where indicated on drawings.

.2 Disconnect switches for mechanical equipment shall be mounted on uni-strut framework.

3.3 TESTS

.1 Operate each disconnect switch to verify that the loads are disconnected.

END OF SECTION

City of Saint John

CONTRACT SPECIFICATIONS

DIVISION 4

FORM OF TENDER

OCTOBER 2023

City of Saint John

TABLE OF CONTENTS

DIVISION 4 – FORM OF TENDER

4.1 TENDER IDENTIFICATION

Tender No: **2023-085304T**

Title of Work: **Equipment Installation - Thermal Interconnect**

4.2 TENDERER'S RESPONSIBILITIES AND AGREEMENT

TO THE CITY OF SAINT JOHN, NEW BRUNSWICK:

The undersigned hereby agrees that failure to complete all required parts of the Form of Tender shall be subject to the reserved rights of the City and shall be grounds for rejection of the Tender in accordance with Section 2.11.

The undersigned Tenderer has carefully examined the site of the Work described herein, has become familiar with local conditions and the character and extent of the Work, has carefully examined every part of the proposed Contract, and thoroughly understands its stipulations, requirements and provisions and has carefully examined all of the following documents which together comprise the Tender Documents:

1. Project Description (Division 1)
2. Instructions to Tenderers and Tendering Procedures (Division 2)
3. The Particular Specifications (Division 3)
4. The Form of Tender (Division 4)
5. The Form of Agreement (Division 5)
6. The General Specifications (Divisions 6 through 31)
7. The Plans and Drawings
8. Addenda Issued

together, the "Tender Documents".

The undersigned Tenderer has determined the quality and quantity of materials required, has investigated the location and determined the source of supply of materials required, has investigated labour conditions, and has arranged for the continuous execution of the Work herein described.

The undersigned Tenderer hereby agrees to be bound by the award of the contract, and if awarded the Contract, to sign the Form of Agreement (Division 5) within five (5) working days following the City's Notice of Selection.

In the event the City accepts its Tender, the undersigned Tenderer hereby agrees to Substantially Complete the Work no later than March 31, 2024.

The undersigned Tenderer agrees that they have received all Addenda and the Tender Price includes the provisions set out in the Addenda.

4.2 TENDERER'S RESPONSIBILITIES AND AGREEMENT (Cont'd)

The undersigned Tenderer further agrees to provide all necessary permits, approvals, labour, material, plant, equipment, tools, incidentals, products, water, light, heat, power, transportation, facilities, services and other means of the specified requirements which are necessary to complete the work in accordance with the contract and agrees to accept, therefore, in payment in full, the unit prices stated herein in the *Schedule of Quantities and Unit Prices*, plus applicable taxes, for the actual quantities performed in accordance with the drawings and specifications, for the total sum of

_____
_____
_____

in Canadian Funds, which price includes HST (the "Tender Price").

By submitting a Tender, the Tenderer absolutely waives any right, cause of action or claim for any compensation of any kind whatsoever as a result of participating in this Request for Tender Call or by reason of the City's failure to accept the Tender submitted by the Tenderer, and the Tenderer shall be deemed to have agreed to waive such right, cause of action or claim.

Place of Signing: Signed, sealed and delivered at _____

Date of Signing: This _____ day of _____, in the year _____

Name and Title: By_____

Legal Name of Tenderer: _____ *PLACE*

Signature of Tenderer or Authorized Agent: _____ *SEAL*

Signature of Witness: _____ *HERE*

Address of Tenderer: _____

_____

4.3 BONDING AND INSURANCE COMMITMENTS

Failure of the Tenderer to complete Sections 4.3.01, 4.3.02 and 4.3.03 may be grounds for rejection of the Tender.

4.3.01 Tender (Bid) Bond or Certified Cheque

A certified cheque or Tender (Bid) Bond accompanies this Tender, as indicated below:

(a) Certified Cheque

Provided is a certified cheque payable to The City of Saint John in the amount of

_____

***Signature of Tenderer or Authorized Agent**:* _____

(b) Tender (Bid) Bond

Provided is a Tender (Bid) Bond payable to The City of Saint John in the amount of

_____

The Tender (Bid) Bond has been negotiated for, procured from and the premium paid to a New Brunswick agent of an insurance company licensed to do business in New Brunswick.

***Signature of Tenderer or Authorized Agent**:* _____

4.3.02 Performance Guarantees

One of the following acceptable forms of Performance Guarantees will accompany the Contract, as indicated below:

Performance Bond and the Labour and Material Payment Bond

The Performance Bond and the Labour and Material Payment Bond, each at fifty percent (50%) of the Tender Price covering the faithful performance of the full Contract, will be issued by an insurer licensed under the *Insurance Act* to transact guarantee insurance or surety insurance.

The Performance Bond and the Labour and Material Payment Bond shall be in the form prescribed by the regulations under the *Construction Remedies Act*. Where permitted pursuant to the *Construction Remedies Act* and where specifically allowed and called for in the Tender Documents as being permitted, the City may allow alternate forms of security.

A surety consent letter or Agreement to Bond must accompany the Tender submission.

***Signature of Tenderer or Authorized Agent**:* _____

4.3.03 Insurance

The undersigned Tenderer has reviewed the insurance requirements in the Contract. The following provision for contract insurances will be utilized, as indicated below:

The insurance required in the contract will be negotiated for, procured from and the premium paid to an insurance company licensed to do business in the Province of New Brunswick.

Signature of Tenderer or Authorized Agent: _____

4.4 STATEMENTS

A Tender which does not include completed statements at Sections 4.4.01 to 4.4.07 hereunder and the duly completed Schedule of Quantities and Unit Prices at Appendix 4A may be Disqualified.

4.4.01 Reference Regarding Tenderer's Financial Status

Name of Reference: _____

Address of Reference: _____

_____

4.4.02 Particulars of Tenderer's Recent Contracts

The Tenderer shall provide hereunder particulars of at least three (3), and if possible, five (5) contracts which the Tenderer has successfully carried to completion within the last three (3) years, or is now carrying to completion.

Tenderers shall be actually engaged in performing the type and standard of work specified, and the projects referenced below shall be work of a similar character to the Work now being tendered and shall be of comparable or greater size.

Tenderers who have not performed work for The City of Saint John within the last three (3) years shall submit additional information with the Form of Tender that would demonstrate the Tenderer's ability to perform the type and standard of work specified and the Tenderer's financial, technical and project management reliability.

4.4.02 Particulars of Tenderer's Recent Contracts (Cont'd)

Contract 1: Brief description of contract: _____

_____

_____

Owner, contact name and telephone number: _____

_____

Contractor's supervisor: _____

Year completed: _____ Contract Value: _____

Contract 2: Brief description of contract: _____

_____

_____

Owner, contact name and telephone number: _____

_____

Contractor's supervisor: _____

Year completed: _____ Contract Value: _____

Contract 3: Brief description of contract: _____

_____

_____

Owner, contact name and telephone number: _____

_____

Contractor's supervisor: _____

Year completed: _____ Contract Value: _____

4.4.02 Particulars of Tenderer's Recent Contracts (Cont'd)

Contract 4: Brief description of contract: _____

_____

_____

Owner, contact name and telephone number: _____

_____

Contractor's supervisor: _____

Year completed: _____ Contract Value: _____

Contract 5: Brief description of contract: _____

_____

_____

Owner, contact name and telephone number: _____

_____

Contractor's supervisor: _____

Year completed: _____ Contract Value: _____

Contract 6: Brief description of contract: _____

_____

_____

Owner, contact name and telephone number: _____

_____

Contractor's supervisor: _____

Year completed: _____ Contract Value: _____

4.4.03 Particulars of Current Construction Work by Tenderer

If none of the projects described in 4.4.02 were in progress in Canada during the twelve (12) months immediately preceding this Tender, the Tenderer shall provide below particulars of a contract which the Tenderer satisfactorily carried out in Canada during that period.

Brief description of contract: _____

_____

_____

Owner, contact name
and telephone number: _____

_____

Date of commencement: _____

Date of (anticipated) completion: _____

Contract value: _____

Contractor's supervisor: _____

4.4.04 Tenderer's Senior Supervisory Staff

The Tenderer shall identify their senior supervisory staff in the spaces below.

Tenderers who have not performed work for the City within the last three (3) years shall submit with their Form of Tender a completed resume for each staff member listed hereunder outlining their experience, education, designations/certificates and continued training/education.)

Name	Position	Qualifications	# Years Experience

4.4.05 Tenderer's Plant

The Tenderer shall list below the construction plant (type of machinery, equipment, trucks, etc.) the Tenderer proposes to use, other plant under the Tenderers control, and the plant the Tenderer proposes to hire, to complete the work within the time allowed.

Type	Make	Model # & Year	Gas/ Diesel	Net Engine Horsepower	Bucket Size Excavator GVW

4.4.06 Tenderer's Other Resources

The Tenderer shall list below the batch plant, gravel pits or quarries, and the like that the Tenderer proposes to use to complete the work within the time allowed.

4.4.07 Sub-Contractors and Suppliers

Tenderers shall state the name and address of each proposed sub-contractor or supplier.

The listing of more than one sub-contractor or supplier for any one sub-trade or failure to submit a complete list of sub-contractors and suppliers may be grounds for rejection of the Tender. After the City has provided the selected Tenderer with written notification of the City's acceptance of its Tender, the selected Tenderer shall not substitute other sub-contractors or suppliers in place of those named below without the written approval of the Engineer.

Sub-Trade or Supplier	Name of Sub-Contractor/Supplier	Address

4.5 SCHEDULE OF QUANTITIES AND UNIT PRICES

The tenderer shall complete and attach as Appendix 4A the required *Schedule of Quantities and Unit Prices* for the Work tendered, in the format specified by the Engineer.

4.6 CERTIFICATE OF INDEPENDENT TENDER DETERMINATION

I, the undersigned, in submitting the accompanying Tender to The City of Saint John for:

Tender No.: _____

Title of Work: _____

_____

do hereby make the following statements that I certify to be true and complete in every respect:

I certify, on behalf of _____ that:

(Corporate Name of Tenderer)

4.6 CERTIFICATE OF INDEPENDENT TENDER DETERMINATION (Cont'd)

1. I have read and I understand the contents of this Certificate;

2. I understand that the accompanying Tender will be disqualified if this Certificate is found not to be true and complete in every respect;

3. I am authorized by the Tenderer to sign this Certificate, and to submit the accompanying Tender, on behalf of the Tenderer;

4. Each person whose signature appears on the accompanying Tender has been authorized by the Tenderer to determine the terms of, and to sign, the Tender, on behalf of the Tenderer;

5. For the purposes of this Certificate and the accompanying Tender, I understand that the word "competitor" shall include any individual or organization, other than the Tenderer, whether or not affiliated with the Tenderer, who:

(a) may submit a Tender in response to this Request for Tender;

(b) could potentially submit a Tender in response to this Request for Tender, based on their qualifications, abilities or experience;

6. The Tenderer discloses that (check one of the following only, as applicable):

☐ the Tenderer has arrived at the accompanying Tender independently from, and without consultation, communication, agreement or arrangement with, any competitor; or

☐ the Tenderer has entered into consultations, communications, agreements or arrangements with one or more competitors regarding this Request for Tender, and the Tenderer discloses, in the attached document(s), complete details thereof, including the names of the competitors and the nature of, and reasons for, such consultations, communications, agreements or arrangements.

7. In particular, without limiting the generality of paragraphs (6)(a) or (6)(b) above, there has been no consultation, communication, agreement or arrangement with any competitor regarding:

(a) prices;

(b) methods, factors or formulas used to calculate prices;

(c) the intention or decision to submit, or not to submit, a Tender; or

(d) the submission of a Tender which does not meet the specifications of the Request for Tender;

except as specifically disclosed pursuant to paragraph (6)(b) above;

4.6 CERTIFICATE OF INDEPENDENT TENDER DETERMINATION (Cont'd)

8. In addition, there has been no consultation, communication, agreement or arrangement with any competitor regarding the quality, quantity, specifications or delivery particulars of the products or services to which this Request for Tender relates, except as specifically authorized by The City of Saint John or as specifically disclosed pursuant to paragraph (6)(b) above;

9. The terms of the accompanying Tender have not been, and will not be, knowingly disclosed by the Tenderer, directly or indirectly, to any competitor, prior to the date and time of the official Tender Opening, or of the awarding of the Contract, whichever comes first, unless otherwise required by law or as specifically disclosed pursuant to paragraph (6)(b) above.

Name of Tenderer or Authorized Agent: _____

Signature of Tenderer or Authorized Agent: _____

Position Title: _____

Date: _____

Address of Tenderer: _____

_____

ATTACHMENT: TENDERER'S CHECKLIST

(The onus is entirely on the Tenderer to understand all the requirements of the tendering process and the Tender Documents. This checklist is provided for information only and is not required to be submitted with the Form of Tender.)

BEFORE SUBMITTING YOUR TENDER, CHECK THE FOLLOWING POINTS:

- ☐ Has your Tender been signed and witnessed?
- ☐ Have you sealed the *Form of Tender* with your corporate seal?
- ☐ Have you enclosed your Tender (Bid) Bond or certified cheque?
- ☐ Have you enclosed the surety consent letter?
- ☐ Have you completed all sections of the *Form of Tender*?
- ☐ Have you completed all schedules and prices in the *Form of Tender*?
- ☐ Have you written each unit price or lump sum price out in words, including the words "dollars" and "cents"?
- ☐ Have you included signed copies of all addenda signature pages?
- ☐ Have you listed your Subcontractors and suppliers?
- ☐ Have you listed your experience in similar work?
- ☐ Have you listed your senior staff?
- ☐ Have you listed the Tenderer's plant?
- ☐ Have you attached required appendices and required supplemental information?
- ☐ Are the documents complete?
- ☐ Is everything legible?

PLEASE MAKE SURE THAT YOU:

(a) Place the Tender in an envelope;
(b) Seal the envelope;
(c) Put the Tender number, title of Work and closing date and time on the sealed envelope;
(d) Put the full legal name and return address of the Tenderer on the envelope; and
(e) Deposit the envelope in the Tender Box located at 175 Rothesay Avenue, 1st Floor, Saint John, N.B.

City of Saint John

CONTRACT SPECIFICATIONS

DIVISION 5

FORM OF AGREEMENT

OCTOBER 2023

City of Saint John

TABLE OF CONTENTS

DIVISION 5 – FORM OF AGREEMENT

5.1 AGREEMENT BETWEEN OWNER AND CONTRACTOR

THIS AGREEMENT made in triplicate between **THE CITY OF SAINT JOHN** herein (and in the Specifications) called the "Owner" or the “City”

AND

_____

herein (and in the Specifications) called the "Contractor".

WITNESSETH: That the Owner and the Contractor agree as follows:

(a) The Contractor shall provide all the materials and perform all the work shown on the drawings and described in the Contract Specifications titled:

Contract No: 2023-085304T

Title: Equipment Installation - Thermal Interconnect

(b) The Contractor shall do and fulfill everything indicated by this Agreement; and

(c) The Contractor shall Substantially Complete the Work no later than March 31, 2024.

5.2 CONTRACT DOCUMENTS

5.2.01 General Specifications

General Specifications, City of Saint John, New Brunswick,
with all applicable divisions, as updated and as listed in the Table of Contents of the Contract Specifications.

5.2.02 Contract Specifications

Contract specifications for

Contract No: 2023-085304T

Title: Equipment Installation - Thermal Interconnect

City of Saint John, New Brunswick,

5.2.03 Drawings

M-1 Canada Games Aquatic Center Basement Level – Mechanical New Work
M-2 Market Square Level 8.4 Mechanical Room – Mechanical New Work
M-3 Details and Schedules
M-4 Schematic
E-1 Canada Games Aquatic Center Basement Level – Electrical New Work
E-2 Market Square Level 8.4 – Electrical New Work
E-3 Electric Panel Schedules
E-4 Single Line Diagram

5.3 ADDENDA

The Contractor agrees that he has received addenda __ to __ inclusive, and that the tender price includes the provisions set out in the addenda.

5.4 CONTRACT PRICE

The Owner shall pay to the Contractor, in lawful money of Canada for the performance of the Contract, the amounts determined for each of the items of work completed at the unit prices as listed in the Schedule of Quantities and Unit Prices, including applicable taxes, submitted with the tender, which is to be attached with this Agreement, for the total tender price of:

$

If the Engineer orders in writing the performance of any work not covered by the drawings or included in the specifications that cannot be classified as coming under any of the contract units and for which a unit price can be agreed upon, then such additional work shall be paid for as described under the General Administration of Contract, Division 6.

5.5 PAYMENT

The Owner shall pay on account of thereof upon the Engineer's Certificate, as invoiced by the Contractor and approved by the Engineer, in the manner described in the Specifications.

5.6 AGREEMENT DOCUMENTS

The General Administration of Contract, Division 6 and the aforesaid Specifications and Drawings are all to be read into and form part of this Agreement and the whole shall constitute the Contract between the parties and it shall inure to the benefit of and be binding upon them and their successors, executors, administrators, and subject to the General Administration of Contract, their assigns.

5.7 EXECUTION OF AGREEMENT

In Witness Whereof the parties hereto have executed this Agreement.

	) SIGNED, SEALED AND DELIVERED)) this _____ day of _____, _____)) by _____) (Contractor))
_____ (Witness)	) _____) (Signature))
_____ (Name and Title)	) _____) (Name and Title))
	) _____) (Signature))
	) _____) (Name and Title)))) *PLACE SEAL HERE*

	))) SIGNED, SEALED AND DELIVERED)) this _____ day of _____, _____)) by THE CITY OF SAINT JOHN.))) _____) MAYOR)) _____) COMMON CLERK)))) *PLACE SEAL HERE*

5.8 AFFIDAVIT OF CORPORATE EXECUTION

CANADA
PROVINCE OF NEW BRUNSWICK
CITY OF SAINT JOHN
I, _____, of the _____
in the County of _____, and Province of New Brunswick
MAKE OATH AND SAY:

(1) THAT I am the _____ of _____, and _____ is the _____ of the said Company, as such I am/we are duly authorized officer(s) of the said Company to execute the foregoing instrument.

(2) THAT the signature _____ subscribed to the within instrument is my signature and in my own proper handwriting and that the signature _____ so subscribed is his signature made thereto by him in my presence.

(3) THAT the Seal affixed to the said instrument purporting to be the Corporate Seal of the said _____ is the Corporate Seal of the said Company and was affixed to the said instrument by me and by order of the Board of Directors of the Company.

SWORN TO BEFORE ME at the_____)
)
of _____)
)
in the Province of _____)
)
this _____ day of _____ A.D., _____.)
)
_____) _____
COMMISSIONER OF OATHS) CONTRACTOR
)

Note: The blank spaces are to be filled in with the name or names of the signing officer(s).

5.9 CHECKLIST FOR INSURANCE REQUIREMENTS

The insurance coverage required by the City is set out in General Administration of Contract, Division 6, of the General Specifications. An Insurance Certificate is to be deposited with the City.

The certificate of insurance should contain at least the following information:

- ❑ Be addressed to the City of Saint John.
- ❑ Be signed by an authorized representative on behalf of the insurance company.
- ❑ Contain a Wrap-up (Project Specific) Liability policy with inclusive limits of at least five million dollars ($5,000,000.00).
- ❑ Show that the City of Saint John, the Contractor and Sub-Contractors, the Engineer and the Architect, are added as Additional Insured with respect to the operations of the Contractor.
- ❑ Confirm coverage for bodily injury and property damage and set forth the amount.
- ❑ Confirm that there is coverage for Contractual Liability with respect to this Contract.
- ❑ Confirm that the policy contains a cross liability clause.
- ❑ Confirm that there is Contingent Employer's Liability Coverage.
- ❑ Confirm that there is coverage for Broad Form Property Damage.
- ❑ Confirm that there is Completed Operations coverage with respect to this contract and that such coverage shall continue to be in force for the duration of the guarantee period (maintenance period) which is a period of twelve (12) months from the date of issuance of the Certificate of Final Completion.
- ❑ Confirm that there is coverage for Non-Owned Automobiles or licensed vehicles.
- ❑ Confirm that there is coverage for Owned Automobiles or licensed vehicles.
- ❑ Confirm that the indicated policies will not be cancelled, substantially amended, or allowed to lapse without the City first being given a thirty (30) day written notice.