NRC·CNRC Real Property Planning and Management

SPECIFICATIONS

SOLICITATION #: 22-58045

BUILDING: M-7,
1200 Montreal Road,
Ottawa, Ontario

PROJECT: M7 Chiller and Heat Pump Replacement

PROJECT #: 5988

Date: August 2022

National Research Council Canada | Conseil national de recherches Canada

Canada

SPECIFICATION

TABLE OF CONTENTS

Construction Tender Form

Project Identification M7 Chiller and Heat Pump Replacement

Tender No.: **22-58045**

1.2 Business Name and Address of Tenderer

Name_____

Address_____

_____

Contact Person(Print Name)_____

Telephone (_____) _____ **Fax**: (_____) _____

1.3 Offer

I/We the Tenderer, hereby offer to Her Majesty the Queen in Right of Canada (hereinafter referred to as "Her Majesty") represented by the National Research Council Canada to perform and complete the work for the above named project in accordance with the Plans and Specifications and other Tender Documents, at the place and in the manner set out therein for the Total Tender Amount (to be expressed in numbers only) of**: $_____. _____ in lawful money of Canada (excluding GST/HST)**

The above amount is inclusive of all applicable (*) Federal, Provincial and Municipal taxes except that in the event of a change in any tax imposed under the Excise Act, the Excise Tax Act, the Old Age Security Act, the Customs Act, the Customs Tariff or any provincial sales tax legislation imposing a retail sales tax on the purchase of tangible personal property incorporated into Real Property, that occurs

.1 after the date this tender was mailed or delivered, or
.2 if this tender is revised, after the date of the last revision

the amount of this offer shall be decreased or decreased in the manner provided for in GC22 of the General Conditions of the Contract Documents.

1.3.1 Offer (continued)

(*) For the purpose of this tender, the Goods and Services Tax (GST) is not to be considered as an applicable tax.

In the province of Quebec, the Quebec Sales Tax is not to be included in the tender amount because the Federal Government is exempt from this tax. Tenderers shall make arrangements directly with the provincial Revenue Department to recover any tax they may pay on good and servives acquired in the performance of this contract. However, tenderers should include in their tender amount Quebec Sales Tax for which an Input Tax Refund is not available.

1.4 Acceptance and Entry into Contract

I/We undertake, within fourteen (14) days of notification of acceptance of my/our offer, to sign a contract for the performance of the work provided I/we are notified, by the Department, of the acceptance of my/our offer within 30 days of the tender closing date.

1.5 Construction Time

I/We Agree to complete the work within the time stipulated in the specification from the date of notification of acceptance of my/our offer.

1.6 Bid Security

I/We herewith enclose tender security in accordance with Article 5 of the General Instruction to Tenderers.

I/We understand that if a security deposit is furnished as tender security and if I/we refuse to enter into a contract when called upon to do so, my/our security deposit shall be forfeited but the Minister may, if it is in the public interest, waive the right of Her Majesty to forfeit the security deposit.

I/We understand that if the security furnished is not in the approved from as described in Article 5 of the General Instructions to Tenderers, my/our tender is subject to disqualification.

1.7 Contract Security

Within fourteen (14) days after receipt of written notification of the acceptance of my/our offer, I/we will furnish contract security in accordance with the Contract Conditions "F" of the Contract Documents.

I/We understand that the contract security referred to herein, if provided in the form of a bill of exchange, will be deposited into the Consolidated Revenue Fund of Canada.

1.8 Appendices

This Tender Form includes Appendix No. _____N/A_____.

1.9 Addenda

The Total Tender Amount provides for the Work described in the following Addenda:

NUMBER	DATE	NUMBER	DATE

(Tenderers shall enter numbers and dates of addenda)

1.10 Execution of Tender

The Tenderer shall refer to Article 2 of the General Instructions to Tenderers.

SIGNED, ATTESTED TO AND DELIVERED on the _____day of _____on behalf of

_____

(Type or print the business name of the Tenderer)

AUTHORIZED SIGNATORY (IES)

_____

(Signature of Signatory)

_____

(Print name & Title of Signatory)

_____

(Signature of Signatory)

_____

(Print name & Title of Signatory)

SEAL

BUY AND SELL NOTICE

M7 Chiller and Heat Pump Replacement

You are invited to submit **one** electronic Technical Proposal and **one** electronic Tender Form in two separate attachments to fulfil the following requirement forming part of this Request for Proposal. One attachment **must** be clearly marked 'Technical Proposal' and the other attachment **must** be marked 'Tender Form'. All financial information **must** be fully contained in the Tender Form, and only in the Tender Form. Vendors who provide financial information in the technical proposal will be disqualified. **All proposals should include the front page of this RFP duly completed.**

The National Research Council Canada, 1200 Montreal Road Ottawa, has a requirement for a project that includes:

Work under this contract covers chiller and heat pump replacements of Building M07 located on the Montreal Road Campus of the National Research Council of Canada

1. Selection Criteria

Potential bidders will be rated in a combination of technical score and price rating. For this project the total score will be established as follows:

Technical rating 40%	=	Technical Score (Points)
Price rating 60%	=	Price Score (Points)
Total Score	=	Max. 100 points

1.1 Requirement for proposal format

The following proposal format information should be implemented when preparing the proposal:

- You are invited to submit the Technical Proposal and Financial Proposal into one (1) email with two attachments clearly identified, all financial information must be fully contained in the Financial Proposal, and only in the Financial Proposal.
- Paper size should be - 216mm x 279mm (8.5" x 11");
- Minimum font size - 11 point Times or equal;
- Minimum margins - 12 mm left, right, top, and bottom;
- One (1) 'page' means one side of a 216mm x 279mm (8.5" x 11") sheet of paper;
- 279mm x 432 mm (11" x 17") fold-out sheets (i.e. for spreadsheets and organization charts) will be counted as two pages;

1.2 Specific requirement for the proposal

The maximum number of pages (including text and graphics) to be submitted for the Rated Requirements is Thirty (30) pages.

The following are not part of the page limitation mentioned above:

- Covering letter;

- Cover Page;
- Tab/Dividers, provided they are free of text and/or graphics
- Front page of the RFP;
- Front page of revision(s) to the RFP;
- Price Proposal Form
- *Mandatory Requirements* & *Evaluated Technical Criteria* tables

Consequence of non-compliance: any pages which extend beyond the above page limitation and any other attachments will be extracted from the proposal and will not be forwarded to the NRC Evaluation Board for evaluation.

When submitting the technical proposal start by demonstrating the mandatory criteria before presenting the evaluated technical criteria.

1.3 Mandatory requirements

Failure to meet the mandatory requirement will render the proposal as non-responsive and no further evaluation will be carried out.

Item	Mandatory Requirements	Proposal Page #(s)
1	The Proponent must have a minimum of ten (10) years' experience in the execution of mechanical projects, and as a contractor providing construction services comparable to this tender. Provide a company profile and relevant history as described in item #1 of the evaluated technical criteria.	
2	The Proponent must supply a CV for the proposed Construction Site Supervisor and Project Manager.	
3	Contractor to demonstrate to be a member of MCAC or any recognized mechanical contractors association in Ontario.	

Include this table with your proposal and indicate the proposal page where the information can be found.

Any Proposal which fails to meet any of the following mandatory requirements will be considered non-compliant and will not be given further consideration. Each requirement should be addressed separately.

1.4 Evaluated Technical Criteria

Item	Evaluated Technical Criteria	Proposal Page # (s)	Max Score
1	Demonstrated experience by the Proponent providing general mechanical construction services relevant to this project. Include 2 comparable projects completed by the proponents firm in the last 10 years with reference names & phone numbers. Maximum 1 page per project. Evaluations will take into account relevance compared to the scope of this tender (up to 3 points for each example project) and whether the reference was satisfied with the work completed (up to 1 point for each example project). It is the responsibility of the bidder to ensure the contact information for the reference is accurate. If the reference cannot be reached or declines to provide input the proponent will received a score of 0/1 for that example.		8
2	Qualifications and overall experience of proposed Construction Site Supervisor and Project Manager. CV will be scored on the basis of related experience (up to 2 points), experience acting as a Construction Site Supervisor on federal government construction projects (up to 2 points) and Project Manager (up to 3 points). Include detailed examples of 2 past projects including reference contacts that can confirm the individual was the Construction Site Supervisor for at least 80% of the duration of those projects. If the reference cannot be reached or declines to provide input the proponent will received a score of 0/1 for that example. CV should be no longer than 3 pages.		7
4	The Proponent should provide their construction schedule for this project, from award to final completion, detailing major milestones, critical path elements, and associated timelines. Schedule evaluation will be based on whether it meets the completion date noted in the tender documents (up to 2 point), and if the tasks and associated timelines demonstrate the contractor understands the scope of work (up to 3 points).		5
	Total		20

Include this table with your proposal and indicate the proposal page where the information can be found.

2. EVALUATION AND RATING

Financial proposals will remain unopened and only the technical components of the proposals considered responsive will be reviewed, evaluated and rated by a NRC Evaluation Board in accordance with the criteria listed in the evaluated technical criteria table.

No further consideration will be given to proponents not achieving the pass mark of 14 out of 20 (70%). The successful Bidder shall be the one who accumulates the highest combined score of the technical assessment (40%) and tendered amount (60%), as shown below:

TABLE A	Bidder #1	Bidder #2	Bidder #3
Technical score	18 out of 25	20 out of 25	23 out of 25
Tendered amount	$190,000	$200,000	$210,000

For information only:

	Technical score (40%)	Tendered amount score (60%)	Final score
Bidder #1	18/25 X 40(%) = 28.8	190 k X 60(%) = 60 190 k	= 88.8
Bidder #2	20/25 X 40(%) = 32	190 k X 60(%) = 57 200 k	= 89
Bidder #3	23/25 X 40(%) = 36.8	190 k X 60(%) = 54.3 210 k	= 91.1 (successful bid)

1. GENERAL

Questions regarding any aspect of the project are to be addressed to and answered only by the Departmental Representative (or his designate) or the Contracting Authority.

Any information received other than from the Departmental Representative (or his designate) or the Contracting Authority will be disregarded when awarding the contract and during construction.

Firms intending to submit tenders on this project should obtain tender documents through the Buyandsell.gc.ca TMA services provider. Addenda, when issued, will be available from the Buyandsell.gc.ca TMA service provider. Firms that elect to base their bids on tender documents obtained from other sources do so at their own risk and will be solely responsible to inform the tender calling authority of their intention to bid. Tender packages are not available for distribution on the actual day of tender closing.

2. MANDATORY SITE VISIT

It is mandatory that the bidder attends one of the site visits at the designated date and time. At least one representative from proponents that intend to bid must attend.

The site visits will be held on September 20th and September 21st 2022 at **9:00**. Meet Allan Mackenzie at Building M-7, Main Entrance, 1200 Montreal Road, Ottawa, ON. Bidders who, for any reason, cannot attend at the specified date and time will not be given an alternative appointment to view the site and their tenders, therefore, will be considered as non-responsive. **NO EXCEPTIONS WILL BE MADE.**

As proof of attendance, at the site visit, the Contracting Authority will have an Attendance Form which MUST be signed by the bidder's representative. It is the responsibility of all bidders to ensure

they have signed the Mandatory Site Visit Attendance form prior to leaving the site. Proposals submitted by bidders who have not attended the site visit or failed to sign the Attendance Form will be deemed non-responsive.

3. CLOSING DATE

Closing date is October 4th, 2022, 14:00

4. TENDER RESULTS

Following the Tender closing, the tender results will be sent by email to all Contractors who submitted a tender.

5. SECURITY REQUIREMENT FOR CANADIAN CONTRACTORS

5.1 MANDATORY SECURITY REQUIREMENT:

This procurement contains a mandatory security requirement as follows:

1. The Contractor must, at all times during the performance of the Contract, hold a valid Designated Organization Screening (DOS), issued by the Canadian Industrial Security Director (CISD), Public Works Government Services Canada.

2. The Contractor personnel requiring access to sensitive work site(s) must EACH hold a valid RELIABILITY STATUS, granted or approved by CISD/PWGSC.

3. The Contractor must comply with the provisions of the:
    a. Security Requirements Checklist attached at Appendix "D"
    b. Industrial Security Manual (Latest Edition) available at: https://www.tpsgc-pwgsc.gc.ca/esc-src/msi-ism/index-eng.html

5.2 VERIFICATION OF SECURITY CLEARANCE AT BID CLOSING

1. The Bidder must hold a valid Designated Organization Screening (DOS) issued by the Canadian Industrial Security Directorate (CISD), Public Works and Government Services Canada (PWGSC), TO BE INCLUDED WITH THEIR TENDER OR PROVIDED WITHIN 48 HOURS FROM THE DATE AND TIME OF TENDER CLOSING. Verifications will be made through CISD to confirm the security clearance status of the Bidder. Failure to comply with this requirement will render the bid non-compliant and no further consideration will be given to the bid.

2. Within 72 hours of tender closing, the General Contractor must name all of his sub-contractors, each of whom must hold a valid RELIABILITY STATUS, granted or approved by CISD/PWGSC, or any other Federal Department or Agency along with the names and birthdates or security clearance certificate numbers of all personnel who will be assigned to the project.

3. It is to be noted that any subcontractor required to perform any part of the work during the performance of the subsequent contract must also adhere to the mandatory security requirement of the contract. As well, no personnel without the required level of security will be allowed on site. It will be the responsibility of the successful bidder to ensure that the security requirement is met throughout the performance of the contract. The Crown will not be held liable or accountable for any delays or additional costs associated with the contractor's non-compliance to the mandatory security requirement. Failure to comply with the mandatory security requirement will be grounds for being declared in default of contract.

4. For any enquiries concerning the project security requirement during the bidding period, the Bidder/Tenderer must contact the Security Officer @ 613-993-8956.

6. WSIB (WORKPLACE SAFETY AND INSURANCE BOARD)

All Bidders must provide a valid WSIB certificate with their Tender or prior to contract award.

7. OFFICE OF THE PROCUREMENT OMBUDSMAN

1. Clause for solicitation documents and regret letters for unsuccessful bidders

   The Office of the Procurement Ombudsman (OPO) was established by the Government of Canada to provide an independent venue for Canadian bidders to raise complaints regarding the award of federal contracts under $25,300 for goods and under $101,100 for services. Should you have any issues or concerns regarding the award of a federal contract below these dollar amounts, contact OPO by e-mail at boa.opo@boa-opo.gc.ca, by telephone at 1-866-734-5169, or by web at www.opo-boa.gc.ca. For more information about OPO, including the available services, please visit the OPO website.

2. Contract Administration

   The parties understand that the Procurement Ombudsman appointed pursuant to Subsection 22.1 (1) of the Department of Public Works and Government Services Act will review a complaint filed by the complainant respecting the administration of the Contract if the requirements of Subsection 22.2(1) of the Department of Public Works and Government Services Act and Sections 15 and 16 of the Procurement Ombudsman Regulations have been met.

   To file a complaint, the Office of the Procurement Ombudsmai1 may be contacted by e-mail at boa.opo@boa-opo.gc.ca, by telephone at 1-866-734-5169, or by web at www.opo-boa.gc.ca.

3. Dispute Resolution

   The Parties agree to make every reasonable eff01i, in good faith, to settle amicably all disputes or claims relating to or arising from the Contract, through negotiations between the Parties' representatives authorized to settle. If the Parties do not reach a settlement within 10 working days, each party hereby consents to fully participate in ai1d bear the cost of mediation led by the Procurement Ombudsman pt1rsuai1t to Subsection 22.1(3)(d) of the Department of Public Work and Government Services Act and Section 23 of the Procurement Ombudsman Regulations.

   The Office of the Procurement Ombudsman may be contacted by telephone at 1-866-734-5169, by e-mail at boa.opo@boa-opo.gc.ca, or by web at www.opo-boa.gc.ca.

The Departmental Representative or his designate for this project is: Allan Mackenzie
Allan.Mackenzie@nrc-cnrc.gc.ca
Telephone: (613) 229-1095

Contracting Authority for this project is: Collin Long
Collin.Long@nrc-cnrc.gc.ca

INSTRUCTIONS TO BIDDERS

Article 1 – Receipt of Tender

1a) Tender must be received **by email only** not later than the specified tender closing time. Electronic bids received after the indicated closing time - NRC servers received time - will be irrevocably rejected. Bidders are urged to send their proposal sufficient time in advance of the closing time to prevent any technical issues. NRC will not be held responsible for bids sent before closing time but received by the NRC servers after the closing time. Tenders received after this time are invalid and shall not be considered, regardless of any reason for their late arrival.

1b) A letter of printed telecommunication from a bidder quoting a price shall not be considered as a valid tender unless a formal tender has been received on the prescribed Tender Form.

1c) Bidders may amend their tenders by **email only** provided that such amendments are received not later than the specified tender closing time.

1d) Any amendments to the tender which are transmitted by **email only** must be signed and must clearly identify the tenderer.

All such amendments are to be addressed to:
National Research Council of Canada
Collin Long, Senior Contracting Officer

Collin.Long@nrc-cnrc.gc.ca

Article 2 – Tender Form & Qualifications

1) All tenders must be submitted on the Construction Tender Form and the tender must be signed in compliance with the following requirements:

a) Limited Company: The full names of the Company and the name(s) and status of the authorized signing officer(s) must be printed in the space provided for that purpose. The signature(s) of the authorized officer(s) and the corporate seal must be affixed.

b) Partnership: The firm name and the name(s) of the person(s) signing must be printed in the space provided. One or more of the partners must sign in the presence of a witness who must also sign. An adhesive colored seal must be affixed beside each signature.

c) Sole Proprietorship: The business name and the name of the sole proprietor must be printed in the space provided. The sole proprietor must sign in the presence of a witness who must also sign. An adhesive coloured seal must be affixed beside each signature.

2) Any alterations in the printed part of the Construction Tender Form or failure to provide the information requested therein, may render the tender invalid.

3) All space in the Construction Tender Form must be completed and any handwritten or typewritten corrections to the parts so completed must be initialed immediately to the side of the corrections by the person or persons executing the tender on behalf of the tenderer.

4) Tenders must be based on the plans, specifications and tender documents provided.

5) A proposal submitted by a bidder who's Board of Directors or proprietor (s) are in majority the same as a former vendor who has declared bankruptcy while performing work for NRC over the last 7-years from the date of issuance of this RFP may be rejected and not eligible for award at NRC's sole discretion. In such case, NRC will advise the ineligible proponent(s).

6) A proposal submitted by a bidder who has had a previous contracts cancelled by NRC due to lack of performance within 3 years from the issuance date of this RFP may be rejected and not eligible for award at NRC's sole discretion. In such case, NRC will advise the ineligible proponent (s).

7) If there is discrepancy between the English version and the French version of this document and any of the attachments and amendments, the English version will takes precedence.

Article 3 - Contract

1) The Contractor will be required to sign a contract similar to the Standard Contract Form for Fixed Price Construction Contracts, a blank specimen of which is enclosed in the package for reference purposes.

Article 4 – Tender Destination

1a) Tenders are to be submitted **by email only**:
National Research Council Canada

Collin.Long@nrc-cnrc.gc.ca

Endorsed "Tender for (insert title of work as it appears in the drawings and specifications)" and must bear the name and address of the tenderer.

1b) Unless otherwise specified, the only documents required to be submitted with the tender are the Tender form, Technical Proposal and the Bid Security.

Article 5 - Security

1a) Bid Security is required and must be submitted in one of the following forms:

i) bonds of the Government of Canada, or bonds unconditionally guaranteed as to principal and interest by the Government of Canada; **OR**

ii) a bid bond.

1b) Regardless of the Bid Security submitted, it should never be more than $250,000 maximum, calculated at 10% of the first $250,000 of the tendered price, plus 5% of any amount in excess of $250,000.

1c) Bid Security shall accompany each tender or, if forwarded separately from the tender, shall be provided not later than the specified tender closing time. Bid bond or E-bond Security must be in the ORIGINAL form. PDF via email is acceptable. FAILURE TO PROVIDE THE REQUIRED BID SECURITY SHALL INVALIDATE THE TENDER.

1d) The successful tenderer is required to provide security within 14 days of receiving notice of tender acceptance. The tenderer must furnish EITHER:

i) a Security Deposit as described in 1(b) above together with a Labour and Material Payment Bond in the amount of at least 50% of the amout payable under the contract, OR
ii) a Performance Bond and a Labour and Material Payment Bond – each in the amount of 50% of the amount payable under the contract.

1e) Bonds must be in an approved form and from the companies whose

bonds are acceptable to the Government of Canada. Samples of the approved form of Bid Bond, Performance Bond and Labour and Material Payment Bond and a list of acceptable Bonding Companies may be obtained from the Contracting Officer, National Research Council, Building M-58, Montreal Road, Ottawa, Ontario, K1A 0R6.

Article 7 – Sales Tax

1) The amount of the tender shall include all taxes as levied under the Excise Act, the Excise Tax Act, the Old Age Security Act, the Customs Act or the Customs Tariff, in force or applicable at the time.

1) In Quebec, the Provincial Sales Tax should not be included in the Tender Price as the Federal Government is exempt. Tenderers should contact the Provincial Revenue Minister to recover all taxes paid for goods and services rendered under this contract.

Tenderers must include in their Tender Price the amount of Provincial Sales Tax for which the exemption does not apply.

Article 8 – Examination of Site

1) All parties tendering shall examine the sites of the proposed work before sending in their tender and make themselves thoroughly acquainted with the same and obtain for themselves any and all information that may be necessary for the proper carrying out of the Contract. No after claim will be allowed or entertained for any work or material that may be requisite and necessary for the proper execution and completion of this Contract with the exception of that provided for under GC 35 in the General Conditions of the General Specification.

Article 9 – Discrepancies, Omissions, Etc.

1a) Bidders finding discrepancies in, or omissions from, drawings, specifications or other documents, or having any doubt as to the meaning or intent of any part thereof, should at once notify the Engineer who will send written instructions or explanation to all bidders.
1b) Neither the Engineer nor the Council will be responsible for oral instructions.

1c) Addenda or corrections issued during the time of the bidding shall be covered in the proposal. However, the contract supersedes all communications, negotiations and agreements, either written or oral, relating to the work and made prior to the date of the contract.

Article 10 – No additional Payments for Increased Costs

1) The only other adjustments in the contract price allowed are those specified in the General Conditions of the General Specification. The contract price will not be amended for change in freight rates, exchange rates, wage rates or cost of materials, plant or services.

Article 11 – Awards

1a) The Council reserves the power and right to reject tenders received from parties who cannot show a reasonable acquaintance with and preparation for the proper performance of the class of work herein specified and shown on plans. Evidence of such competence must be furnished by the tenderers if required to do so.

1b) A tenderer may be required to furnish to the Contracting Office, National Research Council of Canada, Building M-58, 1200 Montreal Road, Ottawa, Ontario, K1A 0R6, Canada, unsigned copies of the insurance requirements as covered by the Insurance Conditions of the General Specification.

1c) The Council does not bind itself to accept the lowest or any tender.

Article 12 – Harmonized Sales Tax

1) The Harmonized Sales Tax (HST) which in now in effect shall be considered an applicable tax for the purpose of this tender. However, the bidder shall NOT include any amount in the bid price for said HST. The successful contractor will indicate on each application for payment as a separate amount the appropriate HST the Owner is legally obliged to pay. This amount will be paid to the Contractor in addition to the amount certified for payment under the Contract in addition to the amount certified for payment under the Contract and will therefore not affect the Contract Price. The Contractor agrees to remit any HST collected or due to Revenue Canada.

Non-resident contractors

RST guide 804
Published August 2006
ISBN: 1-4249-2007-8 (Print), **1-4249-2009-4 (PDF), 1-4249-2008-6 (HTML)**

Publication Archived

Notice to the reader: For Retail Sales Tax (RST) – On July 1, 2010 the 13 per cent Harmonized Sales Tax (HST) took effect in Ontario replacing the existing provincial Retail Sales Tax (RST) and combining it with the federal Goods and Services Tax (GST). As a result, RST provisions described on this page and in other publications ended on June 30, 2010.

Effective July 1, 2010 this publication was archived for RST purposes **only**. Use caution when you refer to it, since it reflects the law in force for RST at the time it was released and may no longer apply.

- The information in this Guide explains the Retail Sales Tax (RST) responsibilities of a non-resident contractor who is awarded a construction contract to perform work in Ontario and their Ontario customers. Please note that this Guide replaces the previous version dated March 2001.

Non-Resident Contractor Defined

A non-resident contractor is a contractor located outside Ontario who has been awarded a construction contract to perform work in Ontario, and who has not maintained a permanent place of business in Ontario continuously for twelve months immediately prior to signing the contract, or which is not a company incorporated under the laws of Ontario. A construction contract is a contract for the erection, remodelling or repair of a building or other structure on land.
A contractor is a person who is in the business of constructing, altering, repairing or improving real property and includes, but is not limited to,

1. a general contractor and subcontractor,
2. a carpenter, bricklayer, stonemason, electrician, plasterer, plumber, painter, decorator, paver, and bridge builder,
3. a sheet metal, tile and terrazzo, heating, air conditioning, insulation, ventilating, papering, road, roofing and cement contractor, who installs or incorporates items into real property. (See RST Guide 206 - Real Property and Fixtures).

Registration and Guarantee Deposit

Non-resident contractors who are awarded a construction contract in Ontario are required to register with the Ministry of Finance (ministry), Centralized Programs Unit and post a guarantee equal to 4 per cent of the total of each Ontario contract. The guarantee can be paid in cash, by certified cheque (payable to the Minister of Finance), letter of credit or by a guarantee bond.

To register with the ministry and to obtain further information on posting a guarantee, contractors should contact the ministry's Centralized Programs Unit, 33 King Street West, PO Box 623, Oshawa, Ontario, L1H 8H7, toll-free 1 866 ONT-TAXS (1 866 668-8297) or fax to 905 435-3617.

Non-resident contractors who sell taxable goods on a supply only basis to Ontario customers, or provide taxable services in Ontario, may obtain a regular Vendor Permit to collect and remit RST on their sales. Non-resident contractors who have been issued a regular Vendor Permit must still register separately with the ministry and post a guarantee if they are awarded a construction contract in Ontario.

Letter of Compliance

After receiving the guarantee, the ministry mails out two copies of a "letter of compliance" to the contractor certifying the Retail Sales Tax (RST) requirements have been met. Contractors must give a copy of the letter to their customers.

If a copy of the compliance letter is not provided, the customer must withhold 4 per cent of all amounts payable to the non resident contractor and pay the withheld amounts to the Minister of Finance (minister). Details relating to the contract should be sent along with the payments to the Centralized Programs Unit. Customers may give the minister a guarantee bond equal to 4 per cent of the total contract price instead of making the 4 per cent payments.

Note: Customers who do not follow these requirements may be held liable for 4 per cent of all amounts payable to the non resident contractor or any other amount that the Ministry deems to be the RST payable resulting from the performance of the contract.

Calculation of RST

Fair Value

RST is payable on the "fair value" of materials, purchased or brought into Ontario, to be used for work performed in Ontario. "Fair value" includes:

- the purchase price in Canadian funds;
- all charges by the supplier for handling and delivery, and
- any federal customs duties and excise taxes paid (but not the federal Goods and Services Tax (GST)).

Contractors are also required to pay RST to Ontario suppliers on the purchase, rental or lease of taxable services, materials, machinery, or equipment.

Machinery and Equipment - Leased

If machinery or equipment is leased from a supplier outside Ontario and brought into the province, RST is payable on the lease payments for the period the machinery or equipment is in Ontario.

Machinery and Equipment - Owned by Contractor

If machinery or equipment is owned by the contractor, RST may be calculated in one of the following ways:

a. If a contractor brings machinery and equipment into Ontario for less than 12 months' use, RST is to be calculated using the following formula:

   1/36 × net book value at date of import × number of months in Ontario × tax rate

   For the purpose of this formula, RST is payable for each month or part of a month that the goods are in Ontario. A month is considered 31 consecutive days and a part month is considered more than 12 days. The RST payable is based on the number of days the machinery and equipment are located in Ontario and not the number of days the items are actually used.

Example: Equipment is brought into Ontario on March 28 and taken out on May 8. The items were in the province for 41 days. RST is payable on the first 31 days' temporary stay in Ontario vs. use of the equipment. Since the remainder (10 days) is not considered part of a month, no RST is payable on this portion.

b. If, at the time the goods are brought into Ontario, it is expected that the machinery or equipment will be in Ontario for more than twelve months, contractors must pay Retail Sales Tax (RST) on the following basis:

   net book value at date of import × tax rate

   If, at the time of import, the length of time is not known, vendors may use the formula under (a). If they later find it necessary to keep the machinery and equipment in Ontario for more than 12 months, the RST paid under (a) may be deducted from the RST payable under (b).

Using formula (a) or (b) above, contractors will calculate and remit the RST payable on the return that is filed when the contract is finished.

(See Completion of Contract section)

Manufacturing for Own Use

Contractors may need to manufacture items, such as doors and windows, for their construction contracts. Manufacturing is work done in a factory away from a construction site, or in a mobile unit or workshop that is on or near the construction site. Manufacturing occurs when raw materials are changed into manufactured goods for use in real property contracts.

Contractors are considered to be manufacturing contractors if they produce goods:
1. for their own use in real property contracts, and
2. the manufactured cost of the goods is more than $50,000 a year.

(See RST Guide 401 - Manufacturing Contractors)

Contracts with the Federal Government

Where a non-resident contractor enters into a construction contract with the federal government, for the construction of a building and/or the installation of equipment, the nature of the equipment will determine whether the contract should be let on a tax-included or tax excluded basis.

Contracts for the construction of a building and the installation of equipment that directly services that building (i.e., elevators, escalators, light fixtures, central heating and air conditioning, etc.) should be tendered on a tax -included basis. Contractors are the consumers of the materials used in fulfilling these contracts and must pay or account for RST on the materials used to complete the contracts. There is NO exemption just because the contract is with the federal government.

Contracts for the installation of equipment that becomes a fixture and does not directly service a building (i.e., material handling equipment, production machinery, communication equipment, training equipment) may be tendered on a tax-excluded basis. Contractors engaged in contracts of this nature are permitted to make tax exempt purchases of such equipment by issuing a valid Purchase Exemption Certificate (PEC) to their supplier. Only non-resident contractors who have registered with the ministry and posted a guarantee may issue a PEC.

Exemptions

Contractors may supply and install equipment or materials for certain customers that may be entitled to an exemption from RST (e.g., manufacturers, Indian band councils, farmers and diplomatic organizations). The equipment or materials, when installed, becomes real property if it is permanently attached to land, or a fixture if it is permanently attached to a building or real property structure. Since

contractors are liable for RST, they should contact the ministry to find out if the customer qualifies for exemption before tendering the contract on a tax-excluded basis.

Status Indians, Indian Bands and Band Councils

Non-resident contractors may purchase building materials exempt from Retail Sales Tax (RST) for certain buildings and structures situated on reserves. The cost of such projects must be paid by the band council, and the buildings must provide a community service for the reserve. Contracts for the construction of an exempt community building project should be made on an RST-excluded basis. Non-resident contractors may purchase the materials exempt from RST by providing suppliers with a valid Purchase Exemption Certificate (PEC). As noted previously, only non-resident contractors who have registered with the ministry and posted a guarantee may issue a PEC. (See RST Guide 204 - Purchase Exemption Certificates).

Non-resident contractors must pay RST on items purchased for incorporation into a building or structure built for individual status Indians on a reserve. (See RST Guide 808 - Status Indians, Indian Bands and Band Councils).

Completion of Contract

When a contract is completed, non-resident contractors who were required to post a guarantee must complete a Non-Resident Contractor Retail Sales Tax Return [PDF - 92 KB] that is provided by the ministry.

If a contractor's guarantee was given in cash or by certified cheque, the amount of the deposit can be deducted from the RST liability owed by the contractor. If the liability is greater than the deposit, the amount remaining must be paid by the contractor. If the deposit is more than the liability, the contractor will receive a refund.

If a guarantee bond was posted instead of cash, the bond will be discharged once the RST liability is paid in full.

All returns are subject to audit.

Legislative References

- Retail Sales Tax Act, Subsections 19(2) and 39(3)(4) and (5)
- Regulation 1012 under the Act, Subsections 15.3(1)(2)(5)(6) and (7)
- Regulation 1013 under the Act, Sections 1 and 3

For More Information

The information contained in this publication is only a guideline. For more information, please contact the Ontario Ministry of Finance at 1 866 ONT-TAXS (1 866 668-8297) or visit our website at ontario.ca/finance.

Acceptable Bonding Companies

Published September 2010

The following is a list of insurance companies whose bonds may be accepted as security by the government.

1. Canadian Companies

- ACE INA Insurance
- Allstate Insurance Company of Canada
- Ascentus Insurance Ltd. (Surety only)
- Aviva Insurance Company of Canada
- AXA Insurance (Canada)
- AXA Pacific Insurance Company
- Canadian Northern Shield Insurance Company
- Certas Direct Insurance Company (Surety only)
- Chartis Insurance Company of Canada (formerly AIG Commercial Insurance Company of Canada)
- Chubb Insurance Company of Canada
- Commonwealth Insurance Company
- Co-operators General Insurance Company
- CUMIS General Insurance Company
- The Dominion of Canada General Insurance Company
- Echelon General Insurance Company (Surety only)
- Economical Mutual Insurance Company
- Elite Insurance Company
- Everest Insurance Company of Canada
- Federated Insurance Company of Canada
- Federation Insurance Company of Canada
- Gore Mutual Insurance Company
- Grain Insurance and Guarantee Company
- The Guarantee Company of North America
- Industrial Alliance Pacific General Insurance Corporation
- Intact Insurance Company
- Jevco Insurance Company (Surety only)
- Lombard General Insurance Company of Canada
- Lombard Insurance Company
- Markel Insurance Company of Canada
- The Missisquoi Insurance Company
- The Nordic Insurance Company of Canada
- The North Waterloo Farmers Mutual Insurance Company (Fidelity only)
- Novex Insurance Company (Fidelity only)
- The Personal Insurance Company
- Pilot Insurance Company
- Quebec Assurance Company
- Royal & Sun Alliance Insurance Company of Canada
- Saskatchewan Mutual Insurance Company
- Scottish & York Insurance Co. Limited
- The Sovereign General Insurance Company
- TD General Insurance Company
- Temple Insurance Company
- Traders General Insurance Company

- Travelers Guarantee Company of Canada
- Trisura Guarantee Insurance Company
- The Wawanesa Mutual Insurance Company
- Waterloo Insurance Company
- Western Assurance Company
- Western Surety Company

2. Provincial Companies

Surety bonds issued by the following companies may be accepted provided that the contract of suretyship was executed in a province in which the company is licensed to do business as indicated in brackets.

- AXA Boreal Insurance Company (P.E.I., N.B., Que., Ont., Man., B.C.)
- AXA Boreal Insurance Company (P.E.I., N.B., Que., Ont., Man., B.C.)
- ALPHA, Compagnie d'Assurances Inc. (Que.)
- Canada West Insurance Company (Ont., Man., Sask, Alta., B.C., N.W.T.) (Surety only)
- The Canadian Union Assurance Company (Que.)
- La Capitale General Insurance Inc. (Nfld. & Lab., N.S., P.E.I., Que.(Surety only), Man., Sask., Alta., B.C., Nun., N.W.T., Yuk.)
- Coachman Insurance Company (Ont.)
- Continental Casualty Company (Nfld. & Lab., N.S., P.E.I., N.B., Que., Ont., Man., Sask., Alta., B.C., Nun., N.W.T., Yuk.)
- GCAN Insurance Company (Nfld. & Lab., N.S., P.E.I., N.B., Que., Ont., Man., Sask., Alta., B.C., Nun., N.W.T., Yuk.)
- The Insurance Company of Prince Edward Island (N.S., P.E.I., N.B.)
- Kingsway General Insurance Company (N.S., N.B., Que., Ont., Man., Sask., Alta., and B.C.)
- Liberty Mutual Insurance Company (Nfld. & Lab., N.S., P.E.I., N.B., Que., Ont., Man., Sask., Alta., B.C., Nun., N.W.T., Yuk.)
- Manitoba Public Insurance Corporation (Man.)
- Norgroupe Assurance Générales Inc.
- Orleans General Insurance Company (N.B., Que., Ont.)
- Saskatchewan Government Insurance Office (Sask.)
- SGI CANADA Insurance Services Ltd. (Ont., Man., Sask., Alta.)
- L'Unique General Insurance Inc. (Nfld. & Lab., N.S., P.E.I., N.B., Que.(Surety only), Ont.(Surety only), Man., Sask., Alta., B.C.(Surety only), Nun., N.W.T., Yuk.)

3. Foreign Companies

- Aspen Insurance UK Limited
- Compagnie Française d'Assurance pour le Commerce Extérieur (Fidelity only)
- Eagle Star Insurance Company Limited
- Ecclesiastical Insurance Office Public Limited Company (Fidelity only)
- Lloyd's Underwriters
- Mitsui Sumitomo Insurance Company, Limited
- NIPPONKOA Insurance Company, Limited
- Sompo Japan Insurance Inc.
- Tokio Marine & Nichido Fire Insurance Co., Ltd.
- XL Insurance Company Limited (Surety only)
- Zurich Insurance Company Ltd

Articles of Agreement

Standard Construction Contract – Articles of Agreement
(23/01/2002)

A1 Contract Documents

A2 Date of Completion of Work and Description of Work

A3 Contract Amount

A4 Contractor's Address

A5 Unit Price Table

Articles of Agreement

These Articles of Agreement made in duplicate this day of .

Between

Her Majesty the Queen, in right of Canada (referred to in the contract documents as " Her Majesty") represented by the National Research Council Canada (referred to in the contract documents as the "Council")

and

(referred to in the contract documents as the "Contractor")

Witness that in consideration for the mutual promises and obligations contained in the contract, Her Majesty and the Contractor covenant and agree as follows:

A1 Contract Documents

(23/01/2002)

1.1 Subject to A1.4 and A1.5, the documents forming the contract between Her Majesty and the Contractor, referred to herein as the contract documents, are

1.1.1 these Articles of Agreement,

1.1.2 the document attached hereto, marked "A" and entitled "Plans and Specifications", referred to herein as the Plans and Specifications,

1.1.3 the document attached hereto, marked "B" and entitled "Terms of Payment", referred to herein as the Terms of Payment,

1.1.4 the document attached hereto, marked "C" and entitled "General Conditions", referred to herein as the General Conditions,

1.1.5 the document attached hereto, marked "D" and entitled "Labour Conditions", referred to herein as the Labour Conditions,

1.1.6 the document attached hereto, marked "E" and entitled "Insurance Conditions", referred to herein as the Insurance Conditions,

1.1.7 the document attached hereto, marked "F" and entitled "Contract Security Conditions", referred to herein as the Contract Security Conditions, and

1.1.8 any amendment or variation of the contract documents that is made in accordance with the General Conditions.

1.1.9 the document entitled Fair Wage Schedules for Federal Construction Contracts referred to herein as Fair Wage Schedules

1.1.10

The Council hereby designates of
of the Government of Canada as the Engineer for the purposes of the contract, and for all purposes of or incidental to the contract, the Engineer's address shall be deemed to be:

1.2 **In the contract**

1.3.1 " Fixed Price Arrangement" means that part of the contract that prescribes a lump sum as payment for performance of the work to which it relates; and

1.3.2 " Unit Price Arrangement" means that part of the contract that prescribes the product of a price multiplied by a number of units of measurement of a class as payment for performance of the work to which it relates.

1.3 Any of the provisions of the contract that are expressly stipulated to be applicable only to a Unit Price Arrangement are not applicable to any part of the work to which a Fixed Price Arrangement is applicable.

1.4 Any of the provisions of the contract that are expressly stipulated to be applicable only to a Fixed Price Arrangement are not applicable to any part of the work to which a Unit Price Arrangement is applicable.

A2 Date of Completion of Work and Description of Work

(23/01/2002)

2.1 The contractor shall, between the date of these Articles of Agreement and the **,** , in the careful and workmanlike manner, diligently perform and complete the following work:

which work is more particularly described in the Plans and Specifications.

A3 Contract Amount

(23/01/2002)

3.1 Subject to any increase, decrease, deduction, reduction or set-off that may be made under the Contract, Her Majesty shall pay the Contractor at the times and in the manner that is set out or referred to in the Terms of Payment

3.1.1 the sum of (GST/HST extra), in consideration for the performance of the work or the part thereof that is subject to Fixed Price Arrangement, and

3.1.2 a sum that is equal to the aggregate of the products of the number of units of Measurement of each class of labour, plant and material that is set out in a Final Certificate of Measurement referred to in GC44.8 multiplied in each case by the appropriate unit price that is set out in the Unit Price Table in consideration for the performance of the work or the part thereof that is subject to a Unit Price Arrangement.

3.2 For the information and guidance of the Contractor and the persons administering the contract on behalf of Her Majesty, but not so as to constitute a warranty , representation or undertaking of any nature by either party, it is estimated that the total amount payable by Her Majesty to the Contractor for the part of the work to which a Unit Price Arrangement is applicable will be approximately $N/A

3.3 A3.1.1 is applicable only to a Fixed Price Arrangement.

3.4 A3.1.2 and A3.2 applicable only to a Unit Price Arrangement.

A4 Contractor's Address

(23/01/2002)

4.1 For all purposes of or incidental to the contract, the Contractor's address shall be deemed to be:

A5 Unit Price Table

(23/01/2002)

5.1 Her Majesty and the Contractor agree that the following table is the Unit Price Table for the purposes of the contract.

Column 1 Item	**Column 2** Class of Labour Plant Or Material	**Column 3** Unit of Measurement	**Column 4** Estimated Total Quantity	**Column 5** Price per Unit	**Column 6** Estimated Total Price
		N/A			

5.2 The Unit Price Table that is set out in A5.1 designates the part of the work to which a Unit Price Arrangement is applicable.

5.3 The part of the work that is not designated in the Unit Price Table referred to in A5.2 is the part of the work to which a Fixed Price Arrangement is applicable.

Articles of Agreement

Signed on behalf of Her Majesty by

_____

as Senior Contracting Officer

and_____

as_____

of the **National Research Council Canada**

on the_____

day of _____

Signed, sealed and delivered by

_____

as_____and
Position

by_____

as_____
Position **Seal**

of

on the_____

day of_____

PART 1 - GENERAL

1.1 NOT USED

.1 Not Used

Consultant for Building Code Review:

Building Code Identification Number (BCIN):

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 NOT USED

.1 Not used.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not used.

END OF SECTION

1. SCOPE OF WORK

.1 Work under this contract covers the Chiller and Heat Pump Replacements in the Council's Building M7 of the National Research Council.

2. DRAWINGS

.1 The following drawings illustrate the work and form part of the contract documents:

5988-M01

5988-M02

5988-M03

5988-M04

5988-M05

5988-M06

5988-E01

5988-E02

5988-E03

3. COMPLETION

.1 Complete all work within 46 week(s) after receipt of notification of acceptance of tender.

4. GENERAL

.1 The word "provide" in this Specification means to supply and install.

.2 Provide items mentioned in either the drawings or the specification.

5. SPECIFIED ACCEPTABLE & ALTERNATIVE EQUIPMENT & MATERIALS

.1 Materials and equipment scheduled and/or specified on the drawings or in the specifications have been selected to establish a performance and quality standard. In most cases, acceptable manufacturers are stated for any material or equipment specified by manufacturer's name and model number. Contractors may base their tender price on materials and equipment supplied by any of the manufacturers' names as acceptable for the particular material or equipment.

.2 In addition to the manufacturers specified or named as acceptable, you may propose alternative manufacturers of materials or equipment to the Departmental Representative for acceptance. For a product to be considered as an alternative product substitute, make a written application to the Departmental Representative during the tender period, not later than seven (7) working days before tender closing.

.3 Certify in writing that the alternative meets all requirements of the specified material or equipment. In addition, it shall be understood that all costs required by or as a result of acceptance or proposed alternatives, will be borne by the Contractor.

.4 Approval of alternatives will be signified by issue of an Addendum to the Tender Documents.

.5 Any alternative manufacturers or materials submitted which are incomplete and cannot be evaluated, or are later than seven (7) working days before tender closing date or after the tender period, will not be considered.

6. MINIMUM STANDARDS

.1 Conform to or exceed minimum acceptable standards of the various applicable federal, provincial and municipal codes such as The National Building Code, The National Fire Code, Canadian Plumbing Code, Canadian Electrical Code, Canadian Code for Construction Safety and the Provincial Construction Safety Act.

.2 Work to conform to referenced standards and codes as reaffirmed or revised to date of specification.

7. WORKPLACE HAZARDOUS MATERIAL INFORMATION SYSTEM (WHMIS)

.1 The General Contractor shall comply with Federal and Provincial legislation regarding the WHMIS. The Contractor's responsibilities include, but are not limited to the following:

.1 To ensure that any controlled product brought on site by the Contractor or sub-contractor is labeled;

.2 To make available to the workers and the Departmental Representative, Material Safety Data Sheets (MSDS) for these controlled products;

.3 To train own workers about WHMIS, and about the controlled products that they use on site;

.4 To inform other Contractors, sub-contractors, the Departmental Representative, authorized visitors and outside inspection agency personnel about the presence and use of such products on the site.

.5 The site foreman or superintendent must be able to demonstrate, to the satisfaction of the Departmental Representative, that he/she has had WHMIS training and is knowledgeable in its requirements. The Departmental Representative can require replacement of this person if this condition or implementation of WHMIS is not satisfactory

8. REQUIREMENTS OF BILL 208, SECTION 18(a)

.1 Under the requirements of Bill 208 of the Ontario Ministry of Labour Occupational Health & Safety Act, the following designated substances may be encountered while performing the work described in these contract documents:

.1 Acrylonitrile, Isocyanates, Arsenic, Lead, Asbestos, Mercury, Benzene, Silica, Coke Oven Emissions, Vinyl Chloride, and Ethylene Oxide

.1 It is the responsibility of the General Contractor to ensure that each prospective sub-contractor for this project has received a copy of the above list.

.2 Designated substance report to be provided to the contractor awarded the project.

9. COST BREAKDOWN

.1 Submit, for approval by the Departmental Representative, a cost breakdown of tender 72 hours after the contract is awarded.

.2 Use the approved cost breakdown as the basis for submitting all claims.

.3 Request Departmental Representative's verbal approval to amount of claim prior to preparing and submitting the claim in its final form.

.4 Contractor costs associated with compliance with occupational health and safety requirements (Canada Labour Code) related to the Coronavirus/COVID-19 pandemic must be included in the initial bid price. These costs may include, but are not limited to, the provision of additional personal protective equipment (PPE) and social distancing requirements as required to complete the project. Contractor must review and incorporate into initial bid pricing compliance with any Coronavirus/COVID-19 related health and safety guidance issued by the local Medical Officer of Health (applicable in the jurisdiction of the project), the Public Health Agency of Canada, Health Canada and/or the provincial Ministry of Health, as applicable.

10. SUB-TRADES

.1 Submit no later than 72 hours after tender closing, a complete list of sub trades for the Departmental Representative's review.

11. PERSONNEL SECURITY AND IDENTIFICATION

.1 All persons employed by the Contractor, or by any sub-contractor and present on the site must be security cleared in accordance with the requirements of the Section entitled Special Instructions to Tenderers.

.2 All such persons must wear and keep visible identification badges as issued by the Security Office of NRC.

12. WORKING HOURS AND SECURITY

.1 Normal working hours on the NRC property are from 8:00 a.m. until 4:30 p.m., Monday to Friday inclusive, except statutory holidays.

.2 At all other times, special written passes are required for access to the building site.

~~.3~~ Before scheduling any work outside normal working hours, obtain permission from the Departmental Representative to perform the specific tasks.

.4 An escort may be required whenever working outside normal hours. Contractor to bear the associated costs.

13. SCHEDULE

.1 The Contractor shall prepare a detailed schedule, fixing the date for commencement and completion of the various parts of the work and update the said schedule. Such schedule shall be made available to the Departmental Representative not later than two weeks after the award of the contract and prior to commencement of any work on site.

.2 Notify Departmental Representative in writing of any changes in the schedule.

.3 Seven (7) days before the scheduled completion date, arrange to do an interim inspection with the Departmental Representative.

14. PROJECT MEETINGS

.1 Hold regular project meetings at times and locations approved by the Departmental Representative.

.2 Notify all parties concerned of meetings to ensure proper coordination of work.

.3 Departmental Representative will set times for project meetings and assumes responsibility for recording and distributing minutes.

15. SHOP DRAWINGS

.1 Submit to Departmental Representative for review, shop drawings, product data and samples specified within 2 weeks after contract award.

.2 Submit to Departmental Representative for review a complete list of all shop drawings, product data and samples specified and written confirmation of corresponding delivery dates within one (1) week after shop drawings, product data and samples approval date. This list shall be updated on a one (1) week basis and any changes to the list shall be immediately notified in writing to the Departmental Representative.

.3 Review shop drawings, data sheets and samples prior to submission.

.4 Submit one (1) electronic copy of all shop drawings and product data and samples for review, unless otherwise specified.

.5 Review of shop drawings and product data by the Departmental Representative does not relieve the Contractor of the responsibility for errors and omissions and for the conformity with contract documents.

16. SAMPLES AND MOCK-UPS

.1 Submit samples in sizes and quantities as specified.

.2 Where colour, pattern or texture is criterion, submit full range of samples.

.3 Construct field samples and mock-ups at locations acceptable to Departmental Representative.

.4 Reviewed samples or mock-ups will become standards of workmanship and material against which installed work will be checked on the project.

17. MATERIALS AND WORKMANSHIP

.1 Install only new materials on this project unless specifically noted otherwise.

.2 Only first class workmanship will be accepted, not only with regard to safety, efficiency, durability, but also with regard to neatness of detail and performance.

18. WORK & MATERIALS SUPPLIED BY OWNER

.1 Work and materials not included in this contract are described on drawings and in this specification.

.2 Deliver to a storage place, as directed by the Departmental Representative, all materials returned to the Owner.

.3 Unless otherwise specified, accept owner-supplied materials at their storage location and provide all transportation as required.

.4 General Contractor's duties:

.1 Unload at site.
.2 Promptly inspect products and report damaged or defective items.
.3 Give written notification to the Departmental Representative for items accepted in good order.
.4 Handle at site, including uncrating and storage.
.5 Repair or replace items damaged on site.
.6 Install, connect finished products as specified.

19. SITE ACCESS

.1 Make prior arrangements with the Departmental Representative before starting work or moving materials and equipment on site.

.2 Obtain approval of Departmental Representative for regular means of access during the construction period.

.3 Obtain approval of Departmental Representative before temporarily suspending operations on site; before returning to the site and before leaving the site at the end of the job.

.4 Provide and maintain access to site.

.5 Build and maintain temporary roads and provide snow removal during period of work.

.6 Provide snow clearing and removal as required during the contract period.

.7 Make good any damage and clean up dirt, debris, etc., resulting from Contractor's use of existing roads.

20. USE OF SITE

.1 Restrict operations on the site to the areas approved by the Departmental Representative

.2 Locate all temporary structures, equipment, storage, etc., to the designated areas.

.3 Restrict parking to the designated areas.

21. ACCEPTANCE OF SITE

.1 Inspect the site before commencing work, review any unexpected conditions with the Departmental Representative.

.2 Commencement of work will imply acceptance of existing conditions.

22. SITE OFFICE & TELEPHONE

.1 Contractor to erect a temporary site office at his own expense.

.2 Install and maintain a telephone, if necessary.

.3 Use of NRC phones is not permitted unless in the case of an emergency.

23. SANITARY FACILITIES

.1 Obtain permission from the Departmental Representative to use the existing washroom facilities in the building or provide sanitary facilities, and bear all associated costs.

24. TEMPORARY SERVICES

.1 A source of temporary power will be made available in the area. Bear all costs to make connections to the power source and perform distribution on site.

.2 Provide all load centres, breakers, conduit, wiring, disconnects, extension cords, transformers, as required from the source of power.

.3 Power is to be used only for power tools, lighting, controls, motors, and not for space heating.

.4 A source of temporary water will be made available if required.

.5 Bear all costs associated with distributing the water to the required locations.

.6 Comply with NRC requirements when connecting to existing systems in accordance with the articles entitled "Co-operation" and "Service Interruptions" of this section.

25. DOCUMENTS REQUIRED AT WORK SITE

.1 The Contractor shall keep on the site, one (1) up-to-date copy of all contract documents, including specifications, drawings, addenda, shop drawings, change notices, schedule and any reports or bulletins pertaining to the work, in good order, available to the Departmental Representative and to his / her representatives at all times.

.2 At least one (1) copy of specifications and drawings shall be marked by the Contractor to show all work "As Built" and shall be provided to the Departmental Representative with the Application for Payment and for the Final Certificate of Completion.

26. CO-OPERATION

.1 Co-operate with NRC staff in order to keep disruption of normal research work to an absolute minimum.

.2 Work out in advance, a schedule for all work which might disrupt normal work in the building.

.3 Have schedule approved by the Departmental Representative.

.4 Notify the Departmental Representative in writing, 72 hours prior to any intended interruption of facilities, areas, corridors, mechanical or electrical services and obtain requisite permission.

27. PROTECTION AND WARNING NOTICES

.1 Provide all materials required to protect existing equipment.

.2 Erect dust barriers to prevent dust and debris from spreading through the building.

.3 Place dust protection in the form of cover sheets over equipment and furniture and tape these sheets to floors, to ensure no dust infiltration.

.4 Repair or replace any and all damage to Owner's property caused during construction, at no cost to the Owner and to the satisfaction of the Departmental Representative.

.5 Protect the buildings, roads, lawns, services, etc. from damage which might occur as a result of this work.

.6 Plan and co-ordinate the work to protect the buildings from the leakage of water, dust, etc.

.7 Ensure that all doors, windows, etc., that could allow transfer of dust, noise, fumes, etc., to other areas of the building are kept closed.

.8 Be responsible for security of all areas affected by the work under the Contract until acceptance by NRC. Take all necessary precautions to prevent entry to the work area by unauthorized persons and guard against theft, fire and damage by any cause. Secure working area at the end of each day's work and be responsible for same.

.9 Provide and maintain adequate safety barricades around the work sites to protect NRC personnel and the public from injury during the construction.

.10 Post warnings, in all instances where possible injury could occur such as Work Overhead, Hard Hat Areas, etc. or as required by the Departmental Representative.

.11 Provide temporary protective enclosures over building entrances and exits to protect pedestrians. All enclosures to be structurally sound against weather and falling debris.

28. BILINGUALISM

.1 Ensure that all signs, notices, etc. are posted in both official languages.

.2 Ensure that all identification of services called for by under this contract are bilingual.

29. LAYOUT OF WORK

.1 Location of equipment, fixtures, outlets and openings indicated on drawings 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 the manufacturer's recommendations for safety, access and maintenance.

.3 Employ competent person to lay out work in accordance with the contract documents.

30. DISCREPANCIES & INTERFERENCES

.1 Prior to the start of the work, examine drawings and specifications. Report at once to the Departmental Representative, any defects, discrepancies, omissions or interferences affecting the work.

.2 Contractor to immediately inform the Departmental Representative in writing, of any discrepancies between the plans and the physical conditions so the Departmental Representative may promptly verify same.

.3 Any work done after such a discovery, until authorized, is at the Contractor's risk.

.4 Where minor interferences as determined by the Departmental Representative are encountered on the job and they have not been pointed out on the original tender or on the plans and specifications, provide offsets, bends or reroute the services to suit job conditions at no extra cost.

.5 Arrange all work so as not to interfere in any way with other work being carried out.

31. MANUFACTURER'S INSTRUCTIONS

.1 Unless otherwise specified, comply with manufacturer's latest printed instructions for materials and installation methods.

.2 Notify the Departmental Representative in writing of any conflict between these specifications and manufacturer's instruction. Departmental Representative will designate which document is to be followed.

32. TEMPORARY HEATING AND VENTILATING

.1 Bear the costs of temporary heat and ventilation during construction including costs of installation, fuel, operation, maintenance, and removal of equipment.

.2 Use of direct-fired heaters discharging waste products into the work areas will not be permitted unless prior approval is given by the Departmental Representative.

.3 Furnish and install temporary heat and ventilation in enclosed areas as required to:
- .1 Facilitate progress of work.
- .2 Protect work and products against dampness and cold.
- .3 Reduce moisture condensation on surfaces to an acceptable level.
- .4 Provide ambient temperature and humidity levels for storage, installation and curing of materials.
- .5 Provide adequate ventilation to meet health regulations for a safe working environment.

.4 Maintain minimum temperature of 10°C (50°F) or higher where specified as soon as finishing work is commenced and maintain until acceptance by the Departmental Representative.
- .1 Maintain ambient temperature and humidity levels as required for comfort of NRC personnel.

.5 Prevent hazardous or unhealthy accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction including also, storage areas and sanitary facilities.
- .1 Dispose of exhaust materials in a manner that will not result in a harmful or unhealthy exposure to persons.

.6 Maintain strict supervision of operation of temporary heating and ventilating equipment.
- .1 Enforce conformance with applicable codes and standards.
- .2 Comply with instructions of the Departmental Representative including provision of full-time watchman services when directed.
- .3 Enforce safe practices.
- .4 Vent direct-fired combustion units to outside.

.7 Submit tenders assuming existing or new equipment and systems will not be used for temporary heating and ventilating.

.8 After award of contract, Departmental Representative may permit use of the permanent system providing agreement can be reached on:
- .1 Conditions of use, special equipment, protection, maintenance, and replacement of filters.
- .2 Methods of ensuring that heating medium will not be wasted and in the case of steam, agreement on what is to be done with the condensate.

.3 Saving on contract price.
.4 Provisions relating to guarantees on equipment.

33. CONNECTIONS TO AND INTERRUPTIONS TO EXISTING SERVICES

.1 Where work involves breaking into or connecting to existing services, carry out work at times and in the manner agreed to by the Departmental Representative and by authorities having jurisdiction, with minimum disruption to NRC Personnel and vehicular traffic and minimum service interruption. Do not operate any NRC equipment or plant.

.2 Before commencing work, establish location and extent of service lines in area of work and notify Departmental Representative of findings.

.3 Submit a schedule to and obtain approval from the Departmental Representative for any shut-down or closure of active service or facility; allow minimum 72 hours notice. Adhere to approved schedule and provide notice to the Departmental Representative.

.4 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.

.5 Provide detours, bridges, alternate feeds, etc., as required to minimize disruptions.

.6 Protect existing services as required and immediately make repairs if damage occurs.

.7 Remove any abandoned service lines as indicated on the contract documents and as approved by the Departmental Representative; cap or otherwise seal lines at cut-off points. Record and provide a copy to the Departmental Representative of locations of maintained, re-routed and abandoned service lines.

34. CUTTING AND PATCHING

.1 Cut existing surfaces as required to accommodate new work.

.2 Remove all items as shown or specified.

.3 Patch and make good with identical materials, the surfaces that have been disturbed, cut or damaged, to the satisfaction of the Departmental Representative.

.4 Where new pipes pass through existing construction, core drill an opening. Size openings to leave 12mm (1/2") clearance around the pipes or pipe insulation. Do not drill or cut any surface without the approval of the Departmental Representative.

.5 Obtain written approval of the Departmental Representative before cutting openings through existing or new structural members.

.6 Seal all openings where cables, conduits or pipes pass through walls with an acoustic sealant conforming to CAN/CGSB-19.21-M87.

.7 Where cables, conduits and pipes pass through fire rated walls and floors, pack space between with compressed glass fibres and seal with fire stop caulking in accordance with CAN/CGSB-19.13-M87 AND NBC 3.1.7.

35. FASTENING DEVICES

.1 Do not use explosive actuated tools, without first obtaining permission from the Departmental Representative.

.2 Comply with the requirements of CSA A-166 (Safety Code for Explosive Actuated Tools).

.3 Do not use any kind of impact or percussion tool without first obtaining permission from the Departmental Representative.

36. OVERLOADING

.1 Ensure that no part of the building or work is subjected to a load which will endanger safety or cause permanent deformation or structural damage.

37. DRAINAGE

.1 Provide temporary drainage and pumping as required to keep excavations and site free of water.

38. ENCLOSURE OF STRUCTURES

.1 Construct and maintain all temporary enclosures as required to protect foundations, sub-soil, concrete, masonry, etc., from frost penetration or damage.

.2 Maintain in place until all chances of damage are over and proper curing has taken place.

.3 Provide temporary weather tight enclosures for exterior openings until permanent sash and glazing and exterior doors are installed.

.4 Provide lockable enclosures as required to maintain the security of NRC facilities and be responsible for the same.

.5 Provide keys to NRC security personnel when required.

.6 Lay out the work carefully and accurately and verify all dimensions and be responsible for them. Locate and preserve general reference points.

.7 Throughout the course of construction, keep continuously acquainted with field conditions, and the work being developed by all trades involved in the project. Maintain an awareness of responsibility to avoid space conflict with other trades.

.8 Conceal all services, piping, wiring, ductwork, etc., in floors, walls or ceilings except where indicated otherwise.

39. STORAGE

.1 Provide storage as required to protect all tools, materials, etc., from damage or theft and be responsible for the same.

.2 Do not store flammable or explosive materials on site without the authorization of the Departmental Representative.

40. GENERAL REVIEW

.1 Periodic review of the Contractor's work by the Departmental Representative does not relieve the Contractor of the responsibility of making the work in accordance with contract documents. Contractor shall carry out his own quality control to ensure that the construction work is in accordance with contract documents.

.2 Inform the Departmental Representative of any impediments to the installation and obtain his / her approval for actual location.

41. INSPECTION OF BURIED OR CONCEALED SERVICES

.1 Prior to concealing any services that are installed, ensure that all inspection bodies concerned, including NRC, have inspected the work and have witnessed all tests. Failure to do so may result in exposing the services again at the Contractor's expense.

42. TESTING

.1 On completion, or as required by local authority inspectors and/or Departmental Representative during progress of work and before any services are covered up and flushing is complete, test all installations in the presence of the Departmental Representative.

.2 Obtain and hand to the Departmental Representative all acceptance certificates or test reports from authority having jurisdiction. The project will be considered incomplete without the same.

43. PARTIAL OCCUPANCY

.1 NRC may request partial occupancy of the facility if the contract extends beyond the expected completion date.

.2 Do not restrict access to the building, routes, and services.

.3 Do not encumber the site with materials or equipment.

44. DISPOSAL OF WASTES

.1 Dispose of waste materials including volatiles, safely off NRC property. Refer to the section entitled "General and Fire Safety Requirements" included as part of this specification.

45. CLEAN-UP DURING CONSTRUCTION

.1 On a daily basis, maintain project site and adjacent area of campus including roofs, free from debris and waste materials.

.2 Provide on-site dump containers for collection of waste materials and rubbish.

46. FINAL CLEAN-UP

.1 Upon completion do a final clean-up to the satisfaction of the Departmental Representative.

.2 Clean all new surfaces, lights, existing surfaces affected by this work, replace filters, etc.

.3 Clean all resilient flooring and prepare to receive protective finish. Protective finish applied by NRC.

47. WARRANTY AND RECTIFICATION OF DEFECTS IN WORK

.1 Refer to General Conditions "C", section GC32.

.2 Ensure that all manufacturers' guarantees and warranties are issued in the name of the **General Contractor** and the National Research Council.

48. MAINTENANCE MANUALS

.1 Provide two (2) bilingual copies of maintenance manuals or two (2) English and two (2) French maintenance manuals and one (1) electronic copy of same immediately upon completion of the work and prior to release of holdbacks.

.2 Manuals to be neatly bound in hard cover loose leaf binders.

.3 Manuals to include operating and maintenance instructions, all guarantees and warranties, shop drawings, technical data, etc., for the material and apparatus supplied under this contract.

END OF SECTION

1. GENERAL CONSTRUCTION SAFETY REQUIREMENTS

.1 The Contractor shall take all necessary steps to protect personnel (workers, visitors, general public, etc.) and property from any harm during the course of the contract.

.2 The Contractor shall be solely responsible for the construction safety of both its employees and those of its sub-contractors at the work site, and for initiating, maintaining and supervising safety precautions, programs and procedures in connection with the performance of the work.

.3 The Contractor shall comply with all Federal, Provincial and Municipal safety codes and regulations and the Occupational Health and Safety Act and the Workplace Safety and Insurance Board. In the event of any conflict between any provisions in legislation or codes, the most stringent provisions shall apply.

.4 Periodic review of the Contractor's work by the Departmental Representative, using the criteria of the contract documents, does not relieve the Contractor of his safety responsibilities in carrying out the work in accordance with the contract documents. The Contractor shall consult with the Departmental Representative to ensure that this responsibility is carried out.

.5 The Contractor shall ensure that only competent personnel are permitted to work on site. Throughout the term of the contract, any person will be removed from the site who is not observing or complying with the safety requirements.

.6 All equipment shall be in safe operating condition and appropriate to the task.

.7 Following a project and site hazard assessment, the Contractor shall develop a Site Specific Safety Plan based on the following minimum requirements. Site Specific Safety Plans must also be robust enough to address any abnormal occurrences, such as, but not limited to: pandemics (COVID-19 or a similar), fire, flooding, in climate weather or other environmental anomalies.

- .1 Provide a safety board mounted in a visible location on the project site, with the following information included thereon:
  - .1 Notice of Project.
  - .2 Site specific Safety Policy.
  - .3 Copy of Ontario Health and Safety Act.
  - .4 Building Schematic showing emergency exits.
  - .5 Building emergency procedures.
  - .6 Contact list for NRC, Contractor and all involved sub-contractors.
  - .7 Any related MSDS sheets.
  - .8 NRC Emergency phone number.

.8 The Contractor shall provide competent personnel to implement its safety program and those of any Health and Safety Act legislation applicable at this project location, and to ensure they are being complied with.

.9 The Contractor shall provide safety orientation to all its employees as well as those of any sub-contractors under its jurisdiction.

.10 The Departmental Representative will monitor to ensure that safety requirements are met and that safety records are properly kept and maintained. Continued disregard for safety standards can cause the contract to be cancelled and the Contractor or sub-contractors removed from the site.

.11 The Contractor will report to the Departmental Representative and jurisdictional authorities, any accident or incident involving Contractor or NRC personnel or the public and/or property arising from the Contractor's execution of the work.

.12 If entry to a laboratory is required as part of the work of the Contractor, a safety orientation shall be provided to all his employees as well as those of any sub-contractors regarding lab safety requirements and procedures, as provided by the Researcher or the Departmental Representative.

2. FIRE SAFETY REQUIREMENTS

.1 Authorities

1. The Fire Commissioner of Canada (FC) is the authority for fire safety at NRC.
2. For the purpose of this document, "Departmental Representative" will be deemed as the NRC person in charge of the project and who will enforce these Fire Safety Requirements.
3. Comply with the following standards as published by the Office of the Fire Commissioner of Canada:
   - .1 Standard No. 301 - June 1982 "Standard for Construction Operations";
   - .2 Standard No. 302 - June 1982 "Standard for Welding and Cutting".

.2 Smoking

.1 Smoking is prohibited inside all NRC buildings, as well as roof areas.

.2 Obey all "NO SMOKING" signs on NRC premises.

.3 Hot Work

.1 Prior to commencement of any "Hot Work" involving welding, soldering, burning, heating, use of torches or salamanders or any open flame, obtain a Hot Work Permit from the Departmental Representative.

.2 Prior to commencement of "Hot Work", review the area of hot work with the Departmental Representative to determine the level of fire safety precautions to be taken.

.4 Reporting Fires

.1 Know the exact location of the nearest Fire Alarm Pull Station and telephone, including the emergency phone number.

.2 REPORT immediately, all fire incidents as follows:

- .1 Activate nearest fire alarm pull station; and
- .2 Telephone the following emergency phone number as appropriate:

FROM AN NRC PHONE 333
FROM ANY OTHER PHONE (613) 993-2411

- .3 When reporting a fire by phone, give the location of fire, building number and be prepared to verify location.
- .4 The person activating fire alarm pull station must remain at a safe distance from the scene of the fire but readily available to provide information and direction to the Fire Department personnel.

.5 Interior and Exterior Fire protection & Alarm Systems

.1 DO NOT OBSTRUCT OR SHUT OFF FIRE PROTECTION EQUIPMENT OR SYSTEMS, INCLUDING BUT NOT LIMITED TO FIRE ALARM SYSTEMS, SMOKE/HEAT DETECTORS, SPRINKLER SYSTEM, PULL STATIONS, EMERGENCY CALL BUTTONS AND PA SYSTEMS, WITHOUT AUTHORIZATION FROM THE DEPARTMENTAL REPRESENTATIVE.

.2 WHEN ANY FIRE PROTECTION EQUIPMENT IS TEMPORARILY SHUT DOWN, ALTERNATIVE MEASURES AS PRESCRIBED BY THE DEPARTMENTAL REPRESENTATIVE SHALL BE TAKEN TO ENSURE THAT FIRE PROTECTION IS MAINTAINED.

.3 DO NOT LEAVE FIRE PROTECTION OR ALARM SYSTEMS INACTIVE AT THE END OF A WORKING DAY WITHOUT NOTIFICATION AND AUTHORISATION FROM THE DEPARTMENTAL REPRESENTATIVE. THE DEPARTMENTAL REPRESENTATIVE WILL ADVISE THE (FPO) OF THE DETAILS OF ANY SUCH EVENT.

.4 DO NOT USE FIRE HYDRANTS, STANDPIPES AND HOSE SYSTEMS FOR OTHER THAN FIRE FIGHTING PURPOSES UNLESS AUTHORISED BY DEPARTMENTAL REPRESENTATIVE.

.6 Fire Extinguishers

.1 Provide a minimum of 1-20 lb. ABC Dry Chemical Fire Extinguisher at each hot work or open flame location.

.2 Provide fire extinguishers for hot asphalt and roofing operations as follows:

1. Kettle area - 1-20 lb. ABC Dry Chemical; and
2. Roof - 1-20 lb. ABC Dry Chemical at each open flame location.

.3 Provide fire extinguishers equipped as below:

1. Pinned and sealed;
2. With a pressure gauge; and
3. With an extinguisher tag signed by a fire extinguisher servicing company.

.4 Carbon Dioxide (CO2) extinguishers will not be considered as substitutes for the above.

.7 Roofing Operations

.1 Kettles:

.1 Arrange for the location of asphalt kettles and material storage with the Departmental Representative before moving on site. Do not locate kettles on any roof or structure and keep them at least 10m (30 feet) away from a building.

.2 Equip kettles with two (2) thermometers or gauges in good working order; a handheld and a kettle-mounted model.

.3 Do not operate kettles at temperatures in excess of 232°C (450°F).

.4 Maintain continuous supervision while kettles are in operation and provide metal covers for the kettles to smother any flames in case of fire. Provide fire extinguishers as required in article 2.6.

.5 Demonstrate container capacities to Departmental Representative prior to start of work.

.6 Store materials a minimum of 6m (20 feet) from the kettle.

.2 Mops:

.1 Use only glass fibre roofing mops.

.2 Remove used mops from the roof site at the end of each working day.

.3 Torch Applied Systems:

.1 DO NOT USE TORCHES NEXT TO WALLS.

.2 DO NOT TORCH MEMBRANES TO EXPOSED WOOD OR CAVITY.

.3 Provide a Fire Watch as required by article 2.9 of this section.

.4 Store all combustible roofing materials at least 3m (10 feet) away from any structure.

.5 Keep compressed gas cylinders a minimum of 6m (20 feet) away from the kettle, protected from mechanical damage and secured in an upright position.

.8 Welding / Grinding Operations

.1 Contractor to provide fire blankets, portable fume extraction devices, screens or similar equipment to prevent exposure to welding flash, or sparks from grinding.

.9 Fire Watch

.1 Provide a fire watch for a minimum of one hour after the termination of any hot work operation.

.2 For temporary heating, refer to General Instructions Section 00 01 00.

.3 Equip fire watch personnel with fire extinguishers as required by article 2.6.

.10 Obstruction of access/egress routes-roadways, halls, doors, or elevators

.1 Advise the Departmental Representative in advance of any work that would impede the response of Fire Department personnel and their apparatus. This includes violation of minimum overhead clearance, erection of barricades and the digging of trenches.

.2 Building exit routes must not be obstructed in any way without special permission from the Departmental Representative, who will ensure that adequate alternative routes are maintained.

.3 The Departmental Representative will advise the FPO of any obstruction that may warrant advanced planning and communication to ensure the safety of building occupants and the effectiveness of the Fire Department.

.11 Rubbish and Waste Materials

.1 Keep rubbish and waste materials to a minimum and a minimum distance of 6m (20 feet) from any kettle or torches.

.2 Do not burn rubbish on site.

.3 Rubbish Containers:

.1 Consult with the Departmental Representative to determine an acceptable safe location for any containers and the arrangement of chutes etc. prior to bringing the containers on site.

.2 Do not overfill the containers and keep area around the perimeter free and clear of any debris.

.4 Storage:

.1 Exercise extreme care when storing combustible waste materials in work areas. Ensure maximum possible cleanliness, ventilation and that all safety standards are adhered to when storing any combustible materials.

.2 Deposit greasy or oily rags or materials subject to spontaneous combustion in CSA or ULC approved receptacles and remove at the end of the workday or shift, or as directed.

.12 Flammable Liquids

.1 The handling, storage and use of flammable liquids is governed by the current National Fire Code of Canada.

.2 Flammable Liquids such as gasoline, kerosene and naphtha may be kept for ready use in quantities not exceeding 45 litres (10 imp gal), provided they are stored in approved safety cans bearing the ULC seal of approval and kept away from buildings, stockpiled combustible materials etc. Storage of quantities of flammable liquids exceeding 45 litres (10 imp gal) for work purposes, require the permission of the Departmental Representative.

.3 Flammable liquids are not to be left on any roof areas after normal working hours.

.4 Transfer of flammable liquids is prohibited within buildings.

.5 Do not transfer flammable liquids in the vicinity of open flames or any type of heat producing device.

.6 Do not use flammable liquids having a flash point below 38°C (100°F) such as naphtha or gasoline as solvents or cleaning agents.

.7 Store flammable waste liquids for disposal in approved container located in a safe, ventilated area. Waste flammable liquids are to be removed from the site on a regular basis.

.8 Where flammable liquids, such as lacquers or urethane are used, ensure proper ventilation and eliminate all sources of ignition. Inform the Departmental Representative prior to, and at the cessation of such work.

3. QUESTIONS OR CLARIFICATIONS

.1 Direct any questions or clarification on Fire or General Safety, in addition to the above requirements, to the Departmental Representative.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

.1 This Section includes requirements for management of construction waste and disposal, which forms the Contractor's commitment to reduce and divert waste materials from landfill and includes the following:

.1 Preparation of a Draft Construction Waste Management Plan that will be used to track the success of the Construction Waste Management Plan against actual waste diversion from landfill.

.2 Preparation of monthly progress reports indicating cumulative totals representing progress towards achieving diversion and reduction goals of waste materials away from landfill and identifying any special programs, landfill options or alternatives to landfill used during construction.

.3 Preparation of a Construction Waste Management Report containing detailed information indicating total waste produced by the project, types of waste material and quantity of each material, and total waste diverted and diversion rates indicated as a percentage of the total waste produced.

.2 Owner has established that this project shall generate the least amount of waste possible and that processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors be employed by the Contractor.

1.2 RELATED REQUIREMENTS

.1 Section 00 10 00 - General Instructions

.2 Section 02 41 19.16 - Selective Interior Demolition

.3 Section 02 42 00 – Removal and Salvage of Construction Materials

.4 Section 23 05 05 - Selective Demolition for HVAC

.5 Section 26 05 05 - Selective Demolition for Electrical

1.3 REFERENCE STANDARDS

.1 ASTM International (ASTM)

.1 ASTM E1609 01, Standard Guide for Development and Implementation of a Pollution Prevention Program

.2 Canada Green Building Council (CaGBC)

.1 LEED Reference Guide for Building Design and Construction, Version 4

.3 Recycling Certification Institute (RCI):

.1 RCI Certification Construction and Demolition Materials Recycling

1.4 DEFINITIONS

.1 Clean Waste: Untreated and unpainted; not contaminated with oils, solvents, sealants or similar materials.

.2 Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, re-modeling, repair and demolition operations.

.3 Hazardous: Exhibiting the characteristics of hazardous substances including properties such as ignitability, corrosiveness, toxicity or reactivity.

.4 Non-hazardous: Exhibiting none of the characteristics of hazardous substances, including properties such as ignitability, corrosiveness, toxicity, or reactivity.

.5 Non-toxic: Not poisonous to humans either immediately or after a long period of exposure.

.6 Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

.7 Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.

.8 Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form; recycling does not include burning, incinerating, or thermally destroying waste.

.9 Return: To give back reusable items or unused products to vendors for credit.

.10 Reuse: To reuse a construction waste material in some manner on the project site.

.11 Salvage: To remove a waste material from the project site to another site for resale or reuse by others.

.12 Sediment: Soil and other debris that has been eroded and transported by storm or well production run off water.

.13 Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

.14 Toxic: Poisonous to humans either immediately or after a long period of exposure.

.15 Trash: Any product or material unable to be reused, returned, recycled, or salvaged.

.16 Volatile Organic Compounds (VOC's): Chemical compounds common in and emitted by many building products over time through outgassing:

.1 Solvents in paints and other coatings;

.2 Wood preservatives; strippers and household cleaners;

.3 Adhesives in particleboard, fiberboard, and some plywood; and foam insulation.

.4 When released, VOC's can contribute to the formation of smog and can cause respiratory tract problems, headaches, eye irritations, nausea, damage to the liver, kidneys, and central nervous system, and possibly cancer.

.17 Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

.18 Construction Waste Management Plan: A project related plan for the collection, transportation, and disposal of the waste generated at the construction site; the purpose of the plan is to ultimately reduce the amount of material being landfilled.

1.5 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate waste management requirements with all Divisions of the Work for the project, and ensure that requirements of the Construction Waste Management Plan are followed.

.2 Preconstruction Meeting: Arrange a pre-construction meeting in accordance with Section 01 10 00 – General Instructions before starting any Work of the Contract attended by the Owner, Contractor, affected Subcontractor's and Departmental Representative to discuss the Contractor's Construction Waste Management Plan and to develop mutual understanding of the requirements for a consistent policy towards waste reduction and recycling.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide required information in accordance with Section 01 10 00 – General Instructions.

.2 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Draft Construction Waste Management Plan (Draft CWM Plan): Submit to Departmental Representative a preliminary analysis of anticipated site generated waste by listing a minimum of five (5) construction or demolition waste streams that have potential to generate the most volume of material indicating methods that will be used to divert construction waste from landfill and source reduction strategies; Departmental Representative will provide commentary before development of Contractor's Construction Waste Management Plan.

.2 Construction Waste Management Plan (CWM Plan): Submit a CWM Plan for this project prior to any waste removal from site and that includes the following information:

.1 Material Streams: Analysis of the proposed jobsite waste being generated, including material types and quantities forming a part of identified material streams in the Draft CWM Plan; materials removed from site destined for alternative daily cover at landfill sites and land clearing debris cannot be considered as contributing to waste diversion and will be included as a component of the total waste generated for the site.

.2 Recycling Haulers and Markets: Investigate local haulers and markets for recyclable materials, and incorporate into CWM Plan.

.3 Alternative Waste Disposal: Prepare a listing of each material proposed to be salvaged, reused, recycled or composted during the course of the project, and the proposed local market for each material.

.4 Landfill Materials: Identify materials that cannot be recycled, reused or composted and provide explanation or justification; energy will be considered as a viable alternative diversion strategy for these materials where facilities exist and are operated in accordance with LEED Construction and Demolition Waste Management requirements.

.5 Landfill Options: The name of the landfill where trash will be disposed of; landfill materials will form a part of the total waste generated by the project.

.6 Materials Handling Procedures: A description of the means by which any recycled waste materials will be protected from contamination, and a description of the means to be employed in recycling the above materials consistent with requirements for acceptance by designated facilities.

.7 Transportation: A description of the means of transportation of the recyclable materials, whether materials will be site separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site, and destination of materials.

1.7 PROJECT CLOSEOUT SUBMISSIONS

.1 Record Documentation: Submit as constructed information in accordance with Section 01 10 00 – General Instructions as follows:

.1 Construction Waste Management Report (CWM Report): Submit a CWM Report for this project in a format that includes the following information:

.1 Accounting: Submit information indicating total waste produced by the project.

.2 Composition: Submit information indicating types of waste material and quantity of each material.

.3 Diversion Rate: Submit information indicating total waste diverted from landfill as a percentage of the total waste produced by the project.

.4 Transportation Documentation and Diversion Documentation: Submit copies of transportation documents or shipping manifests indicating weights of materials, and other evidence of disposal indicating final location of waste diverted from landfill and waste sent to landfill.

.5 Multiple Waste Hauling: Compile all information into a single CWM Report where multiple waste hauling and diversion strategies were used for the project.

1.8 QUALITY ASSURANCE

.1 Resources for Development of Construction Waste Management Report (CWM Report): The following sources may be useful in developing the Draft Construction Waste Management Plan:

.1 Recycling Haulers and Markets: Investigate local haulers and markets for recyclable materials, and incorporate into CWM Plan.

.2 Waste-to-Energy Systems: Investigate local waste-to-energy incentives where systems for diverting materials from landfill for reuse or recycling are not available.

.3 Municipal Garbage & Recycling Waste Websites:

.1 Ontario

.1 National Capital Region (City of Ottawa)

https://app06.ottawa.ca/cgi-bin/search/recycle/q.pl?q=&lang=en

1.9 DELIVERY, STORAGE AND HANDLING

.1 Storage Requirements: Implement a recycling/reuse program that includes separate collection of waste materials as appropriate to the project waste and the available recycling and reuse programs in the project area.

.2 Handling Requirements: Clean materials that are contaminated before placing in collection containers and ensure that waste destined for landfill does not get mixed in with recycled materials:

.1 Deliver materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to recycling process.

.2 Arrange for collection by or delivery to the appropriate recycling or reuse facility.

.3 Hazardous Waste and Hazardous Materials: Handle in accordance with applicable regulations.

PART 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 EXECUTION

3.1 OBJECTIVE

.1 The Federal Sustainable Development Strategy (FSDS) presents the Government of Canada's sustainable development goals and targets, as required by the *Federal Sustainable Development Act.* In keeping with the purpose of this Act – to provide the legal framework for developing and implementing a Federal Sustainable Development Strategy that will make environmental decision-making more transparent and accountable to Parliament – National Research Council (NRC) supports the goals laid out in the FSDS through the activities described in our Departmental Sustainable Development Strategy (DSDS). NRC's DSDS waste management target is as follows:

.1 Divert at least 90% (by weight) of all construction and demolition waste from landfills (striving to achieve 100% by 2030).

.2 Project Waste Diversion Target: 90%.

3.2 (CWM PLAN) IMPLEMENTATION

.1 Manager: Contractor is responsible for designating an on-site party or parties responsible for instructing workers and overseeing and documenting results of the CWM Plan for the project.

.2 Distribution: Distribute copies of the CWM Plan to the job site foreman, each Subcontractor, the Owner, the Departmental Representative and other site personnel as required to maintain CWM Plan.

.3 Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, composting and return methods being used for the project to Subcontractor's at appropriate stages of the project.

.4 Separation Facilities: Lay out and label a specific area to facilitate separation of materials for potential recycling, salvage, reuse, composting and return:

.1 Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials.

.2 Hazardous wastes shall be separated, stored, and disposed of in accordance with local regulations.

.5 Progressive Documentation: Submit a monthly summary of waste generated by the project to ensure that waste diversion goals are on track with project requirements:

.1 Submission of waste summary can coincide with application for progress payment, or similar milestone event as agreed upon between the Contractor and Departmental Representative.

.2 Monthly waste summary shall contain the following information:

.1 The amount in tonnes or m3 and location of material landfilled;

.2 The amount in tonnes or m3 and location of materials diverted from landfill; and

.3 Indication of progress based on total waste generated by the project with materials diverted from landfill as a percentage.

3.3 SUBCONTRACTOR'S RESPONSIBILITY

.1 Subcontractor's shall cooperate fully with the Contractor to implement the CWM Plan.

.2 Failure to cooperate may result in the Owner not achieving their environmental goals, and may result in penalties being assessed by the Contractor to the responsible Subcontractor's.

3.4 CONSTRUCTION WASTE MANAGEMENT FORMS

.1 Departmental Representative will provide Contractor will NRC Waste Management and Disposal Tracking Forms (sample provided below) for recording management of construction waste.

.2 Contractor shall utilize these forms for all waste management and disposal tracking for the duration of the project, and is responsible for maintaining current up to date records at all times during construction.

.3 Contractor is responsible to ensure all waste management tracking forms, weigh-bills, donation receipts, and summary information are incorporated into Operational and Maintenance Manuals upon construction completion in accordance with 01 10 00 – General Instructions.

END OF SECTION

WASTE AUDIT worksheet for NRC Construction, Renovation and Demolition Projects

Worksheet for: Total Inventory ☑ Specific Stage ☐ Individual Floor ☐

Create one worksheet for the entire project or multiple worksheets for each stage of the project, or per floor (where needed). Mark each worksheet accordinalv

Project Name	
Project Type (Construction, Renovation or Demolition)	
Area (sq. m)	
Site Address	
Contact Person & Telephone	
Date	

**** Add or delete materials as project requires***

WASTE CATEGORY AND MATERIAL TYPE	Units	Total Units	Weight (kg) per unit of measurement	Estimated Weight (Metric Tonnes)	Potential Reuse (Metric Tonnes)	Potential Recycle (Metric Tonnes)	Potential Landfill (Metric Tonnes)	Volume (cubic yards) For Project Planning Purposes (i.e. number of bins required)
Masonry and Pavement								
Asphalt (cu. m.)	cu. m.		2400.00	0.00				
Concrete (walls, floors, stairs)	cu. m.		2400.00	0.00				
Brick, block, etc.	cu. m.		1840.00	0.00				
Stone (foundation)	cu. m.		1473.80	0.00				
Glass masonry	cu. m.			0.00				
Marble	cu. m.		2563.00	0.00				
Granite	cu. m.		2750.00	0.00				
Clay tile	cu. m.			0.00				
Other	cu. m.			0.00				
			TOTAL	0.00	0.00	0.00	0.00	0
Walls and Ceilings								
Drywall (12.5 mm)	sq. m.		9.74	0.00				
Drywall (19 mm)	sq. m.		12.25	0.00				
Cellulose insulation	sq. m.		6.41	0.00				
Fiberglass insulation	sq. m.		6.41	0.00				
Solid SM insulation	sq. m.		11.54	0.00				
Ceiling tile (19 mm standard)	sq. m.		6.82	0.00				
Glass (5 - 6 mm)	sq. m.			0.00				
Acoustic composite (ceilings, walls)	sq. m.		0.30	0.00				
Other	sq. m.			0.00				
			TOTAL	0.00	0.00	0.00	0.00	0
Metal								
Steel (structural, stairs, fabrications, joists, deck, siding)	weight		600.00	0.00				
Aluminum (structural, siding)			2700.00	0.00				
Light Metal				0.00				
Studs	lm. of wall			0.00				
Ceiling grid	sq. m.		1.41	0.00				
Steel mesh				0.00				
Miscellaneous				0.00				
Other				0.00				
			TOTAL	0.00	0.00	0.00	0.00	0
Mechanical								
HVAC								
Solid ducts	weight		26238.00	0.00				
Flex ducts	weight		5180.00	0.00				
Metal diffuser (600 X600)	each			0.00				
Light diffuser (boot only)	each			0.00				
Plastic grilles (600 X 600)	each			0.00				
VAV boxes	weight			0.00				
Heat coils	weight			0.00				
A/C units	weight		90.00	0.00				
			TOTAL	0.00	0.00	0.00	0.00	0
Plumbing								
Copper piping (12.5 to 19mm)	lin. m.		1833.30	0.00				
Steel piping (38 to 50mm)	lin. m.		220.00	0.00				
Plastic piping (38 to 50mm)	lin. m.			0.00				
			TOTAL	0.00	0.00	0.00	0.00	0
Fixtures								

Sinks (ceramic/porcelain)	each		10.00	0.00				
Sinks (metal)	each		10.00	0.00				
Faucets	each			0.00				
Water Closet	each		46.00	0.00				
Urinals (wall hung)	each		29.00	0.00				
			TOTAL	0.00	0.00	0.00	0.00	0
Other								
			TOTAL	0.00	0.00	0.00	0.00	0
Windows and Doors								
Doors								
Wood (solid or hollow core)	each		20.00	0.00				
Metal (hollow metal)	each		30.00	0.00				
Garage	each		135.00	0.00				
Frame (wood)	each		23.33	0.00				
Frame (metal)	each		2.33	0.00				
Windows				0.00				
Wood frame	each		216.36	0.00				
Plastic frame	each		125.10	0.00				
Aluminum frame	each		216.67	0.00				
Door Hardware				0.00				
Locksets	each		2.50	0.00				
Hinges, plates, stops, etc.	each		2.50	0.00				
Other (closers, operators, etc.)	each		2.50	0.00				
Other				0.00				
			TOTAL	0.00	0.00	0.00	0.00	0
Wood								
Rough (crating, timber, etc.)	weight			0.00				
Dimension (3 m studs)	each		2.83	0.00				
Plywood (17mm)	sq. m.		0.08	0.00				
Hardwood (floor)	sq. m.		0.02	0.00				
Other				0.00				
			TOTAL	0.00	0.00	0.00	0.00	0
Millwork and Finish Carpentry								
Baseboards and casing (50 mm ht.)	each			0.00				
Lower cabinets (c/w doors)	each		44.10	0.00				
Upper cabinets (c/w doors)	each			0.00				
Counters (9' sections)	each		45.65	0.00				
Other				0.00				
			TOTAL	0.00	0.00	0.00	0.00	0
Flooring								
Carpet (roll)	sq. m.		2.44	0.00				
Carpet tile	sq. m.		2.98	0.00				
Sheet vinyl and linoleum	sq. m.		2.98	0.00				
Rubber cove or carpet base	lin. m.		0.52	0.00				
Terrazzo - 25 mm	sq. m.		0.02	0.00				
Ceramic Tiles	sq. m.		0.21	0.00				
Other				0.00				
			TOTAL	0.00	0.00	0.00	0.00	0
Electrical								
Wiring								
Data	weight			0.00				
Electrical (aluminum, copper, iron, etc)	weight			0.00				
Junction and outlet boxes (standard)	each		3800.00	0.00				
Cover plates	each			0.00				
Electrical panels	weight			0.00				
Conduit (25 mm)	lin. m.			0.00				
Conduit (50 mm)	lin. m.			0.00				
			TOTAL	0.00	0.00	0.00	0.00	0
Lighting								
Fluorescent fixture (600 X 1200)	each		0.82	0.00				
Fluorescent fixture (300 X 1200)	each		0.08	0.00				
Ballast	each		4432.00	0.00				
Lamps	each			0.00				
Complete fixture (600 X 1200)	each			0.00				
Complete fixture (300 X 1200)	each			0.00				
Emergency battery lights	each		6.66	0.00				
Exit lights	each		1.00	0.00				

Fire bells/alarms	each			0.00				
Micellaneous (switches, sensors, etc.)	each		600.00	0.00				
			TOTAL	0.00	0.00	0.00	0.00	0
Other								
			TOTAL	0.00	0.00	0.00	0.00	0
Roofing								
Shingles - asphalt	sq. m.		10.72	0.00				
Tin	sq. m.		616.76	0.00				
Copper	sq. m.			0.00				
Waterproof EDPM	sq. m.		796.67	0.00				
Waterproof PVC	sq. m.			0.00				
Tar and gravel	sq. m.		608.85	0.00				
Other	sq. m.			0.00				
			TOTAL	0.00	0.00	0.00	0.00	0
Specialties & Miscellaneous								
Office Furnishings								
Furniture (workstations and chairs)	each							
Shelving	each							
Bulletin and white boards	each							
Building Furnishings								
Window Coverings (rolling shutters, blinds)	each							
Signs	each							
Lockers	each							
Metal partition (toilet)	each							
Plastic partition (toilet)	each							
Stud-type partition (demountable)	each							
Specilaized Equipment								
Food service equipment	each							
Parking control equipment	each							
Waste/cleaning equipment	each							
Refrigeration equipment	each							
Lifts	each							
Elevators	each							
Escalators	each							
Dumbwaiters	each							
Communications	each							
Telecom raceways/cables	each							
Terminals and connectors	each							
Other	each							
			TOTAL	0.00	0.00	0.00	0.00	0
Packaging								
Cardboard Packaging	weight		60.00	0.00				
Plastic packaging	weight			0.00				
Other				0.00				
			TOTAL	0.00	0.00	0.00	0.00	0
Other								
				0.00				
				0.00				
				0.00				
				0.00				
				0.00				
			TOTAL	0.00	0.00	0.00	0.00	0
			TOTAL	**0.00**	**0.00**	**0.00**	**0.00**	**0**

NRC Construction, Renovation and Demolition PRE-WASTE AUDIT SUMMARY

Project Name	0
Project Type (Construction, Renovation or Demolition)	0
Area (sq. m)	0
Site Address	0
Contact Person & Telephone	0
Date	

Waste Audit Summary

WASTE CATEGORY	Estimated Quantity Generated (Metric Tonnes)	Potential Quantity (Metric Tonnes)			Potential Diversion Rate
		Reuse	Recycle	Landfill	
Masonry and Pavement	0.00	0.00	0.00	0.00	#DIV/0!
Walls and Ceilings	0.00	0.00	0.00	0.00	#DIV/0!
Metal	0.00	0.00	0.00	0.00	#DIV/0!
Mechanical:					
HVAC	0.00	0.00	0.00	0.00	#DIV/0!
Plumbing	0.00	0.00	0.00	0.00	#DIV/0!
Fixtures	0.00	0.00	0.00	0.00	#DIV/0!
Other	0.00	0.00	0.00	0.00	#DIV/0!
Windows and Doors	0.00	0.00	0.00	0.00	#DIV/0!
Wood	0.00	0.00	0.00	0.00	#DIV/0!
Millwork and Finish Carpentry	0.00	0.00	0.00	0.00	#DIV/0!
Flooring	0.00	0.00	0.00	0.00	#DIV/0!
Electrical:				0.00	#DIV/0!
Wiring	0.00	0.00	0.00		
Lighting	0.00	0.00	0.00	0.00	#DIV/0!
Other	0.00	0.00	0.00	0.00	#DIV/0!
Roofing	0.00	0.00	0.00	0.00	#DIV/0!
Specialties & Miscellaneous	0.00	0.00	0.00	0.00	#DIV/0!
Packaging	0.00	0.00	0.00	0.00	#DIV/0!
Other	0.00	0.00	0.00	0.00	#DIV/0!
TOTALS	**0.00**	**0.00**	**0.00**	**0.00**	**#DIV/0!**

NRC Construction, Renovation and Demolition WASTE REDUCTION WORK PLAN

Project Name	0
Project Type (Construction, Renovation or Demolition)	0
Area (sq. m)	0
Site Address	0
Contact Person & Telephone	0
Date	

WASTE CATEGORY AND MATERIAL	Estimated Quantity (Metric Tonnes)	Proposed Action to Reduce, Reuse or Recycle Material (including end-destination)	Projected Quantity (Metric Tonnes)		
			Reuse	Recycle	Landfill
Masonry and Pavement					
Asphalt (cu. m.)	0.00				0.00
Concrete (walls, floors, stairs)	0.00				0.00
Brick, block, etc.	0.00				0.00
Stone (foundation)	0.00				0.00
Glass masonry	0.00				0.00
Marble	0.00				0.00
Granite	0.00				0.00
Clay tile	0.00				0.00
Other	0.00				0.00
Walls and Ceilings					
Drywall (12.5 mm)	0.00				0.00
Drywall (19 mm)	0.00				0.00
Cellulose insulation	0.00				0.00
Fiberglass insulation	0.00				0.00
Solid SM insulation	0.00				0.00
Ceiling tile (19 mm standard)	0.00				0.00
Glass (5 - 6 mm)	0.00				0.00
Acoustic composite (ceilings, walls)	0.00				0.00
Other	0.00				0.00
Windows and Doors					
Doors					
Wood (solid or hollow core)	0.00				0.00
Metal (hollow metal)	0.00				0.00
Garage	0.00				0.00
Windows	0.00				0.00
Wood frame	0.00				0.00
Plastic frame	0.00				0.00
Aluminum frame	0.00				0.00
Door Hardware	0.00				0.00
Locksets	0.00				0.00
Hinges, plates, stops, etc.	0.00				0.00
Other (closers, operators, etc.)	0.00				0.00
Other	0.00				0.00
Wood					
Rough (crating, timber, etc.)	0.00				0.00
Dimension (3 m studs)	0.00				0.00
Plywood (17mm)	0.00				0.00
Hardwood (floor)	0.00				0.00
Other	0.00				0.00
Millwork and Finish Carpentry					
Baseboards and casing (50 mm ht.)	0.00				0.00
Lower cabinets (c/w doors)	0.00				0.00
Upper cabinets (c/w doors)	0.00				0.00
Counters	0.00				0.00
Other	0.00				0.00

Flooring					
Carpet (roll)	0.00				0.00
Carpet tile	0.00				0.00
Sheet vinyl and linoleum	0.00				0.00
Rubber cove or carpet base	0.00				0.00
Terrazzo - 25 mm	0.00				0.00
Ceramic Tiles	0.00				0.00
Other	0.00				0.00
Metal					
Steel (structural, stairs, fabrications, joists, deck, siding)	0.00				0.00
Aluminum (structural, siding)	0.00				0.00
Light Metal	0.00				0.00
Studs	0.00				0.00
Ceiling grid	0.00				0.00
Miscellaneous	0.00				0.00
Other	0.00				0.00
Mechanical					
HVAC					
Solid ducts	0.00				0.00
Flex ducts	0.00				0.00
Metal diffuser	0.00				0.00
Light diffuser (boot only)	0.00				0.00
Plastic grilles	0.00				0.00
VAV boxes	0.00				0.00
Heat coils	0.00				0.00
A/C units, fan coil units, exhaust fans	0.00				0.00
Plumbing	0.00				0.00
Copper piping (12.5 to 19mm)	0.00				0.00
Steel piping (38 to 50mm)	0.00				0.00
Plastic piping (38 to 50mm)	0.00				0.00
Fixtures	0.00				0.00
Sinks (ceramic/porcelain)	0.00				0.00
Sinks (metal)	0.00				0.00
Faucets	0.00				0.00
Water Closet	0.00				0.00
Urinals (wall hung)	0.00				0.00
Other (drinking water fountain, insulation)	0.00				0.00
Electrical					
Wiring					
Data	0.00				0.00
Electrical (aluminum, copper, iron, etc)	0.00				0.00
Junction and outlet boxes (standard)	0.00				0.00
Cover plates	0.00				0.00
Electrical panels	0.00				0.00
Conduit (25 mm)	0.00				0.00
Conduit (50 mm)	0.00				0.00
Lighting					
Fluorescent fixture (600 X 1200)	0.00				0.00
Fluorescent fixture (300 X 1200)	0.00				0.00
Ballast	0.00				0.00
Lamps	0.00				0.00
Complete fixture (600 X 1200)	0.00				0.00
Complete fixture (300 X 1200)	0.00				0.00
Emergency battery lights	0.00				0.00
Exit lights	0.00				0.00
Fire bells/alarms	0.00				0.00
Micellaneous (switches, sensors, etc.)	0.00				0.00
Other	0.00				0.00

Roofing					
Shingles - asphalt	0.00				0.00
Tin	0.00				0.00
Waterproof EDPM	0.00				0.00
Waterproof PVC	0.00				0.00
Tar and gravel	0.00				0.00
Other	0.00				0.00
Specialties & Miscellaneous					
Office Furnishings	0.00				0.00
Furniture (workstations and chairs)	0.00				0.00
Shelving & Filing Cabinets	0.00				0.00
Bulletin and white boards	0.00				0.00
Building Furnishings	0.00				0.00
Window Coverings (rolling shutters, blinds)	0.00				0.00
Signs	0.00				0.00
Lockers	0.00				0.00
Metal partition (toilet)	0.00				0.00
Plastic partition (toilet)	0.00				0.00
Stud-type partition (demountable)	0.00				0.00
Specilaized Equipment	0.00				0.00
Food service equipment	0.00				0.00
Parking control equipment	0.00				0.00
Waste/cleaning equipment	0.00				0.00
Refrigeration equipment	0.00				0.00
Lifts	0.00				0.00
Elevators	0.00				0.00
Escalators	0.00				0.00
Dumbwaiters	0.00				0.00
Communications	0.00				0.00
Telecom raceways/cables	0.00				0.00
Terminals and connectors	0.00				0.00
Other	0.00				0.00
Packaging					
Cardboard Packaging	0.00				0.00
Plastic packaging	0.00				0.00
Other	0.00				0.00
Other					
	0.00				0.00
	0.00				0.00
	0.00				0.00
	0.00				0.00
	0.00				0.00
					0.00
Total	**0.00**		**0.00**	**0.00**	**0.00**

NRC Construction, Renovation and Demolition WASTE REDUCTION WORK PLAN SUMMARY

Project Name	0
Project Type (Construction, Renovation or Demolition)	0
Area (sq. m)	0
Site Address	0
Contact Person & Telephone	0
Date	

Waste Management Summary								
WASTE CATEGORY	**Estimated Quantity (Metric Tonnes)**	**Proposed Action to Reduce, Reuse or Recycle Material (including end-destination)**	**Projected Quantity (Metric Tonnes)**			**Potential Diversion Rate**	**Start date**	**End Date**
			Reuse	**Recycle**	**Landfill**			
Masonry and Pavement	0.00		0.00	0.00	0.00	#DIV/0!		
Walls and Ceilings	0.00		0.00	0.00	0.00	#DIV/0!		
Windows and Doors	0.00		0.00	0.00	0.00	#DIV/0!		
Wood	0.00		0.00	0.00	0.00	#DIV/0!		
Millwork and Finish Carpentry	0.00		0.00	0.00	0.00	#DIV/0!		
Flooring	0.00		0.00	0.00	0.00	#DIV/0!		
Metal	0.00		0.00	0.00	0.00	#DIV/0!		
Mechanical:								
HVAC	0.00		0.00	0.00	0.00	#DIV/0!		
Plumbing	0.00		0.00	0.00	0.00	#DIV/0!		
Fixtures	0.00		0.00	0.00	0.00	#DIV/0!		
Other	0.00		0.00	0.00	0.00	#DIV/0!		
Electrical:								
Wiring	0.00		0.00	0.00	0.00	#DIV/0!		
Lighting	0.00		0.00	0.00	0.00	#DIV/0!		
Other	0.00		0.00	0.00	0.00	#DIV/0!		
Roofing	0.00		0.00	0.00	0.00	#DIV/0!		
Specialties & Miscellaneous	0.00		0.00	0.00	0.00	#DIV/0!		
Packaging	0.00		0.00	0.00	0.00	#DIV/0!		
Other	0.00		0.00	0.00	0.00	#DIV/0!		
TOTAL	**0.00**		**0.00**	**0.00**	**0.00**	**#DIV/0!**		

NRC Construction, Renovation and Demolition WASTE MATERIAL TRACKING FORM

(Entries required for every load leaving the site)

Project Name	#VALUE!
Project Type (Construction, Renovation or Demolition)	#VALUE!
Area (sq. m)	#VALUE!
Site Address	#VALUE!
Contact Person & Telephone	#VALUE!
Date	

Load #	Date	Time	Hauler	If Applicable:		Material Type(s)	Waybill # (if applicable)	Destination	Weight (metric Tonnes)				Comments
				Bin Size (yd^3)	Fill Level				Reuse	Recycling	Unspecified Diversion (Reuse or Recycling)	Landfill	
1	Dec 17/08	3:00pm	Waste Co.	20	3/4	Commingled Recyclates (metals, wood, concrete)	12345	Waste Co.					Waste sent to commingling recycling facility. Total weight and % diversion to be reported by hauler
2	Dec 17/08	4:00pm	Waste Co.	30	Full	Untreated Wood	12346	Waste Co.					Total weight to be reported by hauler
3	Dec 18/08	12:00pm	Waste Co.	20	Over Flowing	Miscellaneous Waste	12347	Landfill					Total weight to be reported by hauler
4	Dec 19/08	12:00pm	Man and His Truck	N/A	N/A	Doors	N/A	Resale					Totals weight estimated by hauler and PM
5													
6													
7													
8													
9													
10													

NRC Construction, Renovation and Demolition FINAL DIVERSION REPORT

Project Name	0
Project Type (Construction, Renovation or Demolition)	0
Area (sq. m)	0
Site Address	0
Contact Person & Telephone	0
Date	

Material	Actual Weight Diverted (metric tonnes)		Final Destination and End-Use of Diverted Materials	Total Weight Landfilled (metric tonnes)	TOTAL WEIGHT (metric tonnes)	Diversion Rate
	Re-used	Recycled				
Masonry and Pavement					0	#DIV/0!
Walls and Ceilings					0	#DIV/0!
Metal					0	#DIV/0!
Mechanical:						
HVAC					0	#DIV/0!
Plumbing					0	#DIV/0!
Fixtures					0	#DIV/0!
Other					0	#DIV/0!
Windows and Doors					0	#DIV/0!
Wood					0	#DIV/0!
Millwork and Finish Carpentry					0	#DIV/0!
Flooring					0	#DIV/0!
Electrical:						
Wiring					0	#DIV/0!
Lighting					0	#DIV/0!
Other					0	#DIV/0!
Roofing					0	#DIV/0!
Specialties & Miscellaneous					0	#DIV/0!
Cardboard					0	#DIV/0!
Other Packaging					0	#DIV/0!
Mixed Recycling					0	#DIV/0!
General Waste					0	#DIV/0!
Other					0	#DIV/0!
TOTAL	**0**	**0**		**0**	**0**	**#DIV/0!**

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.

.2 Acronyms:

.1 AFD - Alternate Forms of Delivery, service provider.
.2 BMM - Building Management Manual.
.3 Cx - Commissioning.
.4 EMCS - Energy Monitoring and Control Systems.
.5 O&M - Operation and Maintenance.
.6 PI - Product Information.
.7 PV - Performance Verification.
.8 TAB - Testing, Adjusting and Balancing.

1.2 GENERAL

.1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:

.1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
.2 Ensure appropriate documentation is compiled into the BMM.
.3 Effectively train O&M staff.

.2 Contractor assists in 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 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.

.3 Design Criteria: as per client's requirements or determined by designer. To meet Project functional and operational requirements.

1.3 COMMISSIONING OVERVIEW

.1 Section 01 91 31 - Commissioning (Cx) Plan.

.2 For Cx responsibilities refer to Section 01 91 31 - Commissioning (Cx) Plan.

.3 Cx to be a line item of Contractor's cost breakdown.

.4 Cx activities supplement field quality and testing procedures described in relevant technical sections.

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

.6 Departmental Representative will issue Interim Acceptance Certificate when:

.1 Completed Cx documentation has been received, reviewed for suitability and approved by Departmental Representative.

.2 Equipment, components and systems have been commissioned.

.3 O&M training has been completed.

1.4 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 unfunctional system, including related systems as deemed required by Departmental Representative, to ensure effective performance.

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

1.5 PRE-CX REVIEW

.1 Before Construction:

.1 Review contract documents, confirm by writing to Departmental Representative.

.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, systems is complete.

.3 Fully understand Cx requirements and procedures.

.4 Have Cx documentation shelf-ready.

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

.6 Submit complete start-up documentation to Departmental Representative.

.7 Have Cx schedules up-to-date.

.8 Ensure systems have been cleaned thoroughly.

.9 Complete TAB procedures on systems, submit TAB reports to Departmental Representative for review and approval.

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

.4 Inform Departmental Representative in writing of discrepancies and deficiencies on finished works.

1.6 CONFLICTS

.1 Report conflicts between requirements of this section and other sections to Departmental Representative before start-up and obtain clarification.

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

1.7 SUBMITTALS

.1 Submittals: in accordance with Section 00 10 00 – General Instructions.

.1 Submit no later than 4 weeks after award of Contract:

.1 Name of Contractor's Cx agent.

.2 Draft Cx documentation.

.3 Preliminary Cx schedule.

.2 Request in writing to Departmental Representative for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.

.3 Submit proposed Cx procedures to Departmental Representative where not specified and obtain written approval at least 8 weeks prior to start of Cx.

.4 Provide additional documentation relating to Cx process required by Departmental Representative.

1.8 COMMISSIONING DOCUMENTATION

.1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms for requirements and instructions for use.

.2 Departmental Representative to review and approve Cx documentation.

.3 Provide completed and approved Cx documentation to Departmental Representative.

1.9 COMMISSIONING SCHEDULE

.1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 00 10 00 – General Instructions.

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

.1 Approval of Cx reports.

.2 Verification of reported results.

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

.4 Training.

1.10 COMMISSIONING MEETINGS

.1 Convene Cx meetings following project meetings as specified herein.

.2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.

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

.4 At 60% construction completion stage. Departmental Representative to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:

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

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

.5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.

.6 Meeting will be chaired by Contractor's Cx Agent, who will record and distribute minutes.

.7 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

1.11 STARTING AND TESTING

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

1.12 WITNESSING OF STARTING AND TESTING

.1 Provide 14 days notice prior to commencement.

.2 Departmental Representative to witness of start-up and testing.

.3 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

1.13 MANUFACTURER'S INVOLVEMENT

.1 Factory testing: manufacturer to:

.1 Coordinate time and location of testing.

.2 Provide testing documentation for approval by Departmental Representative.

.3 Arrange for Departmental Representative to witness tests.

.4 Obtain written approval of test results and documentation from Departmental Representative before delivery to site.

.2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Departmental Representative

.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 manufacturer's 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.

1.14 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 in following distinct phases:

.1 Included in delivery and installation:

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

.2 Visual inspection of quality of installation.

.2 Start-up: follow accepted start-up procedures.

.3 Operational testing: document equipment performance.

.4 System PV: include repetition of tests after correcting deficiencies.

.5 Post-substantial performance verification: to include fine-tuning.

.3 Correct deficiencies and obtain approval from Departmental Representative after distinct phases have been completed and before commencing next phase.

.4 Document require tests on approved PV forms.

.5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Departmental Representative. 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 Departmental Representative.

.2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Departmental Representative.

.3 If evaluation report concludes that major damage has occurred, Departmental Representative shall reject equipment.

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

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

1.15 START-UP DOCUMENTATION

.1 Assemble start-up documentation and submit to Departmental Representative for approval before commencement of commissioning.

.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 Departmental Representative to repeat start-up at any time.

1.16 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 Departmental Representative 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 interim acceptance.

1.17 TEST RESULTS

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

.2 Provide manpower and materials, assume costs for re-commissioning.

1.18 START OF COMMISSIONING

.1 Notify Departmental Representative at least 5 days prior to start of Cx.

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

1.19 INSTRUMENTS / EQUIPMENT

.1 Submit to Departmental Representative 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.

1.20 COMMISSIONING PERFORMANCE VERIFICATION

.1 Carry out Cx:

.1 Under actual 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.

1.21 WITNESSING COMMISSIONING

.1 Departmental Representative to witness activities and verify results.

1.22 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 Departmental Representative within 5 days of test and with Cx report.

1.23 COMMISSIONING CONSTRAINTS

.1 Since access into secure or sensitive areas will be very difficult after occupancy it is necessary to complete Cx of occupancy, weather, and seasonal sensitive equipment and systems in these areas before issuance of the Interim Certificate, using, if necessary, simulated thermal loads.

1.24 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 Departmental Representative in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

1.25 EXTENT OF VERIFICATION

.1 Laboratory areas:

.1 Provide manpower and instrumentation to verify 100 % of reported results.

.2 Critical systems:

.1 Provide manpower and instrumentation to verify 100 % of reported results.

.2 Systems such as the following shall be deemed critical: chillers/chiller plant systems (ie. associated pumps, controllers, etc.), heat exchangers, and heat pumps.

.3 Elsewhere:

.1 Provide manpower and instrumentation to verify 30 % of reported results, unless specified otherwise in other sections.

.4 Number and location to be at discretion of Departmental Representative.

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

.6 Review and repeat commissioning of systems if inconsistencies found in more than 20 % of reported results. Repeat verifications shall be performed in accordance to the following unless otherwise specified.

.1 Laboratory areas:

.1 Second and subsequent verifications:

.1 Provide manpower and instrumentation to verify 100 % of reported results.

.2 Critical systems:

.1 Second and subsequent verifications:

.1 Provide manpower and instrumentation to verify 100 % of reported results.

.3 Elsewhere:

.1 Second verification:

.1 Provide manpower and instrumentation to verify 100 % of all failed tests results.

.2 Provide manpower and instrumentation to verify an additional 20% of reported results, locations to be at the discretion of the Departmental Representative.

.2 Third and subsequent verifications:

.1 Provide manpower and instrumentation to verify 100 % of reported results.

.7 Perform additional commissioning until results are acceptable to Departmental Representative.

1.26 REPEAT VERIFICATIONS

.1 Assume costs incurred by Departmental Representative for third and subsequent verifications where:

.1 Verification of reported results fail to receive Departmental Representative's approval.

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

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

1.27 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.

1.28 DEFICIENCIES, FAULTS, DEFECTS

.1 Correct deficiencies found during start-up and Cx to satisfaction of Departmental Representative.

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

1.29 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 Departmental Representative.

1.30 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.

1.31 TRAINING

.1 In accordance with Section 01 91 41 - Commissioning (Cx) - Training.

1.32 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

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

1.33 OCCUPANCY

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

1.34 INSTALLED INSTRUMENTATION

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

.1 Accuracy complies with these specifications.

.2 Calibration certificates have been deposited with Departmental Representative.

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

1.35 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.

1.36 OWNER'S PERFORMANCE TESTING

.1 Performance testing of equipment or system by Departmental Representative 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 Cx Plan and roles and responsibilities of Cx team.

.2 Related Sections:

.1 Section 01 91 33 - Commissioning (Cx) Forms.
.2 Section 01 91 41 - Commissioning (Cx) – Training.

1.2 REFERENCES

.1 American Water Works Association (AWWA)

.2 National Fire Protection Association (NFPA)

.1 NFPA-13-02, Installation of Sprinkler Systems Handbook.
.2 NFPA-14-02, Automatic Sprinkler Systems Handbook.
.3 NFPA-20-03, Standard for the Installation of Stationary Fire Pumps for Fire Protection.

.3 Public Works and Government Services Canada (PWGSC)

.1 PWGSC - Commissioning Guidelines CP.4 -3rd edition-03.

.4 Underwriters' Laboratories of Canada (ULC)

1.3 GENERAL

.1 Provide a fully functional facility:

.1 Systems, equipment and components meet user's functional requirements before date of acceptance, and operate consistently at peak efficiencies and within specified energy budgets under normal loads.
.2 Facility user and O&M personnel have been fully trained in aspects of installed systems.
.3 Optimized life cycle costs.
.4 Complete documentation relating to installed equipment and systems.

.2 Term "Cx" in this section means "Commissioning".

.3 Use this Cx Plan as master planning document for Cx:

.1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.
.2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.
.3 Sets out deliverables relating to O&M, process and administration of Cx.
.4 Describes process of verification of how built works meet Owner's design requirements.
.5 Produces a complete functional system prior to issuance of Certificate of Occupancy.
.6 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.

.4 Acronyms:

.1 Cx - Commissioning.
.2 BMM - Building Management Manual.
.3 EMCS - Energy Monitoring and Control Systems.
.4 MSDS - Material Safety Data Sheets.
.5 PI - Product Information.
.6 PV - Performance Verification.
.7 TAB - Testing, Adjusting and Balancing.
.8 WHMIS - Workplace Hazardous Materials Information System.

.5 Commissioning terms used in this Section:

.1 Bumping: short term start-up to prove ability to start and prove correct rotation.
.2 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.

1.4 DEVELOPMENT OF 100% CX PLAN

.1 Cx Plan to be 95% completed before added into Project Specifications.

.2 Cx Plan to be 100% completed within 8]weeks of award of contract 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.

.3 Submit completed Cx Plan to Departmental Representative and obtain written approval.

1.5 REFINEMENT OF CX PLAN

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

.1 Changes resulting from Client program modifications.
.2 Approved design and construction changes.

.2 Revise, refine and update every 6 weeks during construction phase. At each revision, indicate revision number and date.

.3 Submit each revised Cx Plan to Departmental Representative for review and obtain written approval.

.4 Include testing parameters at full range of operating conditions and check responses of equipment and systems.

1.6 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM

.1 Departmental Representative to maintain overall responsibility for project and is sole point of contact between members of commissioning team.

.2 Project Manager will select Cx Team consisting of following members:

.1 Departmental Representative is responsible for:
.1 Organizing Cx.
.2 Monitoring operations Cx activities.

.3 Witnessing, certifying accuracy of reported results.

.4 Witnessing and certifying TAB and other tests.

.5 Developing BMM.

.6 Ensuring implementation of final Cx Plan.

.7 Performing verification of performance of installed systems and equipment.

.8 Implementation of Training Plan.

.2 Construction Team: contractor, sub-contractors, suppliers and support disciplines, is responsible for construction/installation in accordance with contract documents, including:

.1 Testing.

.2 TAB.

.3 Performance of Cx activities.

.4 Delivery of training and Cx documentation.

.5 Assigning one person as point of contact with Consultant and PWGSC Cx Manager for administrative and coordination purposes.

.3 Contractor's Cx agent implements specified Cx activities including:

.1 Demonstrations.

.2 Training.

.3 Testing.

.4 Preparation, submission of test reports.

.4 Property Manager: represents lead role in Operation Phase and onwards and is responsible for:

.1 Receiving facility.

.2 Day-To-Day operation and maintenance of facility.

1.7 CX PARTICIPANTS

.1 Employ the following Cx participants to verify performance of equipment and systems:

.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 Client: responsible for intrusion and access security systems.

.6 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.

.7 Provide names of participants to Departmental Representative and details of instruments and procedures to be followed for Cx 3 months prior to starting date of Cx for review and approval.

1.8 EXTENT OF CX

.1 Commission mechanical systems and associated equipment:

.1 HVAC systems:

.1 Air-cooled chiller.
.2 Expansion tank.
.3 Glycol fill station.
.4 Heat exchanger.
.5 Heat pump.
.6 Control systems.

.2 Commission electrical systems and equipment:

.1 Low voltage below 750 V:

.1 Low voltage equipment.
.2 Low voltage distribution systems.

1.9 DELIVERABLES RELATING TO O&M PERSPECTIVES

.1 General requirements:

.1 Compile English and French documentation.
.2 Documentation to be computer-compatible format ready for inputting for data management.

.2 Provide deliverables:

.1 Warranties.
.2 Project record documentation.
.3 Inventory of spare parts, special tools and maintenance materials.
.4 Maintenance Management System (MMS) identification system used.
.5 WHMIS information.
.6 MSDS data sheets.
.7 Electrical Panel inventory containing detailed inventory of electrical circuitry for each panel board. Duplicate of inventory inside each panel.

1.10 DELIVERABLES RELATING TO THE CX PROCESS

.1 General:

.1 Start-up, testing and Cx requirements, conditions for acceptance and specifications form part of relevant technical sections of these specifications.

.2 Definitions:

.1 Cx as used in this section includes:

.1 Cx of components, equipment, systems, subsystems, and integrated systems.
.2 Factory inspections and performance verification tests.

.3 Deliverables: provide:

.1 Cx Specifications.
.2 Startup, pre-Cx activities and documentation for systems, and equipment.
.3 Completed installation checklists (ICL).
.4 Completed product information (PI) report forms.

.5 Completed performance verification (PV) report forms.

.6 Results of Performance Verification Tests and Inspections.

.7 Description of Cx activities and documentation.

.8 Description of Cx of integrated systems and documentation.

.9 Tests performed by Owner.

.10 Training Plans.

.11 Cx Reports.

.12 Prescribed activities during warranty period.

.4 Departmental Representative to witness and certify tests and reports of results provided to Departmental Representative.

.5 Departmental Representative to participate.

1.11 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION

.1 Items listed in this Cx Plan include the following:

.1 Pre-Start-Up inspections: by Departmental Representative prior to permission to start up and rectification of deficiencies to Departmental Representative's satisfaction.

.2 Departmental Representative to use approved check lists.

.3 Departmental Representative will monitor all of these pre-start-up inspections.

.4 Include completed documentation with Cx report.

.5 Conduct pre-start-up tests: conduct pressure, static, flushing, cleaning, and "bumping" during construction as specified in technical sections. To be witnessed and certified by Departmental Representative and does not form part of Cx specifications.

.6 Departmental Representative will monitor some of these inspections and tests.

.2 Pre-Cx activities - MECHANICAL:

.1 HVAC equipment and systems:

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

.2 At this time, complete pre-start-up checks and complete relevant documentation.

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

.4 Perform TAB on systems. TAB reports to be approved by Departmental Representative.

.3 Pre-Cx activities - ELECTRICAL:

.1 Low voltage distribution systems under 750 V:

.1 Requires independent testing agency to perform pre- energization and post-energization tests.

1.12 START-UP

.1 Start up components, equipment and systems.

.2 Equipment manufacturer, supplier, installing specialist sub-contractor, as appropriate, to start-up, under Contractor's direction, following equipment, systems:

.1 Air-cooled chiller.

.2 Expansion tank.

.3 Glycol fill station.

.4 Heat exchanger.

.5 Heat pump.

.6 Control systems.

.3 Departmental Representative to monitor some of these start-up activities.

.1 Rectify start-up deficiencies to satisfaction of Departmental Representative.

.4 Performance Verification (PV):

.1 Approved Cx Agent to perform.

.1 Repeat when necessary until results are acceptable to Departmental Representative.

.2 Use procedures modified generic procedures to suit project requirements.

.3 Departmental Representative to witness and certify reported results using approved PI and PV forms.

.4 Departmental Representative to approve completed PV reports.

.5 Departmental Representative reserves right to verify up to 50% of reported results at random.

.6 Failure of randomly selected item shall result in rejection of PV report or report of system startup and testing.

1.13 CX ACTIVITIES AND RELATED DOCUMENTATION

.1 Perform Cx by specified Cx agency using procedures developed by Departmental Representative and approved by Departmental Representative.

.2 Departmental Representative to monitor Cx activities.

.3 Upon satisfactory completion, Cx agency performing tests to prepare Cx Report using approved PV forms.

.4 Departmental Representative to witness, certify reported results of, Cx activities.

.5 Departmental Representative reserves right to verify a percentage of reported results at no cost to contract.

1.14 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION

.1 Cx to be performed by specified Cx specialist, using procedures developed and approved by Departmental Representative.

.2 Tests to be witnessed by Departmental Representative and documented on approved report forms.

.3 Upon satisfactory completion, Cx specialist to prepare Cx Report, to be certified by Departmental Representative and submitted to Departmental Representative for review.

.4 Departmental Representative reserves right to verify percentage of reported results.

.5 Integrated systems to include:

.1 All cooling and ventilation systems.

.6 Identification:

.1 In later stages of Cx, before hand-over and acceptance Departmental Representative, and Cx Manager to co-operate to complete inventory data sheets and provide assistance to PWGSC in full implementation of MMS identification system of components, equipment, sub-systems, systems.

1.15 INSTALLATION CHECK LISTS (ICL)

.1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.16 PRODUCT INFORMATION (PI) REPORT FORMS

.1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.17 PERFORMANCE VERIFICATION (PV) REPORT

.1 Refer to Section 01 91 33 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.18 DELIVERABLES RELATING TO ADMINISTRATION OF CX

.1 General:

.1 Because of risk assessment, complete Cx of occupancy, weather and seasonal-sensitive equipment and systems in these areas before building is occupied.

1.19 CX SCHEDULES

.1 Prepare detailed critical path Cx Schedule and submit to Departmental Representative for review and approval same time as project Construction Schedule. Include:

.1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:

.1 Design criteria, design intents.

.2 Pre-TAB review: 28 days after contract award, and before construction starts.

.3 Cx agents' credentials: 60 days before start of Cx.

.4 Cx procedures: 3 months after award of contract.

.5 Cx Report format: 3 months after contract award.

.6 Discussion of heating/cooling loads for Cx: 3 months before start-up.

.7 Submission of list of instrumentation with relevant certificates: 21 days before start of Cx.

.8 Notification of intention to start TAB: 21 days before start of TAB.

.9 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.

.10 Notification of intention to start Cx: 14 days before start of Cx.

.11 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 14 days before start of integrated system Cx.

.12 Identification of deferred Cx.

.13 Implementation of training plans.

.14 Cx reports: immediately upon successful completion of Cx.

.2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to Property Manager.

.3 6 months in Cx schedule for verification of performance in all seasons and wear conditions.

.2 After approval, incorporate Cx Schedule into Construction Schedule.

.3 Consultant, Contractor, Contractor's Cx agent, and Departmental Representative will monitor progress of Cx against this schedule.

1.20 CX REPORTS

.1 Submit reports of tests, witnessed and certified by Departmental Representative to Departmental Representative who will verify reported results.

.2 Include completed and certified PV reports in properly formatted Cx Reports.

.3 Before reports are accepted, reported results to be subject to verification by Departmental Representative.

1.21 ACTIVITIES DURING WARRANTY PERIOD

.1 Cx activities must be completed before issuance of Interim Certificate, it is anticipated that certain Cx activities may be necessary during Warranty Period, including:

.1 Fine tuning of HVAC systems.

.2 Adjustment of ventilation rates to promote good indoor air quality and reduce deleterious effects of VOCs generated by off-gassing from construction materials and furnishings.

.3 Full-scale emergency evacuation exercises.

1.22 TESTS TO BE PERFORMED BY OWNER/USER

.1 None is anticipated on this project.

1.23 TRAINING PLANS

.1 Refer to Section 01 91 41 - Commissioning (Cx) - Training.

1.24 FINAL SETTINGS

.1 Upon completion of Cx to satisfaction of Departmental Representative lock control devices in their final positions, indelibly mark settings marked and include in Cx Reports.

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, system and integrated system.

1.2 INSTALLATION/START-UP CHECK LISTS

.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 installation/start-up check lists are acceptable for use. As deemed necessary by Departmental Representative supplemental additional data lists will be required for specific project conditions.

.3 Use check lists for equipment installation. Document check list verifying checks have been made, indicate deficiencies and corrective action taken.

.4 Installer to sign check lists upon completion, certifying stated checks and inspections have been performed. Return completed check lists to Departmental Representative. Check lists will be required during Commissioning and will be included in Building Maintenance Manual (BMM) at completion of project.

.5 Use of check lists will not be considered part of commissioning process but will be stringently used for equipment pre-start and start-up procedures.

1.3 PRODUCT INFORMATION (PI) REPORT FORMS

.1 Product Information (PI) forms compiles gathered data on items of equipment produced by equipment manufacturer, includes nameplate information, parts list, operating instructions, maintenance guidelines and pertinent technical data and recommended checks that is necessary to prepare for start-up and functional testing and used during operation and maintenance of equipment. This documentation is included in the BMM at completion of work.

.2 Prior to Performance Verification (PV) of systems complete items on PI forms related to systems and obtain Departmental Representative's approval.

1.4 PERFORMANCE VERIFICATION (PV) FORMS

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

.2 PV report forms include those developed by Contractor records measured data and readings taken during functional testing and Performance Verification procedures.

.3 Prior to PV of integrated system, complete PV forms of related systems and obtain Departmental Representative's approval.

1.5 SAMPLES OF COMMISSIONING FORMS

.1 Departmental Representative will develop and provide to Contractor required project-specific Commissioning forms in electronic format complete with specification data.

.2 Revise items on Commissioning forms to suit project requirements.

.3 Samples of Commissioning forms and a complete index of produced to date will be attached to this section.

1.6 CHANGES AND DEVELOPMENT OF NEW REPORT FORMS

.1 When additional forms are required, but are not available from Departmental Representative develop appropriate verification forms and submit to Departmental Representative for approval prior to use.

.1 Additional commissioning forms to be in same format as provided by Departmental Representative.

1.7 COMMISSIONING FORMS

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

.2 Strategy for Use:

.1 Departmental Representative 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 Departmental Representative.

.9 Submit immediately after tests are performed.

.10 Reported results in true measured SI unit values.

.11 Provide Departmental Representative with originals of completed forms.

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

1.8 LANGUAGE

.1 To suit the language profile of the awarded contract.

PART 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

Air-Cooled Chiller Cx Checklist

EQUIPMENT INFORMATION

SAP Equipment ID:	
Project No:	Project Number
Drawing No:	
Manufacturer:	
Model No.:	
Serial No.:	
Flow Range (m^3):	
Area Served:	
Location:	
Capacity (Tons):	
Service:	
Refrigerant:	
Refrigerant Charge (□ kg □ lbs):	
Chilled Water Flow (GPM):	
Evaporator - No. of passes:	
Condenser - No. of passes:	
Compressor Motor HP:	
Electrical: V/ φ/ Hz:	
Fluid through Evaporator:	
Number of Circuits:	
Condenser Fan Type:	
Condenser Fan Airflow (m3/h):	
Vibration Isolators:	
Condenser Fan Motor HP:	

PREREQUISITE (check to confirm that the following prerequisites are documented)

□ Shop Drawing Received	□ Installation Complete
□ Start-up Process per Manufacturer's Instructions Complete	□ Connected to BAS
□ Sequence Complete	□ Testing, Adjusting and Balancing Report Received
□ Seismic Review Letter Received	
Comments:	

EQUIPMENT ITEMS TO BE VERIFIED

This checklist does not take the place of the manufacturer's recommended checkout and start-up procedures or report.

Equipment Items	Yes / No	Comments
Equipment identification label has been applied and follows NRC naming convention		

Chiller started by manufacturer and report attached		
Chilled water pipe leak tested		
Local protection/interlocks/alarms are functional		
Coil fins are undamaged		
Verification of abnormal noise and vibration		
Verification of isolation/spring deflection on start-up & shutdown		
Any unusual vibration, noise, etc.?		
Comments:		

ELEMENTS TO BE MEASURED FOR DESIGN VALIDATION

This checklist does not take the place of the manufacturer's recommended checkout and start-up procedures or report.

Measured Element	Instrument (portable/BAS/local)	Design	Measured 1	Measured 2
Chilled water flow (l/s - GPM)				
Entering chilled water temperature (^{o}C - ^{o}F)				
Leaving chilled water temperature (^{o}C - ^{o}F)				
Ambient dry bulb temperature (^{o}C - ^{o}F)				
Ambient wet bulb temperature (^{o}C - ^{o}F)				
Chiller inlet pressure (kPa - "H_2O)				
Chiller outlet pressure (kPa - "H_2O)				
Voltage (T_1-T_{2-}, T_2-T_3, T_3-T_1)				
Amperage (I_1, I_2, I_3)				
Fuse/Breaker Rating (A)				
Comments:				

CONTROL SYSTEM ITEMS TO BE BE VERIFIED

Control System Items	Yes / No	Comments
NRC Graphics Standard Checklist Completed		
NRC BAS Field Equipment Checklist Completed		
NRC Sequence Standard Checklist Completed		
Have the required BacNet points been mapped back to the BAS system?		
Have scheduled points been added to the All Points Log (APL)		
Controller online		
Graphics created		
Link to written sequence on system graphic		
Equipment shown on BAS floor plan		
Network layout shown on BAS floor plan		
SAP Equipment ID used in BAS		
Nametags for chiller and BAS control points installed		
BAS Controller labelled		
Power source labelled on controller		
Comments:		

CONTROL SYSTEM PRE-FUNCTIONAL CHECKS - TBC

		Observations, Notes & Comments
Initial Conditions:		
Manually override the cooling valve to obtain:		
From BAS, command cooling valve closed (note travel time)	Record (mA):	
	Physically check that valve (stem) is open: ☐ Y ☐ N	
From BAS, command cooling valve open (note travel time)	Record (mA):	
	Physically check that valve (stem) is closed: ☐ Y ☐ N	
Return to automatic.		
Return all changed control parameters and conditions to their pre-functional check values.		
Comments:		

TBC - To be completed by Cx Agent and Contractor based on the control sequence.

CONTROL SEQUENCE FUNCTIONAL PERFORMANCE TEST - TBC

Functional Performance Test Procedure	Expected, Actual Response & Comments		Pass (Y / N)
System stopped:			
System start-up:			
Start chilled water pump and ensure chilled water flow	Chilled water proof of flow switch should be energized		
	Verify that the control system energizes the chiller start sequence		
	Verify that the chiller senses chilled water temperature above set point and control system activates chiller start		
	Verify functioning of any other 'start' sequences as described in the sequence of operation		
Shut off the air handling equipment to remove the load on the chilled water system	Verify that the chiller shutdown sequence is initiated and accomplished after the load is removed		
Restart air handling equipment one minute after chiller shutdown	Verify chiller restart sequence is functional		
Normal mode:			
Control points:			
Local protection:			
Alarms:			
Return all changed control parameters and conditions to their pre-functional performance test values.			
Comments:			

TBC - To be completed by Cx Agent and Contractor based on the control sequence.

Expansion Tank Cx Checklist

EQUIPMENT INFORMATION

SAP Equipment ID:	
Project No:	Project Number
Drawing No:	
Manufacturer:	
Model No.:	
Serial No.:	
Location (Rm #):	
Type:	
Fluid:	
CRN No.:	
Total Volume (L):	

Acceptance Volume (L):	
Maximum Operating Pressure (kPa):	
System Served:	
SAP Equipment ID of System/Equipment Served:	

PREREQUISITE (check to confirm that the following prerequisites are documented)

☐ Shop Drawing Received	☐ Installation Complete
☐ Start-up Process per Manufacturer's Instructions Complete	☐ Connected to BAS
☐ Sequence Complete	☐ System Balanced
☐ Seismic Review Letter Received	

Comments:

EQUIPMENT ITEMS TO BE VERIFIED

This checklist does not take the place of the manufacturer's recommended checkout and start-up procedures or report.

Equipment Items	Yes / No	Comments
Expansion tank's installation & start-up completed and form/report attached		
Equipment identification label has been applied and follows NRC naming convention		
Pressure gauges, backflow preventer, air separator and make-up valve installed/operational		
Verification of abnormal noise and vibration		
Relief valve installed and operational		

Comments:

ELEMENTS TO BE MEASURED FOR DESIGN VALIDATION

This checklist does not take the place of the manufacturer's recommended checkout and start-up procedures or report.

Measured Element	Instrument (portable/BAS/local)	Design	Measured 1	Measured 2
Pre-charge pressure (kPa)				
Pressure relief valve setting (kPa)				
Comments:				

CONTROL SYSTEM ITEMS TO BE BE VERIFIED

Control System Items	Yes / No	Comments
NRC Graphics Standard Checklist Completed		
NRC BAS Field Equipment Checklist Completed		
Controller online		
Graphics created		
Equipment shown on BAS floor plan		
Network layout shown on BAS floor plan		
SAP Equipment ID used in BAS		
Nametags for expansion tank and BAS control points installed		
BAS Controller labelled		
Power source labelled on controller		
Comments:		

Glycol Fill Station Cx Checklist

EQUIPMENT INFORMATION

SAP Equipment ID:	
Project No:	Project Number
Drawing No:	
Manufacturer:	
Model No.:	
Serial No.:	
Area Served:	
Location (Rm #):	
Service:	
Glycol Fluid Type:	
Mix Percentage:	
Tank Volume (L):	
Other SAP Equipment Part IDs of System (i.e.50BLR01 & 50HWP01):	

PREREQUISITE (check to confirm that the following prerequisites are documented)

☐ Shop Drawing Received	☐ Installation Complete
☐ Start-up Process per Manufacturer's Instructions Complete	☐ Connected to BAS
☐ Sequence Complete	
Comments:	

EQUIPMENT ITEMS TO BE VERIFIED

This checklist does not take the place of the manufacturer's recommended checkout and start-up procedures or report.

Equipment Items	Yes / No	Comments
Fill station installation & start-up completed and form/report attached		
Equipment identification label has been applied and follows NRC naming convention		
Pressure gauges, check valve, isolation valve installed/operational		
Verification of abnormal noise and vibration		
Relief valve installed and operational		
Comments:		

ELEMENTS TO BE MEASURED FOR DESIGN VALIDATION

This checklist does not take the place of the manufacturer's recommended checkout and start-up procedures or report.

Measured Element	Instrument (portable/BAS/local)	Design	Measured 1	Measured 2
Voltage (T_1-T_2 / T_2-T_3 / T_1-T_3)				
Amperage (I_1, I_2, I_3)				
Fuse/Breaker Rating (A)				
Pump HP				
Pump RPM				
System pressure drop at full flow (kPa - "H_2O)				
Pressure switch setting (kPa - "H_2O)				
Comments:				

CONTROL SYSTEM ITEMS TO BE BE VERIFIED

Control System Items	Yes / No	Comments
NRC Graphics Standard Checklist Completed		
NRC BAS Field Equipment Checklist Completed		
Have scheduled points been added to the All Points Log (APL)		
Controller online		
Graphics created		
Link to written sequence on system graphic		
Equipment shown on BAS floor plan		
Network layout shown on BAS floor plan		
SAP Equipment ID used in BAS		
Nametags for glycol fill station and BAS control points installed		
BAS Controller labelled		
Power source labelled on controller		
Comments:		

CONTROL SYSTEM PRE-FUNCTIONAL CHECKS - TBC

	Observations, Notes & Comments
Test that alarm points all report back to BAS (Y/N):	
Return all changed control parameters and conditions to their pre-functional check values.	
Comments:	

TBC - To be completed by Cx Agent and Contractor based on the control sequence.

Heat Exchanger Cx Checklist

EQUIPMENT INFORMATION

SAP Equipment ID:	
Project No:	Project Number
Drawing No:	
Manufacturer:	
Model No.:	
Serial No.:	
Area Served:	
Location:	

Type of System (ie. Chilled Water, Process Water, Heating, etc.):	
# of Plates / Max # of Plates:	
Other SAP Equipment IDs in System (i.e. 50BLR01, etc.):	
CRN Identification (if applicable):	
Part of System with Seasonal Switchover (if applicable):	
Seasonal Switchover (if applicable):	☐ Automatic ☐ Manual

PREREQUISITE (check to confirm that the following prerequisites are documented)

☐ Shop Drawing Received	☐ Installation Complete
☐ Start-up Process per Manufacturer's Instructions Complete	☐ Connected to BAS
☐ Sequence Complete	
Comments:	

EQUIPMENT ITEMS TO BE VERIFIED

This checklist does not take the place of the manufacturer's recommended checkout and start-up procedures or report.

Equipment Items	Yes / No	Comments
Heat exchanger installation & start-up completed and form/report attached		
Equipment identification label has been applied and follows NRC naming convention		
Pressure and temperatur gauges, isolation valves, drains, air vents, installed/operational		
Verification of abnormal noise and vibration		
Comments:		

ELEMENTS TO BE MEASURED FOR DESIGN VALIDATION

This checklist does not take the place of the manufacturer's recommended checkout and start-up procedures or report.

Measured Element	Instrument (portable/BAS/local)	Design	Measured 1	Measured 2
Hot Side				
Fluid type				
Entering temp (^{o}C - ^{o}F)				
Leaving temp (^{o}C - ^{o}F)				
Fluid flow (l/s - GPM)				
Pressure drop (kPa - "H_20)				
Capacity (kW)				
Cold Side				
Fluid type				
Entering temp (^{o}C - ^{o}F)				
Leaving temp (^{o}C - ^{o}F)				
Fluid flow (l/s - GPM)				
Pressure drop (kPa - "H_20)				
Capacity (kW)				
Comments:				

CONTROL SYSTEM ITEMS TO BE BE VERIFIED

Control System Items	Yes / No	Comments
NRC Graphics Standard Checklist Completed		
NRC BAS Field Equipment Checklist Completed		
Have scheduled points been added to the All Points Log (APL)		
Controller online		
Graphics created		
Link to written sequence on system graphic		
Equipment shown on BAS floor plan		
Network layout shown on BAS floor plan		
SAP Equipment ID used in BAS		
Control valves installed and operations under free cooling mode		

Temperature sensor verified on BAS		
Nametags for cooling tower and BAS control points installed		
BAS Controller labelled		
Power source labelled on controller		
Comments:		

Heat Pump Cx Checklist

EQUIPMENT INFORMATION

SAP Equipment ID:	
Project No:	Project Number
Drawing No:	
Manufacturer:	
Model No.:	
Serial No.:	
Area Served:	
Service:	
Location:	

Electrical: ___V/ ___ φ/ ___ Hz	
Motor Type:	☐ Duct-mounted ☐ Ceiling-mounted ☐ Wall-mounted
Heating Type:	☐ VRF ☐ Reversing Valve
Refrigerant:	
Refrigerant Charge ☐ kg ☐ lbs :	
Compressor Amperage Rating:	

PREREQUISITE (check to confirm that the following prerequisites are documented)

☐ Shop Drawing Received	☐ Installation Complete
☐ Start-up Process per Manufacturer's Instructions Complete	☐ Connected to BAS
☐ Sequence Complete	☐ System Balanced
☐ Seismic Review Letter Received	☐ Refrigerant piping layout design submitted and approved
☐ Piping pressure tested and witnessed by Cx Agent	
Comments:	

EQUIPMENT ITEMS TO BE VERIFIED

This checklist does not take the place of the manufacturer's recommended checkout and start-up procedures or report.

Equipment Items	Yes / No	Comments
Equipment identification label has been applied and adheres to NRC naming convention.		
Outdoor Unit:		
Enough space all around the unit for air flow		
Level on housekeepiung pads		
If located on ground, is it protected from cars and other potential damage		
If located on roof, is it properly tied down for wind requirements		

Insulation is complete on refrigerant lines.		

Indoor Unit:		
Condensate pump installed		
Seismic reatraints installed as required in contract documents		
Is there sufficient access both electrically and mechanically		
Canvas connection installed		
Duct-mounted units - duct connections to both sides of the evaporator are secure and no sigh of leakage		
Wall-mounted/ceiling-mounted units - verify location of condensate pump (if specified). Ensure there is no danger of it falling down		
Refrigerant Piping:		
The refrigerant type is correct.		
Pipe size is as per specification.		
Pipes are supported as per specification.		
Layout does not pose a trip hazard and follows design layout.		
Piping pressure tested for the specified time and pressure.		
Insulation is complete and continuous.		
Expansion Valve:		
Visually inspect them in the field to ensure they are properly connected.		
VRF:		
Vertical and horizontal refrigerant line limit requirements adhere to the design drawing layout and drawing details. **If the installation is suspect for exceeding vertical and horizontal run lines, the Cx Agent needs to go measure it**		
All pieces and parts have been installed and Cx agent has *inspected prior to insulation.* **Important** - Ensure alll fittings in the refrigerant line have been properly installed. (Pay close attention to this as they can be often overlooked, left on floor and not installed. The system will NOT work without them)		
Comments:		

ELEMENTS TO BE MEASURED FOR DESIGN VALIDATION

This checklist does not take the place of the manufacturer's recommended checkout and start-up procedures or report.

Measured Element	Instrument (portable/BAS/local)	Design	Measured 1	Measured 2
Piping pressure test for specified duration and pressure				
Refrigerant charge				
Pipe size to be double checked prior to insulation				
Compressor amperage draw				
Compressor Voltage				
Compressor Suction Side Pressure				
Compressor Suction Side Temperature				
Compressor Discharge Side Pressure				
Superheat				
Airflow of each indoor unit (CFM -				
BTU				
EAT of each indoor unit (^{o}F -^{o}C)				
LAT of each indoor unit (^{o}F - ^{o}C)				
Comments:				

CONTROL SYSTEM ITEMS TO BE BE VERIFIED

Control System Items	Yes / No	Comments
NRC Graphics Standard Checklist Completed		
NRC BAS Field Equipment Checklist Completed		
NRC Sequence Standard Checklist Completed		
Have the required BacNet points been mapped back to the BAS system?		
Have scheduled points been added to the All Points Log (APL)		
Controller online		
Graphics created		
Link to written sequence on system graphic		
Equipment shown on BAS floor plan		

Network layout shown on BAS floor plan		
SAP Equipment ID used in BAS		
Nametags for Heat Pump and BAS control points installed		
BAS Controller labelled		
Power source labelled on controller		
Comments:		

CONTROL SYSTEM PRE-FUNCTIONAL CHECKS - TBC

	Observations, Notes & Comments
Initial Conditions:	
Reversing Valve:	
Put system in heating mode and check that the temperature is trending properly	
Put system in cooling mode and check that the temperature is trending properly	
Return to automatic	
Return all changed control parameters and conditions to their pre-functional check values.	
Comments:	

TBC - To be completed by Cx Agent and Contractor based on the control sequence.

CONTROL SEQUENCE FUNCTIONAL PERFORMANCE TEST - TBC

Functional Performance Test Procedure	Expected, Actual Response & Comments	Pass (Y / N)
System stopped:		
System start-up:		
Normal mode:		
Verify loading and unloading of compressors. Make sure to write a script so that it can be performed in the field. Be specific about how to checkthe unloading and loading and under which conditions it needs to be done so that it is done right		
VRF - Branch Circuit Controller - *Most common point of failure on system startup due to it's complexity.* Cx Agent must write a script based on the specific OEM sequence. Ensure that you test all combinations of scenarios. This will take time but is crucial. For example, say you have a condenser and multiple evaporators, you will have to run one or two in cooling and one or two in heating and then switch them to make sure that the gas and vapour controller (VRF) is working		
If lead-lag sequence, this operation needs to be checked		
Control points:		
Seasonal testing is critical because you cannot simulate wet bulb temperature. If not, you will not be testing the true performance of the condenser or evaporator depending on which way the refrigerant is going		
Local protection:		
Alarms:		
Compressors		
Check that the compressors are working. i.e. if a dual compressor, make sure that each one comes online so that if one fails, the other will take over. Has alarm been generated according to NRC alarm notification requirements		
Return all changed control parameters and conditions to their pre-functional performance test values.		
Comments:		

TBC - To be completed by Cx Agent and Contractor based on the control sequence.

NRC BAS Field Equipment Checklist

return to index

To be completed by BAS Contractor and submitted to NRC team for review prior to start of commissioning.

Item	Qty	Yes/No	Deficiencies
Nameplates for panel/cabinets - Standard is black on white melamine - 1" x 2-3/4"			
Nameplates for controllers - Standard is black on white stick-on label			
Field controllers - Controllers located in finished ceiling space must have an orange circle on t-bar below the controller identifying its location			
Nameplate for Field Devices - Standard is plastic encased card			
Nameplates for room sensors - Standard is black on white stick-on label			
Warning signs - Starters under remote automatic control			
Wiring:			
Tape markings on wiring inside panels to identify BAS point name			
Power wiring - identify circuit breaker panel/circuit breaker number inside each EMCS panel			
Conduit:			
New conduit to be in pre-painted orange conduit			
Existing conduit to use florescent orange paint to identify control wiring			
Prepaint box covers and fittings in florescent orange			

NRC BAS Graphics Standard Checklist

To be completed by BAS Contractor and submitted NRC for review prior to start of commissioning.						
	Building Name					
Item	**System Name**	**i.e 19AHU01**	**System Name**	**i.e 19AHU01**	**System Name**	**i.e 19AHU01**
Building name, system name and system description to be identified on each i.e. **M24 - 24AHU01 – Environmental Lab**						
Location of system to be identified on each graphic (directly under the system name). (i.e. **Basement Mechanical Room 02**						
NRC equipment names used to identify mechanical equipment. Format to be **black on white** consistent with NRCs equipment tags. (except bacnet points- black on blue background)						
Network point path to display when mouse is over BAS point. Applicable for all points						
Provide unique sequence of operation graphic or pop-up window in plain English for each graphic that is depicted on OWS. Provide access to plain English sequence of operation graphic by link button on each system graphic. Sequences operation to be stored on the RPPM BAS server						
Written sequences to use the same naming convention as on the graphics						
Each system to have a link to the appropriate floor plan						
Floor plan graphics (complete with roof plans) are required showing the following:						
Equipment locations						
Controllers and their wiring runs. (location specifics must be included on graphics such as ceiling, closet, etc.						
Sensor locations						
Separate floor plans for temperature locations, controller locations and equipment locations to be the template to accommodate larger buildings						
Floor plan graphics to be colour coded to identify the areas served by each air handling unit						
Each building to have a heating, cooling and ventilation summary table						
Each converted building to have a lighting page						
Items grouped under **miscellaneous alarms** must also have equipment locations identified						
Each system to have identified schedules						

Pump Cx Checklist

EQUIPMENT INFORMATION

SAP Equipment ID:			
Project No:	Project Number		
Drawing No:			
Manufacturer:			
Model No.:			
Serial No.:			
Area Served:			
Location:			
Service:			
Electrical: V/ φ/ Hz			
Fluid:			
System Pump Serves (i.e. distribution for 50CCH01, sprinkler pump, etc.):			
Application:	☐ Lead/Lag	☐ Standby	☐ Other (specify):

PREREQUISITE (check to confirm that the following prerequisites are documented)

☐ Shop Drawing Received	☐ Installation Complete
☐ Start-up Process per Manufacturer's Instructions Complete	☐ Connected to BAS
☐ Sequence Complete	☐ System Balanced
☐ Seismic Review Letter Received	
Comments:	

EQUIPMENT ITEMS TO BE VERIFIED

This checklist does not take the place of the manufacturer's recommended checkout and start-up procedures or report.

Equipment Items	Yes / No	Comments
Pump installation and start-up form completed and report attached		
Equipment identification label has been applied and follows NRC naming convention		
Local protection/interlocks/alarms are functional		
Verifications of abnormal noise and vibration		
Verification of isolation/spring deflection on start-up & shutdown		
Pressure gauges, valves, and strainers installed		
Operational with integral VFD and sensorless control verified		
Comments:		

ELEMENTS TO BE MEASURED FOR DESIGN VALIDATION

This checklist does not take the place of the manufacturer's recommended checkout and start-up procedures or report.

Measured Element	Instrument (portable/BAS/local)	Design	Measured 1	Measured 2
Flow (l/s - GPM)				
Suction pressure at no flow (kPa - "H_2O)				
Pressure differential at full flow (kPa - "H_2O)				
Pump RPM				
Voltage (T_1-T_2-, T_2-T_3, T_3-T_1)				
Amperage (I_1, I_2, I_3)				
Fuse/Breaker Rating (A)				
O/L adjustment (A)				
Motor HP				
Comments:				

CONTROL SYSTEM ITEMS TO BE BE VERIFIED

Control System Items	Yes / No	Comments
NRC Graphics Standard Checklist Completed		
NRC BAS Field Equipment Checklist Completed		
NRC Sequence Standard Checklist Completed		
Have scheduled points been added to the All Points Log (APL)		
Controller online		
Graphics created		
Link to written sequence on system graphic		
Equipment shown on BAS floor plan		
Network layout shown on BAS floor plan		
SAP Equipment ID used in BAS		
Nametags for coil and BAS control points installed		
BAS Controller labelled		
Power source labelled on controller		

If controller is mounted in ceiling space, has location of controller been identified on t-bar with an orange dot sticker		
Comments:		

CONTROL SYSTEM PRE-FUNCTIONAL CHECKS - TBC

	Observations, Notes & Comments	
Initial Conditions:		
Manually override the control damper to obtain:		
From BAS, command damper open	Record (mA):	
	Physically check damper is open:	☐ Y ☐ N
From BAS, command damper closed	Record (mA):	
	Physically check damper is closed:	☐ Y ☐ N
Back to automatic		
Return all changed control parameters and conditions to their pre-functional check values.		
Comments:		

TBC - To be completed by Cx Agent and Contractor based on the control sequence.

CONTROL SEQUENCE FUNCTIONAL PERFORMANCE TEST - TBC

Functional Performance Test Procedure	**Expected, Actual Response & Comments**	**Pass (Y / N)**
System stopped:		
System start-up:		
Normal mode:		
Control points:		
Local protection:		
Alarms:		
Return all changed control parameters and conditions to their pre-functional performance test values.		
Comments:		

TBC - To be completed by Cx Agent and Contractor based on the control sequence.

PART 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 This Section specifies roles and responsibilities of Commissioning Training.

1.2 TRAINEES

.1 Trainees: personnel selected for operating and maintaining this facility. Includes 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.

1.3 INSTRUCTORS

.1 Departmental Representative will provide:

.1 Descriptions of systems.

.2 Instruction on design philosophy, design criteria, and design intent.

.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.

.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 installation, started up and carried out PV tests.

1.4 TRAINING OBJECTIVES

.1 Training to be detailed and 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.

1.5 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 PV Reports.

.3 Project Manager, Commissioning Manager and Facility Manager will review training manuals.

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

.5 Supplement training materials:

.1 Transparencies for overhead projectors.
.2 Multimedia presentations.
.3 Manufacturer's training videos.
.4 Equipment models.

1.6 SCHEDULING

.1 Include in Commissioning Schedule time for training.

.2 Deliver training during regular working hours, training sessions to be 3 hours in length.

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

1.7 RESPONSIBILITIES

.1 Be responsible for:

.1 Implementation of training activities,
.2 Coordination among instructors,
.3 Quality of training, training materials,

.2 Departmental Representative will evaluate training and materials.

.3 Upon completion of training, provide written report, signed by Instructors, witnessed by Departmental Representative.

1.8 TRAINING CONTENT

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

.2 Content includes:

.1 Review of facility and occupancy profile.
.2 Functional requirements.
.3 System philosophy, limitations of systems and emergency procedures.
.4 Review of system layout, equipment, components and controls.
.5 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
.6 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.
.7 Maintenance and servicing.
.8 Trouble-shooting diagnosis.
.9 Inter-Action among systems during integrated operation.
.10 Review of O&M documentation.

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

1.9 VIDEO-BASED TRAINING

.1 Manufacturer's videotapes to be used as training tool with Departmental Representative's review and written approval 3 months prior to commencement of scheduled training.

.2 On-Site training videos:

.1 Videotape training sessions for use during future training.

.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 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 SUMMARY

.1 This Section includes the following:

.1 Demolition and removal of selected portions of interior building components and finishes.

.2 Repair procedures for selective demolition operations.

.2 This section does not include the following:

.1 Removal of hazardous materials or asbestos abatement.

.2 Demolition of exterior building components or structural elements.

.3 Mechanical or electrical equipment, except as required to make minor modifications to allow the work to be completed.

.3 Drawings contain details that suggest directions for solving some of the major demolition and removal requirements for this project; Contractor is required to develop these details further.

1.2 RELATED REQUIREMENTS

.1 Section 00 10 00 – General Instructions

.2 Section 01 74 19 – Waste Management Disposal

1.3 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI)

.1 ANSI A10.8 2011, Safety Requirements for Scaffolding

.2 ASTM International (ASTM)

.1 ASTM C475/C475M-15, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board

1.4 DEFINITIONS

.1 Demolish: Detach items from existing construction and legally dispose of them off site, unless indicated to be removed and salvaged or removed and reinstalled.

.2 Remove and Salvage: Detach items from existing construction and deliver them to Departmental Representative ready for reuse.

.3 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

.4 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed, removed and salvaged, or removed and reinstalled.

.5 Waste Management Coordinator (WMC): Contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.

.6 Draft Construction Waste Management Plan (Draft CWM Plan): Detailed inventory of materials in building indicating estimated quantities of reuse, recycling and landfill, prepared in accordance with Section 01 74 19 - Waste Management and Disposal and as follows:

.1 Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project.

.7 Construction Waste Management Plan (CWM Plan): Written plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 19 - Waste Management and Disposal.

.8 Construction Waste Management Report (CWM Report): Written report identifying actual materials that formed CWM Plan for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 19 - Waste Management and Disposal.

.9 Hazardous Substances: Dangerous substances, dangerous goods, hazardous commodities and hazardous products may include asbestos, mercury and lead, PCB's, poisons, corrosive agents, flammable substances, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly as defined by the Federal Hazardous Products Act (RSC 1985) including latest amendments.

1.5 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate with Departmental Representative for the material ownership as follows:

.1 Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Departmental Representative's property, demolished materials shall become Contractor's property and shall be removed from Project site.

.2 Coordinate selective demolition work so that work of this Section adheres to aesthetic criteria established by the Drawings and specified dimensions with all elements in planes as drawn, maintaining their relationships with all other building elements.

.3 Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Departmental Representative's property:

.1 Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Departmental Representative.

.2 Coordinate with Departmental Representative, who will establish special procedures for removal and salvage.

.2 Pre-Demolition Meeting: Convene pre-installation meeting with Contractor and Departmental Representative in accordance with Section 01 10 00 – General Instructions to:

.1 Confirm extent of salvaged and demolished materials

.2 Review Contractor's demolition plan.

.1 Verify existing site conditions adjacent to demolition work.

.2 Coordination with other construction sub trades.

.3 Hold project meetings in accordance with agreement established between Contractor and Departmental Representative during kick-off meeting.

.4 Ensure key personnel attend.

.5 WMC must provide written report on status of waste diversion activity at each meeting.

.6 Departmental Representative will provide written notification of change to meeting schedule established upon contract award.

1.6 ACTION AND INFORMATION SUBMITTALS

.1 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Schedule of Selective Demolition Activities indicating the following:

.1 Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.

.2 Coordinate with Departmental Representative ongoing site operations, and limit the number of interruptions during regular business hours.

.3 Interruption of utility services.

.4 Coordination for shutoff, capping, and continuation of utility services.

.5 Use of elevator and stairs.

.6 Locations of temporary partitions and means of egress, including for others affected by selective demolition operations.

.7 Coordination with Departmental Representative's continuing occupancy of portions of existing building.

.2 Demolition Plan: Submit a plan of demolition area indicating extent of temporary facilities and supports, methods of removal and demolition prepared by a professional engineer in accordance with requirements of Authority Having Jurisdiction, and as follows:

.1 Proposed Dust Control and Noise Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Departmental Representative reserves the right to make modifications where proposed methods interfere with the Departmental Representative's ongoing operation

.2 Inventory: Submit a list of items that have been removed and salvaged after selective demolition is complete.

.3 Landfill Records: Indicate receipt and acceptance of wastes by a landfill facility.

.2 Informational Submittals: Provide the following submittals when requested by the Departmental Representative:

.1 Qualification Data: Submit information for companies and personnel indicating their capabilities and experience to perform work of this Section including; but not limited to, lists of completed projects with project names and addresses, names and addresses of architects and owners, for work of similar complexity and extent.

1.7 QUALITY ASSURANCE

.1 Regulatory Requirements: Perform work as follows; use most restrictive requirements where differences occur between the municipal, provincial and federal jurisdictions:

.1 Provincial and Federal Requirements: Perform work in accordance with governing environmental notification requirements and regulations of the Authority Having Jurisdiction.

.2 Municipal Requirements: Perform hauling and disposal operations in accordance with regulations of Authority Having Jurisdiction.

.2 Qualifications: Provide proof of qualifications when requested by Departmental Representative:

.1 Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project:

.1 Conform to the provincial Occupational Health and Safety Act and Regulation.

.2 Conform to Workers' Compensation Board Regulations.

.3 Conform to City of local municipal bylaws and regulations governing this type of work.

1.8 SITE CONDITIONS

.1 Owner will occupy portions of building immediately adjacent to selective demolition area:

.1 Conduct selective demolition so that Owner's operations will not be disrupted.

.2 Provide not less than 72 hours' notice to Departmental Representative of activities that will affect Owner's operations.

.2 Maintain access to existing means of egress, walkways, corridors, exits, and other adjacent occupied or used facilities:

.1 .1 Do not close or obstruct means of egress, walkways, corridors, exits, or other occupied or used facilities without written acceptance from authorities having jurisdiction.

.3 Departmental Representative assumes no responsibility for condition of areas to be selectively demolished:

.1 Conditions existing at time of Pre Bid Site Review will be maintained by Departmental Representative as far as practical.

.4 Discovery of Hazardous Substances: It is not expected that Hazardous Substances will be encountered in the Work; immediately notify Departmental Representative if materials suspected of containing hazardous substances are encountered and perform the following activities:

.1 Refer to Regulatory Requirements for directives associated with specific material types.

.2 Hazardous materials will be as defined in the Hazardous Materials Act.

.3 Hazardous materials removal will be coordinated by Departmental Representative before start of the Work.

.4 If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Departmental Representative. Hazardous materials will be removed by Departmental Representative under a separate contract or as a change to the Work.

PART 2 PRODUCTS

2.1 TEMPORARY SUPPORT STRUCTURES

.1 Design temporary support structures required for demolition work and underpinning and other foundation supports necessary for the project using a qualified professional engineer registered or licensed in province of the Work.

2.2 DESCRIPTION

.1 This section of the Work includes, but is not necessarily limited to, the following:

.1 Demolition, removal completely from site, and disposal of all identified components, materials, equipment and debris.

.2 Selective demolition to allow new walls, bulkheads, ceilings and other materials to meet existing construction as indicated.

.3 All material from demolition shall be removed from site immediately with no salvage, selling, sorting or burning permitted on site.

.4 Retain items indicated on drawings for re use in new construction.

2.3 DEBRIS

.1 Make all arrangements for transport and disposal of all demolished materials from the site.

2.4 EQUIPMENT

.1 Provide all equipment required for safe and proper demolition of the building interiors indicated.

2.5 REPAIR MATERIALS

.1 Use repair materials identical to existing materials:

.1 If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

.2 Use a material whose installed performance equals or surpasses that of existing material.

.3 Comply with material and installation requirements specified in individual Specification Sections.

.2 Floor Patching and Levelling Compounds: Cement based, trowelable, self-levelling compounds compatible with specified floor finishes; gypsum based products are not acceptable for work of this Section.

.3 Concrete Unit Masonry: Lightweight concrete masonry units, and mortar, cut and trimmed to fit existing opening to be filled. Provide standard hollow core units, square end units and bond beam units as indicated on drawings.

.4 Prefinished Sheet Steel: Prefinished sheet steel, colour to match existing radiation cabinets, bent and profiled to match existing radiation cabinets.

.5 Gypsum Board Patching Compounds: Joint compound to ASTM C475/C475M, bedding and finishing types thinned to provide skim coat consistency to patch and prepare existing gypsum board walls ready for new finishes in accordance with applicable standards.

2.6 EXISTING MATERIALS

.1 Items to be retained for re use in new construction include, but are not limited to the following:

.1 Carpet Tiles.

.2 Confirm with Departmental Representative any materials that appear to be in re-usable condition prior to disposal.

.3 Confirm with Departmental Representative any materials scheduled for re-use that are not in re-usable condition prior to installation.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Verify that utilities have been disconnected and capped.

.2 Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

.3 Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

.4 Notify the Departmental Representative where existing mechanical, electrical, or structural elements conflict with intended function or design:

.1 Investigate and measure the nature and extent of conflict and submit a written report to Departmental Representative.

.2 Departmental Representative will issue additional instructions or revise drawings as required to correct conflict.

.5 Perform surveys as the work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES

.1 Coordinate existing services indicated to remain and protect them against damage during selective demolition operations.

.2 Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.

- .1 Arrange to shut off affected utilities with utility companies.
- .2 If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.
- .3 Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
- .4 Cut off pipe or conduit to a minimum of 25mm below slab, and remove concrete mound. Patch concrete using cementitious grout.

.3 Coordinate with Mechanical and Electrical Divisions for shutting off, disconnecting, removing, and sealing or capping utilities.

.4 Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.3 PREPARATION

.1 Identify and mark all equipment and materials identified to be retained by Departmental Representative or to be re used in subsequent construction. Separate and store items to be retained in an area away from area of demolition and protect from accidental disposal.

.2 Post warning signs on electrical lines and equipment that must remain energized to serve other areas during period of demolition.

.3 Confirm that all electrical and telephone service lines entering buildings are not disconnected.

.4 Do not disrupt active or energized utilities crossing the demolition site.

.5 Provide and maintain barricades, warning signs, protection for workmen and the public during the full extent of the Work. Read drawings carefully to ascertain extent of protection required.

.6 Mark all materials required to be re used, store in a safe place until ready for re installation.

.7 Adjust all junction boxes, receptacles and switch boxes flush with new wall construction where additional layers to existing construction are indicated.

.8 Remove permanent marker lines used or found on exposed surfaces and at surfaces indicated for subsequent finish materials. Mechanically remove permanent marker lines and associated substrates where permanent marker lines occur and patch surface. Sealing or priming over permanent marker lines is not acceptable.

3.4 CONCRETE SLAB REINFORCING

.1 Locate location of reinforcing steel in concrete slabs prior to cutting or coring using non-destructive, non-ionizing radio frequency locators.

.2 Core concrete slabs to avoid reinforcing steel, electrical conduit or water pipes; adjust core location and coordinate with Departmental Representative where slab features interfere with core drilling.

.3 Notify the Departmental Representative immediately for further instructions where coring or cutting will damage existing slab features.

3.5 SELECTIVE DEMOLITION

.1 Demolish and dismantle work in a neat and orderly manner and in strict accordance with all regulations.

.2 At end of each day's work, leave Work in safe condition so that no part is in danger of toppling or falling.

.3 Demolish in a manner to minimize dusting and to prevent migration of dust.

.4 Selling or burning of materials on the site is not permitted.

.5 Remove concrete bases by cutting and chipping, take precautions against slab cracking and degradation. Grind edges smooth, fill and make level with self-levelling grout.

.6 Fill all openings in concrete block walls with concrete masonry units, coursing to match existing, prepare ready to receive new finishes to match existing.

.1 Provide bond beams in new openings cut into existing concrete masonry unit walls.

.2 Provide finished end masonry units to patch and repair for new jamb sections in existing concrete masonry unit walls.

.7 Fill all openings in gypsum board walls with gypsum board and steel framing to match existing, skim coat to make wall smooth and even.

.8 Demolish existing carpet, resilient flooring and adhesive remnants as follows:

.1 Vacuum existing carpet thoroughly, prior to removal, using vacuum equipped with power head/sweeper.

.2 Apply fine mist water spray to carpet as required to minimize dust generation during removal. Avoid spraying near electrical outlets.

.3 Remove adhesive to the greatest extent possible using scrapping tools and as follows:

.1 Do not use solvent based cleaners to remove adhesive remnants.

.2 Lightly grind floor using machine designed for purpose to remove adhesive remnants.

.3 Vacuum floor ready for application of skim coating.

.4 Repair all slab depressions and damage with cementitious patching compound.

.5 Skim coat floor with minimum 1 mm thick cementitious floor underlayment compatible with new flooring materials.

.4 Floor substrate shall be smooth, free from ridges and depressions, and adhesive remnants that could telegraph through resilient flooring materials and carpets.

.5 Recycle materials in accordance with Section 01 74 19 - Waste Management and Disposal.

.9 Demolish completely all ceiling panels and grid as indicated.

.10 Remove all wall coverings scheduled for demolition. Patch and repair wall surfaces with skim coat of gypsum board joint compound leaving wall surfaces smooth and even ready for new wall finishes.

.11 Patch and repair all walls, floor and ceilings damaged during demolition with material matching adjacent walls, prepare ready for new finishes.

.12 Patch and repair all radiation cabinets, mechanical equipment and electrical fixtures damaged or exposed during demolition to match adjacent finished surfaces.

3.6 PATCHING AND REPAIRING

.1 Floors and Walls:

.1 Where walls or partitions that are demolished extend from one finished area into another, patch and repair floor and wall surfaces in the new space.

.2 Provide a level and smooth surface having uniform finish colour, texture, and appearance.

.3 Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform colour and appearance.

.4 Patch with durable seams that are as invisible as possible.

.5 Provide materials and comply with installation requirements specified in other Sections of these Specifications.

.6 Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.

.7 Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

.2 Ceilings: patch, repair, or re hang existing ceilings as necessary to provide an even plane surface of uniform appearance.

3.7 PROTECTION

.1 Prevent debris from blocking drainage inlets and systems and ground draining, and protect material and electrical systems and services that must remain in operation.

.2 Maintain safe access to and egress from occupied areas adjoining.

.3 Provide and maintain fire prevention equipment and alarms accessible during demolition.

3.8 CLEANING

.1 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 19 - Waste Management and Disposal.

.2 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal, and as follows:

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

.3 Divert excess materials from landfill.

.4 Promptly as the Work progresses, and on completion, clean up and remove from the site all rubbish and surplus material. Remove rubbish resulting from demolition work daily.

.5 Maintain access to exits clean and free of obstruction during removal of debris.

.6 Keep surrounding and adjoining roads, lanes, sidewalks, municipal rights of way clean and free of dirt, soil or debris that may be a hazard to vehicles or persons.

.7 Transport material designated for alternate disposal using approved facilities and organizations in accordance with applicable regulations.

.8 Dispose of materials not designated for alternate disposal in accordance with applicable regulations.

.1 Disposal facilities must be those approved of and listed in CWM Plan.

.2 Written authorization from Departmental Representative is required to deviate from disposal facilities listed in WM Plan.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

.1 This Section includes requirements for careful removal and salvage, and reconditioning of building components identified for storage at a designated remote site, for storage on site, and subsequent reinstallation forming a part of Project ready for re use at a later date.

1.2 RELATED REQUIREMENTS

.1 Section 01 10 00 – General Instructions

.2 Section 01 74 19 – Waste Management and Disposal]

.3 Section 02 41 19.16 - Selective Interior Demolition]

.4 Section 23 05 05 - Selective Demolition for HVAC

.5 Section 26 05 05 - Selective Demolition for Electrical

1.3 DEFINITIONS

.1 Remove and Salvage: Detach items from existing construction and deliver them ready for reuse.

.2 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination Existing Salvaged Work: Coordinate with Departmental Representative for confirmation of materials, components, and items of equipment identified for removal and salvage from their present existing locations and as follows:

.1 Items that are turned over to Departmental Representative.

.2 Off-site or on-site storage locations.

.3 Confirmation of items that are renovated or refurbished ready for reinstallation as a part of Work.

.4 Confirmation of items that Departmental Representative will not re use, but will retain as follows:

.1 Contractor is responsible for loading and handling identified salvaged items using their own forces and equipment.

PART 2 PRODUCTS

2.1 SALVAGED ITEMS

.1 Items salvaged by Contractor include, but are not limited to:

Work	Deliver To
Diversion of miscellaneous office furniture from landfill through re-use/donation or recycling facilities (ie. metal filing cabinets and shelving, office desks and chairs, demountable panel partition systems, window blinds, wood cabinets, etc.)	Off-site applicable re-use or recycling facility
Lighting fixtures for salvage and re-installation	Departmental Representative approved storage location on-site for future re-installation
Diversion of miscellaneous metal mechanical equipment from landfill to appropriate recycling facility (ie. fan coil units, domestic cold water drinking fountains, mechanical piping (sprinkler, plumbing and chilled water), sheet metal ductwork and accessories, etc.)	Off-site applicable recycling facility
Carpet reclamation	Departmental Representative approved storage location on-site for future re-installation
Diversion of miscellaneous metal electrical conduits and wiring from landfill through recycling	Off-site applicable recycling facility
Diversion of architectural elements from landfill through re-use/donation to appropriate recycling facility (ie. ceiling grids, metal blinds, metal studs, doors and associated hardware, glazing, etc.)	Off-site applicable re-use or recycling facility
Diversion of miscellaneous packaging materials and cardboard from landfill through recycling facilities (ie. plastic wrap, cardboard, wood pallets, etc.)	Off-site applicable re-use or recycle facility

.2 Confirm with Departmental Representative additional items that appear salvageable prior to disposal.

PART 3 EXECUTION

3.1 SALVAGE

.1 Remove and handle salvageable items from site to minimize damage and to ensure that usability is maintained.

.2 Clean, decontaminate, or remediate hazardous substances (lead based paint, asbestos dust, PCB residue, and similar substances) from salvaged materials so they are safe for reuse or resale.

.3 Place materials on palettes or wrap in protective film to ensure that loose pieces and projections do not cause injury to personnel, and that salvaged items remain as complete units.

.4 Clean items of construction or building debris, or materials that are not a part of salvaged work before delivering to Departmental Representative.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 03 20 00 - Concrete Reinforcing

.2 Section 03 30 00 - Cast-in-Place Concrete

1.2 REFERENCES

.1 Canadian Standards Association (CSA)
- .1 CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of test and Standard Practices for Concrete.
- .2 CSA-O86S1-09, Engineering Design in Wood.
- .3 CSA O121-08(R2013), Douglas Fir Plywood.
- .4 CSA O151-09, Canadian Softwood Plywood.
- .5 CSA S269.1-1975 (R2003), Falsework for Construction Purposes.
- .6 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples.

1.3 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00.

.2 Each drawing submitted shall bear the signature and stamp of a qualified professional engineer registered in Canada.

.3 Clearly indicate method and schedule of construction, materials, arrangement of joints, ties, shores, braces, liners, and locations of temporary embedded parts. Give proposed strengths of concrete at time of stripping forms.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Formwork lumber: plywood and wood formwork materials to CSA O121 and CSA O86.1.
- .1 Exposed surfaces: new, square-edged, flat, smooth surfaced panels, free of holes, surface markings or other defects.
- .2 Concealed surfaces: square edged, T & G lumber, plywood or other material, suitable to retain concrete without leakage or distortion.
- .3 Plywood: Douglas Fir, to CSA 0121, solid one side or medium density overlaid one side grade. High density overlaid grade for architectural concrete. Sound undamaged sheets with clean, true edges.
- .4 Lumber: to CAN/CSA-0141.

.2 Nails, spikes, staples: galvanized, to CSA B111.

.3 Form release agent: non-staining, chemically active release agent containing compounds that react with free lime present in concrete to provide water insoluble soaps, preventing set of film of concrete in contact with form.

.4 Form ties: removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger or deeper than 25mm dia. in concrete surface. Wire ties not permitted. For architectural concrete use snap ties with plastic cones and concrete plugs.

.5 Joint tape: non-staining, impermeable, self-release type.

PART 3 - EXECUTION

3.1 ERECTION

.1 Do concrete formwork to CAN/CSA-A23.1 except where specified otherwise.

.2 Conform to National Building Code of Canada, 2010.

.3 Verify lines, levels and column centres before proceeding with formwork and ensure dimensions agree with drawings.

.4 Construct forms to produce finished concrete conforming to the shape, dimensions, locations and levels shown on the drawings within the tolerances required by CAN/CSA-A23.1.

.5 Obtain Departmental Representative's consent for use of earth forms. Hand trim sides and bottoms and remove loose earth before placing concrete.

.6 Acquire Departmental Representative's review before framing openings in slabs, beams or columns not detailed on drawings.

.7 Align form joints and make watertight. Keep form joints to a minimum.

.8 Use 20mm chamfer strips on exposed corners of beams, columns, walls and curbs, unless otherwise specified.

.9 Form chases, slots, openings, drips, recesses, expansion and control joints as detailed.

.10 Set anchors, ties, bolts, nailers, templates, cast-in hardware and shelf angles, steel connection units or other inserts into forms and secure against displacement during concreting.

.11 For walls and shear walls, leave one side of form open for inspection of reinforcing steel. Close form only after Departmental Representative has reviewed bar placement.

.12 Leave formwork in place for following minimum periods of time after placing concrete:
- .1 Three days for walls, sides of beams, columns and footings.
- .2 Twenty-eight days for beam soffits, slabs and other structural members, or three days when replaced immediately with adequate approved reshores and when concrete has reached at least 75% of specified 28 day strength.

.13 Re-use of formwork subject to requirements of CAN/CSA-A23.1.

.14 Use new formwork for concrete surfaces which will be exposed to view.

.15 Construct form to produce architectural exposed concrete surfaces to the shape & patterns according to architectural drawings.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 03 10 00 - Concrete Formwork and Accessories

.2 Section 03 30 00 - Cast-in-Place Concrete

1.2 REFERENCES

.1 Canadian Standards Association (CSA)
- .1 CAN/CSA-A23.1-09, Concrete Materials and Methods of Concrete Construction.
- .2 CAN3-A23.3-09, Design of Concrete Structures for Buildings.
- .3 CSA G30.3-M1983(R1998), Cold Drawn Steel Wire for Concrete Reinforcement.
- .4 CSA G30.5-M1983(R1998), Welded Steel Wire Fabric for Concrete Reinforcement.
- .5 CAN/CSA-G30.18-09, Carbon Steel Bars for Concrete Reinforcement.
- .6 CSA W186-M1990 (R2007), Welding of Reinforcing Bars in Reinforced Concrete Construction.

1.3 SOURCE QUALITY CONTROL

.1 Upon request, provide Departmental Representative with certified copy of mill test report of steel supplied, showing physical and chemical analysis.

1.4 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00.

.2 Clearly indicate bar sizes, spacing, location and quantities of reinforcement and mesh, with identifying code marks to permit correct placement without reference to structural drawings. Prepare drawings in accordance with "Reinforcing Steel Manual of Standard Practice".

.3 Detail placement of reinforcing where special conditions occur.

.4 Show walls and beams in full elevation and detail all bars.

.5 Design and detail lap lengths and bar development lengths to CAN3-A23.3, unless otherwise specified on drawings.

1.5 SUBSTITUTIONS

.1 Substitution of different size bars permitted only upon written approval of Departmental Representative.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Reinforcing bars: billet steel, grade 400, deformed bars to CSA G30.18.

.2 Welded steel wire fabric: to CSA G30.5. Provide in flat sheets only.

.3 Chairs, bolsters, bar supports, spacers: adequate for strength and support of reinforcing construction conditions.

.4 Use chairs with plastic coated feet where slab and beam soffits will be exposed.

.5 Mechanical splices: subject to approval of Departmental Representative.

2.2 FABRICATION

.1 Fabricate reinforcing to CAN/CSA-A23.1.

.2 Fabricate to tolerances specified by "Reinforcing Steel Manual of Standard Practice".

.3 Acquire Departmental Representative's review of locations of reinforcement splices other than shown on steel placing drawings.

.4 Ship bundles of bar reinforcement, clearly identified in accordance with bar list.

PART 3 - EXECUTION

3.1 PLACING REINFORCEMENT

.1 Do reinforcing work in accordance with CAN/CSA-A23.1-04 and welding of reinforcing with CSA W186-M1990 (R2007), except where indicated otherwise.

.2 Detail reinforcing to "Reinforcing Steel Manual of Standard Practice", by Reinforcing Steel Institute of Canada.

.3 Conform to National Building Code, 2005.

.4 Maximum chair spacing:

10M	-	600mm
15M	-	1200mm
20M	-	1600mm
25M	-	2000mm

.5 Obtain Departmental Representative's review of reinforcing steel and position before placing concrete.

.6 Clean reinforcing before placing concrete.

.7 Ensure welded wire fabric is adequately supported at centre of slab (or where indicated) during concrete placing.

3.2 FIELD BENDING

.1 Do not field bend or field weld reinforcement, except where indicated or authorized by Departmental Representative.

.2 When field bending is authorized, bend without heat, applying a slow and steady pressure.

.3 Replace bars which develop cracks or splits.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 03 10 00 - Concrete Forming and Accessories

.2 Section 03 20 00 - Concrete Reinforcement

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM).
- .1 National Building Code of Canada 2010.
- .2 ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete.
- .3 ASTM C494/C494M-13, Specification for Chemical Admixtures for Concrete..
- .4 ASTM C1017M-07, Standard Specification for Chemical Admixtures for use in Producing Flowing Concrete.

.2 Canadian Standards Association (CSA)
- .1 CAN/CSA-A23.1-09, Concrete Materials and Methods of Concrete Construction.
- .2 CAN/CSA-A23.2-09, Test Methods of Standard Practices for Concrete.
- .3 CAN/CSA A3000-08, Cementitious Materials Compendium.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Portland cement: to CAN/CSA-A3000, Type 10.

.2 Slag cement: cementitious hydraulic slag, to CAN/CSA-A363.

.3 Water, fine aggregates, normal density coarse aggregates: to CAN/CSA-A23.1.

.4 Air entraining admixture: to ASTM C260.

.5 Chemical admixtures: to ASTM C494.

.6 Pozzolanic mineral admixtures: to ASTM C1017.

.7 Superplasticizing admixtures: to ASTM C494.

.8 Non-shrink grout: premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents, of pouring consistency, capable of developing compressive strength of 50 MPa at 28 days.

.9 Dry Pack: compound consisting of non-metallic aggregate, cement and sufficient water for the mixture to retain its shape when made into a ball by hand and capable of developing compressive strength of 35 MPa at 28 days.

.10 Premoulded joint filler: Bituminous impregnated fiber board: to ASTM D1751.

.11 Dampproof membrane: Kraft/polyethylene membrane:
- .1 Lamination: 0.15mm polyethylene film asphalt bonded both sides to asphalt treated kraft.
- .2 Reinforcement: 13 x 13mm glass fibre cross directional scrim embedded in asphalt laminate.
- .3 Membrane adhesive: as recommended by membrane manufacturer.

2.2 CONCRETE MIXES

.1 Provide certification that plant, equipment, and all materials to be used in concrete comply with requirements of CAN/CSA-A23.1.

.2 Provide certification that mix proportions selected will produce concrete of specified quality and yield and that strength will comply with CAN/CSA-A23.1, Clause 4.4.5.

.3 Slag cement in combination with normal Portland cement to a maximum of 25% may be used, except in suspended slabs, upon approval of Departmental Representative.

.4 Obtain Departmental Representative's consent before using chemical admixtures.

.5 Use of calcium chloride not permitted.

PART 3 - EXECUTION

3.1 WORKMANSHIP

.1 Do cast-in-place concrete work in accordance with CAN/CSA-A23.1, and testing in accordance with CAN/CSA-A23.2, except where specified otherwise.

.2 Conform to National Building Code, 2010.

.3 Obtain Departmental Representative's review of reinforcing placement before placing concrete. Provide 48 hours notice prior to placing of concrete. In slab construction, ensure that all bottom steel and at least 66% of top steel is in place and inspected before commencing concrete placement.

.4 Ensure that reinforcement and inserts are not disturbed during concrete placement.

.5 Prior to placing of concrete in adverse weather, obtain Departmental Representative's review of proposed method for protection during placing and curing.

.6 Maintain accurate records of poured concrete items to indicate date, location of pour quality, air temperature and test samples taken.

3.2 INSERTS

.1 Set sleeves, ties, anchor bolts, pipe hangers and other inserts, as required by other trades, in concrete floors and walls. Also, openings as indicated or specified elsewhere. Sleeves, openings, etc., greater than 100mm square not indicated on structural drawings must be reviewed by Departmental Representative.

.2 Do not provide for any openings through beams or columns without permission of Departmental

Representative.

.3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain agreement for all modifications from Departmental Representative before placing of concrete.

.4 Obtain Departmental Representative's review of conduit routing in slabs prior to placing of concrete.

.5 Check locations and sizes of sleeves, openings, etc., shown on structural drawings with architectural, mechanical and electrical drawings.

3.3 GROUTING

.1 Grout underside of steel column and beam bearing plates with non-shrink type grout to manufacturer's instructions, which results in 100% contact over grouted area.

3.4 FINISHING

.1 Finish concrete to CAN/CSA-A23.1.

.2 Rub exposed sharp edges of concrete walls, columns and beams with carborundum to produce 3mm radius edges unless otherwise detailed.

.3 Sandblast exposed architectural texture wall: allow concrete to cure to sufficient strength so concrete will not be damaged. Use light sandblasting to match originally approved mock-up.

3.5 DEFECTIVE CONCRETE

.1 Remove defective concrete, blemishes and embedded debris and repair as directed by Departmental Representative.

3.6 INSPECTION AND TESTING

.1 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by Departmental Representative, in accordance with CAN/CSA-A23.1, Clause 4.4.

.2 Costs of tests will be paid as per 01 45 00 – Quality Control.

.3 Ship prepaid 3 test cylinders from each 60 cubic meters (max.) of concrete placed to designated testing laboratory.

.4 Prepare one additional test cylinder during cold weather concreting. Cure cylinder on job site under same conditions as concrete it represents.

3.7 WINTER PROTECTION

.1 Carry out winter concreting in strict accordance with CAN/CSA-A23.1, Clause 7.4.

.2 Do not use unvented heaters.

.3 Remove and replace damaged concrete at no cost to Crown.

3.8 HOT WEATHER PROTECTION

.1 Carry out hot weather concreting in accordance with CAN/CSA-A23.1, Clauses 5.2 and 7.4, including use of approved moisture retention film, if applicable.

3.9 JOINT FILLERS

.1 Locate and form isolation joints as indicated. Install jointfiller.

.2 Use 6 mm thick joint filler to separate slabs-on-grade from vertical surfaces. Extend joint filler from bottom of slab to within 12 mm of finished slab surface unless indicated otherwise.

3.10 DAMPPROOF MEMBRANE

.1 Where indicated, install dampproof membrane under concrete slabs-on-grade inside building.

.2 Lap dampproof membrane 150mm minimum at joints and seal. Carry up walls to top of slab.

.3 Seal punctures in dampproof membrane before placing concrete. Use patching material at least 150mm larger than puncture and seal.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 ASTM International (ASTM)
.1 ASTM A 36/A 36M-19, Standard Specification for Carbon Structural Steel.
.2 ASTM A 307-21, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
.3 ASTM A 325-14, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
.4 ASTM A 325M-14, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric).

.2 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-85.10-99, Protective Coatings for Metals.

.3 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturers Association (CPMA).
.1 Handbook of the Canadian Institute of Steel Construction.
.2 CISC/CPMA Standard 2-75, Quick-Drying Primer for use on Structural Steel.

.4 CSA Group (CSA)
.1 CSA G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
.2 CAN/CSA-G164-18, Hot Dip Galvanizing of Irregularly Shaped Articles.
.3 CAN/CSA-S16:19, Limit States Design of Steel Structures.
.4 CSA W47.1:19, Certification of Companies for Fusion Welding of Steel.
.5 CSA W48-18, Filler Metals and Allied Materials for Metal Arc Welding.
.6 CSA W55.3-08(R2018), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
.7 CSA W59-18, Welded Steel Construction (Metal Arc Welding).

.5 Master Painters Institute
.1 MPI-INT 5.1-08, Structural Steel and Metal Fabrications.
.2 MPI-EXT 5.1-08, Structural Steel and Metal Fabrications.

.6 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International
.1 NACE No. 3/SSPC SP-6-06, Commercial Blast Cleaning.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Shop Drawings:
.1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.

.3 Erection drawings:
.1 Submit erection drawings indicating details and information necessary for assembly and erection purposes including:
.1 Description of methods.
.2 Sequence of erection.
.3 Type of equipment used in erection.

.4 Temporary bracings.

.4 Fabrication drawings:
.1 Submit fabrication drawings showing designed assemblies, components and connections are stamped and signed by qualified professional engineer licensed in Ontario, Canada.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials in manufacturer's original, undamaged containers with identification labels intact.

PART 2 - PRODUCTS

2.1 DESIGN REQUIREMENTS

.1 Design details and connections in accordance with requirements of CAN/CSA-S16 to resist forces, moments, shears and allow for movements indicated.

.2 Shear connections:
.1 Select framed beam shear connections from an industry accepted publication such as "Handbook of the Canadian Institute of Steel Construction" when connection for shear only (standard connection) is required.
.2 Select or design connections to support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, provided no point loads act on beam, when shears are not indicated.

.3 Submit sketches stamped and signed by qualified professional engineer licensed in Ontario, Canada for non-standard connections.

2.2 MATERIALS

.1 Structural steel: to CSA-G40.20/G40.21 Grade 350W, except channels and plates that may be grade 300W.

.2 Hollow structural steel (HSS) sections: to ASTM A500, Grade C.

.3 Anchor bolts: to CSA-G40.20/G40.21, Grade 300W or as indicated.

.4 Bolts, nuts and washers: to ASTM A 325/ASTM A 325M.

.5 Welding materials: to CSA W48 Series & CSA W59 and certified by Canadian Welding Bureau.

.6 Hot dip galvanizing: galvanize steel, where indicated, to CAN/CSA-G164, minimum zinc coating of 600 g/m².

2.3 FABRICATION

.1 Fabricate structural steel in accordance with CAN/CSA-S16 and in accordance with reviewed shop drawings.

.2 Continuously seal members by continuous welds. Grind smooth.

PART 3 - EXECUTION

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 GENERAL

.1 Structural steel work: in accordance with CAN/CSA-S16.

.2 Welding: in accordance with CSA W59.

.3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components

3.3 CONNECTION TO EXISTING WORK

.1 Verify dimensions and condition of existing work, report discrepancies and potential problem areas to Departmental Representative / Consultant for direction before commencing fabrication.

3.4 MARKING

.1 Mark materials in accordance with CSA G40.20/G40.21. Do not use die stamping. When steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection

3.5 ERECTION

.1 Erect structural steel, as indicated and in accordance with CAN/CSA-S16.

.2 Field cutting or altering structural members: to approval of Consultant.

.3 Clean with mechanical brush and touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion of erection.

.4 Continuously seal members by continuous welds where indicated. Grind smooth.

3.6 FIELD QUALITY CONTROL

.1 Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by Departmental Representative.

.2 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by Departmental Representative.

.3 Submit test reports to Departmental Representative & Consultant within 1 week of completion of inspection.

3.7 CLEANING

.1 Clean in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 DEFINITIONS

.1 Fire Blocking: materials, components or system installed in a concealed space in the building to restrict the spread of fire and smoke in that concealed space or from that concealed space to an adjacent space.

.2 Fire Stop: a material, component or system, and its means of support, used to protect gaps between fire separations, between fire separations and other construction assemblies, or used in openings where penetrating items wholly or partially penetrate fire separations, to restrict the spread of fire and smoke thus maintaining the fire-resistance continuity of a fire separation.

.3 Fire Stop System: the combination of specific materials and/or devices required with the penetrating item(s), the assembly and the opening to assemble the fire stop.

.4 Intumescent: materials that expand with heat to prevent fire spread through fire separations.

.5 Listed Fire Stop System: a specific field erected construction consisting of the assembly, fire stop materials, any penetrating items and their means of support which have met the requirements for an F, FT, FH, FTH and/or L rating when tested in a fire-resistance rated assembly in accordance with CAN/ULC-S115

- .1 F-Rating: the amount of time a fire stop system can remain in place without the passage of flame through the opening or the occurrence of flaming on the unexposed face of the fire stop.
- .2 FT-Rating: a fire stop system with an F-Rating for the required time period which can also resists the transmission of heat through the fire stop during the same period and limit the rise in temperature on the unexposed face and/or penetrating item of the fire stop.
- .3 FH-Rating: a fire stop system with an F-Rating for the required time period which can also resists the force of a hose stream without developing openings for a prescribed period.
- .4 FTH-Rating: a fire stop system with an FT-Rating for the required time period which also passed the hose stream test for a prescribed period.
- .5 L-Rating: largest test sample leakage rate, determined in accordance with the optional air leakage test of CAN/ULC-S115

.6 Multi-penetration: two or more service penetrations through an opening in the fire separation.

.7 Non-rated Fire Separation: fire separation acting as a barrier to the spread of smoke until a response is initiated such as the activation of a fire suppression system.

.8 Single-penetration: single service penetration through an opening in the fire separation.

.9 System Design Listing: document providing proof of testing with technical details, specifications and requirements that leads to the application of a specific listed fire stop system.

1.2 REFERENCE STANDARDS

.1 ASTM International (ASTM)

- .1 ASTM E2032-09(2017), Standard Guide for Extension of Data From Fire Resistance Tests Conducted in Accordance with ASTM E119.
- .2 ASTM E2174-20a, Standard Practice for On-Site Inspection of Installed Firestops.
- .3 ASTM E2393-20a, Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.

.2 Firestop Contractors International Association (FCIA)
.1 FCIA Firestop Manual of Practice, 6th Edition 2015.

.3 Factory Mutual Approvals (FM)
.1 FM 4991, Approval Standard for Firestop Contractors.

.4 International Firestop Council (IFC)
.1 IFC Guidelines for Evaluating Engineering Judgments.
.2 IFC Guidelines for Evaluating Engineering Judgments - Perimeter Fire Barrier Systems.
.3 IFC Inspection Guidelines for Penetration Firestop Systems and Fire Resistive Joint Systems in Fire Resistance Rated Construction, 5th Edition.

.5 National Research Council Canada (NRC)
.1 National Building Code of Canada 2015 (NBC).

.6 Underwriter's Laboratories of Canada (ULC)
.1 CAN/ULC-S115-11(R2016), Standard Method of Fire Tests of Firestop Systems.
.2 ULC Qualified Firestop Contractor Program.

1.3 SYSTEMS DESCRIPTION

.1 This Section specifies fire stop systems and/or fire stop materials intended to fill gaps between fire separations, between fire separations and other construction assemblies, or used in or around items which fully or partially penetrate a fire separation, to restrict the spread of fire and smoke thus maintaining the integrity of a fire separation.

.2 This Section includes requirements for:
.1 Through-penetration fire stops:
.1 For openings created to allow a penetrating item such as piping, conduits, raceways, ducts, cable trays, cables, tubing or structural components to pass completely through a fire separation or fire-resistance rated assembly.
.2 Membrane penetration fire stops:
.1 For openings where penetrating items such as piping, conduits, raceways, ducts, cable trays, cables, tubing, recessed components (e.g.: panels, electric boxes, devices) or structural components pass through only one membrane of a fire separation or fire-resistance rated assembly.
.3 Blank opening fire stops:
.1 For openings created in a fire separation where the penetrating item has not yet been installed or has been removed.

.3 This Section includes fire stopping work for entire Project including selection, installation and inspection of all required fire stops.

1.4 PRE-INSTALLATION MEETINGS

.1 Convene pre-installation meeting two weeks prior to beginning work of this Section, with Contractor's representative and Departmental Representative to:
- .1 Verify Project requirements.
- .2 Review sustainable requirements.
- .3 Review installation and substrate conditions.
- .4 Coordinate with other building trades.
- .5 Review system design listings, manufacturer's installation instructions and warranty requirements.
- .6 Review quantity and location of mock-ups.

.2 Convene pre-installation meetings with other trades to review:
- .1 Installation procedures and precautions.
- .2 Location, scheduling and sequencing of other work around fire stops that can affect the outcome of the installation.
- .3 Requirements for annular opening sizes.
- .4 Requirements and preparations for wall/floor single and multi-penetrations.
- .5 Requirements for construction and perimeter joints.
- .6 Mock-up requirements.

.3 Submit copies of applicable listed fire stop system details to each trade for opening preparation. Include installation details required for the listed system.

.4 Meeting minutes: Contractor to take minutes of pre-installation meetings and distribute to Departmental Representative and each affected trades.

1.5 SEQUENCING

.1 Proceed with installation only when submittals have been reviewed by Departmental Representative.

.2 Fire stops located in floor assemblies: install before interior partition erections.

.3 Metal deck bonding: unless noted otherwise on system design listing and manufacturer's installation instructions, fire stopping to precede spray applied fireproofing to ensure required bonding.

.4 Pipe and duct insulation: certified fire stop system component.
- .1 Ensure pipe and duct insulation installation precedes fire stopping.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 00 10 00 - General Instructions.

.2 Qualification Statement
- .1 Submit contractor qualification statements and certificates demonstrating compliance with the qualification requirements of this Section, as described in PART 1 - QUALITY ASSURANCE, within 10 working days after award of contract and before starting Work.

.3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

.4 Engineering Judgments:

.1 Where there is no specific tested listed fire stop system available from the manufacturer for a particular fire stop configuration, review systems from other manufacturers to obtain a listed fire stop system.
.2 Submit an Engineering Judgment (EJ) from the system manufacturer if there are no listed systems available from other manufacturers.
.3 Prepare and submit an EJ in accordance with best practices established in the following documents:
  .1 IFC Guidelines for Evaluating Engineering Judgments.
  .2 IFC Guidelines for Evaluating Engineering Judgments - Perimeter Fire Barrier Systems.
.4 For each EJ submitted, include:
  .1 Project name, number and location.
  .2 A description of the proposed system with detailed drawing.
  .3 Installation instructions.
  .4 Complete descriptions of critical elements for the fire stop configuration.
  .5 Copies of all referenced system design listings on which the EJ is based on.
  .6 EJ issuer name and contact information.
  .7 Date of issue of EJ with authorization signature of issuer.
  .8 Manufacturer letter stating their opinion, with supporting justification, that the EJ will perform as a fire stop system were it to be subjected to the appropriate standard fire test method for the required fire rating duration.

.5 Once the EJ has been reviewed, submit the EJ to the authority having jurisdiction for final approval.

.6 EJ shall be issued only by fire stop manufacturer's qualified technical personnel or in concert with the manufacturer by a knowledgeable registered Professional Engineer, a Fire Protection Engineer or an independent testing agency that provides testing and listing services for fire stop systems similar to the EJ being contemplated.

.7 EJ shall be based upon interpolations of previously tested fire stop systems that are either sufficiently similar in nature or clearly bracket the conditions upon which the Engineering Judgment is to be given. Additional knowledge and technical interpretations based upon accepted engineering principles, fire science and fire testing guidelines (e.g.: ASTM E2032) may also be used as further support data.

.8 EJ shall be based upon knowledge of the elements of the construction to be protected and understanding of the probable behaviour of that construction and the recommended fire stop system protecting it were they to be subjected to the adequate standard fire test method for the required fire rating duration.

.9 EJ shall be limited to the specific conditions and configurations upon which EJ was rendered and should be based upon reasonable performance expectations for the recommended fire stop system under those conditions.

.10 EJ shall be accepted only for a single specific job and location and should not be transferred to any other job or location without thorough and appropriate review of all aspects of the next job or location's circumstances.

.11 Sustainable Design Submittals:
  .1 Low-Emitting Materials: submit listing of paints and coatings to comply with VOC and chemical component limits or restrictions requirements.

1.7 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 00 10 00 - General Instructions.

1.8 QUALITY ASSURANCE

.1 Provide systems selection and analysis, installation and inspection of fire stop systems in accordance with the recommended practices detailed in the following guides:
- .1 FCIA Firestop Manual of Practice (MOP).

.2 Qualifications:
- .1 Contractor specializing in selection and installation of fire stops with five years documented experience. Submit a list of five successfully completed projects of similar scale and type.
- .2 Company recognized as a Member in Good Standing with the Firestop Contractors International Association (FCIA). Submit written proof of current membership.
- .3 Training: workers, including site supervisor, to have completed:
  - .1 Manufacturer training on the products/systems installed as part of this Section.
- .4 Certified Firestop Contractor: company certified with one of the following programs:
  - .1 ULC Qualified Firestop Contractor Program. Submit signed copy of ULC Qualified Firestop Contractor Program certificate.
  - .2 FM 4991 Approved Firestop Contractor. Submit signed copy of FM 4991 Approval certificate.

1.9 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:
- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, ULC markings , manufacturing date, shelf life expiry date.

.2 Storage and Protection:
- .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Replace defective, expired or damaged materials with new.
- .3 Coordinate delivery of materials with scheduled installation dates to allow minimum storage time on site.
- .4 Comply with recommended procedures, precautions and measures described in WHMIS Safety Data Sheets (SDS).

1.10 FIELD CONDITIONS

.1 Ambient Conditions:
- .1 Install fire stops when ambient and substrate temperatures are within the limits prescribed by the manufacturer and when the substrate is dry and without risk of condensation.
- .2 Maintain manufacturer's recommended ambient and substrate temperatures for 48 hours before and 72 hours after installation.

.2 Ventilate fire stops in accordance with manufacturers' instructions by natural means or where this is inadequate using forced air circulation.

1.11 WARRANTY

.1 For the Work of this Section 07 84 00 - Fire Stopping, the 12 month warranty period is extended to 24 months.

.2 Manufacturers shall warrant work of this section against defects and deficiencies in the product material for a period of 24 months. Promptly correct any defects or deficiencies, which become apparent within warranty period at no expense.

.3 Contractor shall warrant workmanship on materials and installation for a period of 24 months. Promptly correct any defects or deficiencies which become apparent within warranty period at no expense.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

.1 Provide products from a single manufacturer, to the greatest extent possible, to perform all fire stopping work. Materials of different manufacturers will not be permitted without written authorization from Departmental Representative.

.2 Where there is no specific tested listed fire stop system available from the manufacturer for a particular fire stopping application, provide a listed system from an alternative manufacturer to avoid providing an Engineering Judgment.

2.2 DESIGN/PERFORMANCE CRITERIA

.1 Fire stop and smoke stop systems and systems providing a barrier to smoke spread consisting of a material or combination of materials installed to maintain the integrity of the fire resistance rating of a fire separation in accordance with the requirements of NBC-2015

.2 Non-rated fire separations: provide L-Rated smoke protection fire stop system for application on both sides of separation.

.3 Acoustic insulation properties, as shown in schedule.

.4 Dynamic joints: where required, fire and smoke stop systems to be designed to accommodate a defined amount of movement to account for expansion or contraction in construction joints and mechanical piping, for movement in structural elements and to accommodate for movement and sound and vibration control in mechanical installations.

.5 Insulated pipes and ducts: listed fire stop system designed and tested with actual insulation materials penetrating the fire separation, as indicated on the system design listing.

.6 Use in wet areas: water based products are unacceptable in wet areas or areas that may be subject to occasional water exposure or flooding during and after construction.

.7 Architectural considerations: when exposed to view, fire stop system to consider architectural finish, potential traffic, and exposure to moisture and heat.

.8 Environment considerations: materials selected to consider the environment in which they will be used during and after curing as well as the intended use of space. Fire stop manufacturer to confirm compatibility of the proposed materials/products for the following cases:
   .1 Spaces requiring resistance to infection and biological spread through assemblies.
   .2 Spaces containing sensitive electronic equipment.
   .3 Preventing contamination of laboratory and manufacturing environments.

2.3 MATERIALS

.1 Fire stop and smoke stop systems: in accordance with CAN-ULC-S115
- .1 Asbestos-free materials and systems capable of maintaining effective barrier against the passage of flame, smoke and water and the transmission of heat in compliance with requirements of CAN-ULC-S115 and not to exceed opening sizes for which they are intended, as indicated on System Design Listing.
- .2 Fire stop system rating: to match fire resistance rating of fire separation as indicated.
- .3 Service penetration assemblies and fire stop components: certified by test laboratory to CAN/ULC-S115

.2 Fire and smoke stop systems at openings intended for re-entry such as cables: provide elastomeric seal or non-shrink foam cement mortar.

.3 Fire and smoke stop systems at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: provide elastomeric protection.

.4 Fire and smoke stops behind and around mechanical and electrical boxes within wall, floor and ceiling assemblies: provide elastomeric seal.

.5 Primers: to manufacturer's recommendation for specific material, substrate, and end use.

.6 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.

.7 Packing/damming materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.

.8 Fire stop insulation: pre-formed, semi rigid, non-combustible mineral wool, pre-cut in 1220 mm lengths to required depth and width.

.9 Junction box / outlet sealing putty: intumescent putty, pre-formed in pads.

.10 Sealants: good adhesion without use of primer, high visibility safety colours.
- .1 Flame spread rating: maximum 25.
- .2 Smoke development classification: maximum 50.
- .3 For vertical joints: non-sagging.
- .4 For horizontal joints: single component, self-levelling.

2.4 FIRE STOP IDENTIFICATION

.1 Identification labels and markings to be indelible for the expected service life of the installation.

.2 Fire Stopped Penetrations:
- .1 Provide identification labels at each penetration.
- .2 Identification labels: adhesive plastic stickers with the following information:
  - .1 Penetration number.
  - .2 Floor number.
  - .3 Room number.
  - .4 Product name and number.
  - .5 System Design number.
  - .6 Fire Rating Required: in hours.
  - .7 Fire Stop Contractor 's Name and phone number.
  - .8 Installer 's Name.
  - .9 Date of Installation.
  - .10 Re-penetrated by: Company, Installer and Date.
- .3 Label shall state that the fill material around the penetration is a fire stop system and it shall not be disturbed except by authorized personnel.

.3 Fire Separation (Barrier) Markings:
- .1 Provide identification for all vertical fire separations.
- .2 Identification markings: adhesive tamper evident stickers with lettering at least 75 mm in height with a minimum 10 mm stroke in contrasting colour.
- .3 Marking to incorporate the assembly's fire-resistance rating and the following suggested wording, "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS", or other accepted wording.

.4 Include horizontal red painted line, 75mm in width, between identification markings.

.5 For occupied areas with exposed ceilings: use 50 mm red dot adhesive stickers without horizontal painted lines

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 EXAMINATION

.1 Verify substrate conditions are acceptable for product installation in accordance with manufacturer's instructions and approved system design listings for each condition.

.2 Verify each opening/annular space to ensure it does not exceed the maximum and minimum dimensions indicated on the approved system design listing.

.3 Verify that all joints, service penetrating elements and supporting devices/hangers have been properly installed as indicated on approved system design listings. All temporary lines and markings have been removed to meet the approved system design listings.

.4 Verify that the proposed fire stop system is composed of components that are compatible with each other, the substrates forming the openings, and the items, if any, penetrating the fire stop under conditions of application and service, as demonstrated by the fire stop manufacturer based on testing and field experience.

.5 Pipe and duct insulation: confirm that the proposed fire stop system has been tested with the actual insulation penetrating the fire separation on site, as indicated in the approved system design listing. Maintain insulation around pipes and ducts penetrating the fire separation.

.6 Ensure no additional items have been installed through opening that does not appear on the approved system design listing.

.7 Ensure areas that are to be fire stopped are accessible for proper application and conditions are suitable for installation of the fire stop system. Areas to remain accessible for inspection.

.8 Report in writing to Departmental Representative any defective surfaces or conditions affecting the fire stop system installation, immediately and prior to commencing any installations.

.9 Proceed only once defected surfaces or conditions have been corrected.

.10 Beginning of installation means acceptance of site conditions.

3.3 PREPARATION

.1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.
- .1 Ensure that substrates and surfaces are clean, dry and frost free.
- .2 Ensure substrates and surfaces are free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.

.2 Prepare surfaces in contact with fire stop and smoke stop materials to manufacturer's instructions.

.3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.

.4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

.5 Protect adjacent work areas and finish surfaces from damage during product installation.

.6 Ensure multi-penetration openings have been framed and boarded out, all around the annular opening as indicated in the system design listing prior to prepping the opening.

3.4 INSTALLATION

.1 Install fire stop and smoke stop materials and components in accordance with manufacturer's certified tested system listing.

.2 Coordinate with other sub-trades to ensure that all pipes, conduits, cables, and other items, which penetrate fire separations, have been permanently installed before installation of fire stop systems.

.3 Schedule work to ensure that fire separations and all other construction that conceals penetrations are not erected before installation of fire and smoke stop systems

.4 Protect holes or gaps made by through penetrations, poke through termination devices, and un-penetrated openings or joints to ensure that both continuity and integrity of fire separation are maintained.

.5 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing per manufacturer's instructions.

.6 Tool or trowel exposed surfaces to neat finish.

.7 Remove excess compound promptly as work progresses and upon completion.

.8 Protect gaps around recessed components (e.g.: panels, electrical boxes, outlets) with sealing putty in accordance with manufacturer's instructions.

.9 Do not use damaged or expired material.

.10 Joint Fire Stops:
- .1 For sealant applications, install joint fillers to support fire stop materials during application. Position joint fillers to ensure fire stop material cross-sectional shape and thickness relative to the joint width allows for optimum sealant movement, while developing the required fire-resistance rating.
- .2 Install fire stops using techniques recommended by the manufacturer:
  - .1 Fully wetting joint substrates to optimize adhesion.
  - .2 Completely filling recesses provided for each joint configuration.
  - .3 Providing uniform, cross-sectional shapes and thickness relative to joint width that optimize movement capability.
  - .4 Tooling non-sag fire stop materials immediately after their application and prior to the time skinning begins. Form smooth, uniform beads of configuration indicated or required to:
    - .1 Provide required fire-resistance rating.
    - .2 Eliminate air pockets
    - .3 Ensure contact and adhesion with sides of joint..
- .3 Joint Systems and Perimeter Fire Containment Systems:
  - .1 For systems with dynamic joints, ensure movement capabilities of the installation meet or exceed the movement expectations of the system design listing and manufacturer's installation instructions.

3.5 IDENTIFICATION

.1 General :
- .1 Clean substrate prior to applying identification.
- .2 Final location of identification to be determined on site.
- .3 Identification is not required on both sides of the fire separation.
- .4 Refer to drawings for locations of fire separations and rating required.

.2 Fire Stopped Penetrations:
- .1 Install identification label adjacent to each wall/floor service penetrations fire stopped Provide one identification label per single opening or per grouping cluster.
- .2 Securely apply identification to substrate by providing adequate adhesive.
- .3 Secure tags with metal fasteners or hang with metal chain or wire.
- .4 Identification shall be completely filled out and installed prior to requesting substantial performance.

.3 Fire Separations (Barriers):
- .1 Provide identification at least 4500 mm of the end of each wall and at intervals not exceeding 9000 mm along wall/floor joint fire stops.
- .2 Markings to be installed within ceiling spaces, 600 mm below horizontal fire separation or roof structure unless otherwise indicated.

.3 For occupied areas with exposed ceilings: review location of identification with Departmental Representative before proceeding.

3.6 REPAIRS AND MODIFICATIONS

.1 Identify damaged or re-entered seals requiring repair or modification.

.2 Remove loose or damaged materials. If penetrating items are to be added, remove sufficient material to insert new elements and to avoid damaging the balance of the seal.

.3 Ensure that surfaces to be sealed are clean and dry.

.4 Use only materials that are suitable for repair of original seal, as approved by manufacturer. Do not mix products from different manufacturers.

.5 Repair all damage resulting from fire stop destructive testing.

3.7 FIELD QUALITY CONTROL

.1 Inspections: notify Departmental Representative when ready for inspection and prior to concealing or enclosing fire stop materials and service penetration assemblies.

.2 Manufacturer's Field Services:
- .1 Mock-ups: manufacturer to provide written confirmation that the fire stop system installed meets or exceeds the system design listing requirements for each mock-up application.
- .2 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.
- .3 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.

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

3.8 INSPECTIONS

.1 Third-Party Inspection Firm: provide the services of a third-party inspection firm to conduct random inspections and direct exploratory review (i.e.: destructive testing) during the course of construction and prior to closing off any concealed areas. Inspections and destructive testing shall be performed in compliance with ASTM E2174 and ASTM 2393.

.2 Departmental Representative will conduct random inspections and direct exploratory review (i.e.: destructive testing) during the course of construction and prior to closing off any concealed areas. Inspections and destructive testing will be performed in compliance with ASTM E2174 and ASTM E2393
- .1 Include for a minimum of 2% for each area of 900 square meters for exploratory reviews for each approved system design listing and each trade involved. Perform cut tests at perimeter joints every 15 meters. Perform cut test at bottom and top of wall joints and wall to wall joints and building expansion joints every 15 meters.
- .2 Perform exploratory review as directed by Departmental Representative. Cut out fire stop and remove to ensure fire stop system installation meets or exceeds the system design listing as identified.

.3 Upon completion of construction and before requesting substantial performance review, fire stop contractor and manufacturer's representative shall inspect all fire stopping work and prepare a deficiency list. Submit deficiency list to Departmental Representative for review. Repair any deficiencies and re-inspect work to ensure that all deficiencies have been completed.

.4 Submit formal request for substantial performance review of work once all work is completed, quality control has been performed and all fire stop installations have been inspected and identified with the approved fire stop identification labels.

.5 Departmental Representative will conduct the substantial performance review in the presence of the fire stop contractor and the manufacturer's representative.

.6 Perform all cutting and removal of systems for visual review by Departmental Representative. After review and acceptance are completed, replace fire stop system with new materials.

3.9 FIRE STOPPING LOCATIONS

.1 Provide fire stop and L-Rated smoke-resistant fire stop systems at:
- .1 Penetrations through fire-resistance and smoke-resistance rated masonry, concrete, and gypsum board partitions and walls.
- .2 Penetrations through fire-resistance rated floor slabs/systems, ceilings and roof.
- .3 Edge of floor slabs at curtain wall and precast concrete panels.
- .4 Edge of fire-resistant floor or roof assemblies and exterior wall assemblies.
- .5 Joints at top and bottom of fire-resistance rated masonry and gypsum board partitions. Joints to allow for independent movement.
- .6 Joints at top and bottom of fire-resistance rated walls where they meet non-rated fire separation assemblies.
- .7 Intersection of fire-resistance rated masonry, concrete and gypsum board partitions.
- .8 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.
- .9 Expansion joints in fire-resistance rated floors, walls, ceilings and roof assemblies.
- .10 Perimeter gaps at curtain wall or other exterior wall assembly and horizontal fire-separation.
- .11 Openings and sleeves installed for future use through fire separations.
- .12 Around mechanical and electrical assemblies/devices penetrating fire separations.
- .13 Mechanical and electrical recessed boxes in walls and partitions.
- .14 Rigid ducts: fire stopping to consist of bead of fire stop material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

3.10 CLEANING

.1 Proceed in accordance with Section 00 10 00 - General Instructions.

.2 Remove equipment, excess materials and debris and clean adjacent surfaces immediately after application. Use methods and cleaning materials approved by manufacturer.

.3 Protect fire stops during and after curing period from contact with contaminating substances. Repair all damage.

.4 Remove temporary dams after initial set of fire stop and smoke stop materials.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 ASTM International (ASTM)
- .1 ASTM C919-19, Standard Practice for Use of Sealants in Acoustical Applications.
- .2 ASTM C920-18, Standard Specification for Elastomeric Joint Sealants.

.2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB 37.5-M89, Cutback Asphalt Plastic Cement.

.3 General Services Administration (GSA) - Federal Specifications (FS)
- .1 FS-SS-S-200-E(2)1993, Sealants, Joint, Two-Component, Jet-Blast-Resistant, Cold Applied, for Portland Cement Concrete Pavement.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Safety Data Sheets (SDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with 00 00 00 - General Instructions.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for joint sealants and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Manufacturer's product to describe:
  - .1 Caulking compound.
  - .2 Primers.
  - .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.

.3 Samples:
- .1 Submit 2 samples of each type of material and colour.
- .2 Cured samples of exposed sealants for each colour where required to match adjacent material.

.4 Manufacturer's Instructions:
- .1 Submit instructions to include installation instructions for each product used.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 00 10 00 - General Instructions.

.2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect joint sealants from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

1.5 SITE CONDITIONS

.1 Ambient Conditions:
.1 Proceed with installation of joint sealants only when:
.1 Ambient and substrate temperature conditions are within limits permitted by joint sealant manufacturer or are above 4.4 degrees C.
.2 Joint substrates are dry.
.3 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.

.2 Joint-Width Conditions:
.1 Proceed with installation of joint sealants only where joint widths are more than those allowed by joint sealant manufacturer for applications indicated.

.3 Joint-Substrate Conditions:
.1 Proceed with installation of joint sealants only after contaminants capable of interfering with adhesion are removed from joint substrates.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of Safety Data Sheets (SDS) acceptable to Health Canada.

PART 2 - PRODUCTS

2.1 SEALANT MATERIALS

.1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.

.2 When low toxicity caulks are not possible, confine usage to areas which off gas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize off gas time.

.3 Where sealants are qualified with primers use only these primers.

.4 Modified bitumen sealant (Sealant Type 'A'):
.1 For penetration and terminations of bituminous and modified bituminous membrane: To CAN/CGSB-37.5. As recommended by membrane manufacturer.

.2 Standard of acceptance:
.1 Sopramastic 200 by Soprema.
.2 MBR Flashing Cement by Johns Manville.
.3 Polybitume 570-05 by Henry Bakor.
.4 Or accepted alternate.

.5 Urethanes one part (Sealant Type 'B'):
.1 Non sag: To ASTM C920, Type S, Class 25 or higher, use NT.
.2 Standard of acceptance:
.1 Tremco Dymonic.
.2 BASF NPI.
.3 Sika IA.
.4 Mulco Flextra.
.5 Sherwin-Williams Loxon SI.
.6 Or accepted alternate.

	Type	Use		Movement Capability Class	
S	Single Component	T	Traffic	Class 100/50	100% expansion
M	Multi-Component	NT	Non-traffic		50% compression
	Grade	I	Immersed	Class 50	50%
P	Pourable	M	Mortar	Class 35	35%
NS	Non-sag	G	Glass	Class 25	25%
		O	Other	Class 12.5	12.5%

2.2 JOINT CLEANER

.1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant in accordance with sealant manufacturer's written recommendations.

.2 Primer: in accordance with sealant manufacturer's written recommendations.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for joint sealants installation in accordance with manufacturer's written instructions.
.1 Visually inspect substrate in presence of Departmental Representative.
.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 SURFACE PREPARATION

.1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.

.2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.

.3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

.4 Ensure joint surfaces are dry and frost free.

.5 Prepare surfaces in accordance with manufacturer's directions.

3.3 PRIMING

.1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.

.2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

3.4 BACKUP MATERIAL

.1 Apply bond breaker tape where required to manufacturer's instructions.

.2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.5 MIXING

.1 Mix materials in strict accordance with sealant manufacturer's instructions.

3.6 APPLICATION

.1 Sealant:
- .1 Apply sealant in accordance with manufacturer's written instructions.
- .2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
- .3 Apply sealant in continuous beads.
- .4 Apply sealant using gun with proper size nozzle.
- .5 Use sufficient pressure to fill voids and joints solid.
- .6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.
- .7 Tool exposed surfaces before skinning begins to give slightly concave shape.
- .8 Remove excess compound promptly as work progresses and upon completion.

.2 Curing:
- .1 Cure sealants in accordance with sealant manufacturer's instructions.
- .2 Do not cover up sealants until proper curing has taken place.

3.7 CLEANING

.1 Progress Cleaning: clean in accordance with Section 00 10 00 - General Instructions.
- .1 Leave Work area clean at end of each day.
- .2 Clean adjacent surfaces immediately.
- .3 Remove excess and droppings, using recommended cleaners as work progresses.
- .4 Remove masking tape after initial set of sealant.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 00 10 00 - General Instructions.

3.8 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by joint sealants installation.

END OF SECTION

PART 1 - GENERAL

1.1 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 00 10 00 - General Instructions.

1.2 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 00 10 00 - General Instructions.

1.3 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit in accordance with Section 00 10 00 - General Instructions.

.2 Furnish spare parts as follows:
- .1 One set of filter media for each filter or filter bank in addition to final operating set.

.3 Provide one set of special tools required to service equipment as recommended by manufacturers.

.4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 00 10 00 - General Instructions and with manufacturer's written instructions.

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

.3 Storage and Handling Requirements:
- .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not used.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
- .1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 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.

3.3 SYSTEM CLEANING

.1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 00 10 00 - General Instructions.
- .1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 00 10 00 - General Instructions.

3.5 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 SUMMARY

.1 This Section includes requirements for selective demolition and removal of heating, ventilation, air conditioning systems, refrigerant systems, controls and automated automation components, and related mechanical components and incidentals required to complete work described in this Section to prepare for new construction.

1.2 RELATED SECTIONS

.1 Section 01 10 00 – General Instructions

.2 Section 01 74 19 - Waste Management and Disposal

.3 Section 02 41 19.16 - Selective Interior Demolition

.4 Section 02 42 00 - Removal and Salvage of Construction Materials

.5 Section 26 05 05 – Selective Demolition for Electrical

1.3 REFERENCE STANDARDS

.1 CSA Group (CSA)

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

.2 Federal Halocarbon Regulations, 2003 (SOR/2003-289)

1.4 DEFINITIONS

.1 For purposes of mechanical sections, the following definitions shall apply:

.1 Concealed: mechanical services and equipment is suspended ceilings and in chases and furred spaces.

.2 Exposed: will mean not concealed as defined above.

.3 Demolish: detach items from existing construction and legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.

.4 Remove: planned deconstruction and disassembly of electrical items from existing construction including removal of conduit, junction boxes, cabling and wiring from electrical component to panel taking care not to damage adjacent assemblies designated to remain; legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.

.5 Remove and Salvage: detach items from existing construction and deliver them to Departmental Representative ready for reuse.

.6 Remove and Reinstall: detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

.7 Existing to Remain: existing items of construction that are not removed and that are not otherwise indicated as being removed and salvaged, or removed and reinstalled.

.8 Hazardous Substances: dangerous substances, dangerous goods, hazardous commodities and hazardous products may include asbestos, mercury and lead, PCB’s, poisons, corrosive agents, flammable substances, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly as defined by the Federal Hazardous Products Act (RSC 1985) including latest amendments.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals: Provide in accordance with Section 01 10 00 – General Instructions, and as outlined in the following:

.1 Construction Waste Management Plan (CWM Plan): submit plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 19 - Waste Management and Disposal.

.2 Landfill Records: indicate receipt and acceptance of selective demolition waste and hazardous wastes by a landfill facility licensed to accept hazardous wastes.

.3 Halocarbon Service Logs: Contractor shall complete halocarbon service logs and provide copies to Departmental Representative containing all information in accordance with requirements outlined in the Federal Halocarbon Regulation.

1.6 EXAMIMATION OF THE SITE

.1 Carefully examine conditions at the site which will or may affect your work, and become familiar with both the new and existing construction, finishes, and other work associated with your work in order that your tender price includes for everything necessary for completion of your work within the proposed project schedule.

1.7 SALVAGE AND DEBRIS MATERIALS

.1 Demolished items become property of the Contractor and will be removed from the work site, except items indicated as being reused, salvaged or otherwise indicated to remain in accordance with Section 01 74 19 - Waste Management and Disposal.

.2 Carefully remove materials and items designated for salvage and store in a manner to prevent damage or devaluation of materials in accordance with Section 02 42 00 – Removal and Salvage of Construction Materials.

Part 2 Products

2.1 MATERIAL

.1 HVAC Repair Materials: use only new materials required for completion or repair matching materials damaged during performance of work of this Section; new materials are required to meet assembly or system characteristics as existing systems indicated to remain and carry CSA approval labels required by the Authority Having Jurisdiction.

.2 Fire stopping Repair Materials: use fire stopping materials compatible with existing fire stopping systems where removal or demolition work affects rated assemblies, restore to match existing fire rated performance.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Existing Conditions: visit site, thoroughly examine and become familiar with conditions that may affect the work of this Section before tendering the Bid; Departmental Representative will not consider claims for extras for work or materials necessary for proper execution and completion of the contract that could have been determined by a site visit.

3.2 PREPARATION

.1 Protection of Existing Systems to Remain: protect systems and components indicated to remain in place during selective demolition operations and as follows:

.1 Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.

.2 Notify Departmental Representative and cease operations where safety of buildings being demolished, adjacent structures or services appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

.3 Prevent debris from blocking drainage inlets.

.4 Protect mechanical systems that must remain in operation.

.2 Protection of Building Occupants: sequence demolition work so that interference with the use of the building by the Departmental Representative and users is minimized and as follows:

.1 Prevent debris from endangering the safe access to and egress from occupied buildings.

.2 Notify Departmental Representative and cease operations where safety of occupants appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

3.3 EXECUTION

.1 Demolition and Removal: coordinate requirements of this Section as follows:

.1 Disconnect and cap gas supply and electrical services in accordance with requirements of local Authority Having Jurisdiction.

.2 Do not disrupt active or energized utilities without approval of the Departmental Representative.

.3 Erect and maintain dust proof and weather tight partitions to prevent the spread of dust and fumes to occupied building areas; remove partitions when complete.

.4 Demolish parts of existing building to accommodate new construction and remedial work as indicated.

.5 At end of each day's work, leave worksite in safe condition.

.6 Perform demolition work in a neat and workmanlike manner:

.1 Remove any tools or equipment after completion of work, and leave site clean and ready for subsequent renovation work.

.2 Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.

.2 Halocarbon Requirements: Contractor shall coordinate requirements of this Section as outlined below and in accordance with requirements specified in the Federal Halocarbon Regulation:

.1 Contractor shall generate halocarbon service log records for work on equipment (cooling equipment with CFC's, HCFC's and HRC refrigerants; fire suppression systems; solvent cleaning systems) that may result in the release of a halocarbon.

.2 Contractor shall generate Decommissioning, Dismantling or Destroying (DDD) Notice containing all information in accordance with requirements outlined in the Federal Halocarbon Regulation for all systems to be decommissioned, dismantled or destroyed as part of work activities.

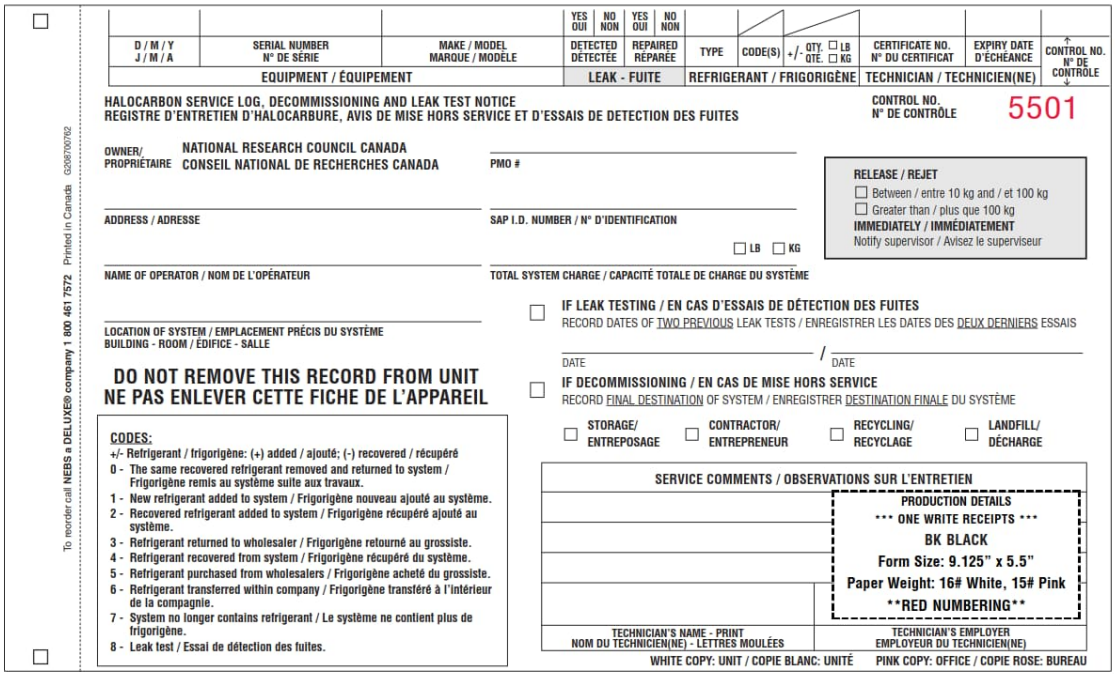
.1 Prior to commencement of DDD activities Contractor shall collect halocarbons in approved, designated container per Federal Halocarbon Regulation.

.2 Contractor shall generate DDD Notice and affix notice to system and provide copies to be maintained on site by Departmental Representative.

.3 Contractor shall provide additional copy of all halocarbon service log records, including DDD Notices in the O&M Manual.

.3 Contractor may generate halocarbon service log records using their internally generated reporting documentation, if service records meet all specified requirements outlined in the Federal

Halocarbon Regulation. Otherwise, the Contractor shall request NRC service logs from Departmental Representative for documentation purposes.



D / M / Y J / M / A	SERIAL NUMBER N° DE SÉRIE	MAKE / MODEL MARQUE / MODÈLE	DETECTED DÉTECTÉE YES OUI / NO NON	REPAIRED RÉPARÉE YES OUI / NO NON	TYPE	CODE(S)	+/- QTY. QTÉ. ☐ LB ☐ KG	CERTIFICATE NO. N° DU CERTIFICAT	EXPIRY DATE D'ÉCHÉANCE	CONTROL NO. N° DE CONTRÔLE
EQUIPMENT / ÉQUIPEMENT			LEAK - FUITE		REFRIGERANT / FRIGORIGÈNE			TECHNICIAN / TECHNICIEN(NE)		

HALOCARBON SERVICE LOG, DECOMMISSIONING AND LEAK TEST NOTICE
REGISTRE D'ENTRETIEN D'HALOCARBURE, AVIS DE MISE HORS SERVICE ET D'ESSAIS DE DETECTION DES FUITES

CONTROL NO. N° DE CONTRÔLE 5501

OWNER/ PROPRIÉTAIRE: NATIONAL RESEARCH COUNCIL CANADA / CONSEIL NATIONAL DE RECHERCHES CANADA

PMO #

ADDRESS / ADRESSE

SAP I.D. NUMBER / N° D'IDENTIFICATION

☐ LB ☐ KG

NAME OF OPERATOR / NOM DE L'OPÉRATEUR

TOTAL SYSTEM CHARGE / CAPACITÉ TOTALE DE CHARGE DU SYSTÈME

RELEASE / REJET
☐ Between / entre 10 kg and / et 100 kg
☐ Greater than / plus que 100 kg
IMMEDIATELY / IMMÉDIATEMENT
Notify supervisor / Avisez le superviseur

LOCATION OF SYSTEM / EMPLACEMENT PRÉCIS DU SYSTÈME
BUILDING - ROOM / ÉDIFICE - SALLE

DO NOT REMOVE THIS RECORD FROM UNIT
NE PAS ENLEVER CETTE FICHE DE L'APPAREIL

☐ IF LEAK TESTING / EN CAS D'ESSAIS DE DÉTECTION DES FUITES
RECORD DATES OF TWO PREVIOUS LEAK TESTS / ENREGISTRER LES DATES DES DEUX DERNIERS ESSAIS
DATE / DATE

☐ IF DECOMMISSIONING / EN CAS DE MISE HORS SERVICE
RECORD FINAL DESTINATION OF SYSTEM / ENREGISTRER DESTINATION FINALE DU SYSTÈME
☐ STORAGE/ ENTREPOSAGE ☐ CONTRACTOR/ ENTREPRENEUR ☐ RECYCLING/ RECYCLAGE ☐ LANDFILL/ DÉCHARGE

CODES:
+/- Refrigerant / frigorigène: (+) added / ajouté; (-) recovered / récupéré
0 - The same recovered refrigerant removed and returned to system / Frigorigène remis au système suite aux travaux.
1 - New refrigerant added to system / Frigorigène nouveau ajouté au système.
2 - Recovered refrigerant added to system / Frigorigène récupéré ajouté au système.
3 - Refrigerant returned to wholesaler / Frigorigène retourné au grossiste.
4 - Refrigerant recovered from system / Frigorigène récupéré du système.
5 - Refrigerant purchased from wholesalers / Frigorigène acheté du grossiste.
6 - Refrigerant transferred within company / Frigorigène transféré à l'intérieur de la compagnie.
7 - System no longer contains refrigerant / Le système ne contient plus de frigorigène.
8 - Leak test / Essai de détection des fuites.

SERVICE COMMENTS / OBSERVATIONS SUR L'ENTRETIEN

PRODUCTION DETAILS
*** ONE WRITE RECEIPTS ***
BK BLACK
Form Size: 9.125" x 5.5"
Paper Weight: 16# White, 15# Pink
RED NUMBERING

TECHNICIAN'S NAME - PRINT / NOM DU TECHNICIEN(NE) - LETTRES MOULÉES
TECHNICIAN'S EMPLOYER / EMPLOYEUR DU TECHNICIEN(NE)

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3.4 CLOSEOUT ACTIVITIES

.1 Demolition Waste Disposal: arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle centre) except where explicitly noted otherwise for materials being salvaged for reuse in new construction in accordance with requirements outlined in Section 01 74 19 - Waste Management and Disposal.

.2 Halocarbon Service Logs: arrange for supplemental copies of all halocarbon service logs as specified in the Federal Halocarbon Regulations, including DDD Notices, to be incorporated into O&M Manuals upon project completion.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 07 84 00 - Fire Stopping.

.2 Section 07 92 00 - Joint Sealants.

.3 Section 23 08 16 - Cleaning and Start-Up of HVAC Piping Systems.

1.2 REFERENCE STANDARDS

.1 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.2 CSA Group (CSA)
- .1 CAN/CSA B139 Series 19, Installation Code for Oil Burning Equipment.

.3 Green Seal Environmental Standards (GSES)
- .1 Standard GS-11-2015, Edition 3.2, Environmental Standard for Paints and Coatings.

.4 National Research Council Canada (NRC)
- .1 National Fire Code of Canada 2015 (NFC).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 00 10 00 - General Instructions.

.2 Product Data:
- .1 Provide manufacturer's printed product literature, specifications and datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 00 10 00 - General Instructions and with manufacturer's written instructions.

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

PART 2 - PRODUCTS

2.1 MATERIAL

.1 Paint: zinc-rich to CAN/CGSB-1.181
- .1 Primers, Paints: in accordance with manufacturer's recommendations for surface conditions.

.2 Primer: maximum VOC limit 250 g/L to Standard GS-11.
.3 Paints: maximum VOC limit 150 g/L to Standard GS-1.

.2 Sealants: maximum VOC limit to to GSES GS-36.

.3 Adhesives: maximum VOC limit to to GSES GS-36.

.4 Fire Stopping: in accordance with Section 07 84 00 - Fire Stopping.

PART 3 - EXECUTION

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 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.

3.3 CLEARANCES

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and National Fire Code of Canada, CAN/CSA B139.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer without interrupting operation of other system, equipment, components.

3.4 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.
.1 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.

3.5 AIR VENTS

.1 Install air vents to CAN/CSA B139 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.

3.6 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.

3.7 PIPEWORK INSTALLATION

.1 Install pipework to CAN/CSA B139.

.2 Screwed fittings jointed with Teflon tape.

.3 Protect openings against entry of foreign material.

.4 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.5 Assemble piping using fittings manufactured to ANSI standards

.6 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.
.1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.

.7 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.8 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

.9 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.10 Install, except where indicated, to permit separate thermal insulation of each pipe.

.11 Group piping wherever possible.

.12 Ream pipes, remove scale and other foreign material before assembly.

.13 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.14 Provide for thermal expansion as indicated.

.15 Valves:
- .1 Install in accessible locations.
- .2 Remove interior parts before soldering.
- .3 Install with stems above horizontal position unless indicated.
- .4 Valves accessible for maintenance without removing adjacent piping.
- .5 Install globe valves in bypass around control valves.
- .6 Use ball or butterfly valves at branch take-offs for isolating purposes except where specified.
- .7 Install butterfly valves on chilled water and related condenser water systems only.
- .8 Install butterfly valves between weld neck flanges to ensure full compression of liner.
- .9 Install plug cocks or ball valves for glycol service.
- .10 Use chain operators on valves NPS 2-1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.

.16 Check Valves:
- .1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.
- .2 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

3.8 SLEEVES

.1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.

.2 Material: schedule 40 black steel pipe.

.3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.

.4 Sizes: 6 mm minimum clearance between sleeve and uninsulated 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:
  - .1 Provide space for fire stopping.
  - .2 Maintain the fire-resistance rating integrity of the fire separation.
- .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.

3.9 ESCUTCHEONS

.1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.

.2 Construction: one piece type with set screws.
- .1 Chrome or nickel plated brass or type 302 stainless steel..

.3 Sizes: outside diameter to cover opening or sleeve.
.1 Inside diameter to fit around pipe or outside of insulation if so provided.

3.10 PREPARATION FOR FIRE STOPPING

.1 Coordinate the installation of fire stopping around pipes, insulation and adjacent fire separation in accordance with Section 07 84 00 - Fire Stopping.

.2 Pipes subject to movement: conform to fire stop system design listing to ensure pipe movement without damaging fire stopping material or installation.

.3 Insulated pipes: ensure integrity of insulation and vapour barriers.

3.11 FLUSHING OUT OF PIPING SYSTEMS

.1 Flush system in accordance with Section 23 08 16 - Cleaning and Start-Up of HVAC Piping Systems.

.2 Before start-up, clean interior of piping systems in accordance with requirements of Section 00 10 00 - General Instructions, supplemented as specified in relevant mechanical sections.

.3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.12 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.

.2 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work.

.3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.

.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 Departmental Representative.

.6 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.

.7 Insulate or conceal work only after approval and certification of tests by Departmental Representative.

3.13 EXISTING SYSTEMS

.1 Connect into existing piping systems at times approved by Departmental Representative.

.2 Request written approval by Departmental Representative 10 days minimum, prior to commencement of work.

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

3.14 CLEANING

.1 Clean in accordance with Section 00 10 00 - General Instructions.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 American Society of Mechanical Engineers (ASME)
- .1 ASME B31.1-2020, Power Piping.
- .2 ASME B31.3-2018, Process Piping.
- .3 ASME Boiler and Pressure Vessel Code, 2021.
  - .1 ASME BPVC.I-2021, 2021 ASME Boiler and Pressure Vessel Code, Section I: Power Boilers
  - .2 ASME BPVC.V-2021, 2021 ASME Boiler and Pressure Vessel Code, Section V: Nondestructive Examination.
  - .3 ASME BPVC.IX-2021, 2021 ASME Boiler and Pressure Vessel Code, Section IX: Welding and Brazing Qualifications.

.2 American Water Works Association (AWWA)
- .1 AWWA C206-17, Field Welding of Steel Water Pipe.

.3 American Welding Society (AWS)
- .1 AWS C1.1M/C1.1-2019, Recommended Practices for Resistance Welding.
- .2 AWS W1-2015, Welding Inspection Handbook..

.4 CSA Group (CSA)
- .1 CSA B51-19, Boiler, Pressure Vessel and Pressure Piping Code.
- .2 CSA W47.2-11 (R2020), Certification of Companies for Fusion Welding of Aluminum.
- .3 CSA W48-18, Filler Metals and Allied Materials for Metal Arc Welding.
- .4 CSA-W117.2-2019, Safety in Welding, Cutting and Allied Processes.
- .5 CSA W178.1-2018, Certification of Welding Inspection Organizations.
- .6 CSA W178.2-2018, Certification of Welding Inspectors.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 00 10 00 - General Instructions.

1.3 QUALITY ASSURANCE

.1 Qualifications:
- .1 Welders:
  - .1 Welding qualifications in accordance with CSA B51.
  - .2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.
  - .3 Submit welder's qualifications to Departmental Representative.
  - .4 Each welder to possess identification symbol issued by authority having jurisdiction.
  - .5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.
- .2 Inspectors:
  - .1 Inspectors qualified to CSA W178.2.
- .3 Certifications:
  - .1 Registration of welding procedures in accordance with CSA B51.
  - .2 Copy of welding procedures available for inspection.
  - .3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 00 10 00 - General Instructions.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

PART 2 - PRODUCTS

2.1 ELECTRODES

.1 Electrodes: in accordance with CSA W48 Series

PART 3 - EXECUTION

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 QUALITY OF WORK

.1 Welding: in accordance with ASMEB31.1, ASME B31.3, ASME BPVC.1, ASME BPVC.IX and AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, applicable requirements of provincial authority having jurisdiction.

3.3 INSTALLATION REQUIREMENTS

.1 Identify each weld with welder's identification symbol.

.2 Backing rings:
- .1 Where used, fit to minimize gaps between ring and pipe bore.
- .2 Do not install at orifice flanges.

.3 Fittings:
- .1 NPS 2 and smaller: install welding type sockets.
- .2 Branch connections: install welding tees or forged branch outlet fittings.

3.4 INSPECTION AND TESTS - GENERAL REQUIREMENTS

.1 Review weld quality requirements and defect limits of applicable codes and standards with Departmental Representative before work is started.

.2 Formulate "Inspection and Test Plan" in co-operation with Departmental Representative.

.3 Do not conceal welds until they have been inspected, tested and approved by inspector.

.4 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

3.5 SPECIALIST EXAMINATIONS AND TESTS

.1 General:
- .1 Perform examinations and tests by specialist qualified to CSA W178.1 and CSA W178.2 and approved by Departmental Representative.
- .2 To ASME BPVC.V, CSA B51 and requirements of authority having jurisdiction
- .3 Inspect and test 50% of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination and full gamma ray radiographic (hereinafter referred to as "radiography") tests.

.2 Hydrostatically test welds to ASME B31.1

.3 Visual examinations: include entire circumference of weld externally and wherever possible internally.

.4 Failure of visual examinations:
- .1 Upon failure of welds by visual examination, perform additional testing as directed by Departmental Representative of total of up to 10% of welds, selected at random by Departmental Representative by radiographic.

.5 Full radiographic tests for piping systems.
- .1 Spot radiography:
  - .1 Conduct spot radiographic tests of up to 10% of welds, selected at random by Departmental Representative from welds which would be most difficult to repair in event of failure after system is operational.
- .2 Radiographic film:
  - .1 Identify each radiographic film with date, location, name of welder, and submit to Departmental Representative. Replace film if rejected because of poor quality.
- .3 Interpretation of radiographic films:
  - .1 By qualified radiographer.
- .4 Failure of radiographic tests:
  - .1 Extend tests to welds by welder responsible when those welds fails tests.

3.6 DEFECTS CAUSING REJECTION

.1 As described in ASME B31.1 and ASME Boiler and Pressure Vessels Code.

.2 In addition, chilled water systems:
- .1 Undercutting greater than 0.8 mm adjacent to cover bead on outside of pipe.
- .2 Undercutting greater than 0.8 mm adjacent to root bead on inside of pipe.
- .3 Undercutting greater than 0.8 mm at combination of internal surface and external surface.
- .4 Incomplete penetration and incomplete fusion greater than total length of 38 mm in 1500 mm length of weld depth of such defects being greater than 0.8 mm.
- .5 Repair cracks and defects in excess of 0.8 mm in depth.
- .6 Repair defects whose depth cannot be determined accurately on basis of visual examination or radiographic tests.

3.7 REPAIR OF WELDS WHICH FAILED TESTS

.1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

3.8 CLEANING

.1 Clean in accordance with Section 00 10 00 - General Instructions.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 23 05 53 - Identification for HVAC Piping and Equipment.

1.2 REFERENCE STANDARDS

.1 American Society of Mechanical Engineers (ASME)
- .1 ASME B40.100-2013, Pressure Gauges and Gauge Attachments.
- .2 ASME B40.200-2008 (R2013), Thermometers, Direct Reading and Remote Reading.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 00 10 00 - General Instructions.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 00 10 00 - General Instructions and with manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Design point to be at mid-point of scale or range.

.2 Refer as indicated.

2.2 DIRECT READING THERMOMETERS

.1 Industrial, variable angle type, mercury-free, liquid filled, 125 mm scale length: to ASME B40.200.
- .1 Resistance to shock and vibration.

2.3 REMOTE READING THERMOMETERS

.1 100 mm diameter mercury-free, liquid filled, vapour activated dial type: to ASME B40.200, accuracy within one scale division, brass movement, stainless steel capillary, stainless steel spiral armour, stainless steel bulb and polished brass or stainless steel case for wall mounting.

2.4 THERMOMETER WELLS

.1 Copper pipe: copper or bronze.

.2 Steel pipe: brass or stainless steel.

2.5 PRESSURE GAUGES

.1 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel, phosphor bronze,bourdon tube having 0.5% accuracy full scale unless otherwise specified.

.2 Provide:
- .1 Siphon for steam service.
- .2 Snubber for pulsating operation.
- .3 Diaphragm assembly for corrosive service.
- .4 Gasketted pressure relief back with solid front.
- .5 Bronze stop cock.

PART 3 - EXECUTION

3.1 GENERAL

.1 Install thermometers and gauges so they can be easily read from floor or platform.
- .1 If this cannot be accomplished, install remote reading units.

.2 Install between equipment and first fitting or valve.

3.2 THERMOMETERS

.1 Install in wells on piping. Include 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 Chillers.

.3 Install wells as indicated only for balancing purposes.

.4 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

.1 Install in locations as follows:
- .1 Suction and discharge of pumps.
- .2 Upstream and downstream of PRV's.
- .3 Inlet and outlet of coils.
- .4 Inlet and outlet of liquid side of heat exchangers.
- .5 In other locations as indicated.

.2 Install gauge cocks for balancing purposes, elsewhere as indicated.

.3 Use extensions where pressure gauges are installed through insulation.

3.4 NAMEPLATES

.1 Install engraved lamicoid nameplates in accordance with Section 23 05 53 - Identification for HVAC Piping and Equipment, identifying medium.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 00 10 00 - General Instructions.
.1 Leave Work area clean at end of each day.

3.6 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by thermometer and gauge installation.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 American Society of Mechanical Engineers (ASME)
- .1 ASME B1.20.1-2013 (R2018), Pipe Threads, General Purpose (Inch).
- .2 ASME B16.18-2018, Cast Copper Alloy Solder Joint Pressure Fittings.

.2 ASTM International (ASTM)
- .1 ASTM B62-17, Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
- .1 MSS-SP-80-2019, Bronze Gate Globe, Angle and Check Valves.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 00 10 00 - General Instructions.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 00 10 00 - General Instructions.

1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials/Spare Parts:
- .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.
- .2 Tools:
  - .1 Furnish special tools for maintenance of systems and equipment.
  - .2 Include following:
    - .1 Lubricant gun for expansion joints.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 00 10 00 - General Instructions and with manufacturer's written instructions.

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

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Valves:
- .1 Except for specialty valves, to be single manufacturer.
- .2 Products to have CRN registration numbers.

.2 End Connections:
- .1 Connection into adjacent piping/tubing:
  - .1 Steel pipe systems: screwed ends to ASME B1.20
  - .2 Copper tube systems: solder ends to ASME B16.18

.3 Lockshield Keys:
- .1 Where lockshield valves are specified, provide 10 keys of each size: malleable iron cadmium plated.

.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: regrindable.

.5 Ball Valves:
- .1 NPS 2 and under:
  - .1 Body and cap: cast high tensile bronze to ASTM B62
  - .2 Pressure rating: Class 125, 860 kPa steam.
  - .3 Connections: solder ends to ANSI.
  - .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.

.6 Butterfly Valves:
- .1 NPS 2-1/2 through NPS 6, 2068 kPa with grooved ends.
  - .1 Body: cast bronze, with copper-tube dimensioned grooved ends.
  - .2 Disc: elastomer coated ductile iron with integrally cast stem.
  - .3 Operator: lever.

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 CLEANING

.1 Clean in accordance with Section 00 10 00 - General Instructions.
.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 American Society of Mechanical Engineers (ASME)
- .1 ASME B31.1-2020, Power Piping.

.2 ASTM International (ASTM)
- .1 ASTM A125-96(2018), Standard Specification for Steel Springs, Helical, Heat-Treated.
- .2 ASTM A307-14e1, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .3 ASTM A563-15, Standard Specification for Carbon and Alloy Steel Nuts.

.3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
- .1 MSS SP 58-2018, Pipe Hangers and Supports - Materials, Design, Selection and Manufacture, Application and Installation.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 00 10 00 - General Instructions.

.2 Product Data:
- .1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 00 10 00 - General Instructions.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 00 10 00 - General Instructions and with manufacturer's written instructions.

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

PART 2 - PRODUCTS

2.1 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 ASME B31.1 or MSS SP 58.

.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 SP 58.

.2 Performance Requirements:
.1 Design supports, platforms, catwalks, hangers to withstand seismic events.

2.2 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with MSS SP 5 and ASME B31.1.

.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 electro-plating galvanizing process.
.3 Ensure steel hangers in contact with copper piping are epoxy coated.

.2 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 UL listed to MSS SP 58.

.3 Hanger rods: threaded rod material to MSS SP 58:
.1 Ensure that hanger rods are subject to tensile loading only.
.2 Provide linkages where lateral or axial movement of pipework is anticipated.
.3 Do not use 22 mm or 28 mm rod.

.4 Pipe attachments: material to MSS SP 58:
.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.

.5 Adjustable clevis: material to MSS SP 58, UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
.1 Ensure "U" has hole in bottom for rivetting to insulation shields.

.6 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP 58.

.7 U-bolts: carbon steel to MSS SP 58 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 epoxy coated.

.8 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP 58.

2.4 RISER CLAMPS

.1 Steel or cast iron pipe: galvanized carbon steel to MSS SP 58, type 42, UL listed.

.2 Copper pipe: carbon steel copper plated to MSS SP 58, type 42.

.3 Bolts: to ASTM A307.

.4 Nuts: to ASTM A563.

2.5 INSULATION PROTECTION SHIELDS

.1 Insulated cold piping:
- .1 64 kg/m^3 density insulation plus insulation protection shield to: MSS SP 58, 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 SP 58.

2.6 CONSTANT SUPPORT SPRING HANGERS

.1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with ±5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).

.2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.

.3 Provide upper and lower factory set travel stops.

.4 Provide load adjustment scale for field adjustments.

.5 Total travel to be actual travel +20%. Difference between total travel and actual travel 25 mm minimum.

.6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.7 VARIABLE SUPPORT SPRING HANGERS

.1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.

.2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.

.3 Variable spring hanger complete with factory calibrated travel stops.

.4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with ±5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.8 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel. Submit calculations with shop drawings.

2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

.1 Provide templates to ensure accurate location of anchor bolts.

2.10 HOUSE-KEEPING PADS

.1 Provide 150 mm high concrete housekeeping pads for base-mounted equipment; size pads 50 mm larger than equipment; chamfer pad edges.

2.11 OTHER EQUIPMENT SUPPORTS

.1 Fabricate equipment supports from structural grade steel.

.2 Submit structural calculations with shop drawings.

2.12 ROOFTOP PIPE SUPPORT SYSTEM

.1 300 mm square HPDE mounting base with rubber base mat for vibration absorption and roof surface protection. Complete with strut corner fittings and securing hardware.

.2 Unistrut pipe support frame/strut channel fastened to mounting base and sized to accommodate side by side piping distribution as shown on drawings.

.3 Acceptable Material: Ecofoot QF120.

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 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.

.3 Clevis plates:
.1 Attach to concrete with 4 minimum concrete inserts, one at each corner.

.4 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

.5 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.

.6 Use variable support spring hangers where:
.1 Transfer of load to adjacent piping or to connected equipment is not critical.
.2 Variation in supporting effect does not exceed 25 % of total load.

3.3 HANGER SPACING

.1 Copper piping: up to NPS ½: every 1.5 m.

.2 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.

.3 Within 300 mm of each elbow.

Maximum Pipe Size: NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1¼	2.4 m	1.8 m
1½	3.0 m	2.4 m
2	3.0 m	2.4 m
2½	3.7 m	3.0 m
3	3.7 m	3.0 m

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 CLEANING

.1 Clean in accordance with Section 00 10 00 - General Instructions.
- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 Section Includes:
- .1 Vibration isolation materials and components, seismic control measures and their installation.

1.2 REFERENCE STANDARDS

.1 National Fire Protection Association (NFPA)
- .1 NFPA (Fire) 13, Standard for the Installation of Sprinkler Systems, 2019 Edition.

.2 National Research Council Canada (NRC)
- .1 National Building Code of Canada 2015 (NBC).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals: in accordance with Section 00 10 00 - General Instructions.
- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 00 10 00 - General Instructions. Include product characteristics, performance criteria, and limitations.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:
- .1 Deliver, store and handle in accordance with Section 00 10 00 - General Instructions.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Size and shape of bases type and performance of vibration isolation as indicated.

2.2 SPRINGS

.1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.

.2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.

.3 Colour code springs.

2.3 SPRING MOUNT

.1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.

.2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.

.3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.

.4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.

.5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.

2.4 HANGERS

.1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.

.2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.

.3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.

.4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.

.5 Type H4 - stable spring, elastomeric element with precompression washer and nut with deflection indicator.

2.5 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES

.1 Acoustic barriers: between pipe and support, consisting of 25 mm minimum thick heavy duty duck and neoprene isolation material.

2.6 STRUCTURAL BASES

.1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2400 mm on smallest dimension, split for field welding on sizes over 2400 mm on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.

.2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.

.3 Bases to clear housekeeping pads by 25 mm minimum.

2.7 SEISMIC CONTROL MEASURES

.1 General:
- .1 Seismic control systems to work in every direction.
- .2 Fasteners and attachment points to resist same maximum load as seismic restraint.
- .3 Drilled or power driven anchors and fasteners not permitted.
- .4 No equipment, equipment supports or mounts to fail before failure of structure.
- .5 Supports of cast iron or threaded pipe not permitted.
- .6 Seismic control measures not to interfere with integrity of fire stopping.

.2 Static equipment:
- .1 Anchor equipment to equipment supports. Anchor equipment supports to structure.
- .2 Suspended equipment:
  - .1 Use one or more of following methods depending upon site conditions:
    - .1 Install tight to structure.
    - .2 Cross brace in every direction.
    - .3 Brace back to structure.
    - .4 Cable restraint system.
- .3 Seismic restraints:
  - .1 Cushioning action gentle and steady.
  - .2 Never reach metal-like stiffness.

.3 Vibration isolated equipment:
- .1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.
- .2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.
- .3 As indicated.

.4 Piping systems:
- .1 Fire protection systems: to NFPA (Fire) 13.
- .2 Piping systems: hangers longer than 305 mm; brace at each hanger.
- .3 Compatible with requirements for anchoring and guiding of piping systems.

.5 Bracing methods:
- .1 Approved by Departmental Representative.
- .2 Structural angles or channels.
- .3 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

.6 Service and utilities entrance into building.

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 Seismic control measures to meet requirements of NBC.

.2 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.

.3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

.4 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:

- .1 Up to NPS 4: first 3 points of support. NPS 5 to NPS 8: first 4 points of support. NPS 10 and Over: first 6 points of support.
- .2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.

.5 Where isolation is bolted to floor use vibration isolation rubber washers.

.6 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.3 FIELD QUALITY CONTROL

.1 Inspection and Certification:

- .1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC system after start up and TAB of systems.
- .2 Take vibration measurements for equipment as indicated.
- .3 Provide Departmental Representative with notice 24 hours in advance of commencement of tests.
- .4 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).
- .5 Submit complete report of test results.

.2 Letter of compliance to be submitted, stamped by professional engineer licensed in the Province of Ontario, certifying that all equipment/piping has been installed in accordance with applicable seismic requirements.

3.4 CLEANING

.1 Proceed in accordance with Section 00 10 00 - General Instructions.

.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 requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.

1.2 REFERENCE STANDARDS

.1 Canadian General Standards Board (CGSB)
  .1 CAN/CGSB-24.3-92, Identification of Piping Systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals: in accordance with Section 00 10 00 - General Instructions.

1.4 QUALITY ASSURANCE

.1 Quality assurance submittals: submit following in accordance with Section 00 10 00 - General Instructions.

.2 Health and Safety:
  .1 Do construction occupational health and safety in accordance with Section . 00 10 00 - General Instructions

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:
  .1 Deliver, store and handle in accordance with Section 00 10 00 - General Instructions.
  .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 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.

2.2 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, 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.

2.3 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 Departmental Representative.

2.4 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 plastic-coated cloth with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.

.7 Colours and Legends:
.1 Where not listed, obtain direction from Departmental 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 supply	Green	CH. WTR. SUPPLY
Chilled water return	Green	CH. WTR. RETURN
Glycol supply	Yellow	GLYCOL SUPPLY
Glycol return	Yellow	GLYCOL RETURN
Sanitary	Green	SAN

2.5 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.

2.6 VALVES, CONTROLLERS

.1 Brass tags with 12 mm stamped identification data filled with black paint.

2.7 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.

2.8 LANGUAGE

.1 Identification in English and French.

.2 Use one nameplate and label for each language.

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

.2 Provide ULC registration plates as required by respective agency.

3.3 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.

3.4 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.

3.5 CLEANING

.1 Proceed in accordance with Section 00 10 00 - General Instructions.

.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 Departmental Representative 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.

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.

1.6 PRE-TAB REVIEW

.1 Review Contract Documents before project construction is started and confirm in writing to Departmental Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to Departmental Representative 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 Departmental Representative for verification of TAB reports.

1.9 START OF TAB

.1 Notify Departmental Representative 7 days prior to start of TAB.

.2 Start TAB when building is essentially completed, including:

.3 Installation of ceilings, doors, windows, other construction affecting TAB.

.4 Application of weatherstripping, sealing, and caulking.

.5 Pressure, leakage, other tests specified elsewhere Division 23.

.6 Provisions for TAB installed and operational.

.7 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 Air systems:
  - .1 Filters in place, clean.
  - .2 Duct systems clean.
  - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
  - .4 Correct fan rotation.
  - .5 Fire, smoke, volume control dampers installed and open.
  - .6 Coil fins combed, clean.
  - .7 Access doors, installed, closed.
  - .8 Outlets installed, volume control dampers open.
- .3 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 Other HVAC systems: plus 5%, minus 5%.
- .2 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 Prior to TAB, submit to Departmental Representative list of instruments used together with serial numbers.

.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.3 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.

1.13 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit, prior to commencement of TAB:

.2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.14 PRELIMINARY TAB REPORT

.1 Submit for checking and approval of Departmental Representative, 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 electronic copy of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.

1.16 VERIFICATION

.1 Reported results subject to verification by Departmental Representative.

.2 Provide personnel and instrumentation to verify up to 30% of reported results.

.3 Number and location of verified results as directed by Departmental Representative.

.4 Pay costs to repeat TAB as required to satisfaction of Departmental Representative.

1.17 SETTINGS

.1 After TAB is completed to satisfaction of Departmental Representative, 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 Departmental Representative.

1.19 AIR SYSTEMS

.1 Standard: TAB to most stringent of this section or TAB standards of AABC.

.2 Do TAB of systems, equipment, components, controls specified Division 23.

.3 Qualifications: personnel performing TAB qualified to standards of AABC.

.4 Quality assurance: perform TAB under direction of supervisor qualified to standards of AABC .

.5 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

.6 Locations of equipment measurements: to include as appropriate:
- .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
- .2 At controllers, controlled device.

.7 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

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 RELATED REQUIREMENTS

.1 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.2 REFERENCE STANDARDS

.1 ASTM International (ASTM)
- .1 ASTM B209M-14, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
- .2 ASTM C335/C335M-17, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
- .3 ASTM C449-07(2019), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
- .4 ASTM C553-13(2019), Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- .5 ASTM C612-14(2019), Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- .6 ASTM C921-10(2015), Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.2 Canadian General Standards Board (CGSB)
- .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.3 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).

.4 Underwriters Laboratories of Canada (ULC)
- .1 CAN/ULC-S102-2018-REV1, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.3 DEFINITIONS

.1 For purposes of this section:
- .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
- .2 "EXPOSED" - means "not concealed" as previously defined.
- .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.

.2 TIAC Codes:
- .1 CRD: Code Round Ductwork,
- .2 CRF: Code Rectangular Finish.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 00 10 00 - General Instructions.

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.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 00 10 00 - General Instructions.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.

PART 2 - PRODUCTS

2.1 FIRE AND SMOKE RATING

.1 To CAN/ULC-S102:
  .1 Maximum flame spread rating: 25.
  .2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

.4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
  .1 Mineral fibre: to ASTM C553.
  .2 Jacket: to CGSB 51-GP-52Ma.
  .3 Maximum "k" factor: to ASTM C553.

2.3 JACKETS

.1 Canvas:
  .1 220 gm/m^2 cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.

.2 Lagging adhesive: compatible with insulation.

.3 Aluminum:
  .1 To ASTM B209 with and without moisture barrier as scheduled in PART 3 of this section.
  .2 Thickness: 0.50 mm sheet.
  .3 Finish: Smooth.

.4 Jacket banding and mechanical seals: 19 mm wide, 0.5 mm thick stainless steel.
.1 Stainless steel:
.5 Type: 304.
.6 Thickness: 0.50 mm sheet.
.7 Finish: Smooth.
.8 Jacket banding and mechanical seals: 19 mm wide, 0.5 mm thick stainless steel.

2.4 ACCESSORIES

.1 Vapour retarder lap adhesive:
.1 Water based, fire retardant type, compatible with insulation.

.2 Indoor Vapour Retarder Finish:
.1 Vinyl emulsion type acrylic, compatible with insulation.

.3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.

.4 ULC Listed canvas jacket.

.5 Outdoor Vapour Retarder Mastic:
.1 Vinyl emulsion type acrylic, compatible with insulation.
.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m^2.

.6 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.

.7 Contact adhesive: quick-setting.

.8 Canvas adhesive: washable.

.9 Tie wire: 1.5 mm stainless steel.

.10 Banding: 19 mm wide, 0.5 mm thick stainless steel.

.11 Facing: 25 mm stainless steel hexagonal wire mesh.

.12 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

PART 3 - EXECUTION

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PRE-INSTALLATION REQUIREMENTS

.1 Pressure test ductwork systems complete, witness and certify.

.2 Ensure surfaces are clean, dry, free from foreign material.

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturers instructions and as indicated.

.3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
.1 Ensure hangers, and supports are outside vapour retarder jacket.

.5 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.

3.4 DUCTWORK INSULATION SCHEDULE

.1 Insulation types and thicknesses: conform to following table:

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular cold and dual temperature supply air ducts	C-1	yes	50
Round cold and dual temperature supply air ducts	C-2	yes	50
Rectangular warm air ducts	C-1	no	25
Round warm air ducts	C-1	no	25
Supply, return and exhaust ducts exposed in space being served	none		
Outside air ducts to mixing plenum	C-1	yes	25
Mixing plenums	C-1	yes	25
Exhaust duct between dampers and louvres	C-1	no	25
Acoustically lined ducts	none		

.2 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:
.1 Use TIAC code C-1 insulation, scored to suit diameter of duct.
.1 Finishes: conform to following table:

	TIAC Code	
	Rectangular	Round
Indoor, concealed	none	none
Indoor, exposed within mechanical room	CRF/1	CRD/2
Inddor, exposed elsewhere	CRF/2	CRD/3
Outdoor, exposed to precipitation	CRF/3	CRD/4
Outdoor, elsewhere	CRF/4	CRD/5

3.5 CLEANING

.1 Clean in accordance with Section 00 10 00 - General Instructions.
  .1 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.

1.2 REFERENCE STANDARDS

.1 ASTM International (ASTM)
- .1 ASTM B209M-14, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.
- .2 ASTM C335/C335M-17, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.2 Canadian General Standards Board (CGSB)
- .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts.

.3 Manufacturer's Trade Associations
- .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).

.4 Underwriters' Laboratories of Canada (ULC)
- .1 CAN/ULC-S102-2018-REV1, Surface Burning Characteristics of Building Materials and Assemblies.
- .2 CAN/ULC-S702-14, Thermal Insulation, Mineral Fibre, for Buildings

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 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals: in accordance with Section 00 10 00 - General Instructions.

.2 Product Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 00 10 00 - General Instructions. Include product characteristics, performance criteria, and limitations.

1.5 QUALITY ASSURANCE

.1 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project.

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 Section 10 00 - 00 General Instructions.
- .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.

PART 2 - PRODUCTS

2.1 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102.
- .1 Maximum flame spread rating: 25.
- .2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Mineral fibre specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees 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.
- .2 Maximum "k" factor: to CAN/ULC-S702.

.4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
- .1 Mineral fibre: to CAN/ULC-S702.
- .2 Jacket: to CGSB 51-GP-52Ma.
- .3 Maximum "k" factor: to CAN/ULC-S702.

2.3 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 m diameter stainless steel.

.5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

2.4 VAPOUR RETARDER LAP ADHESIVE

.1 Water based, fire retardant type, compatible with insulation.

2.5 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.6 JACKETS

.1 Polyvinyl Chloride (PVC):
- .1 One-piece moulded type to CAN/CGSB-51.53 with pre-formed shapes as required
- .2 Colours: White.
- .3 Minimum service temperatures: -20 degrees C.
- .4 Maximum service temperature: 65 degrees 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.

.2 Stainless steel:
- .1 Type: 316.
- .2 Thickness: 0.25 mm.
- .3 Finish: smooth.
- .4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
- .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.

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 manufacturers 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 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: A-3.
.1 Securements: SS bands at 300 mm on centre.
.2 Seals: VR lap seal adhesive, VR 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. degrees C	TIAC Code	Pipe sizes (NPS) and insulation thickness (mm) Run	to 1	1¼ to 2	2½ to 4	5 to 6	8 & over
Chilled Water or Glycol	4-13	A-3	25	25	25	25	25	25
Chilled Water or Glycol	below 4	A-3	25	25	38	38	38	38

.5 Finishes:
- .1 Exposed indoors: PVC.
- .2 Exposed outdoors: stainless steel.
- .3 Exposed in mechanical rooms: PVC.
- .4 Concealed, indoors: PVC on valves, fittings. No further finish.
- .5 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
- .6 Finish attachments: SS bands, at 150 mm on centre. Seals: wing.
- .7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.7 CLEANING

.1 Proceed in accordance with Section 00 10 00 - General Instructions.

.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 REQUIREMENTS

.1 Section 23 08 16 - Cleaning and Start-Up of HVAC Piping Systems.

1.2 REFERENCE STANDARDS

.1 ASTM International (ASTM)
- .1 ASTM E202-18, 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 16 - Cleaning and Start-Up of HVAC 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 Boiler and/or chiller operation.
  - .3 Pressure bypass open/closed.
  - .4 Control pressure failure.
  - .5 Maximum heating demand.
  - .6 Maximum cooling demand.
  - .7 Boiler and/or chiller failure.
  - .8 Cooling tower (and/or industrial fluid cooler) fan failure.
  - .9 Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.

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 full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.
  - .3 Conduct flue gas analysis test on boilers at full load and at low fire conditions.

.7 Chilled water system capacity test:
- .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
  - .1 Adding heat from building heating system or;
  - .2 Raising space temperature by turning off cooling and air systems for sufficient period of time before starting testing and pre-heating building to summer design space temperature (occupied) or above. Set OAD and RAD for minimum outside air if OAT is near outside design temperature or to maximum recirculation if RAT is greater that OAT. RAT to be at least 23 degrees C minimum.
- .2 Test procedures:
  - .1 Open fully cooling coil control valves.
  - .2 Set thermostats on associated AHU's for maximum cooling.
  - .3 Set AHU's for design maximum air flow rates.
  - .4 Set load or demand limiters on chillers to 100%.
  - .5 After system has stabilized, record chilled water, and condenser water flow rates and supply and return temperatures simultaneously.

1.7 GLYCOL SYSTEMS

.1 Test to prove concentration will prevent freezing to minus 40 degrees C Test inhibitor strength and include in procedural report. Refer to ASTM E202.

1.6 SANITARY AND STORM DRAINAGE SYSTEMS

.1 Ensure that traps are fully and permanently primed.

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 Requirements:
.1 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

1.2 REFERENCE STANDARDS

.1 ASTM International (ASTM)
.1 ASTM E202-18, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:
.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 00 10 00 - General Instructions. Include product characteristics, performance criteria, and limitations.

.2 Quality assurance submittals: submit following in accordance with Section 00 10 00 - General Instructions.
.1 Instructions: submit manufacturer's installation instructions.
.1 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

1.4 QUALITY ASSURANCE

.1 Health and Safety:
.1 Do construction occupational health and safety in accordance with Section 00 10 00 - General Instructions.

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 10 00 -00 General Instructions.

PART 2 - PRODUCTS

2.1 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.

.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 ½ 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 degrees 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 maximum design. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38 degrees C. Drain as quickly as possible. Refill with clean water. Circulate for 6 hours 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).

.8 Glycol Systems:
.1 In addition to procedures specified above perform specified procedures.
.2 Test to prove concentration will prevent freezing to minus 40 degrees C. Test inhibitor strength and include in procedural report. Refer to ASTM E202.

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 Clean out strainers repeatedly until system is clean.
.4 Repeat with water at design temperature.
.5 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
.6 Bring system up to design temperature and pressure.
.7 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
.8 Adjust pipe supports, hangers, springs as necessary.
.9 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
.10 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
.11 Check operation of drain valves.
.12 Adjust valve stem packings as systems settle down.
.13 Fully open balancing valves (except those that are factory-set).
.14 Check operation of over-temperature protection devices on circulating pumps.
.15 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

3.4 CLEANING

.1 Proceed in accordance with Section 00 10 00 - General Instructions.

.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 REQUIREMENTS

.1 Section 23 05 00 - Common Work Results for HVAC.

1.2 REFERENCE STANDARDS

.1 American Welding Society (AWS)
- .1 AWS A5.8/A5.8M:2019, Specification Filler Metals for Brazing and Braze Welding.

.2 ASME
- .1 ASME B16.4-2016, Gray-Iron Threaded Fittings Classes 125 and 250.
- .2 ASME B16.15-2018, Cast Copper Alloy Threaded Fittings Classes 125 and 250.
- .3 ASME B16.18-2018, Cast Copper Alloy, Solder Joint Pressure Fittings.
- .4 ASME B16.22-2018, Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.

.3 ASTM International (ASTM)
- .1 ASTM B32-20, Standard Specification for Solder Metal.
- .2 ASTM B88M-20, Standard Specification for Seamless Copper Water Tube Metric.
- .3 ASTM E202-18, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 00 10 00 - General Instructions.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 00 10 00 - General Instructions.

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:
- .1 Furnish 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.

1.6 QUALITY ASSURANCE

.1 Regulatory Requirements: ensure Work is performed in compliance with applicable Provincial/Territorial regulations.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 00 10 00 - General Instructions and with manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 TUBING

.1 Type L hard drawn copper tubing: to ASTM B88M.

2.2 FITTINGS

.1 Cast bronze threaded fittings: to ASME B16.15.

.2 Wrought copper and copper alloy solder joint pressure fittings: to ASME B16.22.

.3 Cast iron threaded fittings: to ASME B16.4.

.4 Cast copper alloy solder joint pressure fittings: to ASME B16.18.

2.3 FLANGES

.1 Brass or bronze: threaded.

.2 Cast iron: threaded.

.3 Orifice flanges: slip-on, raised face, 2100 kPa.

2.4 JOINTS

.1 Solder, tin-antimony, 95:5: to ASTM B32.

.2 Silver solder BCUP: to AWS A5.8.

.3 Brazing: as indicated.

2.5 VALVES

.1 Connections:
- .1 NPS 2 and smaller: ends for soldering.
- .2 NPS 2½ and larger: flanged ends.

.2 Balancing, for TAB:
- .1 Sizes: calibrated balancing valves, as specified.
- .2 NPS 2 and under:
  - .1 Globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.

.2 Elsewhere: globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.

.3 Drain valves: gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.

.4 Swing check valves:
.1 NPS 2 and under:
.1 Class 125, swing, as specified Section 23 05 23.01 - Valves - Bronze.
.2 NPS 2½ and over:
.1 Flanged ends: as specified Section 23 05 23.01 - Valves - Bronze.

.5 Ball valves:
.1 NPS 2 and under: as specified Section 23 05 23.01 - Valves - Bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hydronic systems installation in accordance with manufacturer's written instructions.
.1 Visually inspect substrate in presence of Departmental Representative.
.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

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 PIPING INSTALLATION

.1 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.

.2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping where ever practical.

.3 Slope piping in direction of drainage and for positive venting.

.4 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.

.5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.

.6 Assemble piping using fittings manufactured to ANSI standards.

3.4 VALVE INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.

.2 Install ball valves at branch take-offs and to isolate each piece of equipment, and as indicated.

.3 Install chain operators on valves NPS 2½ and over where installed more than 2400 mm above floor in Mechanical Equipment Rooms.

3.5 CIRCUIT BALANCING VALVES

.1 Install flow measuring stations and flow balancing valves as indicated.

.2 Remove handwheel after installation and TAB is complete.

.3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.6 FLUSHING AND CLEANING

.1 Flush and clean in presence of Departmental Representative.

.2 Flush after pressure test for a minimum of 4 hours.

.3 Fill with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for minimum of 8 hours.

.4 Refill system with clean water. Circulate for at least 4 hours. Clean out strainer screens/baskets regularly. Then drain.

.5 Refill system with clean water. Circulate for at least 2 hours. Clean out strainer screens/baskets regularly. Then drain.

.6 Drainage to include drain valves, dirt pockets, strainers, low points in system.

.7 Re-install strainer screens/baskets only after obtaining Departmental Representative's approval.

3.7 FILLING OF SYSTEM

.1 Refill system with clean water adding water treatment (glycol) as specified.

3.8 FIELD QUALITY CONTROL

.1 Testing:
- .1 Test system in accordance with Section 23 05 00 - Common Work Results for HVAC.
- .2 For glycol systems, retest with ethylene glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves.

.2 Balancing:
- .1 Balance water systems to within plus or minus 5% of design output.

3.9 CLEANING

.1 Progress Cleaning: clean in accordance with Section 00 10 00 - General Instructions.
  .1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 00 10 00 - General Instructions.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 23 05 00 - Common Work Results for HVAC.

.2 Section 23 05 15 - Common Installation Requirements for HVAC Pipework.

.3 Section 23 05 23.01 - Valves - Bronze.

.4 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.5 Section 23 08 13 - Performance Verification HVAC Systems.

.6 Section 3 08 16 - Cleaning and Start-Up of HVAC Piping Systems.

1.2 REFERENCE STANDARDS

.1 American Water Works Association (AWWA)
- .1 AWWA C111/A21.11-17, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.2 American Society of Mechanical Engineers (ASME)
- .1 ASME B16.1-2020, Grey Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
- .2 ASME B16.3-2016, Malleable Iron Threaded Fittings: Classes 150 and 300.
- .3 ASME B16.5-2020, Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard.
- .4 ASME B16.9-2018, Factory-Made Wrought Buttwelding Fittings.
- .5 ASME B18.2.1-2012, Square Hex, Heavy Hex and Askew Head Bolts and Hex, Heavy Hex, Hex Flange. Loded Head and Lag Screws (Inch Series).
- .6 ASME B18.2.2-2015, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).

.3 ASTM International (ASTM)
- .1 ASTM A47/A47M-99(2018)e1, Standard Specification for Ferritic Malleable Iron Castings.
- .2 ASTM A53/A53M-20, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
- .3 ASTM A536-84(2019)e1, Standard Specification for Ductile Iron Castings.
- .4 ASTM E202-18, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.

.4 CSA Group (CSA)
- .1 CSA B242-05 (R2016), Groove and Shoulder Type Mechanical Pipe Couplings.
- .2 CSA W48-18, Filler Metals and Allied Materials for Metal Arc Welding.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 00 10 00 - General Instructions.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 00 10 00 - General Instructions.

1.5 EXTRA STOCK MATERIALS

.1 Supply spare parts as follows:
- .1 Valve seats: 1 minimum for every ten valves, each size. Minimum one.
- .2 Discs: 1 minimum for every ten valves, each size. Minimum one.
- .3 Stem packing: 1 minimum for every ten valves, each size. Minimum one.
- .4 Valve handles: 2 minimum of each size.
- .5 Gaskets for flanges: 1 minimum for every ten flanges.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PIPE

.1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
- .1 To NPS 6: Schedule 40.

2.2 PIPE JOINTS

.1 NPS 2 and under: screwed fittings with PTFE tape.

.2 NPS 2-1/2 and over: welding fittings and flanges to CSA W48.

.3 Roll grooved: standard coupling to CSA B242

.4 Flanges: raised face, weld neck to AWWA C111/ A21.11.

.5 Orifice flanges: slip-on raised face, 2100 kPa.

.6 Flange gaskets: to AWWA C111/ A21.11.

.7 Pipe thread: taper.

.8 Bolts and nuts: to ASME B18.1 and ASME B18.2.

.9 Roll grooved coupling gaskets: type EPDM.

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.
.2 Steel: to ASME B16.5

.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: malleable iron to ASTM A47/A47M ductile iron to ASTM A536.

2.4 VALVES

.1 Reference Section 23 05 23.01 - Valves - Bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hydronic systems installation in accordance with manufacturer's written instructions.
.1 Visually inspect substrate in presence of Departmental Representative.
.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PIPING INSTALLATION

.1 Install pipework in accordance with Section 23 05 15 - Common Installation Requirements for HVAC Pipework.

3.3 CIRCUIT BALANCING VALVES

.1 Install flow measuring stations and flow balancing valves as indicated.

.2 Remove handwheel after installation and when TAB is complete.

.3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.4 CLEANING, FLUSHING AND START-UP

.1 In accordance with Section 23 08 16 - Cleaning and Start-Up of HVAC Piping Systems.

3.5 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.

3.6 BALANCING

.1 Balance water systems to within plus or minus 5 % of design output.

.2 In accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

3.7 GLYCOL CHARGING

.1 Include mixing tank and positive displacement pump for glycol charging.

.2 Retest for concentration to ASTM E202 after cleaning

3.8 PERFORMANCE VERIFICATION

.1 In accordance with Section 23 08 13 - Performance Verification HVAC Systems.

3.9 CLEANING

.1 Progress Cleaning: clean in accordance with Section 00 10 00 - General Instructions.
.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 00 10 00 - General Instructions.

3.10 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by hydronic systems installation.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 American Society of Mechanical Engineers (ASME)
- .1 ASME BPVC.VIII.1-2021, 2021 ASME Boiler and Pressure Vessel Code Section VIII, Division 1 - Rules for Construction of Pressure Vessels.

.2 ASTM International (ASTM)
- .1 ASTM A278/A278M-01(2020), Standard Specification for Grey Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).
- .2 ASTM B62-17, Standard Specification for Composition Bronze or Ounce Metal Castings.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 00 10 00 - General Instructions.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for expansion tanks, air vents, separators, valves, and strainers and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 00 10 00 - General Instructions.

.2 Operation and Maintenance Data: submit operation and maintenance data for hydronic specialties for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 00 10 00 - General Instructions and with manufacturer's written instructions.

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

.3 Storage and Handling Requirements:
- .1 Store materials and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect hydronic specialties from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 DIAPHRAGM TYPE EXPANSION TANK

.1 Vertical steel pressurized diaphragm type expansion tank.

.2 Capacity: as indicated.

.3 Diaphragm sealed in EPDM suitable for 115 degrees C operating temperature.

.4 Working pressure: 860 kPa with ASME stamp and certification.

.5 Air precharged to 84 kPa (initial fill pressure of system).

.6 Base mount for vertical installation.

.7 Supports: provide supports with hold down bolts and installation templates.

.8 Renewable diaphragm.

2.2 AUTOMATIC AIR VENT

.1 Standard float vent: brass body and NPS 1/8 connection and rated at 310 kPa working pressure.

.2 Industrial float vent: cast iron body and NPS 1/2 connection and rated at 860 kPa working pressure.

2.3 PIPE LINE STRAINER

.1 NPS 1/2 to 2: bronze body to ASTM B62, solder end connections, Y pattern.

.2 NPS 2-1/2 to 12: cast iron body to ASTM A278/A278M, Class 30 flanged connections.

.3 Blowdown connection: NPS 1.

.4 Screen: stainless steel with 1.19 mm perforations.

.5 Working pressure: 860 kPa.

2.4 SUCTION DIFFUSER

.1 Body: cast iron with flanged connections.

.2 Strainer: with built-in, disposable 1.19 mm mesh, low pressure drop screen and NPS 1 blowdown connection.

.3 Permanent magnet particle trap.

.4 Full length straightening vanes.

.5 Pressure Grey tappings.

.6 Adjustable support leg.

2.5 GLYCOL MAKE-UP PACKAGE

.1 The contractor shall supply and install, as indicated on the plans and in the specifications, a prefabricated, automatic and autonomous make-up package for the glycol system.

.2 System shall include 64 litre (17 U.S. gallon) storage/mixing tank with molded-in level gauge, 125 mm (5") fill/access opening and cover; pump suction hose with inlet strainer; pressure pump with fuse protection; low fluid level pump cut-out float switch; manual diverter valve for purging air and agitating contents of storage tank; digital pressure switch adjustable from 0 kPa (0 psig) to 310 kPa (45 psig) cut-out pressure; factory cut-out pressure set to 115 kPa (18psig); digital pressure display, visual alarm on low level, low level alarm comes with remote dry contacts. Unit to be c/w UL listed and fused power supply adapter with LED power indicator light, 100-240VAC/50-60Hz/1 to 24 VDC, supplied loose for field installation.

.3 A 25 mm (1") Ø glycol solution recovery line shall be piped in from the system relief valve outlet to the solution container, through its lid in such a way that the lid can be removed for filling and mixing.

.4 Acceptable material: Axiom DMF300.

2.6 BUFFER TANK

.1 Furnish and install a buffer tank for the chilled water system as shown on the drawings and schedule. Selection shall be based upon system flows with pipe size as a minimum in accordance with the basis of design.

.2 Tank shall be fabricated of steel, rated for 125 psig working pressure, stamped and registered in accordance with ASME BPVC.VIII.1 for unfired pressure vessels, and include two performance chambers within the vessel separated by internal baffle.

.3 Unit shall have a separate venting chamber at top. At the top of the venting chamber shall be an integral full port float actuated brass venting mechanism. Separate drain connection at bottom.

.4 Acceptable material: Taco BTL0150F02-125N or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hydronic specialties installation in accordance with manufacturer's written instructions.
   .1 Visually inspect substrate in presence of Departmental Representative.
   .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
   .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and data sheets.

3.3 GENERAL

.1 Run drain lines and blow off connections to terminate above nearest drain.

.2 Maintain adequate clearance to permit service and maintenance.

.3 Should deviations beyond allowable clearances arise, request and follow Departmental Representative's directive.

.4 Check shop drawings for conformance of tappings for ancillaries and for equipment operating weights.

3.4 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 as indicated.

3.5 AIR VENTS

.1 Install at high points of systems.

.2 Install gate valve on automatic air vent inlet. Run discharge to nearest drain or service sink.

3.6 EXPANSION TANKS

.1 Adjust expansion tank pressure to suit design criteria.

.2 Install lockshield type valve at inlet to tank.

3.7 PRESSURE SAFETY RELIEF VALVES

.1 Run discharge pipe to terminate above nearest drain.

3.8 SUCTION DIFFUSERS

.1 Install on inlet to pumps having suction size greater than 50.

3.9 CLEANING

.1 Progress Cleaning: clean in accordance with Section 00 10 00 - General Instructions.
  .1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 00 10 00 - General Instructions.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 American Society of Mechanical Engineers (ASME)
- .1 ASME B16.5-2020, Pipe Flanges and Flanged Fittings, NPS ½ through NPS 24, Metric/Inch.

.2 American Society for Testing and Materials International (ASTM)
- .1 ASTM A48/A48M-03(2016), Standard Specification for Gray Iron Castings.
- .2 ASTM B111/B111M-18a, Standard Specification for Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock.
- .3 ASTM B584-14, Standard Specification for Copper Alloy Sand Castings for General Applications.

.3 CSA Group (CSA)
- .1 CSA B214-21, Installation Code for Hydronic Heating Systems.

.4 Compressed Gas Association (CGA)
- .1 CGA G-6.3, Carbon Dioxide Cylinder Filling and Handling Procedures.

.5 National Electrical Manufacturers' Association (NEMA)
- .1 NEMA MG 1-2016, Motors and Generators.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 00 10 00 - General Instructions.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for pump, circulator, and equipment and include product characteristics, performance criteria, physical size, finish and limitations indicate point of operation, and final location in field assembly.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 00 10 00 - General Instructions.

.2 Operation and Maintenance Data: submit operation and maintenance data for hydronic pumps for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 00 10 00 - General Instructions and with manufacturer's written instructions.

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

.3 Storage and Handling Requirements:
- .1 Store materials and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect hydronic pumps from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 EQUIPMENT

.1 Size and select components to: CSA B214.

2.2 VERTICAL IN-LINE CIRCULATORS

.1 Single stage, single suction type, vertical inline pump.
.1 Seals: Close-coupled serviceable without disturbing piping connections.
.2 Include casing drain plug and 1/4 inch suction and discharge ports.

.2 Casing: Cast iron ASTM A48, 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 Drill and tap casing for gauge ports on both suction and discharge connections.
.4 Drill and tap casing on bottom for drain port.

.3 Impeller: To ASTM B584, bronze, fully enclosed and dynamically balanced to CGA G-6.3 and fitted to shaft with key. Use two-plane balancing when installed impeller diameter is less than 6 times impeller width.

.4 Pump Shaft Sleeve: Brass to ASTM B111.687.

.5 Flanges: To ASME B16.5, Class 250.

.6 Flush Line: 3/8 inch braided stainless steel complete with vent.

.7 Gasket: Synthetic fibre.

.8 Mechanical Seal: Non-Potable Fluid, Type Armstrong 2A, Inside Single Spring and rated to 230°F maximum.

.9 Motor: NEMA Premium® Motor to NEMA MG 1.
.1 Horsepower: 5 hp.
.2 Enclosure: ODP.
.3 Efficiency: NEMA Premium 12.12.
.4 Power supply: 575/3/60.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hydronic pump installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.
.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and data sheets.

3.3 INSTALLATION

.1 Install hydronic pumps to: CSA B214.

.2 In line circulators: install as indicated by flow arrows.
.1 Support at inlet and outlet flanges or unions.
.2 Install with bearing lubrication points accessible.

.3 Base mounted type: supply templates for anchor bolt placement.
.1 Include anchor bolts with sleeves. Place level, shim unit and grout.
.2 Align coupling in accordance with manufacturer's recommended tolerance.
.3 Check oil level and lubricate. After run-in, tighten glands.

.4 Ensure that pump body does not support piping or equipment.
.1 Provide stanchions or hangers for this purpose.
.2 Refer to manufacturer's installation instructions for details.

.5 Pipe drain tapping to floor drain.

.6 Install volute venting pet cock in accessible location.

.7 Check rotation prior to start-up.

.8 Install pressure gauge test cocks.

3.4 START-UP

.1 General:
.1 In accordance with Section 00 10 00 - General Instructions; 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 minimum.
.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.
.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.

3.5 PERFORMANCE VERIFICATION (PV)

.1 General:
.1 Verify performance in accordance with Section 00 10 00 - General Instruction, supplemented as specified herein.

.2 Verify that manufacturer's performance curves are accurate.

.3 Ensure valves on pump suction and discharge provide tight shut-off.

.4 Net Positive Suction Head (NPSH):
.1 Application: measure NPSH for pumps which operate on open systems and with water at elevated temperatures.
.2 Measure using procedures prescribed in Section 00 10 00 - General Instructions.
.3 Where procedures do not exist, discontinue PV, report to Departmental Representative and await instructions.

.5 Multiple Pump Installations - Series and Parallel:
.1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.

.6 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.

.7 Commissioning Reports: in accordance with Section 00 10 00 - General Instructions, supplemented as specified herein. Reports to include:
.1 Record of points 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 Use Report Forms specified in Section 00 10 00 - General Instructions.
.3 Pump performance curves (family of curves).

3.6 CLEANING

.1 Progress Cleaning: clean in accordance with Section 00 10 00 - General Instructions.
.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 00 10 00 - General Instructions.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 ASME
- .1 ASME BPVC.VII-2021, 2021 ASME Boiler and Pressure Vessel Code, Section VII: Recommended Guidelines for the Care of Power Boilers.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Safety Data Sheets (SDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 00 10 00 - General Instructions.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for HVAC water treatment systems and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit 2 copies of WHMIS SDS. Indicate VOC's for adhesive and solvents during application and curing.

.3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 00 10 00 - General Instructions.

.2 Operation and Maintenance Data: submit operation and maintenance data for HVAC water treatment systems for incorporation into manual.

.3 Include following:
- .1 Log sheets as recommended by Departmental Representative.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 00 10 00 - General Instructions and with manufacturer's written instructions.

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

.3 Storage and Handling Requirements:
- .1 Store materials and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect HVAC water treatment systems from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 MANUFACTURER

.1 Equipment, chemicals, and service provided by one supplier.

2.2 POT FEEDER

.1 Welded steel, pressure rating 1200 kPa. Temperature rating: 90 degrees C.

2.3 WATER TREATMENT FOR HYDRONIC SYSTEMS

.1 Chilled water and glycol system: pot feeder, 19 L, operating pressure 1200 kPa.

.2 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.

2.4 CHEMICALS

.1 Provide 1 years supply.

.2 All chemicals utilized are to conform to applicable NRC standards. Coordinate requirements with NRC Departmental Representative.

.3 Chilled Water: CorrShield OR4407.

2.5 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.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for HVAC water treatment systems installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

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 INSTALLATION

.1 Install HVAC water treatment systems in accordance with ASME BPVC.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.

3.4 CHEMICAL FEED PIPING

.1 Install crosses at changes in direction. Install plugs in unused connections.

3.5 CLEANING OF MECHANICAL SYSTEM

.1 Provide copy of recommended cleaning procedures and chemicals for approval by Departmental Representative.

.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.

3.6 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 Departmental Representative in writing on matters regarding installed water treatment systems.

.5 Commissioning procedures - Water Softeners:
- .1 Demonstrate compliance with specifications by chemical analyses of raw water and treated water.
- .2 Determine, demonstrate actual softening capacity between regenerations.
- .3 Establish regeneration intervals and procedures.
- .4 Train O&M personnel in regeneration procedures.

.6 Commissioning procedures - Water side of closed circuit coolers, Cooling Tower Systems:
- .1 Verify operation of bleed-off system.
- .2 Establish bleed-off flow rate.
- .3 Establish rate of chemical feed - continual and periodic.
- .4 Test system water for chlorides, TDS, suspended solids, algae, slime, inhibitor level, pH, alkalinity, hardness, other impurities and microbiological organisms.
- .5 Compare with readings of total dissolved and suspended solids metre.
- .6 Read make-up water metre, compare with chiller load summation (ton-hours).
- .7 Test make-up water for chlorides, hardness.
- .8 Compare test results with readings from TDS metre.
- .9 Record quantity of make-up water, compare with summation of chiller load (in ton-hours).
- .10 Record types, quantities of chemicals applied.

.7 Commissioning procedures - Closed Circuit Hydronic Systems:
- .1 Analyze water in system.
- .2 Based upon an assumed rate of loss approved by Departmental Representative, establish rate of chemical feed.
- .3 Record types, quantities of chemicals applied.

.8 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.

.9 Certificates:
- .1 Upon completion, furnish certificates confirming satisfactory installation and performance.

.10 Commissioning Reports:
- .1 To include system schematics, test results, test certificates, raw and treated water analyses, design criteria, other data required by Departmental Representative.

.11 Commissioning activities during Warranty Period:
- .1 Check out water treatment systems on regular basis and submit written report to Departmental Representative.

3.7 CLEANING

.1 Progress Cleaning: clean in accordance with Section 00 10 00 - General Instructions.
  .1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 00 10 00 - General Instructions.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 07 92 00 - Joint Sealants.

1.2 REFERENCE STANDARDS

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

.2 ASTM International (ASTM)
- .1 ASTM A653/A653M-20, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- .1 SMACNA 008-2008, IAQ Guideline for Occupied Buildings Under Construction, 2nd Edition.
- .2 SMACNA 016-2012, HVAC Air Duct Leakage Test Manual, 2nd Edition.
- .3 SMACNA 1966-2006, HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 00 10 00 - General Instructions.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 00 10 00 - General Instructions.

PART 2 - PRODUCTS

2.1 SEAL CLASSIFICATION

.1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	C
250	C
125	C
125	Unsealed

.2 Seal classification:
- .1 Class C: transverse joints and connections made air tight with gaskets, sealant, tape or combination thereof. Longitudinal seams unsealed.
- .2 Unsealed seams and joints.

2.2 SEALANT

.1 Sustainability Characteristics:
- .1 Adhesives and sealants: in accordance with Section 07 92 00 - Joint Sealants.
- .2 Adhesives and sealants: VOC limit 250 g/L maximum to SCAQMD Rule 1168 GS-36.

.2 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

2.3 TAPE

.1 Tape: polyvinyl treated, open weave fibreglass tape, 50 mm wide.

2.4 DUCT LEAKAGE

.1 In accordance with SMACNA 016.

2.5 FITTINGS

.1 Fabrication: to SMACNA.

.2 Radiused elbows:
- .1 Rectangular: standard radius.
- .2 Round: smooth radius, centreline radius: 1.5 times diameter.

.3 Mitred elbows, rectangular:
- .1 To 407 mm: with single thickness turning vanes.
- .2 Over 407 mm: with double thickness turning vanes.

.4 Branches:
- .1 Rectangular main and branch: with radius on branch 1.5 times width of duct 45 degrees entry on branch.
- .2 Round main and branch: enter main duct at 45 degrees with conical connection.
- .3 Provide volume control damper in branch duct near connection to main duct.
- .4 Main duct branches: with splitter damper.

.5 Transitions:
- .1 Diverging: 20 degrees maximum included angle.
- .2 Converging: 30 degrees maximum included angle.

2.6 GALVANIZED STEEL

.1 Lock forming quality: to ASTM A653/A653M Z90 zinc coating.

.2 Thickness, fabrication and reinforcement: to ASHRAE and SMACNA.

.3 Joints: to ASHRAE, SMACNA and proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

2.7 HANGERS AND SUPPORTS

.1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for metal duct installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 GENERAL

.1 Do work in accordance with ASHRAE and SMACNA.

.2 Support risers in accordance with ASHRAE and SMACNA.

.3 Install breakaway joints in ductwork on sides of fire separation.

.4 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

3.3 HANGERS

.1 Strap hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: in accordance with ASHRAE, SMACNA and as follows:

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

3.4 SEALING AND TAPING

.1 Apply sealant in accordance with SMACNA and to manufacturer's recommendations.

.2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers recommendations.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 00 10 00 - General Instructions.

.1 Leave Work area clean at end of each day.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 ASTM International (ASTM)
- .1 ASTM C177-19, Standard Test Method for Steady-State Heat Flux and Thermal Measurements Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- .2 ASTM C423-17, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- .3 ASTM C916-20, Standard Specification for Adhesives for Duct Thermal Insulation.
- .4 ASTM C1071-19, Standard specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
- .5 ASTM C1338-19, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
- .6 ASTM G21-15(2021)e1, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

.2 North American Insulation Manufacturers Association (NAIMA)
- .1 NAIMA AH116-2002, Fibrous Glass Duct Construction Standards.

.3 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
- .1 SMACNA 008-2008, IAQ Guideline for Occupied Buildings Under Construction, 2nd Edition.
- .2 SMACNA 1966-2006, HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition.

.4 Underwriter's Laboratories of Canada (ULC)
- .1 CAN/ULC-S102-2018-REV1, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 00 10 00 - General Instructions.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 00 10 00 - General Instructions.

.2 Operation and Maintenance Data: submit operation and maintenance data for duct liners for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 00 10 00 - General Instructions.

PART 2 - PRODUCTS

2.1 DUCT LINER

.1 General:
- .1 Mineral Fibre duct liner: air surface coated mat facing.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102.
- .3 Recycled Content: EcoLogo certified with minimum 35% by weight recycled content.
- .4 Fungi resistance: to ASTM C1338 and ASTM G21.

.2 Rigid:
- .1 Use on flat surfaces.
- .2 25 mm thick, to ASTM C1071 Type 2, fibrous glass rigid board duct liner.
- .3 Density: 48 kg/m^3 minimum.
- .4 Thermal resistance to be minimum 0.76 (m^2. degrees C)/W for 25 mm thickness when tested in accordance with ASTM C177, at 24 degrees C mean temperature
- .5 Maximum velocity on faced air side: 20.3 m/s.
- .6 Minimum NRC of 0.70 at 25 mm thickness based on Type A mounting to ASTM C423
- .7 Recycled Content: EcoLogo certified containing minimum 45% by weight recycled content.

2.2 ADHESIVE

.1 Adhesive: to ASTM C916.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 29 degrees C to plus 93 degrees C.

.3 Water-based fire retardant type.

2.3 FASTENERS

.1 Weld pins 2.0 mm diameter, length to suit thickness of insulation. Metal retaining clips, 32 mm square.

2.4 JOINT TAPE

.1 Poly-Vinyl treated open weave fibreglass membrane 50 mm wide.

2.5 SEALER

.1 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68 degrees C to plus 93 degrees C.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for duct liner installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 GENERAL

.1 Do work in accordance with SMACNA 1966, NAIMA AH116 and as indicated except as specified otherwise.

.2 Line inside of ducts where indicated.

.3 Duct dimensions, as indicated, are clear inside duct lining.

3.3 DUCT LINER

.1 Install in accordance with manufacturer's recommendations, and as follows:
- .1 Fasten to interior sheet metal surface with 100% coverage of adhesive to ASTM C916.
  - .1 Exposed leading edges and transverse joints to be factory coated or coated with adhesive during fabrication.
- .2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425 mm on centres; impact driven mechanical fasteners to compress duct liner sufficiently to hold it firmly in place.
  - .1 Spacing of mechanical fasteners in accordance with SMACNA 1966 and NAIMA AH116.

.2 In systems, where air velocities exceeds 20.3 m/s, install galvanized sheet metal noising to leading edges of duct liner.

3.4 JOINTS

.1 Seal butt joints, exposed edges, weld pin and clip penetrations and damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's written recommendations, and as follows:
- .1 Bed tape in sealer.
- .2 Apply 2 coats of sealer over tape.

.2 Replace damaged areas of liner at discretion of Departmental Representative.

.3 Protect leading and trailing edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 00 10 00 - General Instructions.

.1 Leave Work area clean at end of each day.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 American Society of Mechanical Engineers (ASME)
- .1 ASME Boiler and Pressure Vessel Code, 2021.

.2 CSA Group (CSA)
- .1 CSA B51-19, Boiler, Pressure Vessel, and Pressure Piping Code.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit submittals in accordance with Section 00 10 00 - General Instructions.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for heat exchangers and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Manufacturer's Instructions: submit manufacturer's installation instructions.

.6 Manufacturers Reports:
- .1 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 00 10 00 - General Instructions.

.2 Operation and Maintenance Data: submit operation and maintenance data for heat exchangers for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 00 10 00 - General Instructions and with manufacturer's written instructions.

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

.3 Storage and Handling Requirements:
- .1 Store materials and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect heat exchangers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 EQUIPMENT

.1 Plate Heat Exchanger:
- .1 Water to water.
  - .1 Designed, constructed and tested in with accordance ASME Boiler and Pressure Vessel Code, CSA B51 and provincial pressure vessel regulations.
- .2 Frames: carbon steel with baked epoxy enamel paint, stainless steel side bolts and shroud.
- .3 Plates: type 304 stainless steel.
- .4 Gaskets: as recommended by manufacturer to suit fluid temperature.
- .5 Nozzles: ASA rubber rated flange type.
- .6 Supports: as indicated.
- .7 Piping connections: as indicated.
- .8 Capacity: as indicated.
- .9 Dimensions: as indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for heat exchanger installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

.2 General: install level and firmly anchored to supports in accordance with manufacturer's recommendations.

.3 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.

.4 Plate exchangers: install in accordance with manufacturer's recommendations.

3.3 APPURTENANCES

.1 Install with hose bib drain valve.

.2 Install thermometer wells with thermometers on inlet and outlet of primary and secondary side.

.3 Install pressure gauge on steam inlet.

3.4 FIELD QUALITY CONTROL

.1 Site Tests and Inspections:
- .1 Perform tests as directed by Departmental Representative to ensure heat exchangers are functional.
- .2 Obtain reports within 3 days of review and submit immediately to Departmental Representative.

3.5 SYSTEM START-UP

.1 General: perform start-up operations in accordance with Section 00 10 00 - General Instructions, supplemented 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.

.7 General: perform performance verification in accordance with Section 00 10 00 - General Instructions, supplemented as specified.

.8 Timing: only after TAB of hydronic systems have been successfully completed.

.9 Primary side:
- .1 Measure flow rate, pressure drop, and water temperature at heater inlet and outlet.
- .2 Control valve: verify proper operation without binding, slack in components.
- .3 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.
- .4 Calculate heat transfer from primary and secondary sides.
- .5 Simulate heating water temperature schedule and repeat above procedures.
- .6 Verify settings, operation, safe discharge from safety valves and relief valves.
- .7 Verify settings, operation of operating, limit and safety controls and alarms.
- .8 Reports:
  - .1 In accordance with Section 00 10 00 - General Instructions, supplemented as specified herein.

3.6 CLEANING

.1 Progress Cleaning: clean in accordance with Section 00 10 00 - General Instructions.
- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 00 10 00 - General Instructions.

3.7 DEMONSTRATION

.1 Training: provide training in accordance with Section 00 10 00 - General Instructions, supplemented as follows:

3.8 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by heat exchanger installation.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 25 90 01 - EMCS: Site Requirements, Applications and Systems Sequences of Operation.

1.2 REFERENCE STANDARDS

.1 American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)
- .1 ASHRAE 15-2019/ASHRAE 34-2019 package, Safety Standard for Refrigeration Systems and Classification of Refrigerants.
- .2 ASHRAE 34-2019, Designation and Safety Classification of Refrigerants.

.2 American Society for Testing and Materials International (ASTM)
- .1 ASTM A536-84(2019)E1, Standard Specification for Ductile Iron Castings.
- .2 ASTM B117-19, Standard Practice for Operating Salt Spray (Fog) Testing.
- .3 ASTM D1654-08(2016)e1, Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.

.3 American Water Works Association (AWWA)
- .1 ANSI/AWWA C606-15, Standard for Grooved and Shouldered Joints.

.4 Environment Canada, (EC)/Environmental Protection Services (EPS)
- .1 EPS 1/RA/2-1996, Environmental Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.

.5 Underwriters Laboratories
- .1 UL 207, Refregerant-Containing Components and Accessories, Nonelectrical.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit submittals in accordance with Section 00 10 00 - General Instructions.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for rotary-screw water chillers and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 00 10 00 - General Instructions.

.2 Operation and Maintenance Data: submit operation and maintenance data for rotary-screw water chillers for incorporation into manual.

.3 Data to include:
- .1 Description of equipment giving manufacturers name, model type and year, capacity and serial numbers.
- .2 Provide part load performance curves.
- .3 Details on operation, servicing and maintenance.

.4 Recommended spare parts list.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 00 10 00 - General Instructions and with manufacturer's written instructions.

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

.3 Storage and Handling Requirements:
.1 Store materials and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect rotary-screw water chillers from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 CHILLER MATERIALS AND COMPONENTS

.1 General: Install and commission, as shown on the schedules and plans, factory assembled, charged, and tested air cooled scroll compressor chiller(s) as specified herein. Chiller shall be designed, selected, and constructed using a refrigerant with Flammability rating of "1", as defined by ASHRAE 34 Number Designation and Safety Classification of Refrigerants. Chiller shall include not less than two refrigerant circuits above 50 tons (200 kW), scroll compressors, direct-expansion type evaporator, air-cooled condenser, refrigerant, lubrication system, interconnecting wiring, safety and operating controls including capacity controller, control centre, motor starting components and special features as specified herein or required for safe, automatic operation.

.2 Cabinet: External structural members shall be constructed of heavy gauge, galvanized steel coated with baked on powder paint which, when subject to ASTM B117, 1000 hour, 5% salt spray test, yields minimum ASTM D1654 rating of "6".

.3 Operating Characteristics: Provide low and high ambient temperature control options as required to ensure unit is capable of operation from 30°F to 115°F (-1°C to 46°C) ambient temperature. Optional: -10°F to 125°F (-23°C to 52°C) ambient.

.4 Service Isolation valves: Discharge (ball type) isolation valves factory installed per refrigerant circuit. Includes a system high-pressure relief valve in compliance with ASHRAE 15.

.5 Pressure Transducers and Readout Capability:
.1 Discharge Pressure Transducers: Permits unit to sense and display discharge pressure.
.2 Suction Pressure Transducers: Permits unit to sense and display suction pressure.
.3 High Ambient Control: Allows units to operate when the ambient temperature is above 115°F (46°C). Includes discharge pressure transducers

2.2 COMPRESSORS

.1 Compressors: Shall be hermetic, scroll-type, including:
- .1 Compliant design for axial and radial sealing.
- .2 Refrigerant flow through the compressor with 100% suction cooled motor.
- .3 Large suction side free volume and oil sump to provide liquid handling capability.
- .4 Compressor crankcase heaters to provide extra liquid migration protection.
- .5 Annular discharge check valve and reverse vent assembly to provide low-pressure drop, silent shutdown and reverse rotation protection.
- .6 Initial oil charge.
- .7 Oil level sight glass.
- .8 Vibration isolator mounts for compressors.
- .9 Brazed-type connections for fully hermetic refrigerant circuits.
- .10 Compressor Motor overloads capable of monitoring compressor motor current. Provides extra protection against compressor reverse rotation, phase-loss and phase-imbalance.

2.3 REFRIGERANT CIRCUIT COMPONENTS

.1 Each refrigerant circuit shall include: a discharge service ball type isolation valve, high side pressure relief, liquid line shutoff valve with charging port, low side pressure relief device, filter-drier, solenoid valve, sight glass with moisture indicator, thermostatic expansion valves, and flexible, closed-cell foam insulated suction line and suction pressure transducer.

2.4 HEAT EXCHANGERS

.1 Evaporator:
- .1 Evaporator shall be brazed-plate stainless steel construction capable of refrigerant working pressure of 650 psig (3103 kPa) and liquid side pressure of 150 psig (1034 kPa) Option for 300 psig (2068 kPa) available.
- .2 Brazed plate heat exchangers shall be UL listed.
- .3 Exterior surfaces shall be covered with 3.4" (19 mm), flexible, closed cell insulation, thermal conductivity of 0.26k (BTU/HR-Ft² - °F/in.) maximum.
- .4 Water nozzles shall be provided with grooves for field provided ANSI/AWWA C-606 mechanical couplings.
- .5 Evaporator shall include vent and drain fittings and thermostatically controlled heaters to protect to -20°F (-29°C) ambient in off-cycle.
- .6 A 20-mesh, serviceable wye-strainer and mechanical couplings shall be provided for field installation on evaporator inlet prior to startup.

.2 Air-cooled Condenser:
- .1 Coils: Condenser coils shall be constructed of a single material to avoid galvanic corrosion due to dissimilar metals. Coils and headers are brazed as one piece. Integral sub cooling is included. Coils shall be designed for a design working pressure of 650 PSIG (45 bar). Condenser coil shall be washable with potable water under 100 psi (7 bar) pressure.
- .2 Low Sound Fans: Shall be dynamically and statically balanced, direct drive, corrosion resistant glass fibre reinforced composite blades molded into a low noise, full-airfoil cross section, providing vertical air discharge and low sound. Each fan shall be provided in an individual compartment to prevent crossflow during fan cycling. Guards of heavy gauge, PVC (poly- vinylchloride) coated or galvanized steel shall be factory installed.
- .3 Fan Motors: High efficiency, direct drive, 6 pole, 3 phase, insulation class "F", current protected, Totally Enclosed Air-Over (TEAO) , rigid mounted, with double sealed, permanently lubricated, ball bearings.

.4 Low Sound Fans with Variable Speed Drives. All fans shall be powered by VSDs. Fans shall provide vertical air discharge from extended orifices. Fans shall be composed of corrosion resistant aluminum hub and glass-fibre-reinforced polypropylene composite blades molded into a low-noise airfoil section. Fan impeller shall be dynamically balanced for vibration-free operation. Fan guards of heavy gauge, PVC (polyvinyl chloride) coated or galvanized steel.

2.5 CONTROLS

.1 General: Automatic start, stop, operating, and protection sequences across the range of scheduled conditions and transients.

.2 Power/Control Enclosure: Rain and dust tight NEMA 3R powder painted steel cabinet with hinged, latched, and gasket sealed door.

.3 Microprocessor Control Centre:

.1 Automatic control of compressor start/stop, anti-coincidence and anti-recycle timers, automatic pump-down at system shutdown, condenser fans, evaporator pump, evaporator heater, unit alarm contacts, and chiller operation from -10°F to 125°F (-23°C to 52°C) ambient. Automatic reset to normal chiller operation after power failure.

.2 Software stored in non-volatile memory, with programmed setpoints retained in lithium battery backed real-time-clock (RTC) memory for minimum 5 years.

.3 Forty character liquid crystal display, descriptions in English (or Spanish, French, Italian, or German), numeric data in English (or Metric) units. Sealed keypad with sections for Setpoints, Display/Print, Entry, Unit Options & clock, and On/Off Switch.

.4 Programmable Setpoints (within Manufacturer limits): display language; chilled liquid temperature setpoint and range, remote reset temperature range, daily schedule/holiday for start/stop, manual override for servicing, low and high ambient cutouts, low liquid temperature cutout, low suction pressure cutout, high discharge pressure cutout, anti-recycle timer (compressor start cycle time), and anti-coincident timer (delay compressor starts).

.5 Display Data: Return and leaving liquid temperatures, low leaving liquid temperature cutout setting, low ambient temperature cutout setting, outdoor air temperature, English or metric data, suction pressure cutout setting, each system suction pressure, liquid temperature reset via a 4-20 milliamp or 0-10 VDC input, anti-recycle timer status for each compressor, anti-coincident system start timer condition, compressor run status, no cooling load condition, day, date and time, daily start/stop times, holiday status, automatic or manual system lead/lag control, lead system definition, compressor starts/operating hours (each), status of hot gas valves, evaporator heater and fan operation, run permissive status, number of compressors running, liquid solenoid valve status, load & unload timer status, water pump status.

.6 System Safeties: Shall cause individual compressor systems to perform auto shut down; manual reset required after the third trip in 90 minutes. System Safeties include: high discharge pressure, low suction pressure, high pressure switch, and motor protector. Compressor motor protector shall protect against damage due to high input current or thermal overload of windings.

.7 Unit Safeties: Shall be automatic reset and cause compressors to shut down if low ambient, low leaving chilled liquid temperature, under voltage, and flow switch operation.

.8 Alarm Contacts: Low ambient, low leaving chilled liquid temperature, low voltage, low battery, and (per compressor circuit): high discharge pressure, and low suction pressure.

.9 BAS Communications: Chiller to be equipped with BACnet card suitable for integration into existing BAS system. Reference controls schematic on mechanical drawings for required controls points, and allow for an additional 5 points on BAS to be determined during CX stage. Reference Section 25 90 01 - EMCS: Site Requirements, Applications and Systems Sequences of Operation for chiller sequence of operation.

.4 Manufacturer shall provide any controls not listed above, necessary for automatic chiller operation. Mechanical Contractor shall provide field control wiring necessary to interface sensors to the chiller control system.

2.6 POWER CONNECTION AND DISTRIBUTION

.1 Power Panels:
- .1 NEMA 3R/12 rain/dust tight, powder painted steel cabinets with hinged, latched, and gasket sealed outer doors. Provide main power connection(s), control power connections, compressor and fan motor start contactors, current overloads, and factory wiring.
- .2 Power supply shall enter unit at a single location, be 3 phase of scheduled voltage, and connect to individual terminal blocks per compressor. Separate disconnecting means and/or external branch circuit protection (by Contractor) required per applicable local or national codes.

.2 Compressor, control and fan motor power wiring shall be located in an enclosed panel or routed through liquid tight conduit.

2.7 ACCESSORIES AND OPTIONS

.1 Some accessories and options supersede standard product features. Your Johnson Controls representative will be pleased to provide assistance.
- .1 Microprocessor controlled, Factory installed Across-the-Line type compressor motor starters as standard.
- .2 Low Ambient Control: Permits unit operation to -10°F ambient. Standard unit controls to 30°F ambient.
  - .1 High Ambient Control: Permits unit operation above 115°F ambient.
- .3 Power Supply Connections:
  - .1 Single Point Power Supply: Single point Terminal Block for field connection and interconnecting wiring to the compressors. Separate external protection must be supplied, by others, in the incoming power wiring, which must comply with the National Electric Code and/or local codes.
- .4 Control Power Transformer: Converts unit power voltage to 120-1-60 (500 VA capacity). Factory-mounting includes primary and secondary wiring between the transformer and the control panel.
- .5 Low Temperature Process Glycol: Leaving chilled liquid setpoint range 10°F to 50°F (-12°C to 10°C).
- .6 Low Temperature Process Glycol: Leaving chilled liquid setpoint range 10°F to 50°F (-12°C to 10°C).
- .7 Hydronic Kit:
  - .1 Hydronic kit shall be factory installed within the framework of the chiller, lowering additional installation costs and decreasing floor space occupied by mechanical equipment.
  - .2 The hydronic kit shall include features such as:
    - .1 Factory-installed Y strainer with a drain port.
    - .2 Factory-installed butterfly shut off valve for servicing pumps.
    - .3 Factory-installed Armstrong 4392 pump with two drain ports on the lower side of the casing.
    - .4 ¼" NPT fitting for field provided venting device.
    - .5 ¼" NPT fitting for factory-installed thermal dispersion flow switch.
    - .6 Flow Trex Combination Valve, including shut off valve, check valve and balancing capability.
  - .3 The unit with the hydronic kit shall have single point power, reducing installation time and cost.
  - .4 The hydronic kit shall have remote on/off control through the chiller micropanel.
  - .5 Hydronic kit piping and components shall be heated and insulated for freeze protection.
  - .6 Hydronic kit shall use variable speed drive (VSD), which:
    - .1 Reduces commissioning time needed to balance the system.

.2 Saves energy when used in variable primary flow arrangements.

2.8 FREE COOLING SYSTEM

.1 The unit shall be equipped with an integral free cooling package. The package shall include coil banks sized to deliver submitted capacity at submitted ambient temperature. A system of valves and controls shall be utilized to switch the chiller between mechanical cooling and either the mixed cooling or free cooling modes of operation when ambient temperatures permit.Pa rtial free cooling shall be achieved whenever the ambient temperature falls below the free cooling setpoint of the chiller. In this mixed cooling mode of operation the unit shall utilize ambient air to pre-cool the incoming fluid, while the unit's compressors achieve the leaving fluid temperature setpoint. Free-cooling shall be achieved whenever the ambient temperature is at or below the temperature needed to completely cool the fluid in the coils.

.1 Microchannel Economizer Coils:

.1 Coils shall be manufactured to UL 207. The coils shall be subjected to leak testing by use of helium. Casing and endplates shall be made from an aluminum construction. Coils shall be comprised of vertical microchannel tubes constructed from aluminum. The tube wall thickness is designed to assure long life operation of the coil. The fins shall be constructed of die-formed aluminum. Mounting of the coils is completed by either use of mounting brackets, threaded flush nut insert, or studs. On multi-metal systems, a corrosion inhibitor must be used if the fluid piping contains copper, brass, iron or other metals. The economizer coils shall only be for use in closed systems.

.1 Strainer - The free cooling system shall require the installation of a strainer prior to the system inlet. The strainer must have a minimum of 20 mesh to prevent the microchannel coils from becoming clogged with system debris. Strainer is field provided and field installed. Failure to install strainer may result in damage to the economizer coils.

.2 Corrosion Inhibitor - The free cooling system requires the use of a corrosion inhibitor due to dissimilar metals used in construction of the economizer coils and piping.

.2 Piping - A Fisen installed piping package shall be provided for the unit. Piping shall be as indicated on drawings. No components not specifically identified in this document or upon the enclosed Fisen drawings shall be included. Construction and material for piping shall be as indicated below. Drains at the base of each coils shall be provided to remove and recover coil fluid.

.1 Pipe and Fittings Construction:

.1 Fisen will provide at our option one or a mixture of the following:

.1 Schedule 40 black steel pipe, welded or with grooved mechanical couplings and standard grooved fittings and 150 pound flanges. (Typically used on pipe 2" and larger.)

.2 Type L hard drawn copper with wrought copper fittings or copper grooved mechanical couplings and standard copper grooved fittings. (Typically used on pipe 1-1/2" and smaller.)

.3 Schedule 10 304 stainless steel pipe, welded or with grooved mechanical couplings and standard grooved fittings, 150 pound flanges, or 150 pound malleable iron screwed fittings.

.4 ANSI/AWWA C606, or equivalent, for black steel pipe. ANSI/AWWA C606, or equivalent, for copper pipe. Provide ANSI/AWWA C606, or equivalent, for stainless steel pipe.

.2 Pipe and Fittings Insulation - All non-economizing chilled water piping, fittings and hydronic specialties are provided with 3/4" elastomeric insulation. Insulation shall be UV resistant without the application of covering paint. Depending upon material availability at the time of fabrication, standard elastomeric insulation may be provided and coated with an ultraviolet resistant finish. Components and piping provided on the base unit shall retain factory provided insulation type and size unless specifically noted elsewhere in this document. Insulation is installed using a contact adhesive. As a contact adhesive, in all cases, both surfaces to be joined are coated with adhesive. For application to large, flat or curved metal surfaces such as ducts, very large pipes, tanks and vessels, full adhesive coverage is used. For application as pipe insulation and fitting covers, only the seams and joints are adhered with contact adhesive.

.3 Balancing Valve - The unit shall be provided with a circuit balancing valve as shown on the flow schematic diagram. The valve shall be designed with a ductile iron body.The valve shall function to provide precision flow measurement, precision flow balancing, and shut-off. The valve shall have provisions for connecting a portable differential pressure meter.

.4 3-Way On/Off Bypass Valve - Fisen shall provide and install as shown on the hydronic schematic, a three way bypass valve.The valve shall be used to facilitate system fluid bypassing the free cooling system when outdoor air temperatures exceed setpoint. The valve arrangement shall permit the coils to be piped in series with the chiller's evaporator barrel to gain free cooling assist with the chiller finishing the job when outdoor air conditions are correct.

.5 Butterfly Isolation Valve - Fisen shall provide and install as shown on the hydronic schematic, an isolation valve. These butterfly valves are designed for pressures ranging from full vacuum to 300 psi/2065 kPa and for bi-directional, dead end services to full working pressure. The valve shall have a ductile iron body and disc conforming to ASTM A536, grade 65-45-12. The valve seat shall be suitable for service with the fluid being used and shall have a full 360° continuous contact with the seating surface. The valve shall be provided with a handle operator. Standard valve seat shall be an EPDM material with a temperature range of -30°F to 250°F and recommended for cold and hot water service.

.3 Butterfly Isolation Valve - Fisen shall provide and install as shown on the hydronic schematic, an isolation valve. These butterfly valves are designed for pressures ranging from full vacuum to 300 psi/2065 kPa and for bi-directional, dead end services to full working pressure. The valve shall have a ductile iron body and disc conforming to ASTM A536, grade 65-45-12. The valve seat shall be suitable for service with the fluid being used and shall have a full 360° continuous contact with the seating surface. The valve shall be provided with a handle operator. Standard valve seat shall be an EPDM material with a temperature range of -30°F to 250°F and recommended for cold and hot water service.

.1 Human Machine Interface - The unit shall ship with a HMI referred to as an Equipment Touch installed in the unit control panel. The HMI provides the operator with status and the ability to adjust setpoint and alter machine configuration depending upon the access level entered. Programs for the equipment touch display files are resident in the unit controller.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for rotary-screw water chiller installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.3 GENERAL

.1 Provide appropriate protection apparatus.

.2 Install unit as indicated, to manufacturers recommendations, and in accordance with EPS 1/RA/2

.3 Ensure adequate clearances for servicing and maintenance.

.4 Manufacturer to approve installation, to supervise startup and to instruct operators. Include 3 days per unit.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 00 10 00 - General Instructions.
- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 00 10 00 - General Instructions.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by rotary-screw water chiller installation.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 Air-Conditioning, Heating and Refrigeration Institute (AHRI).

.2 CSA Group (CSA)
- .1 CAN/CSA-C13256-2001(R2011), Water-Source Heat Pumps-Testing and Rating for Performance, Part 1 Water-to-Air and Brine-to-Air Heat Pumps.

.3 Environment Canada, (EC) / Environmental Protection Services (EPS)
- .1 EPS 1/RA/2-1996, Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.
- .2 Environment Canada-1994, Ozone-Depleting Substances Alternatives and Suppliers List.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 00 10 00 - General Instructions.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for heat pumps and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 00 10 00 - General Instructions.

.2 Operation and Maintenance Data: submit operation and maintenance data for heat pumps for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 00 10 00 - General Instructions and with manufacturer's written instructions.

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

.3 Storage and Handling Requirements:
- .1 Store materials and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect heat pumps from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

1.5 WARRANTY

.1 For computer room air conditioning 12 months warranty period is extended to 60 months.

.2 Contractor hereby warrants that computer room air conditioning will not spall or show visible evidence of cracking, except for normal hairline shrinkage cracks, in accordance with CCDC 2 General Conditions GC 12.3, but for 5 years.

PART 2 - PRODUCTS

2.1 DESCRIPTION

.1 Heat pumps: to EPS 1/RA/2, CSA and Ontario Hydro Inspection approved and with AHRI or CSA certification seal

2.2 REFRIGERANTS

.1 Type of Refrigerant: R-410A.

2.3 DRAIN PANS

.1 Design and construct condensate drain pans under indoor coils so that no water can accumulate and install to allow for easy cleaning.

2.4 INCREMENTAL WATER SOURCE HEAT PUMP

.1 General:
- .1 Horizontal type, as indicated, consisting of factory-assembled package containing fan, air-to-refrigerant coil, compressor, 4-way reversing valve, water-to-refrigerant heat exchanger, controls for use with R-410A.

.2 Performance: as indicated.
- .1 Certified in accordance with CAN/CSA-C13256.
- .2 Ratings in accordance with CAN/CSA-C13256.

.3 Basic unit:
- .1 Compressor: welded hermetic type with internal vibration isolation. Controls to prevent compressor short cycling.
- .2 Air-to-refrigerant coil: aluminum plate fins mechanically bonded to aluminum tubing with joints brazed and with controls factory installed.
- .3 Water-to-refrigerant heat exchanger: Coaxial type.
- .4 Refrigerant piping: factory assembled, tested charged with R410-A sealed, with capillary metering device, thermal expansion valve, pilot operated refrigerant reversing valve, high pressure and low temperature safety cut-outs.
- .5 Water piping within unit: factory assembled and tested to 1.4 MPa minimum.
- .6 FPT connections: gate valve tested to 1.4 MPa minimum WOG (on supply line) and ball valve tested to 2.8 MPa minimum WOG (on return line), flexible hose with threaded swivel connections on supply and return lines to heat exchanger.
- .7 Piping connections: arranged so that only one supply and return connections to hydronic system is required on site.
- .8 Fan: centrifugal forward curved with double inlet, statically and dynamically balanced direct driven from multi-speed, factory lubricated motor.

.9 Filters: 25 mm thick replaceable media in aluminum frame.
  .1 Provide spare filter for each unit.
.10 Unit cabinet: constructed of heavy gauge die-formed galvanized steel with welded corner bracing, complete with provision for connection to return ductwork, hanger brackets and vibration isolators.
  .1 Console cabinet acoustically insulated.
  .2 Grilles: rigid bar type with vanes factory set to deflect supply air into room.
  .3 Finish: oven baked enamel.
.11 Provide for field connection of water and electrical services.
.12 Condensate drain: manufactured from aluminum, pan and piping designed to ensure complete removal of water.
  .1 Drain connections: minimum NPS 3/4.
.13 Controls: to match existing.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for heat pumps installation in accordance with manufacturer's written instructions.
  .1 Visually inspect substrate in presence of Departmental Representative.
  .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Install where indicated and in accordance with manufacturer's instructions.

.2 Secure with hold-down bolts in accordance with manufacturer's recommendations.

.3 Make duct connections through flexible connections.

.4 Level unit with fans running. Align duct work. flexible connections. Misalignment with fan stopped not to strain or damage flexible connection.

.5 Make piping connections.

.6 Nothing to obstruct ready access to components or to prevent removal of components for servicing.

3.3 DRAIN PANS

.1 Install so that no water can accumulate. Arrange easy access for cleaning.

.2 Include internal or external trap for proper draining.

3.4 START-UP AND COMMISSIONING

.1 Have manufacturer certify installation.

.2 Have manufacturer present during start-up tests and start up units and certify performance.

.3 Submit written start-up and commissioning reports to Departmental Representative.

3.5 CLOSEOUT ACTIVITIES

.1 Manufacturer to deliver verbal, video, and written instructions to operating personnel.

3.6 CLEANING

.1 Progress Cleaning: clean in accordance with Section 00 10 00 - General Instructions.
.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 1000 00 - General Instructions.

3.7 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by heat pumps installation.

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 Requirements
- .1 Section 25 05 01 - EMCS: General Requirements.

1.2 DEFINITIONS

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

.2 AEL: ratio between total test period less any system downtime accumulated within that period and test period.

.3 Downtime: results whenever EMCS is unable to fulfil required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:
- .1 Outage of main power supply in excess of back-up power sources, provided that:
  - .1 Automatic initiation of back-up was accomplished.
  - .2 Automatic shut-down and re-start of components was as specified.
- .2 Failure of communications link, provided that:
  - .1 Controller automatically and correctly operated in stand-alone mode.
  - .2 Failure was not due to failure of any specified EMCS equipment.
- .3 Functional failure resulting from individual sensor inputs or output devices, provided that:
  - .1 System recorded said fault.
  - .2 Equipment defaulted to fail-safe mode.
  - .3 AEL of total of all input sensors and output devices is at least 99% during test period.

1.3 DESIGN REQUIREMENTS

.1 Confirm with Departmental 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.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 00 10 00 - General Instructions.

.2 Final Report: submit report to Departmental 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 Departmental 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 Departmental Representative in accordance with Section 1000 00 - General Instructions.

.5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.5 CLOSEOUT SUBMITTALS

.1 Provide documentation, O&M Manuals, and training of O&M personnel for review of Departmental Representative before interim acceptance in accordance with Section 1000 00 - General Instructions.

1.6 COMMISSIONING

.1 Do commissioning in accordance with Section 00 10 00 - General Instructions.

.2 Carry out commissioning under direction of Departmental Representative and in presence of Departmental Representative.

.3 Inform, and obtain approval from, Departmental Representative in writing at least 14 days prior to commissioning or each test. Indicate:

.1 Location and part of system to be tested or commissioned.

.2 Testing/commissioning procedures, anticipated results.

.3 Names of testing/commissioning personnel.

.4 Correct deficiencies, re-test in presence of Departmental Representative until satisfactory performance is obtained.

.5 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.

.6 Load system with project software.

.7 Perform tests as required.

1.7 COMPLETION OF COMMISSIONING

.1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by Departmental Representative.

1.8 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

.1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

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 normal industry standards.

PART 3 - EXECUTION

3.1 PROCEDURES

.1 Test each system independently and then in unison with other related systems.

.2 Commission each system using procedures prescribed by the Departmental Representative.

.3 Commission integrated systems using procedures prescribed by Departmental Representative.

.4 Debug system software.

.5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs 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.

3.2 FIELD QUALITY CONTROL

.1 Pre-Installation Testing.
- .1 General : consists of field tests of equipment just prior to installation.
- .2 Testing may be on site or at Contractor's premises as approved by Departmental Representative.
- .3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of Building Controller's including MCU's, LCU's, and TCU's.
- .4 Equip each Building Controller with sensor and controlled device of each type (AI , AO , DI , DO).
- .5 Additional instruments to include:
  - .1 DP transmitters.
  - .2 VAV supply duct SP transmitters.
  - .3 DP switches used for dirty filter indication and fan status.
- .6 In addition to test equipment, provide inclined manometer, digital micro-manometer, milli-amp meter, source of air pressure infinitely adjustable between 0 and 500 Pa, to hold steady at any setting and with direct output to milli-amp metre at source.
- .7 After setting, test zero and span in 10% increments through entire range while both increasing and decreasing pressure.

.8 Departmental Representative to mark instruments tracking within 0.5% in both directions as "approved for installation".
.9 Transmitters above 0.5% error will be rejected.
.10 DP switches to open and close within 2% of setpoint.

.2 Completion Testing.
.1 General : test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.
.2 Include following activities:
.1 Test and calibrate field hardware including stand-alone capability of each controller.
.2 Verify each A-to-D convertor.
.3 Test and calibrate each AI using calibrated digital instruments.
.4 Test each DI to ensure proper settings and switching contacts.
.5 Test each DO to ensure proper operation and lag time.
.6 Test each AO 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 Verify each CDL including energy optimization programs.
.10 Debug software.
.11 Blow out flow measuring and static pressure stations with high pressure air at 700 kPa.
.12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on commissioning technician and Departmental Representative. This document will be used in final startup testing.
.3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Departmental Representative and provide:
.1 2 technical personnel capable of re-calibrating field hardware and modifying software.
.2 Detailed daily schedule showing items to be tested and personnel available.
.3 Departmental Representative's acceptance signature to be on executive and applications programs.
.4 Commissioning to commence during final startup testing.
.5 O&M personnel to assist in commissioning procedures as part of training.
.6 Commissioning to be supervised by qualified supervisory personnel and Departmental Representative.
.7 Commission systems considered as life safety systems before affected parts of the facility are occupied.
.8 Operate systems as long as necessary to commission entire project.
.9 Monitor progress and keep detailed records of activities and results.
.4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirefunctions in accordance with contract requirements.
.1 Prior to beginning of 30 day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.
.1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.
.2 Test to last at least 30 consecutive 24 hour days.
.3 Tests to include:
.1 Demonstration of correct operation of monitored and controlled points.
.2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.

.4 System will be accepted when:
.1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.
.2 Requirements of Contract have been met.
.5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.
.6 Correct defects when they occur and before resuming tests.
.5 Departmental Representative to verify reported results.

3.3 ADJUSTING

.1 Final adjusting: upon completion of commissioning as reviewed by Departmental Representative, set and lock devices in final position and permanently mark settings.

3.4 DEMONSTRATION

.1 Demonstrate to Departmental 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 in accordance with Section 1000 00 - General Instructions.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 Section Includes:
- .1 General requirements for building Energy Monitoring and Control System (EMCS) that are common to NMS EMCS Sections.

.2 Related Requirements
- .1 Section 25 05 54 - EMCS: Identification.

1.2 ABBREVIATIONS AND ACRONYMS

.1 Acronyms used in EMCS:
- .1 AEL - Average Effectiveness Level
- .2 AI - Analog Input
- .3 AIT - Agreement on International Trade
- .4 AO - Analog Output
- .5 BACnet - Building Automation and Control Network.
- .6 BC(s) - Building Controller(s).
- .7 BECC - Building Environmental Control Centre.
- .8 CAD - Computer Aided Design.
- .9 CDL - Control Description Logic.
- .10 CDS - Control Design Schematic.
- .11 COSV - Change of State or Value.
- .12 CPU - Central Processing Unit.
- .13 DI - Digital Input.
- .14 DO - Digital Output.
- .15 DP - Differential Pressure.
- .16 ECU - Equipment Control Unit.
- .17 EMCS - Energy Monitoring and Control System.
- .18 HVAC - Heating, Ventilation, Air Conditioning.
- .19 IDE - Interface Device Equipment.
- .20 I/O - Input/Output.
- .21 ISA - Industry Standard Architecture.
- .22 LAN - Local Area Network.
- .23 LCU - Local Control Unit.
- .24 MCU - Master Control Unit.
- .25 NAFTA - North American Free Trade Agreement.
- .26 NC - Normally Closed.
- .27 NO - Normally Open.
- .28 OS - Operating System.
- .29 O&M - Operation and Maintenance.
- .30 OWS - Operator Work Station.
- .31 PC - Personal Computer.
- .32 PCI - Peripheral Control Interface.
- .33 PCMCIA - Personal Computer Micro-Card Interface Adapter.
- .34 PID - Proportional, Integral and Derivative.
- .35 RAM - Random Access Memory.
- .36 SP - Static Pressure.
- .37 ROM - Read Only Memory.

.38 TCU - Terminal Control Unit.
.39 USB - Universal Serial Bus.
.40 UPS - Uninterruptible Power Supply.
.41 VAV - Variable Air Volume.

1.3 CONTRACTORS QUALIFICATIONS

.1 The EMCS controls systems contractor shall:
- .1 Be an authorized distributor of the product lines listed in these specifications and on the drawings.
- .2 Have a proven record of at least five (5) years of experience in the installation and maintenance of DDC/BAS control systems.
- .3 Have in-house qualified technicians and tradesmen for the installation, maintenance and repair of systems.
- .4 Have an office within 20 km of the project site and shall be able to offer emergency service 24 hrs/day, 365 days/year.
- .5 BAS contractor shall also have experience in remote communication of BAS data transfer applications through the use of a standard telephone modem and personal computer. It shall be possible to modify all software and analyze all system data from the Contractor's or the Departmental Representative's office.
- .6 Ainsworth Inc. shall be considered as Base Bid for this project. Any alternate Controls Contractor wishing to submit a quotation to execute the work shall submit a prequalification proposal to the Engineer for evaluation, 7 working days prior to tender closing. Tenders submitted without prequalification will not be accepted. Approved alternatives will be added by a pre-tender addendum.

1.4 DEFINITIONS

.1 Point: may be logical or physical.
- .1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.
- .2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.

.2 Point Name: composed of two parts, point identifier and point expansion.
- .1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25 character field for each point identifier. "System" is system that point is located on.
  - .1 Area descriptor: building or part of building where point is located.
  - .2 System descriptor: system that point is located on.
  - .3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be shortforms or acronyms. Database must provide 25 character field for each point identifier.
- .2 Point expansion: comprised of three fields, one for each descriptor. Expanded form of shortform or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide 32 character field for each point expansion.
- .3 Bilingual systems to include additional point identifier expansion fields of equal capacity for each point name for second language.
  - .1 System to support use of numbers and readable characters including blanks, periods or underscores to enhance user readability for each of the above strings.

.3 Point Object Type: points fall into following object types:
.1 AI (analog input).
.2 AO (analog output).
.3 DI (digital input).
.4 DO (digital output).
.5 Pulse inputs.

.4 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.
.1 Printouts: to ANSI/IEEE 260.1.
.2 Refer also to Section 25 05 54 - EMCS: Identification.

1.5 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).
.1 ANSI/ISA 5.5-1985, Graphic Symbols for Process Displays.

.2 American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).
.1 ANSI/IEEE 260.1-2004 (R2010), American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).

.3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
.1 ASHRAE STD 135-2020, BACNET - Data Communication Protocol for Building Automation and Control Network.

.4 Consumer Electronics Association (CEA).
.1 CEA-709.1-B-2002, Control Network Protocol Specification.

.5 Electrical and Electronic Manufacturers Association (EEMAC).
.1 EEMAC 2Y-1-1958, Light Grey Colour for Indoor Switch Gear.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

.1 Make submittals in accordance with Section 00 10 00 - General Instructions.

1.7 DELIVERY, STORAGE AND HANDLING

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

1.8 EXISTING- CONTROL COMPONENTS

.1 Re-use field control devices that are usable in their original configuration provided that they conform to applicable codes, standards specifications.
.1 Do not modify original design of existing devices without written permission from Departmental Representative.
.2 Provide for new, properly designed device where re-usability of components is uncertain.

.2 Inspect and test existing devices intended for re-use within 30 days of award of contract, and prior to installation of new devices.
- .1 Furnish test report within 40 days of award of contract listing each component to be re-used and indicating whether it is in good order or requires repair by Departmental Representative.
- .2 Failure to produce test report will constitute acceptance of existing devices by contractor.

.3 Non-functioning items:
- .1 Provide with report specification sheets or written functional requirements to support findings.
- .2 Departmental Representative will repair or replace existing items judged defective yet deemed necessary for EMCS.

.4 Submit written request for permission to disconnect controls and to obtain equipment downtime before proceeding with Work.

.5 Assume responsibility for controls to be incorporated into EMCS after written receipt of approval from Departmental Representative.
- .1 Be responsible for items repaired or replaced by Departmental Representative.
- .2 Be responsible for repair costs due to negligence or abuse of equipment.
- .3 Responsibility for existing devices terminates upon final acceptance of applicable portions of EMCS as approved by Departmental Representative.

.6 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

PART 2 - PRODUCTS

2.1 EQUIPMENT

.1 Control Network Protocol and Data Communication Protocol: to CEA 709.1 and ASHRAE STD 135.

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

2.2 ADAPTORS

.1 Provide adaptors between metric and imperial components.

PART 3 - EXECUTION

3.1 MANUFACTURER'S RECOMMENDATIONS

.1 Installation: to manufacturer's recommendations.

3.2 PAINTING

.1 Painting:
- .1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.

.2 Restore to new condition, finished surfaces too extensively damaged to be primed and touched up to make good.
.3 Clean and prime exposed hangers, racks, fastenings, and other support components.
.4 Paint unfinished equipment installed indoors to EEMAC 2Y-1.

3.3 FIELD QUALITY CONTROL

.1 Verification requirements in accordance with Section 00 10 00 - General Instructions, include:
.1 Materials and resources.
.2 Storage and collection of recyclables.
.3 Construction waste management.
.4 Resource reuse.
.5 Recycled content.
.6 Local/regional materials.
.7 Certified Wood.
.8 Low-emitting materials.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 Section Includes:
- .1 At minimum detailed narrative description of Sequence of Operation of each system including ramping periods and reset schedules.
  - .1 Control Description Logic (CDL) for each system.
  - .2 Input/Output Point Summary Tables for each system.
  - .3 System Diagrams consisting of the following; EMCS System architectural diagram, Control Design Schematic for each system (as viewed on OWS), System flow diagram for each system with electrical ladder diagram for MCC starter interface.

1.2 SEQUENCING

.1 Sequencing of operations for systems as follows:
- .1 Air Cooled Chiller Free Cooling System:
  - .1 Mode Selection Algorithm:
    - .1 Mechanical Cooling Mode Selection - Mechanical cooling mode shall be initiated when outdoor air temperature rises above free cooling setpoint plus deadband. Setpoint shall be adjustable by an LCD Screen or by BAS through BACnet integration.
    - .2 Mixed Cooling Mode Selection - Mixed cooling mode shall be initiated when outdoor air temperature falls below the free cooling setpoint. Setpoint shall be adjustable by an LCD Screen or by BAS through BACnet integration.
    - .3 Free Cooling Mode Selection - Free cooling mode is initiated when outdoor air temperature falls below the free cooling setpoint, 34ºF (Adj.). The free cooling enable setpoint shall be adjustable by an LCD Screen or by BAS through BACnet integration
    - .4 Sub System Interlock - There shall be a 2°F (adj.) offset between the mode setpoints. Any single mode of operation shall be inhibited from operating simultaneously with another mode.
  - .2 Mechanical Cooling Mode:
    - .1 Mode Initiation - This mode is initiated by the Mode Selection Algorithm.
    - .2 Compressor Operation- In the mechanical cooling mode of operation, the unit shall follow the Air Cooled Chillers packaged capacity control sequence of operation to stage compressors to maintain supply fluid temperature at setpoint, 42ºF (Adj.).
    - .3 Condenser Fan Operation- In the mechanical cooling mode of operation, the unit shall follow the Air Cooled Chillers packaged capacity control sequence of operation for staging condenser fans on and off.
    - .4 Free Cooling Valve Operation- In the mechanical cooling mode of operation, the free cooling bypass valve shall be closed to the free cooling coils and open to the bypass line.
    - .5 Sub System Interlock - This sub-system shall be inhibited unless the condenser fan is proven on and a call for fan operation is present.
  - .3 Mixed Cooling Mode:
    - .1 Mode Initiation - This mode is initiated by the Mode Selection Algorithm.
    - .2 Compressor Operation- In the mixed cooling mode of operation, the unit shall follow the Air Cooled Chillers packaged capacity control sequence of operation to stage compressors to maintain supply water temperature at setpoint, 42ºF (Adj.).

.3 Condenser Fan Operation- In the mixed cooling mode of operation, the condenser fans shall all be enabled to run, providing maximum airflow across the free cooling coils unless inhibited by the chillers control board. Refrigerant head pressure shall be monitored and if head pressure falls below normal, condenser fan control shall be returned to the chiller.

.4 Free Cooling Valve Operation- In the mixed cooling mode of operation, the free cooling bypass valve shall be open to the free cooling coils and closed to the bypass line.

.5 Sub System Interlock - This sub-system shall be inhibited unless the condenser fan is proven on and a call for fan operation is present.

.4 Free Cooling Mode:

.1 Mode Initiation - This mode is initiated by the Mode Selection Algorithm.

.2 Compressor Operation- In the free cooling mode of operation, there are no operating compressors.

.3 Condenser Fan Operation- In the free cooling mode of operation, the condenser fans shall all be enabled to run, providing maximum airflow across the free cooling coils. In the event chilled water supply temperature falls below 41ºF (Typ. Adj.), condenser fans shall be indexed off to maintain water temperature at setpoint.

.4 Free Cooling Valve Operation-In the free cooling mode of operation, the free cooling bypass valve shall be open to the free cooling coils and closed to the bypass line.

.5 Sub System Interlock - This sub-system shall be inhibited unless the condenser fan is proven on and a call for fan operation is present.

.2 Chilled Water/Glycol Cooling System:

.1 The chiller's onboard controllers will operate the chiller in sequence with internal controller to perform start-up, capacity control, anti-cycling, efficiency optimization/free cooling, pump flow and safeties. The EMCS shall monitor points through BACnet integration as indicated on controls schematic on drawings. The EMCS shall provide control points through BACnet integration to enable/disable, chilled water setpoint reset, free cooling set point reset, and pump start/stop.

.2 The chillers safety circuits will be monitored and the system will report a general alarm condition if a safety is tripped.

.3 A manual reset of the chiller safety will be required before the chiller can be restarted.

.4 The EMCS shall monitor the chilled water supply and return temperatures and reset temperature setpoint to maintain building cooling loop set point

.5 The chiller controls will maintain peak chiller efficiency to maintain supply loop temperature set-point. Capacity control will be accommodated through staging of compressors and condenser fans and chiller pump speed as per chillers on board sequence.

.6 Cooling Loop Temperature/Pressure Control:

.1 Chilled water pumps (07CWP01 & 07CWP02) to operate continuously in a duty/standby configuration. The pumps shall be alternated on a time shared basis and the lag pump shall start should the lead pump fail.

.2 The variable speed drives shall be run as required to maintain the set differential pressure in the system as sensed by the differential pressure sensor. Reduce system pump speed by locking out maximum speed to maintain Delta temperature at design condition. The rate of modulation shall limit the flow rate to change to maximum 10% per minute.

.3 The EMCS shall monitor pump speed, amps, status and alarm.

.4 During TAB procedures, the minimum VFD speed shall be set to achieve minimum system flow rate requirements (To be verified by chiller manufacturer).

.5 A standalone pressure regulated bypass valve shall be set at time of TAB to protect pump operation against low/no flow condition when all system control valves are in closed position. Controls contractor to assist with achieving set differential pressure at regulated bypass.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

1.1 REFERENCES

.1 Perform all work to meet or exceed the requirements of the Canadian Electrical Code, CSA Standard C22.1 - (latest edition).

.2 Consider CSA Electrical Bulletins in force at time of tender submission, while not identified and specified by number in this Division, to be forming part of related CSA Part II standard.

.3 Do overhead and underground systems in accordance with CSA C22.3 except where specified otherwise.

.4 Where requirements of this specification exceed those of above-mentioned standards, this specification shall govern.

.5 Notify the NRC Departmental Representative as soon as possible when requested to connect equipment supplied by NRC which is not CSA approved.

.6 Refer to Sections 00 10 00 & 01 35 30.

1.2 PERMITS AND FEES

.1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.

.2 Pay all fees required for the performance of the work.

1.3 START-UP

.1 Instruct the NRC Departmental Representative and operating personnel in the operation, care and maintenance of equipment supplied under this contract.

1.4 INSPECTION AND FEES

.1 Furnish a Certificate of Acceptance from the Authorized Electrical Inspection Department on completion of work.

.2 Request and obtain Special Inspection approval from the Authorized Electrical Inspection Department for any non-CSA approved control panels or other equipment fabricated by the contractor as part of this contract.

.3 Pay all fees required for inspections.

1.5 OPERATION & MAINTENANCE (O&M) MANUALS

.1 O&M manuals to include but not limited to
- .1 Letter of warranty
- .2 ESA inspection certificate
- .3 Fire alarm ventilation report
- .4 Updated panel schedule c/w circuit breaker size
- .5 Shop drawings
- .6 As-builts
- .7 Load balancing report

.8 Mechanical equipment start-up reports
.9 Seismic review letter

.2 Refer to 00 10 00 for additional information.

1.6 FINISHES

.1 Shop finish metal enclosure surfaces by removal of rust and scale, cleaning, application of rust resistant primer inside and outside, and at least two coats of finish enamel.
.1 Outdoor electrical equipment "equipment green" finish to EEMAC Y1-1-1955.
.2 Indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1-1958.

.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

1.7 ACOUSTICAL PERFORMANCE

.1 In general, provide equipment producing minimal sound levels in accordance with the best and latest practices established by the electrical industry.

.2 Do not install any device or equipment containing a magnetic flux path metallic core, such as gas discharge lamp ballasts, dimmers, solenoids, etc., which are found to produce a noise level exceeding that of comparable available equipment.

1.8 EQUIPMENT IDENTIFICATION

.1 Identify with 3mm (1/8") Brother, P-Touch non-smearing tape, or an alternate approved by the NRC Departmental Representative, all electrical outlets shown on drawings and/or mentioned in the specifications. These are the lighting switches, exit signs, recessed and surface mounted receptacles such as those in offices and service rooms and used to plug in office equipment, telecommunication equipment or small portable tools. Indicate only the source of power (Ex. for a receptacle fed from panel L32 circuit #1: "L32-1").

.2 P-Touch label to be:
.1 Black letters on a white background for normal power circuits.
.2 Black letters on a yellow background for emergency power circuits.
.3 White letters on a red background for fire alarm device.

.3 Light fixtures are the only exceptions for electrical equipment identification (except as noted in 8.14 below). They are not to be identified.

.4 Identify with lamicoid nameplates all electrical equipment shown on the drawings and/or mentioned in the specification such as motor control centers, switchgear, splitters, fused switches, isolation switches, motor starting switches, starters, panelboards, transformers, high voltage cables, industrial type receptacles, junction boxes, control panels, etc., regardless of whether or not the electrical equipment was furnished under this section of the specification.

.5 Coordinate names of equipment and systems with other Divisions to ensure that names and numbers match.

.6 Wording on lamicoid nameplates to be approved by the NRC Departmental Representative prior to fabrication.

.7 Provide two sets of lamicoid nameplates for each piece of equipment; one in English and one in French.

.8 Lamicoid nameplates shall identify the equipment, the voltage characteristics and the power source for the equipment. Example: A new 120/240 volt single phase circuit breaker panelboard, L16, is fed from panelboard LD1 circuit 10.

"PANEL L16
120/240 V
FED FROM LD1-10"

PANNEAU L16
120/240 V
ALIMENTE PAR LD1-10

.9 Provide warning labels for equipment fed from two or more sources - "DANGER MULTIPLE POWER FEED" black letters on a yellow background. These labels are available from NRC's Facilities Maintenance group in building M-19.

.10 Lamicoid nameplates shall be rigid lamicoid, minimum 1.5 mm (1/16") thick with:
- .1 Black letters engraved on a white background for normal power circuits.
- .2 Black letters engraved on a yellow background for emergency power circuits.
- .3 White letters engraved on a red background for fire alarm equipment.

.11 For all interior lamicoid nameplates, mount nameplates using two-sided tape.

.12 For all exterior lamicoid nameplates, mount nameplates using self-tapping 2.3 mm (3/32") dia. slot head screws - two per nameplate for nameplates under 75 mm (3") in height and a minimum of 4 for larger nameplates. Holes in lamicoid nameplates to be 3.7 mm (3/16") diameter to allow for expansion of lamicoid due to exterior conditions.
- .1 No drilling is to be done on live equipment.
- .2 Metal filings from drilling are to be vacuumed from the enclosure interiors.

.13 All lamicoid nameplates shall have a minimum border of 3 mm (1/8"). Characters shall be 9 mm (3/8") in size unless otherwise specified.

.14 Identify lighting fixtures which are connected to emergency power with a label "EMERGENCY LIGHTING/ÉCLAIRAGE D'URGENCE", black letters on a yellow background. These labels are available from NRC's Facilities Maintenance group in building M-19.

.15 Provide neatly typed updated circuit directories in a plastic holder on the inside door of new panelboards.

.16 Carefully update panelboard circuit directories whenever adding, deleting, or modifying existing circuitry.

.17 Identify molded case breaker with lamicoid nameplate.

1.9 WIRING IDENTIFICATION

.1 Unless otherwise specified, identify wiring with permanent indelible identifying markings, using 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.

1.10 CONDUIT AND CABLE IDENTIFICATION

.1 All new conduits to be factory painted, colour-coded EMT, type as follows:
- .1 Fire alarm – red conduit
- .2 Emergency power circuits – yellow conduit
- .3 Voice/data – blue conduit
- .4 Gas detection system – purple conduit
- .5 Building Automation system – orange conduit
- .6 Other base building low voltage control system – white conduit
- .7 Security system – green conduit
- .8 Research center control system – black conduit

.2 Apply paint to the covers of junction boxes and condulets of existing conduits as follows:
- .1 Fire alarm – red
- .2 Emergency power circuits – yellow
- .3 Voice/data – blue
- .4 Gas detection system – purple
- .5 Building Automation system – orange
- .6 Other base building low voltage control system - white
- .7 Security system – green
- .8 Research center control system - black

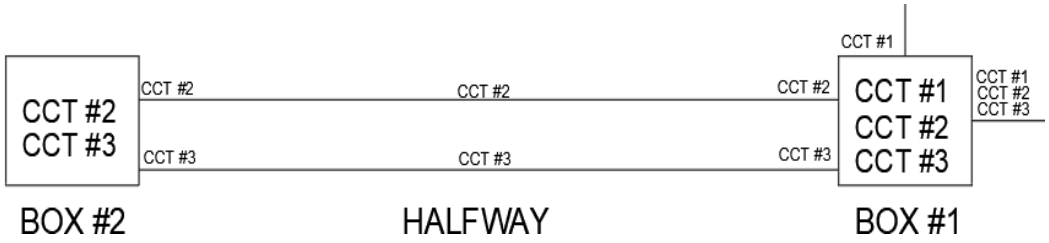
.3 For system running with cable, half-lap wrap with dedicated coloured PVC tape to 100 mm width, tape every 5 m and both sides where cable penetrates a wall.

.4 All other systems to follow site instruction from NRC departmental representative.

.5 Identify all electrical circuits in every junction box and pull box on the box cover with 9mm letter size P-touch label. Identify all electrical circuits on each conduit end where conduit penetrates a wall ,enclosure ,junction box or pull box , and halfway of each conduit run between walls ,enclosures ,junction boxes or pull boxes with 3mm letter size P-touch label.

.6 Identify electrical circuit on each cable 250MCM or larger with lamicoid nameplate, or cable 4/0 or smaller with P-touch label, on every splitter, every 30m of each cable run and cable end where cable penetrates a wall, enclosure, junction box or pull box.

.7 Sample diagram shown as below:



1.11 MANUFACTURER'S & APPROVALS LABELS

.1 Ensure that manufacturer's registration plates are properly affixed to all apparatus showing the size, name of equipment, serial number, and all information usually provided, including voltage, cycle, phase and the name and address of the manufacturer.

.2 Do not paint over registration plates or approval labels. Leave openings through insulation for viewing the plates. Contractor's or sub-contractor's nameplate not acceptable.

1.12 WARNING SIGNS AND PROTECTION

.1 Provide warning signs, as specified or to meet requirements of Authorized Electrical Inspection Department and NRC Departmental Representative.

.2 Accept the responsibility to protect those working on the project from any physical danger due to exposed live equipment such as panel mains, outlet wiring, etc. Shield and mark all live parts with the appropriate voltage. Caution notices shall be worded in both English and French.

1.13 LOAD BALANCE

.1 Measure phase current to new panelboards with normal loads operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes, and revise panelboard schedules.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

1.14 MOTOR ROTATION

.1 For new motors, ensure that motor rotation matches the requirements of the driven equipment.

.2 For existing motors, check rotation before making wiring changes in order to ensure correct rotation upon completion of the job.

1.15 GROUNDING

.1 Thoroughly ground all electrical equipment, cabinets, metal supporting frames, ventilating ducts and other apparatus where grounding is required in accordance with the requirements of the latest edition of the Canadian Electrical Code Part 1, C.S.A. C22.1 and corresponding Provincial and Municipal regulations. Do not depend upon conduits to provide the ground circuits.

.2 Run separate green insulated stranded copper grounding conductors in all electrical conduits including those feeding toggle switches and receptacles.

1.16 TESTS

.1 Provide any materials, equipment and labour required and make such tests deemed necessary to show proper execution of this work, in the presence of the NRC Departmental Representative.

.2 Correct any defects or deficiencies discovered in the work in an approved manner at no additional expense to the Owner.

.3 Megger all branch circuits and feeders using a 600V tester for 240V circuits and a 1000V tester for 600V circuits. If the resistance to ground is less than permitted by Table 24 of the Code, consider such circuits defective and do not energize.

.4 The final approval of insulation between conductors and ground, and the efficiency of the grounding system is left to the discretion of the local Electrical Inspection Department.

1.17 COORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, fuses, are installed to values and settings as indicated on the Drawings.

1.18 WORK ON LIVE EQUIPMENT & PANELS

.1 NRC requires that work be performed on non-energized equipment, installation, conductors and power panels. For purposes of quotation assume that all work is to be done after normal working hours and that equipment, installation, conductors and power panels are to be de-energized when worked upon.

.2 Coordinate all shutdowns with the NRC departmental representative. High voltage (more than 1KV) grounding must be provided by certified electrician.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This Section includes requirements for selective demolition and removal of electrical, communications and safety and security components including removal of conduit, junction boxes, and panels to source (home run removal) and incidentals required to complete work described in this Section ready for new construction.

1.2 RELATED REQUIREMENTS

.1 Section 01 10 00 – General Instructions

.2 Section 01 74 19 – Waste Management and Disposal

.3 Section 02 41 19.16 - Selective Interior Demolition

.4 Section 02 42 00 - Removal and Salvage of Construction Materials

1.3 REFERENCE STANDARDS

.1 CSA Group (CSA)

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

1.4 DEFINITIONS

.1 Demolish: Detach items from existing construction and legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.

.2 Remove: Planned deconstruction and disassembly of electrical items from existing construction including removal of conduit, junction boxes, cabling and wiring from electrical component to panel taking care not to damage adjacent assemblies designated to remain; legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.

.3 Remove and Salvage: Detach items from existing construction and deliver them to Departmental Representative ready for reuse.

.4 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and re-install them where indicated.

.5 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed and salvaged, or removed and reinstalled.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Action Submittals: Provide in accordance with Section 01 10 00 – General Instructions before starting work of this Section:

.1 Construction Waste Management Plan (CWM Plan): Submit plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 19 - Waste Management and Disposal.

.2 Landfill Records: Indicate receipt and acceptance of selective demolition waste and hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.6 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.

.2 Scheduling: Account for Departmental Representative continued occupancy requirements during selective demolition with Section 02 41 19.16 - Selective Interior Demolition.

1.7 QUALITY ASSURANCE

.1 Regulatory Requirements: Perform work of this Section in accordance with:

.1 Federal Workers' Compensation Service.

.2 Government of Canada, Labour Program: Workplace Safety.

1.8 SITE CONDITIONS

.1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition on their observed condition at time of site examination before tendering.

.2 Discovery of Hazardous Substances: It is not expected that Hazardous Substances will be encountered in Work; immediately notify Departmental Representative if materials suspected of containing hazardous substances are encountered and perform following activities:

.1 Refer to Section 01 10 00 – General Instructions for directives associated with specific material types.

.2 Hazardous substances will be as defined in Hazardous Products Act.

.3 Stop work in area of suspected hazardous substances.

.4 Take preventative measures to limit users' and workers' exposure, provide barriers and other safety devices and do not disturb.

.5 .Hazardous substances will be removed by Departmental Representative under a separate contract or as a change to Work.

.6 Proceed only after written instructions have been received from Departmental Representative.

1.9 SALVAGE AND DEBRIS MATERIALS

.1 Demolished items become Contractor's property and will be removed from Project site; except for items indicated as being reused, salvaged, or otherwise indicated to remain Departmental Representative's property.

.2 Carefully remove materials and items designated for salvage and store in a manner to prevent damage or devaluation of materials in accordance with Section 02 42 00 - Removal and Salvage of Construction Materials.

.1 Leave main electrical distribution panel in place; panel can be used for temporary construction power for this and subsequent contracts in accordance with Section 01 10 00 – General Instructions; coordinate temporary power connections with Departmental Representative.

Part 2 Products

2.1 MATERIALS

.1 General Patching and Repair Materials: Refer to Section 02 41 19.16 - Selective Interior Demolition or listing of patching and repair materials incidental to removal or demolition of components associated with work of this Section.

.2 Electrical Repair Materials: Use only new materials, CSA or ULC labelled as appropriate and matching components remaining after work associated with components identified for removal or demolition are completed.

.3 Fire stopping Repair Materials: Use fire stopping materials compatible with existing fire stopping systems where removal or demolition work affects rated assemblies, restore to match existing fire rated performance.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Existing Conditions: Visit site, thoroughly examine and become familiar with conditions that may affect the work of this Section before tendering the Bid; Departmental Representative will not consider claims for extras for work or materials necessary for proper execution and completion of the contract that could have been determined by a site visit.

3.2 PREPARATION

.1 Protection of Existing Systems to Remain: Protect systems and components indicated to remain in place during selective demolition operations and as follows:

.1 Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.

.2 Departmental Representative and cease operations where safety of buildings being demolished, adjacent structures or services appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

.3 Prevent debris from blocking drainage inlets.

.4 Protect mechanical systems that will remain in operation.

.2 Protection of Building Occupants: Sequence demolition work so that interference with the use of the building by the Departmental Representative and users is minimized and as follows:

.1 Prevent debris from endangering safe access to and egress from occupied buildings.

.2 Notify Departmental Representative and cease operations where safety of occupants appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

3.3 EXECUTION

.1 Demolition and Removal: Coordinate requirements of this Section with information contained in Section 02 41 19.16 - Selective Interior Demolition and as follows:

.1 Maintain electrical service and main distribution panel as is, ready for subsequent Work.

.2 Remove existing luminaires, electrical devices and equipment including associated conduits, boxes, wiring, and similar items unless specifically noted otherwise.

.3 Disconnect and remove existing fire alarm system including associated conduits, boxes, wiring, and similar items unless specifically noted otherwise.

.4 Disconnect and remove communication systems including associated conduits, boxes, cabling, and similar items unless specifically noted otherwise.

.5 Disconnect and remove telephone outlets, associated conduit, cabling and sub terminal backboards and related accessories; maintain telephone service and main terminal backboard as is.

.6 Perform demolition work in a neat and workmanlike manner:

.1 Remove tools or equipment after completion of work, and leave site clean and ready for subsequent renovation work.

.2 Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.

.7 Place weatherproof blank cover plates on exterior outlet boxes remaining after demolition and removal activities.

.8 Remove existing conduits, boxes, cabling and wiring associated with removed luminaires, electrical devices and equipment.

.9 Grind off conduits and make flush with surface of concrete where conduits are cast into concrete; seal open ends of conduit with silicone sealant and leave in place.

.10 Seal open ends of conduit with silicone sealant and leave in place where they are inaccessible or cannot be removed without damaging adjacent construction.

3.4 CLOSEOUT ACTIVITIES

.1 Demolition Waste Disposal: Arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle centre) except where explicitly noted otherwise for materials being salvaged for re use in new construction in accordance with Section 02 42 00 - Removal and Salvage of Construction Materials.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 CSA Group (CSA)
- .1 CSA C22.2 No. 18.4-15 (R2019), Hardware for the Support of Conduit, Tubing, and Cable.
- .2 CSA C22.2 No. 65-18, Wire Connectors.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
- .1 EEMAC 1Y-2-1961, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

.3 National Electrical Manufacturers Association (NEMA).

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Pressure type wire connectors to: CSA C22.2 No. 65, with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors to: CSA C22.2 No. 65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Bushing stud connectors: to EEMAC 1Y-2 and NEMA to consist of:
- .1 Connector body and stud clamp for copper conductors.
- .2 Clamp for copper conductors.
- .3 Stud clamp bolts.
- .4 Bolts for copper conductors.
- .5 Sized for conductors as indicated.

.4 Clamps or connectors for armoured cable,TECK cable, flexible conduit, as required to: CSA C22.2 No. 18.4.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and cables 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 bushing stud connectors in accordance with EEMAC 1Y-2 and NEMA.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

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

.2 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

PART 2 - PRODUCTS

2.1 BUILDING WIRES

.1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.

.2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, Jacketted.

2.2 TECK 90 CABLE

.1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Conductors:
- .1 Grounding conductor: copper as indicated.

.3 Insulation:
- .1 Cross-linked polyethylene XLPE.
- .2 Rating:, 600 V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: galvanized steel.

.6 Fastenings:
- .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
- .2 Channel type supports for two or more cables at 1200 mm centres.
- .3 Threaded rods: 6 mm diameter to support suspended channels.

.7 Connectors:
- .1 Watertight, approved for TECK cable.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

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

.2 Perform tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

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 Install minimum #12 AWG green insulated ground wire in all conduits used for power circuits.

3.3 INSTALLATION OF TECK 90 CABLE (0 -1000 V)

.1 Group cables wherever possible on channels.

.2 Install cable concealed, securely supported by hangers.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

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

PART 2 - PRODUCTS

2.1 EQUIPMENT

.1 Grounding conductors: bare stranded copper, , soft annealed, size as indicated.

.2 Insulated grounding conductors: green, copper conductors, size as indicated.

.3 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

- .1 Grounding and bonding bushings.
- .2 Protective type clamps.
- .3 Bolted type conductor connectors.
- .4 Thermit welded type conductor connectors.
- .5 Bonding jumpers, straps.
- .6 Pressure wire connectors.

PART 3 - EXECUTION

3.1 INSTALLATION GENERAL

.1 Install connectors in accordance with manufacturer's instructions.

.2 Protect exposed grounding conductors from mechanical injury.

.3 Use mechanical connectors for grounding connections to equipment provided with lugs.

.4 Soldered joints not permitted.

.5 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.

.6 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.7 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

.8 Ground secondary service pedestals.

3.2 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting, cable trays.

3.3 FIELD QUALITY CONTROL

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

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

END OF SECTION

PART 1 - GENERAL

1.1 NOT USED

.1 Not used.

PART 2 - PRODUCTS

2.1 SUPPORT CHANNELS

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

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.4 Fasten exposed conduit or cables to building construction or support system using straps.
- .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
- .2 Two-hole steel straps for conduits and cables larger than 50 mm.
- .3 Beam clamps to secure conduit to exposed steel work.

.5 Suspended support systems.
- .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
- .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.

.6 For surface mounting of two or more conduits use channels at 1.2 m on centre spacing.

.7 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.8 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.9 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.10 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.

.11 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCE STANDARDS

.1 CSA Group (CSA)
.1 CSA C22.1-21, Canadian Electrical Code, Part 1, 25th Edition.

PART 2 - PRODUCTS

2.1 JUNCTION AND PULL BOXES

.1 Construction:welded steel enclosure.

.2 Covers Flush Mounted: 25 mm minimum extension all around.

.3 Covers Surface Mounted: screw-on flat covers.

PART 3 - EXECUTION

3.1 SPLITTER INSTALLATION

.1 Mount plumb, true and square to building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION AND PULL BOXES INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1

3.3 IDENTIFICATION

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

.2 Identification Labels: size 2 indicating system name,voltage and phase or as indicated.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 CSA Group (CSA)
.1 CSA C22.1-21, Canadian Electrical Code, Part 1, 25th Edition.

PART 2 - PRODUCTS

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 GALVANIZED STEEL OUTLET BOXES

.1 One-piece electro-galvanized construction.

.2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

.3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.

.4 102 mm square or octagonal outlet boxes for lighting fixture outlets.

.5 Extension and plaster rings for flush mounting devices in finished plaster walls.

2.3 CONDUIT BOXES

.1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.4 FITTINGS - GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges 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, mineral insulated and armoured cable connections. Do not install reducing washers.

.5 Vacuum clean interior of outlet boxes before installation of wiring devices.

.6 Identify systems for outlet boxes as required.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 CSA Group (CSA)
- .1 CSA C22.2 No. 18.3-2012 (R2017), Conduit, Tubing, and Cable Fittings.
- .2 CSA C22.2 No. 45-M1981 (R2008), Rigid Metal Conduit.
- .3 CSA C22.2 No. 56-17, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .4 CSA C22.2 No. 83-M1985 (R2017), Electrical Metallic Tubing.

PART 2 - PRODUCTS

2.1 CONDUITS

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

.2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside

.3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.

.4 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

2.2 CONDUIT FASTENINGS

.1 One hole steel straps to secure surface conduits 50 mm and smaller.
- .1 Two hole steel straps for conduits larger than 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits at 1.2 m on centre.

.4 Threaded rods, 6 mm diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

.1 Fittings: to CSA C22.2 No. 18.3, manufactured for use with conduit specified. Coating: same as conduit.

.2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.

.3 Watertight connectors and couplings for EMT.
- .1 Set-screws are not acceptable.

2.4 FISH CORD

.1 Polypropylene.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits except in mechanical and electrical service rooms.

.3 Use epoxy coated conduit in corrosive areas.

.4 Use electrical metallic tubing (EMT) except in cast concrete above 2.4 m not subject to mechanical injury.

.5 Use flexible metal conduit for connection to motors in dry areas.

.6 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.

.7 Install conduit sealing fittings in hazardous areas.
.1 Fill with compound.

.8 Minimum conduit size for lighting and power circuits: 21 mm.

.9 Bend conduit cold:
.1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.10 Mechanically bend steel conduit over 21 mm diameter.

.11 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.12 Install fish cord in empty conduits.

.13 Remove and replace blocked conduit sections.
.1 Do not use liquids to clean out conduits.

.14 Dry conduits out before installing wire.

3.2 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on suspended and/or surface channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCE STANDARDS

.1 CSA Group (CSA)
- .1 CSA C22.2 No.42-10 (R2020), General Use Receptacles, Attachment Plugs and Similar Devices.
- .2 CAN/CSA C22.2 No.42.1-13 (R2017), Cover Plates for Flush-Mounted Wiring Devices.

PART 2 - PRODUCTS

2.1 RECEPTACLES

.1 Duplex receptacles, CSA type 5-15 R, 125 V, 5-20 R, 15/20 A, U ground, to: CSA C22.2 No. 42 with following features:
- .1 Ivory urea moulded housing.
- .2 Suitable for No. 10 AWG for back and side wiring.
- .3 Break-off links for use as split receptacles.
- .4 Eight back wired entrances, four side wiring screws.
- .5 Triple wipe contacts and rivetted grounding contacts.

.2 Other receptacles with ampacity and voltage as indicated.

.3 Receptacles of one manufacturer throughout project.

2.2 COVER PLATES

.1 Cover plates for wiring devices to: CSA C22.2 No. 42.1.

.2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.

.3 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

.4 Weatherproof spring-loaded cover plates complete with gaskets for single receptacles or switches.

2.3 SOURCE QUALITY CONTROL

.1 Cover plates from one manufacturer throughout project.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wiring devices installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Receptacles:
- .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
- .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .3 Install GFI type receptacles as indicated.

.2 Cover plates:
- .1 Install suitable common cover plates where wiring devices are grouped.
- .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

END OF SECTION

PART 1 - GENERAL

1.1 NOT USED

.1 Not used.

PART 2 - PRODUCTS

2.1 FUSES - GENERAL

.1 Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.

.2 Fuses: product of one manufacturer.

2.2 FUSE TYPES

.1 Class J fuses.
- .1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
- .2 Type J2, fast acting.

.2 Class C fuses.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install fuses in mounting devices immediately before energizing circuit.

.2 Ensure correct fuses fitted to physically matched mounting devices.
- .1 Install rejection clips for Class R fuses.

.3 Ensure correct fuses fitted to assigned electrical circuit.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 CSA Group (CSA)
  .1 CSA C22.2 No. 5-16, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.

PART 2 - PRODUCTS

2.1 BREAKERS GENERAL

.1 Moulded-case circuit breakers, circuit breakers, and ground-fault circuit-interrupters, and accessory high-fault protectors: to CSA C22.2 No. 5.

.2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.

.3 Common-trip breakers: with single handle for multi-pole applications.

.4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
  .1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.

.5 Circuit breakers with interchangeable trips as indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install circuit breakers as indicated.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

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

.2 Section 26 28 13.01 - Fuses - Low Voltage.

PART 2 - PRODUCTS

2.1 DISCONNECT SWITCHES

.1 Fusible, non-fusible, disconnect switch in CSA enclosure.

.2 Provision for padlocking in off switch position by 3 locks.

.3 Mechanically interlocked door to prevent opening when handle in ON position.

.4 Fuses: size as indicated, in accordance with Section 26 28 13.01 - Fuses - Low Voltage.

.5 Fuseholders: relocatable and suitable without adaptors, for type and size of fuse indicated.

.6 Quick-make, quick-break action.

.7 ON-OFF switch position indication on switch enclosure cover.

2.2 EQUIPMENT IDENTIFICATION

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

.2 Indicate name of load controlled on size 4 nameplate.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Common Work Results - Electrical Section 26 05 00

1.2 DESCRIPTION

.1 This specification is to cover a complete Variable Frequency motor Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor.

.2 The drive manufacturer shall supply the drive and all necessary controls as herein specified. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of twenty years. All VFDs installed on this project shall be from the same manufacturer.

1.3 QUALITY ASSURANCE

.1 Referenced Standards:

1. Institute of Electrical and Electronic Engineers (IEEE)
   - .1 Standard 519-1992, IEEE Guide for Harmonic Content and Control.
   - .2 Underwriters laboratories
     - .1 UL508C

.3 National Electrical Manufacturer's Association (NEMA)
   - .1 ICS 7.0, AC Adjustable Speed Drives

.4 IEC 16800 Parts 1 and 2

.5 CSA 22.2

.2 Qualifications:

.1 VFDs and options shall be UL listed and CSA approved as a complete assembly. VFDs that require the customer to supply external fuses for the VFD to be UL listed are not acceptable. VFDs requiring additional branch circuit protection are not acceptable. The base VFD shall be UL listed for 100 KAIC without the need for input fusing.

1.4 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 00 10 00.

.2 Include schematic, wiring, interconnection diagrams.

.3 Indicate:

.1 Outline dimensions, conduit entry locations and weight.

.2 Customer connection and power wiring diagrams.

.3 Complete technical product description includes a complete list of options provided. **Any portions of the specifications not complied with must be clearly indicated or the supplier and contractor shall be liable to provide all components required to meet the specification.**

.4 Compliance to IEEE 519 – harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD).

.1 The VFD manufacturer shall provide calculations, where required on the drawing; specific to the installation, showing total harmonic voltage distortion is less than 5%.

.2 Input filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with the IEEE electrical system standard 519. All VFDs shall include a minimum of 5% equivalent impedance reactors, **no exceptions**.

.4 Motors specified and supplied with mechanical equipment. Refer to Division 23.

1.5 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 00 10 00.

.2 Include operation and maintenance data for each type and style of starter.

.3 On completion of the installation, the supplier shall provide the following:
- .1 Full commissioning report documenting all programmable settings, AC input voltage, DC Bus voltage, current draw at maximum speed, and a description of ambient conditions.
- .2 One operator's manual for each VFD installed.
- .3 One 8.5" x 11" wiring diagram for each VFD installed.

1.6 GENERAL DESIGN CHARACTERISTICS

.1 The VFD shall be of the Pulse Width Modulated (PWM) type.

.2 The VFD shall be rated for variable torque applications, with an overload rating of 110% for 60 seconds.

.3 All VFD's shall be factory UL/cUL Listed.

.4 All packaged drive systems shall be CSA Listed.

.5 The VFD shall have the capability of operating multiple motors. The minimum VFD continuous current rating shall be the sum of the full load current ratings of the connected motors.

.6 The VFD shall have a minimum displacement power factor of 0.96 or higher at all output frequencies.

.7 The VFD manufacturer shall have a minimum of ten years experience in the Canadian Market.

PART 2 - PRODUCTS

2.1 VARIABLE FREQUENCY DRIVES

.1 The VFD package as specified herein shall be enclosed in a NEMA rated enclosure, completely assembled and tested by the manufacturer in an ISO 9001 facility. The VFD tolerated voltage window shall allow the VFD to operate from a line of +30% nominal, and -35% nominal voltage as a minimum.
- .1 Environmental operating conditions: 0 – 40^0 C continuous. Altitude 0 to 3300 feet above sea level, up to 95% humidity, non-condensing. All circuit boards shall have conformal coating.
- .2 The VFD shall operate within the following rated values.
  - .1 Output Frequency Range: 0.1 to 400 Hz.
  - .2 Overload Rating: VT – 110% for 60 seconds
  - .3 Input Voltage: 3 phase + ground , 600V +10%/-20%
  - .4 Input Frequency: 48-62 Hz

.3 The VFD shall be designed to include the following protective functions and display for maintainability:

.1 *Instantaneous Over Current Protection*: The VFD output shall be turned off if the operating current exceeds the specified level.

.2 *Motor Overload Protection*: cUL/CSA approved electronic thermal overload protection.

.3 *External Trip Input*: Programmable for either N/O or N/C operation.

.4 *Over Voltage Protection*: The VFD output shall turned off if the DC Bus voltage exceeds the specified level.

.5 *Ground Fault Protection*: The VFD output shall turned off in the event of a ground fault.

.6 *Line or Load Phase Loss Protection*: Programmable for enable - disable

.7 *Software Lock*: The VFD shall include a software function that prevents changes to the user-defined settings.

.8 *CPU or EEPROM Error*: The VFD output shall turned off in the event of an error in the CPU or EEPROM.

.2 All VFDs shall have the following features:

.1 All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.

.2 The keypad shall include Hand-Off-Auto selections and manual speed control. There shall be fault reset and “Help” buttons on the keypad. The Help button shall include “on-line” assistance for programming and troubleshooting.

.3 There shall be a built-in time clock in the VFD keypad. The clock shall have a battery back up with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. If the battery fails, the VFD shall automatically revert to hours of operation since initial power up. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter sets and output relays. The VFD shall have a digital input that allows an override to the time clock (when in the off mode) for a programmable time frame. There shall be four (4) separate, independent timer functions that have both weekday and weekend settings. Capacitor backup is not acceptable.

.4 The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to setpoint without safety tripping or component damage (flying start).

.5 The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430-150 for 4-pole motors.

.6 The VFD shall have 5% equivalent impedance internal reactors to reduce the harmonics to the power line and to add protection from AC line transients. The 5% equivalent impedance may be from dual (positive and negative DC bus) reactors, or 5% AC line reactors. VFDs with only one DC reactor shall add an AC line reactor.

.7 The VFD shall include a coordinated AC transient protection system consisting of 4-120 joule rated MOV’s (phase to phase and phase to ground), a capacitor clamp, and 5% equivalent impedance internal reactors.

.8 The VFD shall provide a programmable proof of flow Form-C relay output (broken belt/broken coupling). The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay outputs shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false underload condition.

.3 All VFDs to have the following adjustments:

.1 Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.

.2 Two (2) PID Setpoint controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed loop control. The VFD shall have 250 ma of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. There shall be two parameter sets for the first PID that allow the sets to be

switched via a digital input, serial communications or from the keypad for night setback, summer/winter setpoints, etc. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain setpoint of an independent process (i.e. valves, dampers, etc.). All setpoints, process variables, etc. to be accessible from the serial communication network.

.3 Two (2) programmable analog inputs shall accept current or voltage signals.

.4 Two (2) programmable analog outputs (0-20ma or 4-20 ma). The outputs may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, and other data.

.5 Six (6) programmable digital inputs.

.6 Three (3) programmable digital Form-C relay outputs. The relays shall include programmable on and off delay times and adjustable hysteresis. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating 2 amps RMS. Outputs shall be true Form-C type contacts; open collector outputs are not acceptable.

.7 Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close.

.8 Two independently adjustable accel and decel ramps with 1 – 1800 seconds adjustable time ramps.

.9 The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and audible motor noise.

.10 The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows higher carrier frequency without derating the VFD or operating at high carrier frequency only at low speeds.

.11 The VFD shall include password protection against parameter changes.

.4 The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (LED and alpha-numeric codes are not acceptable). All VFD faults shall be displayed in English words.

.5 All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):

.1 Output Frequency
.2 Motor Speed (RPM, %, or Engineering units)
.3 Motor Current
.4 Drive Temperature
.5 DC Bus Voltage
.6 Output Voltage

.6 The VFD shall include a fireman's override input. Upon receipt of a contact closure from the fireman's control station, the VFD shall operate in one of two modes: 1) Operate at a programmed predetermined fixed speed or operate in a specific fireman's override PID algorithm that automatically adjusts motor speed based on override set point and feedback. The mode shall override all other inputs (analog/digital, serial communication, and all keypad commands), except customer defined safety run interlock, and force the motor to run in one of the two modes above. "Override Mode" shall be displayed on the keypad. Upon removal of the override signal, the VFD shall resume normal operation.

.7 Serial Communications

.1 The VFD shall have an RS-485 port as standard. The standard protocols shall be Modbus, BACnet, Johnson Controls N2 bus, and Siemens Building Technologies FLN. Each individual drive shall have the protocol in the base VFD. The use of third-party gateways and multiplexers is not acceptable. All protocols shall be "certified" by the governing authority (i.e. BTL Listing for BACnet). Use of non-certified protocols is not allowed.

.2 The BACnet connection shall be an RS485, MS/TP interface operating at 9.6, 19.2, 38.4, or 76.8 Kbps. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:
- .1 Data Sharing – Read Property – B.
- .2 Data Sharing – Write Property – B.
- .3 Device Management – Dynamic Device Binding (Who-Is; I-AM).
- .4 Device Management – Dynamic Object Binding (Who-Has; I-Have).
- .5 Device Management – Communication Control – B.

.3 Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed/frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The DDC shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible.

.8 EMI/RFI filters. All VFDs shall include EMI/RFI filters. The VFD shall comply with standard EN 61800-3 for the First Environment, restricted level with up to 100' of motor cables. No Exceptions. Certified test lab test reports shall be provided with the submittals.

.9 All VFDs through 60HP shall be protected from input and output power mis-wiring. The VFD shall sense this condition and display an alarm on the keypad. The VFD shall not be damaged by this condition.

.10 OPTIONAL FEATURES – Optional features to be furnished and mounted by the drive manufacturer. All optional features shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label. The bypass enclosure door and VFD enclosure must be interlocked such that input power is turned off before either enclosure can be opened. The VFD and Bypass as a package shall have a UL listed short circuit rating of 100,000 amps and shall be indicated on the data label.
- .1 A complete factory wired and tested bypass system consisting of an output contactor and bypass contactor, service (isolation) switch and VFD input fuses are required. Bypass designs, which have no VFD only fuses, or that incorporate fuses common to both the VFD and the bypass will not be accepted
- .2 Door interlocked padlockable disconnect switch that will disconnect all input power from the drive and all internally mounted options.
- .3 If Drive is located outdoors, a cabinet with thermostatically controlled heater, suitable for operation at -40^0 C continuous.

.11 The following operators shall be provided:
Bypass Hand-Off-Auto
Drive mode selector and light
Bypass mode selector and light
Bypass fault reset
Bypass LDC display, 2 lines, for programming and status/fault/warning indications
- .1 Motor protection from single phase power conditions - The Bypass system must be able to detect a single-phase input power condition while running in bypass, disengage the motor in a controlled fashion, and give a single-phase input power indication. Bypass systems not incorporating single phase protection in Bypass mode are not acceptable.
- .2 The systems (VFD and Bypass) tolerated voltage window shall allow the system to operate from a line of +30%, -35% nominal voltage as a minimum. The system shall incorporate circuitry that will allow the drive or bypass contactor to remain "sealed in" over this voltage tolerance at a minimum.

.3 The Bypass system shall NOT depend on the VFD for bypass operation. The bypass shall be completely functional in both Hand and Automatic modes even if the VFD has been removed from the enclosure for repair/replacement.

.4 Serial communications – the bypass and VFD shall be capable of being monitored and or controlled via serial communications. Provide communications protocols for ModBus; Johnson Controls N2; Siemens Building Technologies FLN (P1) and BACnet in the bypass controller.

.5 BACnet Serial communication bypass capabilities shall include, but not be limited to; bypass run-stop control; the ability to force the unit to bypass; and the ability to lock and unlock the keypad. The bypass shall have the capability of allowing the DDC to monitor feedback such as, bypass current (in amps), bypass kilowatt hours (resettable), bypass operating hours (resettable), and bypass logic board temperature. The DDC shall also be capable of monitoring the bypass relays output status, and all digital input status. All bypass diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible. The following additional bypass status indications and settings shall be transmitted over the serial communications bus – keypad "Hand" or "Auto" selected, and bypass selected. The DDC system shall also be able to monitor if the motor is running under load in both VFD and bypass (proof of flow) in the VFD mode over serial communications or Form-C relay output. A minimum of 40 field parameters shall be capable of being monitored in the bypass mode.

.6 Run permissive circuit - there shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, time-clock control, or serial communications) the VFD and bypass shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a VFD system input and allows motor operation. Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close.

.7 The bypass control shall monitor the status of the VFD and bypass contactors and indicate when there is a welded contactor contact or open contactor coil. This failed contactor operation shall be indicated on the Bypass LCD display as well as over the serial communications protocol.

.8 The bypass control shall include a programmable time delay for bypass start and keypad indication that this time delay is in process. This will allow VAV boxes to be driven open before the motor operates at full speed in the bypass mode. The time delay shall be field programmable from 0 – 120 seconds.

.9 The bypass control shall be programmable for manual or automatic transfer to bypass. The user shall be able to select via keypad programming which drive faults will generate an automatic transfer to bypass and which faults require a manual transfer to bypass.

.10 There shall be an adjustable motor current sensing circuit for the bypass and VFD mode to provide proof of flow indication. The condition shall be indicated on the keypad display, transmitted over the building automation protocol and on a relay output contact closure.

.11 The bypass controller shall have six programmable digital inputs, and five programmable Form-C relay outputs.

.12 The relay outputs from the bypass shall be programmable for any of the following indications.

- .1 System started
- .2 System running
- .3 Bypass override enabled
- .4 Drive fault
- .5 Bypass fault
- .6 Bypass H-O-A position
- .7 Motor proof of flow (broken belt)
- .8 Overload
- .9 Bypass selected
- .10 Bypass run
- .11 System started (damper opening)
- .12 Bypass alarm
- .13 Over temperature

.13 The digital inputs for the system shall accept 24VAC or 24VDC. The bypass shall incorporate internally sourced power supply and not require an external control power source. The bypass power board shall supply 250 ma of 24 VDC for use by others to power external devices.

.14 Customer Interlock Terminal Strip – provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in VFD or Bypass mode. The remote start/stop contact shall operate in VFD and bypass modes. The terminal strip shall allow for independent connection of up to four (4) unique safety inputs.

.15 The user shall be able to select the text to be displayed on the keypad when the safety opens. Example text display indications include “Firestat”, “Freezestat”, “Over pressure” and “Low pressure”. The user shall also be able to determine which of the four (4) safety contacts is open over the serial communications connection.

.16 Class 10, 20, or 30 (selectable) electronic motor overload protection shall be included.

.17 Standard of acceptance:

.1 ABB ACH Series and E-Clipse Bypass or equivalent approved by NRC departmental representative. **Approval does not relieve supplier of specification requirements.**

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Installation shall be the responsibility of the electrical contractor. The contractor shall install the drive-in accordance with the requirements of the VFD manufacturer’s installation manual.

.2 The contractor is to verify that the jobsite conditions for installation meet the factory recommendations and code required conditions for the VFD installation prior to installation. These shall include as a minimum:

.1 Clearance spacing.

.2 Compliance with environmental ratings of the VFD system.

.3 Separate conduit installation of the input wiring, the motor wiring, and control wiring. At no time does any of this wiring run in parallel with each other.

.4 All power and control wiring are complete.

.3 The VFD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The VFD system shall not be operated while the unit is covered.

3.2 ON-SITE STARTUP

.1 The manufacturer shall provide start-up and commissioning of the variable frequency drive and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. The commissioning personnel shall be the same personnel that will provide the factory service and warranty repairs at the customer site. Sales personnel and other agents who are not factory certified technicians for drive repair shall not be acceptable as commissioning agents.

.2 Start-up services shall include checking for verification of proper operation and installation of the VFD, its options and its interface wiring to the building automation system. Included in this service shall be as a minimum:

.1 Verification of contractor wire terminations and conduit runs to and from the VFD.

.2 Up to four hours of customer operator training on the operation and service diagnostics at the time of commissioning. On-site training is to be provided by the same factory trained application engineering and service personnel to demonstrate full programming and operating features and

procedures. Date and time for this training is to be coordinated with the NRC Departmental Representative.

.3 Measurement for verification of proper operation of the following:
- .1 Motor voltage and frequency. Verification of proper motor operation.
- .2 Control input for proper building automation system interface and control calibration.
- .3 Calibration check for the following set-points:
  - .1 minimum speed
  - .2 maximum speed
  - .3 acceleration and deceleration rates.

.3 Commissioning agent to verify the programming of the VFD and to provide a written copy of the settings to the engineer.

.4 Commissioning agent to lock out critical frequencies throughout the operating curve of the equipment as identified and required by the engineer. The agent shall record amperages at six (minimum) different frequencies from minimum to maximum speed.

3.3 PRODUCT SUPPORT

.1 Factory trained application engineering and service personnel that are thoroughly familiar with the VFD products offered shall be locally available at both the specifying and installation locations. A toll free 24/365 technical support line shall be available.

.2 A computer-based training CD or 8-hour professionally generated video (VCR format) shall be provided to the owner at the time of project closeout. The training shall include installation, programming and operation of the VFD, bypass and serial communication.

3.4 WARRANTY

.1 Warranty shall be 24 months from the date of certified start-up. The warranty shall include all parts, labor, travel time and expenses

END OF SECTION

TP1 Amount Payable – General

1.1 Subject to any other provisions of the contract, Her Majesty shall pay the Contractor, at the times and in the manner hereinafter set out, the amount by which

1.1.1 the aggregate of the amounts described in TP2 exceeds

1.1.2 the aggregate of the amounts described in TP3

and the Contractor shall accept that amount as payment in full satisfaction for everything furnished and done by him in respect of the work to which the payment relates.

TP2 Amounts Payable to the Contractor

2.1 The amounts referred to in TP1.1.1 are the aggregate of

2.1.1 the amounts referred to in the Articles of Agreement, and

2.1.2 the amounts, if any, that are payable to the Contractor pursuant to the General Conditions.

TP3 Amounts Payable to Her Majesty

3.1 The amounts referred to in TP1.1.2 are the aggregate of the amounts, in any, that the Contractor is liable to pay Her Majesty pursuant to the contract.

3.2 When making any payments to the Contractor, the failure of Her Majesty to deduct an amount referred to in TP3.1 from an amount referred to in TP2 shall not be constitute a waiver of the right to do so, or an admission of lack of entitlement to do so in any subsequent payment to the Contractor.

TP4 Time of Payment

4.1 In these Terms of Payment

4.1.1 The "payment period" means a period of 30 consecutive days or such other longer period as is agreed between the Contractor and the Departmental Representative.

4.1.2 An amount is "due and payable" when it is due and payable by Her Majesty to the Contractor according to TP4.4, TP4.7 or TP4.10.

4.1.3 An amount is overdue when it is unpaid on the first day following the day upon which it is due and payable.

4.1.4 The "date of payment" means the date of the negotiable instrument of an amount due and payable by the Receiver General for Canada and given for payment.

4.1.5 The "Bank Rate" means the discount rate of interest set by the Bank of Canada in effect at the opening of business on the date of payment.

4.2 The Contractor shall, on the expiration of a payment period, deliver to the Departmental Representative in respect of that payment period a written progress claim that fully describes any part of the work that has been completed, and any material that was delivered to the work site but not incorporated into the work during that payment period.

4.3 The Departmental Representative shall, not later than ten days after receipt by him of a progress claim referred to in TP4.2,

4.3.1 inspect the part of the work and the material described in the progress claim; and

4.3.2 issue a progress report, a copy of which the Departmental Representative will give to the Contractor, that indicates the value of the part of the work and the material described in the progress claim that, in the opinion of the Departmental Representative,

4.3.2.1 is in accordance with the contract, and

4.3.2.2 was not included in any other progress report relating to the contract.

4.4 Subject to TP1 and TP4.5 Her Majesty shall, not later than 30 days after receipt by the Departmental Representative of a progress claim referred to in TP4.2, pay the Contractor

4.4.1 an amount that is equal to 95% of the value that is indicated in the progress report referred to in TP4.3.2 if a labour and material payment bond has been furnished by the Contractor, or

4.4.2 an amount that is equal to 90% of the value that is indicated in the progress report referred to in TP4.3.2 if a labour and material payment bond has not been furnished by the Contractor.

4.5 It is a condition precedent to Her Majesty's obligation under TP4.4 that the Contractor has made and delivered to the Departmental Representative,

4.5.1 a statutory declaration described in TP4.6 in respect of a progress claim referred to in TP4.2,

4.5.2 in the case of the Contractor's first progress claim, a construction schedule in accordance with the relevant sections of the Specifications, and

4.5.3 if the requirement for a schedule is specified, an update of the said schedule at the times identified in the relevant sections of the Specifications.

4.6 A statutory declaration referred to in TP4.5 shall contain a deposition by the Contractor that

4.6.1 up to the date of the Contractor's progress claim, the Contractor has complied with all his lawful obligations with respect to the Labour Conditions; and

4.6.2 up to the date of the Contractor's immediately preceding progress claim, all lawful obligations of the Contractor to subcontractors and suppliers of material in respect of the

work under the contract have been fully discharged.

4.7 Subject to TP1 and TP4.8, Her Majesty shall, not later than 30 days after the date of issue of an Interim Certificate of Completion referred to in GC44.2, pay the Contractor the amount referred to in TP1 less the aggregate of

4.7.1 the sum of all payments that were made pursuant to TP4.4;

4.7.2 an amount that is equal to the Departmental Representative's estimate of the cost to Her Majesty or rectifying defects described in the Interim Certificate of Completion; and

4.7.3 an amount that is equal to the Departmental Representative's estimate of the cost to Her Majesty of completing the parts of the work described in the Interim Certificate of Completion other than the defects referred to in TP4.7.2.

4.8 It is a condition precedent to Her Majesty's obligation under TP4.7 that the Contractor has made and delivered to the Departmental Representative,

4.8.1 a statutory declaration described in TP4.9 in respect of an Interim Certificate of Completion referred to in GC44.2, and

4.8.2 if so specified in the relevant sections of the Specifications, and update of the construction schedule referred to in TP4.5.2 and the updated schedule shall, in addition to the specified requirements, clearly show a detailed timetable that is acceptable to the Departmental Representative for the completion of any unfinished work and the correction of all defects.

4.9 A statutory declaration referred to in TP4.8 shall contain a deposition by the contractor that up to the date of the Interim Certificate of Completion the Contractor has

4.9.1 complied with all of the Contractor's lawful obligations with respect to the Labour Conditions;

4.9.2 discharged all of the Contractor's lawful obligations to the subcontractors and suppliers of material in respect of the work under the contract; and

4.9.3 discharged the Contractor's lawful obligations referred to in GC14.6.

4.10 Subject to TP1 and TP4.11, Her Majesty shall, not later than 60 days after the date of issue of a Final Certificate of Completion referred to in GC44.1, pay the Contractor the amount referred to in TP1 less the aggregate of

4.10.1 the sum of all payments that were made pursuant to TP4.4; and

4.10.2 the sum of all payments that were made pursuant to TP4.7.

4.11 It is a condition precedent to Her Majesty's obligation under TP4.10 that the Contractor has made and delivered a statutory declaration described in TP4.12 to the Departmental Representative.

4.12 A statutory declaration referred to in TP4.11 shall, in addition to the depositions described in TP4.9, contain a deposition by the Contractor that all of the Contractor's lawful obligations and any lawful claims against the Contractor that arose out of the performance of the contract have been discharged and satisfied.

TP5 Progress Report and Payment Thereunder Not Binding on Her Majesty

5.1 Neither a progress report referred to in TP4.3 nor any payment made by Her Majesty pursuant to these Terms of Payment shall be construed as an admission by Her Majesty that the work, material or any part thereof is complete, is satisfactory or is in accordance with the contract.

TP6 Delay in Making Payment

6.1 Nothwithstanding GC7 any delay by Her Majesty in making any payment when it is due pursuant to these Terms of Payment shall not be a breach of the contract by Her Majesty.

6.2 Her Majesty shall pay, without demand from the Contractor, simple interest at the Bank Rate plus 1 -1/4 per centum on any amount which is overdue pursuant to TP4.1.3, and the interest shall apply from and include the day such amount became overdue until the day prior to the date of payment except that

6.2.1 interest shall not be payable or paid unless the amount referred to in TP6.2 has been overdue for more that 15 days following

6.2.1.1 the date the said amount became due and payable, or

6.2.1.2 the receipt by the Departmental Representative of the Statutory Declaration referred to in TP4.5, TP4.8 or TP4.11,

whichever is the later, and

6.6.2 interest shall not be payable or paid on overdue advance payments if any.

TP7 Right of Set-off

7.1 Without limiting any right of set-off or deduction given or implied by law or elsewhere in the contract, Her Majesty may set off any amount payable to Her Majesty by the Contractor under this contract or under any current contract against any amount payable to the Contractor under this contract.

7.2 For the purposes of TP7.1, "current contract" means a contract between Her Majesty and the Contractor

7.2.1 under which the Contractor has an undischarged obligation to perform or supply work, labour or material, or

7.2.2 in respect of which Her Majesty has, since the date of which the Articles of Agreement were made, exercised any right to take the work that is the subject of the contract out of the Contractor's hands.

TP8 Payment in Event of Termination

8.1 If the contract is terminated pursuant to GC41, Her Majesty shall pay the Contractor any amount that is lawfully due and payable to the Contractor as soon as is practicable under the circumstances.

TP9 Interest on Settled Claims

9.1 Her Majesty shall pay to the Contractor simple interest on the amount of a settled claim at an average Bank Rate plus 1 ¼ per centum from the date the settled claim was outstanding until the day prior to the date of payment.

9.2 For the purposes of TP9.1,

9.2.1 a claim is deemed to have been settled when an agreement in writing is signed by the Departmental Representative and the Contractor setting out the amount of the claim to be paid by Her Majesty and the items or work for which the said amount is to be paid.

9.2.2 an "average Bank Rate" means the discount rate of interest set by the Bank of Canada in effect at the end of each calendar month averaged over the period the settled claim was outstanding.

9.2.3 a settled claim is deemed to be outstanding from the day immediately following the date the said claim would have been due and payable under the contract had it not been disputed.

9.3 For the purposes of TP9 a claim means a disputed amount subject to negotiation between Her Majesty and the Contractor under the contract.

GC1 Interpretation

1.1 In the contract

1.1.1 where reference is made to a part of the contract by means of numbers preceded by letters, the reference shall be construed to be a reference to the particular part of the contract that is identified by that combination of letters and numbers and to any other part of the contract referred to therein;

1.1.2 "contract" means the contract document referred to in the Articles of Agreement;

1.1.3 "contract security" means any security given by the Contractor to Her Majesty in accordance with the contract;

1.1.4 "Departmental Representative" means the officer or employee or Her Majesty who is designated pursuant to the Articles of Agreement and includes a person specially authorized by him to perform, on his behalf, any of his functions under the contract and is so designated in writing to the Contractor;

1.1.5 "material" includes all commodities, articles and things required to be furnished by or for the Contractor under the contract for incorporation into the work;

1.1.6 "Minister" includes a person acting for, or if the office is vacant, in place of the Minister and his successors in the office, and his or their lawful deputy and any of his or their representatives appointed for the purposes of the contract;

1.1.7 "person" includes, unless the context otherwise requires, a partnership, proprietorship, firm, joint venture, consortium and a corporation;

1.1.8 "plant" includes all animals, tools, implements, machinery, vehicles, buildings, structures, equipment and commodities, articles and things other than material, that are necessary for the due performance of the contract;

1.1.9 "subcontractor' means a person to whom the Contractor has, subject to GC4, subcontracted the whole or any part of the work;

1.1.10 "superintendant" means the employee of the Contractor who is designated by the Contractor to act pursuant to GC19;

1.1.11 "work includes, subject only to any express stipulation in the contract to the contrary, everything that is necessary to be done, furnished or delivered by the Contractor to perform the contract.

1.2 The headings in the contract documents, other than in the Plans and Specifications, form no part of the contract but are inserted for convenience of reference only.

1.3 In interpreting the contract, in the event of discrepancies or conflicts between anything in the Plans and Specifications and the General Conditions, the General Conditions govern.

1.4 In interpreting the Plans and Specifications, in the event of discrepancies or conflicts between

1.4.1 the Plans and Specifications, the Specifications govern;

1.4.2 the Plans, the Plans drawn with the largest scale govern; and

1.4.3 figured dimensions and scaled dimensions, the figured dimensions govern.

GC2 Successors and Assigns

2.1 The contract shall inure to the benefit of and be binding upon the parties hereto and their lawful heirs, executors, administrators, successors and assigns.

GC3 Assignment of Contract

3.1 The contract may not be assigned by the Contractor, either in whole or in part, without the written consent of the Minister.

GC4 Subcontracting by Contractor

4.1 Subject to this General Condition, the Contractor may subcontract any part of the work.

4.2 The Contractor shall notify the Departmental Representative in writing of his intention to subcontract.

4.3 A notification referred to in GC4.2 shall identify the part of the work, and the subcontractor with whom it is intended to subcontract.

4.4 The Departmental Representative may object to the intended subcontracting by notifying the Contractor in writing within six days of receipt by the Departmental Representative of a notification referred to in GC4.2.

4.5 If the Departmental Representative objects to a subcontracting pursuant to GC4.4, the Contractor shall not enter into the intended subcontract.

4.6 The contractor shall not, without the written consent of the Departmental Representative, change a subcontractor who has been engaged by him in accordance with this General Condition.

4.7 Every subcontract entered into by the Contractor shall adopt all of the terms and conditions of ths contract that are of general application.

4.8 Neither a subcontracting nor the Departmental Representative's consent to a subcontracting by the Contractor shall be construed to relieve the Contractor from any obligation under the contract or to impose any liability upon Her Majesty.

GC5 Amendments

5.1 No amendment or change in any of the provisions of the contract shall have any force or effect until it is reduced to writing.

GC6 No Implied Obligations

6.1 No implied terms or obligations of any kind by or on behalf of Her Majesty shall arise from anything in the contract and the express covenants and agreements therein contained and made by Her Majesty are the only covenants and agreements upon which any rights against Her Majesty are to be founded.

6.2 The contract supersedes all communications, negotiations and agreements, either written or oral, relating to the work that were made prior to the date of the contract.

GC7 Time of Essence

7.1 Time is of the essence of the contract.

GC8 Indemnification by Contractor

8.1 The Contractor shall indemnify and save Her Majesty harmless from and against all claims, demand, losses, costs, damages, actions, suits, or proceedings by whomever made, brought or prosecuted and in any manner based upon, arising out of, related to, occasioned by or attributable to the activities of the Contractor, his servants, agents, subcontractors and sub-subcontractors in performing the work including an infringement or an alleged infringement of a patent of invention or any other kind of intellectual property.

8.2 For the purpose of GC8.1, "activities" includes any act improperly carried out, any omission to carry out an act and any delay in carrying out an act.

GC9 Indemnification by Her Majesty

9.1 Her Majesty shall, subject to the Crown Liability Act, the Patent Act, and any other law that affects Her Majesty's rights, powers, privileges or obligations, indemnify and save the Contractor harmless from and against all claims, demands, losses, costs, damage, actions, suits or proceedings arising out of his activities under the contract that are directly attributable to

9.1.1 lack of or a defect in Her Majesty's title to the work site whether real or alleged; or

9.1.2 an infringement or an alleged infringement by the Contractor of any patent of invention or any other kind of intellectual property occurring while the Contractor was performing any act for the purposes of the contract employing a model, plan or design or any other thing related to the work that was supplied by Her Majesty to the Contractor.

GC10 Members of House of Commons Not to Benefit

10.1 As required by the Parliament of Canada Act, it is an express condition of the contract that no member of the House of Commons shall be admitted to any share of part of the contract or to any benefit arising therefrom.

GC11 Notices

11.1 Any notice, consent, order, decision, direction or other communication, other than a notice referred to in GC11.4, that may be given to the Contractor pursuant to the contract may be given in any manner.

11.2 Any notice, consent, order, decision, direction or other communication required to be given in writing, to any party pursuant to the contract shall, subject to GC11.4, be deemed to have been effectively given

11.2.1 to the Contractor, if delivered personally to the Contractor or the Contractor's superintendent, or forwarded by mail, telex or facsimile to the Contractor at the address set out in A4.1, or

11.2.2 to Her Majesty, if delivered personally to the Departmental Representative, or forwarded by mail, telex or facsimile to the Departmental Representative at the address set out in A1.2.1.

11.3 Any such notice, consent, order, decision, direction or other communication given in accordance with GC11.2 shall be deemed to have been received by either party

11.3.1 if delivered personally, on the day that it was delivered,

11.3.2 if forwarded by mail, on the earlier of the day it was received and the sixth day after it was mailed, and

11.3.3 if forwarded by telex or facsimile, 24 hours after it was transmitted.

11.4 A notice given under GC38.1.1, GC40 and GC41, if delivered personally, shall be delivered to the Contractor if the Contractor is doing business as sole proprietor or, if the Contractor is a partnership or corporation, to an officer thereof.

GC12 Material, Plant and Real Property Supplied by Her Majesty

12.1 Subject to GC12.2, the Contractor is liable to Her Majesty for any loss of or damage to material, plant or real property that is supplied or placed in the care, custody and control of the Contractor by Her Majesty for use in connection with the contract, whether or not that loss or damage is attributable to causes beyond the Contractor's control.

12.2 The Contractor is not liable to Her Majesty for any loss or damage to material, plant or real property referred to in GC12.1 if that loss or damage results from and is directly attributable to reasonable wear and tear.

12.3 The Contractor shall not use any material, plant or real property referred to in GC12.1 except for

the purpose of performing this contract.

12.4 When the Contractor fails to make good any loss or damage for which he is liable under GC12.1 within a reasonable time after being required to do so by the Departmental Representative, the Departmental Representative may cause the loss or damage to be made good at the Contractor's expense, and the Contractor shall thereupon be liable to Her Majesty for the cost thereof and shall, on demand, pay to Her Majesty an amount equal to that cost.

12.5 The Contractor shall keep such records of all material, plant and real property referred to in GC12.1 as the Departmental Representative from time to time requires and shall satisfy the Departmental Representative, when requested, that such material, plant and real property are at the place and in the condition which they ought to be.

GC13 Material, Plant and Real Property Become Property of Her Majesty

13.1 Subject to GC14.7 all material and plant and the interest of the Contractor in all real property, licenses, powers and privileges purchased, used or consumed by the Contractor for the contract shall, after the time of their purchase, use or consumption be the property of Her Majesty for the purposes of the work and they shall continue to be the property of Her Majesty.

13.1.1 in the case of material, until the Departmental Representative indicates that he is satisfied that it will not be required for the work, and

13.1.2 in the case of plant, real property, licenses, powers and privileges, until the Departmental Representative indicates that he is satisfied that the interest vested in Her Majesty therein is no longer required for the purposes of the work.

13.2 Material or plant that is the property of Her Majesty by virtue of GC13.1 shall not be taken away from the work site or used or disposed of except for the purposes of the work without the written consent of the Departmental Representative.

13.3 Her Majesty is not liable for loss of or damage from any cause to the material or plant referred to in GC13.1 and the Contractor is liable for such loss or damage notwithstanding that the material or plant is the property of Her Majesty.

GC14 Permits and Taxes Payable

14.1 The Contractor shall, within 30 days after the date of the contract, tender to a municipal authority an amount equal to all fees and charges that would be lawfully payable to that municipal authority in respect of building permits as if the work were being performed for a person other than Her Majesty.

14.2 Within 10 days of making a tender pursuant to GC14.1, the Contractor shall notify the Departmental Representative of his action and of the amount tendered and whether or not the municipal authority has accepted that amount.

14.3 If the municipal authority does not accept the amount tendered pursuant to GC14.1 the Contractor shall pay that amount to Her Majesty within 6 days after the time stipulated in GC14.2.

14.4 For the purposes of GC14.1 to GC14.3 "municipal authority" means any authority that would have jurisdiction respecting permission to perform the work if the owner were not Her Majesty.

14.5 Notwithstanding the residency of the Contractor, the Contractor shall pay any applicable tax arising from or related to the performance of the work under the contract.

14.6 In accordance with the Statutory Declaration referred to in TP4.9, a Contractor who has neither residence nor place of business in the province in which work under the contract is being performed shall provide Her Majesty with proof of registration with the provincial sales tax authorities in the said province.

14.7 For the purpose of the payment of any applicable tax or the furnishing of security for the payment of any applicable tax arising from or related to the performance of the work under the contract, the Contractor shall, notwithstanding the fact that all material, plant and interest of the Contractor in all real property, licenses, powers and privileges, have become the property of Her Majesty after the time of purchase, be liable, as a user or consumer, for the payment or for the furnishing of security for the payment of any applicable tax payable, at the time of the use or consumption of that material, plant or interest of the Contractor in accordance with the relevant legislation.

GC15 Performance of Work under Direction of Departmental Representative

15.1 The Contractor shall

15.1.1 permit the Departmental Representative to have access to the work and its site at all times during the performance of the contract;

15.1.2 furnish the Departmental Representative with such information respecting the performance of the contract as he may require; and

15.1.3 give the Departmental Representative every possible assistance to enable the Departmental Representative to carry out his duty to see that the work is performed in accordance with the contract and to carry out any other duties and exercise any powers specially imposed or conferred on the Departmental Representative under the contract.

CG16 Cooperation with Other Contractors

16.1 Where, in the opinion of the Departmental Representative, it is necessary that other contractors or workers with or without plant and material, be sent onto the work or its site, the Contractor shall, to the satisfaction of the Departmental Representative, allow them access and cooperate with them in the carrying out of their duties and obligation.

16.2 If

16.2.1 the sending onto the work or its site of other contractors or workers pursuant to GC16.1 could not have been reasonably foreseen or anticipated by the Contractor when entering into the contract, and

16.2.2 the Contractor incurs, in the opinion of the Departmental Representative, extra expense in complying with GC16.1, and

16.2.3 The Contractor has given the Departmental Representative written notice of his claim for the extra expense referred to in GC16.2.2 within 30 days of the date that the other contractors or workers were sent onto the work or its site,

Her Majesty shall pay the Contractor the cost, calculated in accordance with GC48 to GC50, of the extra labour, plant and material that was necessarily incurred.

GC17 Examination of Work

17.1 If, at any time after the commencement of the work but prior to the expiry of the warranty or guarantee period, the Departmental Representative has reason to believe that the work or any part thereof has not been performed in accordance with the contract, the Departmental Representative may have that work examined by an expert of his choice.

17.2 If, as a result of an examination of the work referred to in GC17.1, it is established that the work was not performed in accordance with the contract, then, in addition to and without limiting or otherwise affecting any of Her Majesty's rights and remedies under the contract either at law or in equity, the Contractor shall pay Her Majesty, on demand, all reasonable costs and expenses that were incurred by Her Majesty in having that examination performed.

GC18 Clearing of Site

18.1 The Contractor shall maintain the work and its site in a tidy condition and free from the accumulation of waste material and debris, in accordance with any directions of the Departmental Representative.

18.2 Before the issue of an interim certificate referred to in GC44.2, the Contractor shall remove all the plant and material not required for the performance of the remaining work, and all waste material and other debris, and shall cause the work and its site to be clean and suitable for occupancy by Her Majesty's servants, unless otherwise stipulated in the contract.

18.3 Before the issue of a final certificate referred to in GC44.1, the Contractor, shall remove from the work and its site all of the surplus plant and material and any waste material and other debris.

18.4 The Contractor's obligations described in GC18.1 to GC18.3 do not extend to waste material and other debris caused by Her Majesty's servants or contractors and workers referred to in GC16.1.

GC19 Contractor's Superintendent

19.1 The Contractor shall, forthwith upon the award of the contract, designate a superintendent.

19.2 The Contractor shall forthwith notify the Departmental Representative of the name, address and telephone number of a superintendent designate pursuant to GC19.1.

19.3 A superintendent designated pursuant to GC19.1 shall be in full charge of the operations of the Contractor in the performance of the work and is authorized to accept any notice, consent, order, direction, decision or other communication on behalf of the Contractor that may be given to the superintendent under the contract.

19.4 The Contractor shall, until the work has been completed, keep a competent superintendent at the work site during working hours.

19.5 The Contractor shall, upon the request of the Departmental Representative, remove any superintendent who, in the opinion of the Departmental Representative, is incompetent or has been conducting himself improperly and shall forthwith designate another superintendent who is acceptable to the Departmental Representative.

19.6 Subject to GC19.5, the Contractor shall not substitute a superintendent without the written consent of the Departmental Representative.

19.7 A breach by the Contractor of GC19.6 entitles the Departmental Representative to refuse to issue any certificate referred to in GC44 until the superintendent has returned to the work site or another superintendent who is acceptable to the Departmental Representative has been substituted.

GC20 National Security

20.1 If the Minister is of the opinion that the work is of a class or kind that involves the national security, he may order the Contractor

20.1.1 to provide him with any information concerning persons employed or to be employed by him for purposes of the contract; and

20.1.2 to remove any person from the work and its site if, in the opinion of the Minister, that person may be a risk to the national security.

20.2 The Contractor shall, in all contracts with persons who are to be employed in the performance of the contract, make provision for his performance of any obligation that may be imposed upon him under GC19 to GC21.

20.3 The Contractor shall comply with an order of the Minister under GC20.1

GC21 Unsuitable Workers

21.1 The Contractor shall, upon the request of the Departmental Representative, remove any person employed by him for purposes of the contract who, in the opinion of the Departmental Representative, is incompetent or has conducted himself improperly, and the Contractor shall not permit a person who has been removed to return to the work site.

GC22 Increased or Decreased Costs

22.1 The amount set out in the Articles of Agreement shall not be increased or decreased by reason of any increase or decrease in the cost of the work that is brought about by an increase or decrease in the cost of labour, plant or material or any wage adjustment arising pursuant to the Labour Conditions.

22.2 Notwithstanding GC22.1 and GC35, an amount set out in the Articles of Agreement shall be adjusted in the manner provided in GC22.3, if any change in a tax imposed under the Excise Act, the Excise Tax Act, the Old Age Security Act, the Customs Act, the Customs Tariff or any provincial sales tax legislation imposing a retail sales tax on the purchase of tangible personal property incorporated into Real Property

22.2.1 occurs after the date of the submission by the Contractor of his tender for the contract,

22.2.2 applies to material, and

22.2.3 affects the cost to the Contractor of that material.

22.3 If a change referred to in GC22.2 occurs, the appropriate amount set out in the Articles of Agreement shall be increased or decreased by an amount equal to the amount that is established by an examination of the relevant records of the Contractor referred to in GC51 to be the increase or decrease in the cost incurred that is directly attributable to that change.

22.4 For the purpose of GC22.2, where a tax is changed after the date of submission of the tender but public notice of the change has been given by the Minister of Finance before that date, the change shall be deemed to have occurred before the date of submission of the tender.

GC23 Canadian Labour and Material

23.1 The Contractor shall use Canadian labour and material in the performance of the work to the full extent to which they are procurable, consistent with proper economy and expeditious carrying out of the work.

23.2 Subject to GC23.1, the Contractor shall, in the performance of the work, employ labour from the locality where the work is being performed to the extent to which it is available, and shall use the offices of the Canada Employment Centres for the recruitment of workers wherever practicable.

23.3 Subject to GC23.1 and GC23.2, the Contractor shall, in the performance of the work, employ a reasonable proportion of persons who have been on active service with the armed forces of Canada and have been honourably discharged therefrom.

GC24 Protection of Work and Documents

24.1 The Contractor shall guard or otherwise protect the work and its site, and protect the contract, specifications, plans, drawings, information, material, plant and real property, whether or not they are supplied by Her Majesty to the Contractor, against loss or damage from any cause, and he shall not use, issue, disclose or dispose of them without the written consent of the Minister, except as may be essential for the performance of the work.

24.2 If any document or information given or disclosed to the Contractor is assigned a security rating by the person who gave or disclosed it, the Contractor shall take all measures directed by the Departmental Representative to be taken to ensure the maintenance of the degree of security that is ascribed to that rating.

24.3 The Contractor shall provide all facilities necessary for the purpose of maintaining security, and shall assist any person authorized by the Minister to inspect or to take security measures in respect of the work and its site.

24.4 The Departmental Representative may direct the Contractor to do such things and to perform such additional work as the Departmental Representative considers reasonable and necessary to ensure compliance with or to remedy a breach of GC24.1 to GC24.3.

GC25 Public Ceremonies and Signs

25.1 The Contractor shall not permit any public ceremony in connection with the work without the prior consent of the Minister.

25.2 The Contractor shall not erect or permit the erection of any sign or advertising on the work or its site without the prior consent of the Departmental Representative.

GC26 Precautions against Damage, Infringement of Rights, Fire, and Other Hazards

26.1 The Contractor shall, at his own expense, do whatever is necessary to ensure that

26.1.1 no person, property, right, easement or privilege is injured, damaged or infringed by reasons of the Contractor's activities in performing the contract;

26.1.2 pedestrian and other traffic on any public or private road or waterway is not unduly impeded, interrupted or endangered by the performance or existence of the work or plant;

26.1.3 fire hazards in or about the work or its site are eliminated and, subject to any direction that may be given by the Departmental Representative, any fire is promptly extinguished;

26.1.4 the health and safety of all persons employed in the performance of the work is not endangered by the method or means of its performance;

26.1.5 adequate medical services are available to all persons employed on the work or its site at all times during the performance of the work;

26.1.6 adequate sanitation measures are taken in respect of the work and its site; and

26.1.7 all stakes, buoys and marks placed on the work or its site by or under the authority of the Departmental Representative are protected and are not removed, defaced, altered or destroyed.

26.2 The Departmental Representative may direct the Contractor to do such things and to perform such additional work as the Departmental Representative considers reasonable and necessary to ensure

compliance with or to remedy a breach of GC26.1.

26.3 The Contractor shall, at his own expense, comply with a direction of the Departmental Representative made under GC26.2.

GC27 Insurance

27.1 The Contractor shall, at his own expense, obtain and maintain insurance contracts in respect of the work and shall provide evidence thereof to the Departmental Representative in accordance with the requirements of the Insurance Conditions "E".

27.2 The insurance contracts referred to in GC27.1 shall

27.2.1 be in a form, of the nature, in the amounts, for the periods and containing the terms and conditions specified in Insurance Conditions "E", and

27.2.2 provide for the payment of claims under such insurance contracts in accordance with GC28.

GC28 Insurance Proceeds

28.1 In the case of a claim payable under a Builders Risk/Installation (All Risks) insurance contract maintained by the Contractor pursuant to GC27, the proceeds of the claim shall be paid directly to Her Majesty, and

28.1.1 the monies so paid shall be held by Her Majesty for the purposes of the contract, or

28.1.2 if Her Majesty elects, shall be retained by Her Majesty, in which event they vest in Her Majesty absolutely.

28.2 In the case of a claim payable under a General Liability insurance contract maintained by the Contractor pursuant to GC27, the proceeds of the claim shall be paid by the insurer directly to the claimant.

28.3 If an election is made pursuant to GC28.1, the Minister may cause an audit to be made of the accounts of the Contractor and of Her Majesty in respect of the part of the work that was lost, damaged or destroyed for the purpose of establishing the difference, if any, between

28.3.1 the aggregate of the amount of the loss or damage suffered or sustained by Her Majesty, including any cost incurred in respect of the clearing and cleaning of the work and its site and any other amount that is payable by the Contractor to Her Majesty under the contract, minus any monies retained pursuant to GC28.12, and

28.3.2 the aggregate of the amounts payable by Her Majesty to the Contractor pursuant to the contract up to the date of the loss or damage.

28.4 A difference that is established pursuant to GC28.3 shall be paid forthwith by the party who is determined by the audit to be the debtor to the party who is determined by the audit to be the

creditor.

28.5 When payment of a deficiency has been made pursuant to GC28.4, all rights and obligations of Her Majesty and the Contractor under the contract shall, with respect only to the part of the work that was the subject of the audit referred to in GC28.3, be deemed to have been expended and discharged.

28.6 If an election is not made pursuant to GC28.1.2 the Contractor shall, subject to GC28.7, clear and clean the work and its site and restore and replace the part of the work that was lost, damaged or destroyed at his own expense as if that part of the work had not yet been performed.

28.7 When the Contractor clears and cleans the work and its site and restores and replaces the work referred to in GC 28.6, Her Majesty shall pay him out of the monies referred to in GC28.1 so far as they will thereunto extend.

28.8 Subject to GC28.7, payment by Her Majesty pursuant to GC28.7 shall be made in accordance with the contract but the amount of each payment shall be 100% of the amount claimed notwithstanding TP4.4.1 and TP4.4.2.

GC29 Contract Security

29.1 The Contractor shall obtain and deliver contract security to the Departmental Representative in accordance with the provisions of the Contract Security Conditions.

29.2 If the whole or a part of the contract security referred to in GC29.1 is in the form of a security deposit, it shall be held and disposed of in accordance with GC43 and GC45.

29.3 If a part of the contract security referred to in GC29.1 is in the form of a labour and material payment bond, the Contractor shall post a copy of that bond on the work site.

GC30 Changes in the Work

30.1 Subject o GC5, the Departmental Representative may, at any time before he issues his Final Certificate of Completion,

30.1.1 order work or material in addition to that provided for in the Plans and Specifications; and

30.1.2 delete or change the dimensions, character, quantity, quality, description, location or position of the whole or any part of the work or material proved for in the Plans and Specifications or in any order made pursuant to GC30.1.1,

if that additional work or material, deletion, or change is, in his opinion, consistent with the general intent of the original contract.

30.2 The Contractor shall perform the work in accordance with such orders, deletions and changes that are made by the Departmental Representative pursuant to GC30.1 from time to time as if they had appeared in and been part of the Plans and Specifications.

30.3 The Departmental Representative shall determine whether or not anything done or omitted by the Contractor pursuant to an order, deletion or change referred to in GC30.1 increased or decreased the cost of the work to the Contractor.

30.4 If the Departmental Representative determines pursuant to GC30.3 that the cost of the work to the Contractor has been increased, Her Majesty shall pay the Contractor the increased cost that the Contractor necessarily incurred for the additional work calculated in accordance with GC49 or GC50.

30.5 If the Departmental Representative determines pursuant to GC303.3 that the cost of the work to the Contractor has been decreased, Her Majesty shall reduce the amount payable to the Contractor under the contract by an amount equal to the decrease in the cost caused by the deletion or change referred to in GC30.1.2 and calculated in accordance with GC49.

30.6 GC30.3 to GC30.5 are applicable only to a contract or a portion of a contract for which a Fixed Price Arrangement is stipulated in the contract.

30.7 An order, deletion or change referred to in GC30.1 shall be in writing, signed by the Departmental Representative and given to the Contractor in accordance with GC11.

GC31 Interpretation of Contract by Departmental Representative

31.1 If, ar any time before the Departmental Representative has issued a Final Certificate of Completion referred to in GC44.1, any question arises between the parties about whether anything has been done as required by the contract or about what the Contractor is required by the contract to do, and, in particular but without limiting the generality of the foregoing, about

31.1.1 the meaning of anything in the Plans and Specification,

31.1.2 the meaning to be given to the Plans and Specifications in case of any error therein, omission therefrom, or obscurity or discrepancy in their working or intention,

31.1.3 whether or not the quality or quantity of any material or workmanship supplied or proposed to be supplied by the Contractor meets the requirements of the contract,

31.1.4 whether or not the labour, plant or material provided by the Contractor for performing the work and carrying out the contract are adequate to ensure that the work will be performed in accordance with the contract and that the contract will be carried out in accordance with its terms,

31.1.5 what quantity of any kind of work has been completed by the Contractor, or

31.1.6 the timing and scheduling of the various phases of the performance of the work,

the question shall be decided by the Departmental Representative whose decision shall be final and conclusive in respect of the work.

31.2 The Contractor shall perform the work in accordance with any decisions of the Departmental

Representative that are made under GC31.1 and in accordance with any consequential directions given by the Departmental Representative.

GC32 Warranty and Rectification of Defects in Work

32.1 Without restricting any warranty or guarantee implied or imposed by law or contained in the contract documents, the Contractor shall, at his own expense,

32.1.1 rectify and make good any defect or fault that appears in the work or comes to the attention of the Minister with respect to those parts of the work accepted in connection with the Interim Certificate of Completion referred to GC44.2 within 12 months from the date of the Interim Certificate of Completion;

32.1.2 rectify and make good any defect or fault that appears in or comes to the attention of the Minister in connection with those parts of the work described in the Interim Certificate of Completion referred to in GC44.2 within 12 months from the date of the Final Certificate of Completion referred to in GC44.1.

32.2 The Departmental Representative may direct the Contractor to rectify and make good any defect or fault referred to in GC32.1 or covered by any other expressed or implied warranty or guarantee.

32.3 A direction referred to in GC32.2 shall be in writing, may include a stipulation in respect of the time within which a defect or fault is required to be rectified and made good by the Contractor, and shall be given to the Contractor in accordance with GC11.

32.4 The Contractor shall rectify and make good any defect or fault described in a direction given pursuant to GC32.2 within the time stipulated therein.

GC33 Non-Compliance by Contractor

33.1 If the Contractor fails to comply with any decision or direction given by the Departmental Representative pursuant to GC18, GC24, GC26, GC31 or GC32, the Departmental Representative may employ such methods as he deems advisable to do that which the Contractor failed to do.

33.2 The Contractor shall, on demand, pay Her Majesty an amount that is equal to the aggregate of all cost, expenses and damage incurred or sustained by Her Majesty by reason of the Contractor's failure to comply with any decision or direction referred to in GC33.1, including the cost of any methods employed by the Departmental Representative pursuant to GC33.1.

GC34 Protesting Departmental Representative's Decisions

34.1 The Contractor may, within ten days after the communication to him of any decision or direction referred to in GC30.3 or GC33.1, protest that decision or direction.

34.2 A protest referred to in GC34.1 shall be in writing, contain full reasons for the protest, be signed

by the Contractor and be given to Her Majesty by delivery to the Departmental Representative.

34.3 If the Contractor gives a protest pursuant to GC34.2, any compliance by the Contractor with the decision or direction that was protested shall not be construed as an admission by the Contractor of the correctness of that decision or direction, or prevent the Contractor from taking whatever action he considers appropriate in the circumstances.

34.4 The giving of a protest by the Contractor pursuant to GC34.2 shall not relieve him from complying with the decision or direction that is the subject of the protest.

34.5 Subject to GC34.6, the Contractor shall take any action referred to in GC34.3 within three months after the date that a Final Certificate of Completion is issued under GC44.1 and not afterwards.

34.6 The Contractor shall take any action referred to in GC34.3 resulting from a direction under GC32 within three months after the expiry of a warranty or guarantee period and not afterwards.

34.7 Subject to GC34.8, if Her Majesty determines that the Contractor's protest is justified, Her Majesty shall pay the Contractor the cost of the additional labour, plant and material necessarily incurred by the Contractor in carrying out the protested decision or direction.

34.8 Costs referred to in GC34.7 shall be calculated in accordance with GC48 to GC50.

GC35 Changes in Soil Conditions and Neglect or Delay by Her Majesty

35.1 Subject to GC35.2 no payment, other than a payment that is expressly stipulated in the contract, shall be made by Her Majesty to the Contractor for any extra expense or any loss or damage incurred or sustained by the Contractor.

35.2 If the Contractor incurs or sustains any extra expense or any loss or damage that is directly attributable to

35.2.1 a substantial difference between the information relating to soil conditions at the work site that is contained in the Plans and Specifications or other documents supplied to the Contractor for his use in preparing his tender or a reasonable assumption of fact based thereon made by the Contractor, and the actual soil conditions encountered by the Contractor at the work site during the performance of the contract, or

35.2.2 any neglect or delay that occurs after the date of the contract on the part of Her Majesty in providing any information or in doing any act that the contract either expressly requires Her Majesty to do or that would ordinarily be done by an owner in accordance with the usage of the trade,

he shall, within ten days of the date the actual soil conditions described in GC35.2.1 were encountered or the neglect or delay described in GC35.2.2 occurred, give the Departmental Representative written notice of his intention to claim for that extra expense or that loss or damage.

35.3 When the Contractor has given a notice referred to in GC35.2, he shall give the Departmental Representative a written claim for extra expense or loss or damage within 30 days of the date that

a Final Certificate of Completion referred to in GC44.1 is issued and not afterwards.

35.4 A written claim referred to in GC35.3 shall contain a sufficient description of the facts and circumstances of the occurrence that is the subject of the claim to enable the Departmental Representative to determine whether or not the claim is justified and the Contractor shall supply such further and other information for that purpose as the Departmental Representative requires from time to time.

35.5 If the Departmental Representative determines that a claim referred to in GC35.3 is justified, Her Majesty shall make an extra payment to the Contractor in an amount that is calculated in accordance with GC47 to GC50.

35.6 If, in the opinion of the Departmental Representative, an occurrence described in GC35.2.1 results in a savings of expenditure by the Contractor in performing the contract, the amount set out in the Articles of Agreement shall, subject to GC35.7, be reduced by an amount that is equal to the saving.

35.7 The amount of the saving referred to in GC35.6 shall be determined in accordance with GC47 to GC49.

35.8 If the Contractor fails to give a notice referred to in GC35.2 and a claim referred to in GC35.3 within the times stipulated, an extra payment shall not be made to him in respect of the occurrence.

GC36 Extension of Time

36.1 Subject to GC36.2, the Departmental Representative may, on the application of the Contractor made before the day fixed by the Articles of Agreement for completion of the work or before any other date previously fixed under this General Condition, extend the time for its completion by fixing a new date if, in the opinion of the Departmental Representative, causes beyond the control of the Contractor have delayed its completion.

36.2 An application referred to in GC36.1 shall be accompanied by the written consent of the bonding company whose bond forms part of the contract security.

GC37 Assessments and Damages for Late Completion

37.1 For the purposes of this General Condition

37.1.1 the work shall be deemed to be completed on the date that an Interim Certificate of Completion referred to in GC44.2 is issued, and

37.1.2 "period of delay" means the number of days commencing on the day fixed by the Articles of Agreement for completion of the work and ending on the day immediately preceding the day on which the work is completed but does not include any day within a period of extension granted pursuant to GC36.1, and any other day on which, in the opinion of the Departmental Representative, completion of the work was delayed for reasons beyond the control of the Contractor.

37.2 If the Contractor does not complete the work by the day fixed for its completion by the Articles of Agreement but completes it thereafter, the Contractor shall pay Her Majesty an amount equal to the aggregate of

37.2.1 all salaries, wages and travelling expenses incurred by Her Majesty in respect of persons overseeing the performance of the work during the period of delay;

37.2.2 the cost incurred by Her Majesty as a result of the inability to use the completed work for the period of delay; and

37.2.3 all other expenses and damages incurred or sustained by Her Majesty during the period of delay as a result of the work not being completed by the day fixed for its completion.

37.3 The Minister may waive the right of Her Majesty to the whole or any part of the amount payable by the Contractor pursuant to GC37.2 I , in the opinion of the Minister, it is in the public interest to do so.

GC38 Taking the Work Out of the Contractor's Hands

38.1 The Minister may, at his sole discretion, by giving a notice in writing to the Contractor in accordance with GC11, take all or any part of the work out of the Contractor's hands, and may employ such means as he sees fit to have the work completed if the Contractor

38.1.1 Has not, within six days of the Minister or the Departmental Representative giving notice to the Contractor in writing in accordance with GC11, remedied any delay in the commencement or any default in the diligent performance of the work to the satisfaction of the Departmental Representative;

38.1.2 has defaulted in the completion of any part of the work within the time fixed for its completion by the contract;

38.1.3 has become insolvent;

38.1.4 has committed an act of bankruptcy;

38.1.5 has abandoned the work;

38.1.6 has made an assignment of the contract without the consent required by GC3.1; or

38.1.7 has otherwise failed to observe or perform any of the provisions of the contract.

38.2 If the whole or any part of the work is taken out of the Contractor's hands pursuant to GC38.1,

38.2.1 the Contractor's right to any further payment that is due or accruing due under the contract is, subject only to GC38.4, extinguished, and

38.2.2 the Contractor is liable to pay Her Majesty, upon demand, an amount that is equal to the amount of all loss and damage incurred or sustained by Her Majesty in respect of the

Contractor's failure to complete the work.

38.3 If the whole or any part of the work that is taken out of the Contractor's hands pursuant to GC38.1 is completed by Her Majesty, the Departmental Representative shall determine the amount, if any, of the holdback or a progress claim that had accrued and was due prior to the date on which the work was taken out of the Contractor's hands and that is not required for the purposes of having the work performed or of compensating Her Majesty for any other loss or damage incurred or sustained by reason of the Contractor's default.

38.4 Her Majesty may pay the Contractor the amount determined not to be required pursuant to GC38.3.

GC39 Effect of Taking the Work Out of the Contractor's Hands

39.1 The taking of the work or any part thereof out of the Contractor's hands pursuant to GC38 does not operate so as to relieve or discharge him from any obligation under the contract or imposed upon him by law except the obligation to complete the performance of that part of the work that was taken out of his hands.

39.2 If the work or any part thereof is taken out of the Contractor's hands pursuant to GC38, all plant and material and the interest of the Contractor is all real property, licenses, powers and privileges acquired, used or provided by the Contractor under the contract shall continue to be the property of Her Majesty without compensation to the Contractor.

39.3 When the Departmental Representative certifies that any plant, material, or any interest of the Contractor referred to in GC39.2 is no longer required for the purposes of the work, or that it is not in the interest of Her Majesty to retain that plant, material or interest, it shall revert to the Contractor.

G40 Suspension of Work by Minister

40.1 The Minister may, when in his opinion it is in the public interest to do so, require the Contractor to suspend performance of the work either for a specified or an unspecified period by giving a notice of suspension in wiring to the Contractor in accordance with GC11.

40.2 When a notice referred to in GC40.1 is received by the Contractor in accordance with GC11, he shall suspend all operations in respect of the work except those that, in the opinion of the Departmental Representative, are necessary for the care and preservation of the work, plant and material.

40.3 The Contractor shall not, during a period of suspension, remove any part of the work, plant or material from its site without the consent of the Departmental Representative.

40.4 If a period of suspension is 30 days or less, the Contractor shall, upon the expiration of that period, resume the performance of the work and he is entitled to be paid the extra cost, calculated in accordance with GC48 to GC50, of any labour, plant and material necessarily incurred by him as a result of the suspension.

40.5 If, upon the expiration of a period of suspension of more than 30 days, the Minister and the Contractor agree that the performance of the work will be continued by the Contractor, the Contractor shall resume performance of the work subject to any terms and conditions agreed upon by the Minister and the Contractor.

40.6 If, upon the expiration of a period of suspension of more than 30 days, the Minister and the Contractor do not agree that performance of the work will be continued by the Contractor or upon the terms and conditions under which the Contractor will continue the work, the notice of suspension shall be deemed to be a notice of termination pursuant to GC41.

GC41 Termination of Contract

41.1 The Minister may terminate the contract at any time by giving a notice of termination in writing to the Contractor in accordance with GC11.

41.2 When a notice referred to in GC41.1 is received by the Contractor in accordance with GC11, he shall, subject to any conditions stipulated in the notice, forthwith cease all operations in performance of the contract.

41.3 If the contract is terminated pursuant to GC41.1, Her Majesty shall pay the Contractor, subject to GC41.4, an amount equal to

41.3.1 the cost to the contractor of all labour, plant and material supplied by him under the contract up to the date of termination in respect of a contract or part thereof for which a Unit Price Arrangement is stipulated in the contract, or

41.3.2 the lesser of

41.3.2.1 an amount, calculated in accordance with the Terms and Payment, that would have been payable to the Contractor had he completed the work, and

41.3.2.2 an amount that is determined to be due to the Contractor pursuant to GC49 in respect of a contract or part thereof for which a Fixed Price Arrangement is stipulated in the contract

less the aggregate of all amounts that were paid to the Contractor by Her Majesty and all amounts that are due to Her Majesty from the Contractor pursuant to the contract.

41.4 If Her Majesty and the Contractor are unable to agree about an amount referred to in GC41.3 that amount shall be determined by the method referred to in GC50.

GC42 Claims Against and Obligations of the Contractor or Subcontractor

42.1 Her Majesty may, in order to discharge lawful obligations of and satisfy claims against the Contractor or a subcontractor arising out of the performance of the contract, pay any amount that is due and payable to the Contractor pursuant to the contract directly to the obligees of and the claimants against the Contractor or the subcontractor but such amount if any, as is paid by Her Majesty, shall not exceed that amount which the Contractor would have been obliged to pay to

such claimant had the provisions of the Provincial or Territorial lien legislation, or, in the Province of Quebec, the law relating to privileges, been applicable to the work. Any such claimant need not comply with the provisions of such legislation setting out the steps by way of notice, registration or otherwise as might have been necessary to preserve or perfect any claim for lien or privilege which claimant might have had;

42.2 Her Majesty will not make any payment as described in GC42.1 unless and until that claimant shall have delivered to Her Majesty:

42.2.1 a binding and enforceable Judgment or Order of a court of competent jurisdiction setting forth such amount as would have been payable by the Contractor to the claimant pursuant to the provisions of the applicable Provincial or Territorial lien legislation, or, in the Province of Quebec, the law relating to privileges, had such legislation been applicable to the work; or

42.2.2 a final and enforceable award of an arbitrator setting forth such amount as would have been payable by the Contractor to the claimant pursuant to the provisions of the applicable Provincial or Territorial lien legislation, or, in the Province of Quebec, the law relating to privileges, had such legislation been applicable to the work; or

42.2.3 the consent of the Contractor authorizing a payment.

For the purposes of determining the entitlement of a claimant pursuant to GC42.2.1 and GC42.2.2, the notice required by GC42.8 shall be deemed to replace the registration or provision of notice after the performance of work as required by any applicable legislation and no claim shall be deemed to have expired, become void or unenforceable by reason of the claimant not commencing any action within the time prescribed by any applicable legislation.

42.3 The Contractor shall, by the execution of his contract, be deemed to have consented to submit to binding arbitration at the request of any claimant those questions that need be answered to establish the entitlement of the claimant to payment pursuant to the provisions of GC42.1 and such arbitration shall have as parties to it any subcontractor to whom the claimant supplied material, performed work or rented equipment should such subcontractor wish to be adjoined and the Crown shall not be a party to such arbitration and, subject to any agreement between the Contractor and the claimant to the contrary, the arbitration shall be conducted in accordance with the Provincial or Territorial legislation governing arbitration applicable in the Province or Territory in which the work is located.

42.4 A payment made pursuant to GC42.1 is, to the extent of the payment, a discharge of Her Majesty's liability to the Contractor under the contract and may be deducted from any amount payable to the Contractor under the contract.

42.5 To the extent that the circumstances of the work being performed for Her Majesty permit, the Contractor shall comply with all laws in force in the Province or Territory where the work is being performed relating to payment period, mandatory holdbacks, and creation and enforcement of mechanics' liens, builders' liens or similar legislation or in the Province of Quebec, the law relating to privileges.

42.6 The Contractor shall discharge all his lawful obligations and shall satisfy all lawful claims against him arising out of the performance of the work at least as often as the contract requires Her

Majesty to pay the Contractor.

42.7 The Contractor shall, whenever requested to do so by the Departmental Representative, make a statutory declaration deposing to the existence and condition of any obligations and claims referred to in GC42.6.

42.8 GC42.1 shall only apply to claims and obligations

42.8.1 the notification of which has been received by the Departmental Representative in writing before payment is made to the Contractor pursuant to TP4.10 and within 120 days of the date on which the claimant

42.8.1.1 should have been paid in full under the claimant's contract with the Contractor or subcontractor where the claim is for money that was lawfully required to be held back from the claimant; or

42.8.1.2 performed the last of the services, work or labour, or furnished the last of the material pursuant to the claimant's contract with the Contractor or subcontractor where the claim is not for money referred to in GC42.8.1.1, and

42.8.2 the proceedings to determine the right to payment of which, pursuant to GC42.2. shall have commenced within one year from the date that the notice referred to in GC42.8.1 was received by the Departmental Representative, and

the notification required by GC42.8.1 shall set forth the amount claimed to be owing and the person who by contract is primarily liable.

42.9 Her Majesty may, upon receipt of a notice of claim under GC42.8.1, withhold from any amount that is due and payable to the Contractor pursuant to the contract the full amount of the claim or any portion thereof.

42.10 The Departmental Representative shall notify the Contractor in writing of receipt of any claim referred to in GC42.8.1 and of the intention of Her Majesty to withhold funds pursuant to GC42.9 and the Contractor may, at any time thereafter and until payment is made to the claimant, be entitled to post, with Her Majesty, security in a form acceptable to Her Majesty in an amount equal to the value of the claim, the notice of which is received by the Departmental Representative and upon receipt of such security Her Majesty shall release to the Contractor any funds which would be otherwise payable to the Contractor, that were withheld pursuant to the provisions of GC42.9 in respect of the claim of any claimant for whom the security stands.

GC43 Security Deposit – Forfeiture or Return

43.1 If

43.1.1 the work is taken out of the Contractor's hands pursuant to GC38,

43.1.2 the contract is terminated pursuant to GC41, or

43.1.3 the Contractor is in breach of or in default under the contract,

Her Majesty may convert the security deposit, if any, to Her own use.

43.2 If Her Majesty converts the contract security pursuant to GC43.1, the amount realized shall be deemed to be an amount due from Her Majesty to the Contractor under the contract.

43.3 Any balance of an amount referred to in GC43.2 that remains after payment of all losses, damage and claims of Her Majesty and others shall be paid by Her Majesty to the Contractor if, in the opinion of the Departmental Representative, it is not required for the purposes of the contract.

GC44 Departmental Representative's Certificates

44.1 On the date that

44.1.1 the work has been completed, and

44.1.2 the Contractor has complied with the contract and all orders and directions made pursuant thereto,

both to the satisfaction of the Departmental Representative, the Departmental Representative shall issue a Final Certificate of Completion to the Contractor.

44.2 If the Departmental Representative is satisfied that the work is substantially complete he shall, at any time before he issues a certificate referred to in GC44.1, issue an Interim Certificate of Completion to the Contractor, and

44.2.1 for the purposes of GC44.2 the work will be considered to be substantially complete,

44.2.1.1 when the work under the contract or a substantial part thereof is, in the opinion of the Departmental Representative, ready for use by Her Majesty or is being used for the purpose intended; and

44.2.1.2 when the work remaining to be done under the contract is, in the opinion of the Departmental Representative, capable of completion or correction at accost of not more that

44.2.1.2.1 -3% of the first $500,000, and

44.2.1.2.2 -2% of the next $500,000, and

44.2.1.2.3 -1% of the balance

of the value of the contract at the time this cost is calculated.

44.3 For the sole purpose of GC44.2.1.2, where the work or a substantial part thereof is ready for use or is being used for the purposes intended and the remainder of the work or a part thereof cannot be completed by the time specified in A2.1, or as amended pursuant to GC36, for reasons beyond the control of the Contractor or where the Departmental Representative and the Contractor agree not to complete a part of the work within the specified time, the cost of that part of the work

which was either beyond the control of the Contractor to complete or the Departmental Representative and the Contractor have agreed not to complete by the time specified shall be deducted from the value of the contract referred to GC44.2.1.2 and the said cost shall not form part of the cost of the work remaining to be done in determining substantial completion.

44.4 An Interim Certificate of Completion referred to in GC44.2 shall describe the parts of the work not completed to the satisfaction of the Departmental Representative and all things that must be done by the Contractor

44.4.1 before a Final Certificate of Completion referred to in GC44.1 will be issued, and

44.4.2 before the 12-month period referred to in GC32.1.2 shall commence for the said parts and all the said things.

44.5 The Departmental Representative may, in addition to the parts of the work described in an Interim Certificate of Completion referred to in GC44.2, require the Contractor to rectify any other parts of the work not completed to his satisfaction and to do any other things that are necessary for the satisfactory completion of the work.

44.6 If the contract or a part thereof is subject to a Unit Price Arrangement, the Departmental Representative shall measure and record the quantities of labour, plant and material, performed, used and supplied by the Contractor in performing the work and shall, at the request of the Contractor, inform him of those measurements.

44.7 The Contractor shall assist and co-operate with the Departmental Representative in the performance of his duties referred to in GC44.6 and shall be entitled to inspect any record made by the Departmental Representative pursuant to GC44.6.

44.8 After the Departmental Representative has issued a Final Certificate of Completion referred to in GC44.1, he shall, if GC44.6 applies, issue a Final Certificate of Measurement.

44.9 A Final Certificate of Measurement referred to in GC44.8 shall

44.9.1 contain the aggregate of all measurements of quantities referred to in GC44.6, and

44.9.2 be binding upon and conclusive between Her Majesty and the Contractor as to the quantities referred to therein.

GC45 Return of Security Deposit

45.1 After an Interim Certificate of Completion referred to in GC44.2 has been issued, Her Majesty shall, if the Contractor is not in breach of or in default under the contract, return to the Contractor all or any part of the security deposit that, in the opinion of the Departmental Representative, is not required for the purposes of the contract.

45.2 After a Final Certificate of Completion referred to in GC44.1 has been issued, Her Majesty shall return to the Contractor the remainder of any security deposit unless the contract stipulates otherwise.

45.3 If the security deposit was paid into the Consolidated Revenue Fund of Canada, Her Majesty shall pay interest thereon to the Contractor at a rate established from time to time pursuant to section 21(2) of the Financial Administration Act.

GC46 Clarification of Terms in GC47 to GC50

46.1 For the purposes of GC47 to GC50,

46.1.1 "Unit Price Table" means the table set out in the Articles of Agreement, and

46.1.2 "plant" does not include tools customarily provided by a tradesman in practicing his trade.

GC47 Additions or Amendments to Unit Price Table

47.1 Where a Unit Price Arrangement applies to the contract or a part thereof the Departmental Representative and the Contractor may, by an agreement in writing,

47.1.1 add classes of labour or material, and units of measurement, prices per unit and estimated quantities to the Unit Price Table if any labour, plant or material that is to be included in the Final Certificate of Measurement referred to in GC44.8 is not included in any class of labour, plant or material set out in the Unit Price Table; or

47.1.2 subject to GC47.2 and GC47.3, amend a price set out in the Unit Price Table for any class of labour, plant or material included therein if the Final Certificate of Measurement referred to in GC44.8 shows or is expected to show that the total quantity of that class of labour, plant or material actually performed, used or supplied by the Contractor in performing the work is

47.1.2.1 less than 85% of that estimated total quantity, or

47.1.2.2 in excess of 115% of that estimated total quantity.

47.2 In no event shall the total cost of an item set out in the Unit Price Table that has been amended pursuant to GC47.1.2.1 exceed the amount that would have been payable to the Contractor had the estimated total quantity actually been performed, used or supplied.

47.3 An amendment that is made necessary by GC47.1.2.2 shall apply only to the quantities that are in excess of 115%.

47.4 If the Departmental Representative and the Contractor do not agree as contemplated in GC47.1, the Departmental Representative shall determine the class and the unit of measurement of the labour, plant or material and, subject to GC47.2 and GC47.3, the price per unit therefore shall be determined in accordance with GC50.

GC48 Determination of Cost – Unit Price Table

48.1 Whenever, for the purposes of the contract, it is necessary to determine the cost of labour, plant or material, it shall be determined by multiplying the quantity of that labour, plant or material expressed in the unit set out in column 3 of the Unit Price Table by the price of that unit set out in column 5 of the Unit Price Table.

GC49 Determination of Cost – Negotiation

49.1 If the method described in GC48 cannot be used because the labour, plant or material is of a kind or class that is not set out in the Unit Price Table, the cost of that labour, plant or material for the purposes of the contract shall be the amount agreed upon from time to time by the Contractor and the Departmental Representative.

49.2 For the purposes of GC49.1, the Contractor shall submit to the Departmental Representative any necessary cost information requested by the Departmental Representative in respect of the labour, plant and material referred to in GC49.1

GC50 Determination of Cost – Failing Negotiation

50.1 If the methods described in GC47, GC48 or GC49 fail for any reason to achieve a determination of the cost of labour, plant and material for the purposes referred to therein, that cost shall be equal to the aggregate of

50.1.1 all reasonable and proper amounts actually expended or legally payable by the Contractor in respect of the labour, plant and material that falls within one of the classes of expenditure described in GC50.2 that are directly attributable to the performance of the contract,

50.1.2 an allowance for profit and all other expenditures or costs, including overhead, general administration cost, financing and interest charges, and every other cost, charge and expenses, but not including those referred to in GC50.1.1 or GC50.1.3 or a class referred to in GC50.2, in an amount that is equal to 10% of the sum of the expenses referred to in GC50.1.1, and

50.1.3 interest on the cost determined under GC50.1.1 and GC50.1.2, which interest shall be calculated in accordance with TP9,

provide that the total cost of an item set out n the Unit Price Table that is subject to the provisions of GC47.1.2.1 does not exceed the amount that would have been payable to the Contractor had the estimated total quantity of the said item actually be performed, used or supplied.

50.2 For purposes of GC50.1.1 the classes of expenditure that may be taken into account in determining the cost of labour, plant and material are,

50.2.1 payments to subcontractors;

50.2.2 wages, salaries and travelling expenses of employees of the Contractor while they are actually and properly engaged on the work, other than wages, salaries, bonuses, living

and travelling expenses of personnel of the Contractor generally employed at the head office or at a general office of the Contractor unless they are engaged at the work site with the approval of the Departmental Representative,

50.2.3 assessments payable under any statutory authority relating to workmen's compensation, unemployment insurance, pension plan or holidays with pay;

50.2.4 rent that is paid for plant or an amount equivalent of the said rent if the plant is owned by the Contractor that is necessary for and used in the performance of the work, if the rent of the equivalent amount is reasonable and use of that plant has been approved by the Departmental Representative;

50.2.5 payments for maintaining and operating plant necessary for and used in the performance of the work, and payments for effecting such repairs thereto as, in the opinion of the Departmental Representative, are necessary to the proper performance of the contract other than payments for any repairs to the plant arising out of defects existing before its allocation to the work;

50.2.6 payments for material that is necessary for and incorporated in the work, or that is necessary for and consumed in the performance of the contract;

50.2.7 payments for preparation, delivery, handling, erection, installation, inspection protection and removal of the plant and material necessary for and used in the performance of the contract; and

50.2.8 any other payments made by the Contractor with the approval of the Departmental Representative that are necessary for the performance of the contract.

GC51 Records to be kept by Contractor

51.1 The Contractor shall

51.1.1 maintain full records of his estimated and actual cost of the work together with all tender calls, quotations, contracts, correspondence, invoices, receipts and vouchers relating thereto.

51.1.2 make all records and material referred to in GC5.1.1 available to audit and inspection by the Minister and the Deputy Receiver General for Canada or by persons acting on behalf of either of both of them, when requested;

51.1.3 allow any of the person referred to in GC51.1.2 to make copies of and to take extracts from any of the records and material referred to in GC51.1.1; and

51.1.4 furnish any person referred to in GC51.1.2 with any information he may require from time to time in connection with such records and material.

51.2 The records maintained by the Contractor pursuant to GC51.1.1 shall be kept intact by the Contractor until the expiration of two years after the date that a Final Certificate of Completion referred to in GC44.1 was issued or until the expiration of such other period of time as the

Minister may direct.

51.3 The Contractor shall cause all subcontractors and all other persons directly or indirectly controlled by or affiliated with the Contractor and all persons directly or indirectly having control of the Contractor to comply with GC51.1 and GC51.2 as if they were the Contractor.

GC52 Conflict of Interest

52.1 It is a term of this contract that no former public office holder who is not in compliance with the Conflict of Interest and Post-Employment Code for Public Office Holders shall derive a direct benefit from this contract.

GC53 Contractor Status

53.1 The Contractor shall be engaged under the contract as an independent contractor.

53.2 The Contractor and any employee of the said Contractor is not engaged by the contract as an employee, servant or agent of Her Majesty.

53.3 For the purposes of GC53.1 and GC53.2 the Contractor shall be solely responsible for any and all payments and deductions required to be made by law including those required for Canada or Quebec Pension Plans, Unemployment Insurance, Worker's Compensation or Income Tax.

GENERAL CONDITONS

IC 1 Proof of Insurance
IC 2 Risk Management
IC 3 Payment of Deductible
IC 4 Insurance Coverage

GENERAL INSUANCE COVERAGES

GCI 1 Insured
GIC 2 Period of Insurance
GIC 3 Proof of Insurance
GIC 4 Notification

COMMERCIAL GENERAL LIABILITY

CGL 1 Scope of Policy
CGL 2 Coverages/Provisions
CGL 3 Additional Exposures
CGL 4 Insurance Proceeds
CGL 5 Deductible

BUILDER'S RISK – INSTALLATION FLOATER – ALL RISKS

BR 1 Scope of Policy
BR 2 Property Insured
BR 3 Insurance Proceeds
BR 4 Amount of Insurance
BR 5 Deductible
BR 6 Subrogation
BR 7 Exclusion Qualifications

INSURER'S CERTIFICATE OF INSURANCE

General Conditions

IC 1 Proof of Insurance
(02/12/03)

Within thirty (30) days after acceptance of the Contractor's tender, the Contractor shall, unless otherwise directed in writing by the Contracting Officer, deposit with the Contracting Officer an Insurer's Certificate of Insurance in the form displayed in this document and, if requested by the Contracting Officer, the originals or certified true copies of all contracts of insurance maintained by the Contractor pursuant to the Insurance Coverage Requirements shown hereunder.

IC 2 Risk Management
(01/10/94)

The provisions of the Insurance Coverage Requirements contained hereunder are not intended to cover all of the Contractor's obligations under GC8 of the General Conditions "C" of the contract. Any additional risk management measures or additional insurance coverages the Contractor may deem necessary to fulfill its obligations under GC8 shall be at its own discretion and expense.

IC 3 Payment of Deductible
(01/10/94)

The payment of monies up to the deductible amount made in satisfaction of a claim shall be borne by the Contactor.

IC 4 Insurance Coverage
(02/12/03)

The Contractor has represented that it has in place and effect the appropriate and usual liability insurance coverage as required by these Insurance Conditions and the Contractor has warranted that it shall obtain, in a timely manner and prior to commencement of the Work, the appropriate and usual property insurance coverage as required by these Insurance Conditions and, further, that it shall maintain all required insurance policies in place and effect as required by these Insurance Conditions.

INSURANCE COVERAGE REQUIREMENTS

PART I
GENERAL INSUANCE COVERAGES (GIC)

GCI 1 Insured
(02/12/03)

Each insurance policy shall insure the Contractor, and shall include, as an Additional Named Insured, Her Majesty the Queen in right of Canada, represented by the National Research Council Canada.

GIC 2 Period of Insurance
(02/12/03)

Unless otherwise directed in writing by the Contracting Officer or otherwise stipulated elsewhere in these Insurance Conditions, the policies required hereunder shall be in force and be maintained from the date of the contract award until the day of issue of the Departmental Representative's Final Certificate of Completion.

GIC 3 Proof of Insurance
(01/10/94)

Within twenty five (25) days after acceptance of the Contractor's tender, the Insurer shall, unless otherwise directed by the Contractor, deposit with the Contractor an Insurer's Certificate of Insurance in the form displayed in the document and, if requested, the originals or certified true copies of all contracts of insurance maintained by the Contractor pursuant to the requirements of these Insurance Coverages.

GIC 4 Notification
(01/10/94)

Each Insurance policy shall contain a provision that (30) days prior written notice shall be given by the Insurer to Her Majesty in the event of any material change in or cancellation of coverage. Any such notice received by the Contractor shall be transmitted forthwith to Her Majesty.

PART II
COMMERCIAL GENERAL LIABILITY

CGL 1 Scope of Policy
(01/10/94)

The policy shall be written on a form similar to that known and referred to in the insurance industry as IBC 2100 – Commercial General Liability policy (Occurrence form) and shall provide for limit of liability of not less than $2,000,000 inclusive for Bodily Injury and Property Damage for any one occurrence or series of occurrences arising out of one cause. Legal or defence cost incurred in respect of a claim or claims shall not operate to decrease the limit of liability.

CGL 2 Coverages/Provisions
(01/10/94)

The policy shall include but not necessarily be limited to the following coverages/provisions.

2.1 Liability arising out of or resulting from the ownership, existence, maintenance or use of premises by the Contractor and operations necessary or incidental to the performance of this contract.

2.2 "Broad Form" Property Damage including the loss of use of property.

2.3 Removal or weakening of support of any building or land whether such support be natural or otherwise.

2.4 Elevator liability (including escalators, hoists and similar devices).

2.5 Contractor's Protective Liability

2.6 Contractual and Assumed Liabilities un this contact.

2.7 Completed Operations Liability – The insurance, including all aspects of this Part II of these Insurance Conditions shall continue for a period of at least one (1) year beyond the date of the Departmental Representative's Final Certificate of Completion for the Completed Operations.

2.8 Cross Liability – The Clause shall be written as follows:

Cross Liability – The insurance as is afforded by this policy shall apply in respect to any claim or action brought against any one Insured by any other Insured. The coverage shall apply in the same manner and to the same extent as though a separate policy had been issued to each Insured. The inclusion herein of more than one Insured shall not increase the limit of the Insurer's liability.

2.9 Severability of Interests – The Clause shall be written as follows:

Severability of Interests – This policy, subject to the limits of liability stated herein, shall apply separately to each Insured in the same manner and to the same extent as if a separate policy had been issued to each. The inclusion herein of more than one insured shall not increase the limit of the Insurer's liability.

CGL 3 Additional Exposures
(02/12/03)

The policy shall either include or be endorsed to include the following exposures of hazards if the Work is subject thereto:

3.1 Blasting

3.2 Pile driving and calsson work

3.3 Underpinning

3.4 Risks associated with the activities of the Contractor on an active airport

3.5 Radioactive contamination resulting from the use of commercial isotopes

3.6 Damage to the portion of an existing building beyond that directly associated with an addition, renovation or installation contract.

3.7 Marine risks associated with the contraction of piers, wharves and docks.

CGL 4 Insurance Proceeds
(01/10/94)

Insurance Proceeds from this policy are usually payable directly to a Claimant/Third Party.

CGL 5 Deductible
(02/12/03)

This policy shall be issued with a deductible amount of not more than $10,000 per occurrence applying to Property Damage claims only.

PART III
BUILDER'S RISK – INSTALLATION FLOATER – ALL RISKS

BR 1 Scope of Policy
(01/10/94)

The policy shall be written on an "All Risks" basis granting coverages similar to those provided by the forms known and referred to in the insurance industry as "Builder's Risk Comprehensive Form" or "Installation Floater – All Risks".

BR 2 Property Insured
(01/10/94)

The property insured shall include:

2.1 The Work and all property, equipment and materials intended to become part of the finished Work at the site of the project while awaiting, during and after installation, erection or construction including testing.

2.2 Expenses incurred in the removal from the construction site of debris of the property insured, including demolition of damaged property, de-icing and dewatering, occasioned by loss, destruction or damage to such property and in respect of which insurance is provided by this policy.

BR 3 Insurance Proceeds
(01/10/94)

3.1 Insurance proceeds from this policy are payable in accordance with GC28 of the General Conditions "C" of the contract.

3.2 This policy shall provide that the proceeds thereof are payable to Her Majesty or as the Minister may direct.

3.3 The Contractor shall do such things and execute such documents as are necessary to effect payment of the proceeds.

BR 4 Amount of Insurance
(01/10/94)

The amount of insurance shall not be less than the sum of the contract value plus the declared value (if any) set forth in the contract documents of all material and equipment supplied by Her Majesty at the site of the project to be incorporated into and form part of the finished Work.

BR 5 Deductible
(02/12/03)

The Policy shall be issued with a deductible amount of not more than $10,000.

BR 6 Subrogation
(01/10/94)

The following Clause shall be included in the policy:

"All rights of subrogation or transfer of rights are hereby waived against any corporation, firm, individual or other interest, with respect to which, insurance is provided by this policy".

BR 7 Exclusion Qualifications
(01/10/94)

The policy may be subject to the standard exclusions but the following qualifications shall apply:

7.1 Faulty materials, workmanship or design may be excluded only to the extent of the cost of making good thereof and shall not apply to loss or damage resulting therefrom.

7.2 Loss or damage caused by contamination by radioactive material may be excluded except for loss or damage resulting from commercial isotopes used for industrial measurements, inspection, quality control radiographic or photographic use.

7.3 Use and occupancy of the project or any part of section thereof shall be permitted where such use and occupancy is for the purpose for which the project is intended upon completion.

INSURER'S CERTIFICATE OF INSURANCE

(TO BE COMPLETED BY INSURER (NOT BOKER) AND DELIVERD TO NATIONAL RESEARCH COUNCIL CANADA WITH 30 DAYS FOLLOWING ACCEPTANCE OF TENDER)

CONTRACT

DESCRIPTION OF WORK	CONTRACT NUMBER	AWARD DATE
LOCATION		

INSURER

NAME
ADDRESS

BROKER

NAME
ADDRESS

INSURED

NAME OF CONTRACTOR
ADDRESS

ADDITIONAL INSURED

HER MAJESTY THE QUEEN IN RIGHT OF CANADA AS REPRESENTED BY THE NATIONAL RESEARCH COUNCIL CANADA

THIS DOCUENT CERTIFIES THAT THE FOLLOWING POLICES OF INSURANCE ARE AT PRESENT IN FORCE COVERING ALL OPERATIONS OF THE INSURE IN CONNECTION WITH THE CONTRACT MADE BETWEEN THE NAMED INSURED AND THE NATIONAL RESEARCH COUNCIL CANADA AND IN ACCORDANCE WITH THE INSURANCE CONDITIONS "E"

POLICY					
TYPE	NUMBER	INCEPTION DATE	EXPIRY DATE	LIMITS OF LIABILITY	DEDUCTIBLE
COMMERCIAL GENERAL LIABILITY					
BUILDERS RISK "AL RISKS"					
INSTALLATION FLOATER "ALL RISKS"					

THE INSURER AGREES TO NOTIFY THE NATIONAL RESEARCH COUNCIL CANADA IN WRITING 30 DAYS PRIOR TO ANY MATERIAL CHANGE IN OR CANCELLATION OF ANY POLICY OR COVERAGE SPECIFICALLY RELATED TO THE CONTRACT

NAME OF INSURER'S OFFICER OR AUTHORIZED EMPLOYEE	SIGNATURE	DATE:
		TELEPHONE NUMBER:

ISSUANCE OF THIS CERTIFIATE SHALL NOT LIMIT OR RESTRICT THE RIGHT OF THE NATIONAL RESEARCH COUNCIL CANADA TO REQUEST AT ANY TIME DUPLICATE COPIES OF SAID INSURANCE POLICIES

CS1 Obligation to provide Contract Security

1.1 The Contractor shall, at the Contractor's own expense, provide one or more of the forms of contract security prescribed in CS2.

1.2 The Contractor shall deliver to the Departmental Representative the contract security referred to in CS1.1 within 14 days after the date that the Contractor receives notice that the Contractor's tender or offer was accepted by Her Majesty.

CS2 Prescribed Types and Amounts of Contract Security

2.1 The Contractor shall deliver to the Departmental Representative pursuant to CS1

2.1.1 a performance bond and a labour and material payment bond each in an amount that is equal to not less than 50% of the contract amount referred to in the Articles of Agreement, or

2.1.2 a labour and material payment bond in an amount that is equal to not less than 50% of the contract amount referred to in the Articles of Agreement, and a security deposit in an amount that is equal to

2.1.2.1 not less than 10% of the contract amount referred to in the Articles of Agreement where that amount does not exceed $250,000, or

2.1.2.2 $25,000 plus 5% of the part of the contract amount referred to in the Articles of Agreement that exceeds $250,000, or

2.1.3 a security deposit in an amount prescribed by CS2.12 plus an additional amount that is equal to 10% of the contract amount referred to in the Articles of Agreement.

2.2 A performance bond and a labour and material payment bond referred to in CS2.1 shall be in a form and be issued by a bonding or surety company that is approved by Her Majesty.

2.3 The amount of a security deposit referred to in CS2.1.2 shall not exceed $250,000 regardless of the contract amount referred to in the Articles of Agreement.

2.4 A security deposit referred to in CS2.1.2 and CS2.1.3 shall be in the form of

2.4.1 a bill of exchange made payable to the Receiver General of Canada and certified by an approved financial institution or drawn by an approved financial institution on itself, or

2.4.2 bonds of or unconditionally guaranteed as to principal and interest by the Government of Canada.

2.5 For the purposes of CS2.4

2.5.1 a bill of exchange is an unconditional order in writing signed by the Contractor and addressed to an approved financial institution, requiring the said institution to pay, on demand, at a fixed or determinable future time a sum certain of money to, or to the order

of, the Receiver General for Canada, and

2.5.2 If a bill of exchange is certified by a financial institution other than a chartered bank then it must be accompanied by a letter or stamped certification confirming that the financial institution is in a t least one of the categories referred to in CS2.5.3

2.5.3 an approved financial institution is

2.5.3.1 any corporation or institution that is a member of the Canadian Payments Association,

2.5.3.2 a corporation that accepts deposits that are insured by the Canada Deposit Insurance Corporation or the Régie de l'assurance-dépôts du Québec to the maximum permitted by law,

2.5.3.3 a credit union as defined in paragraph 137(6)(b) of the *Income Tax Act*,

2.5.3.4 a corporation that accepts deposits from the public, if repayment of the deposit is guaranteed by Her Majesty in right of a province, or

2.5.3.5 The Canada Post Corporation.

2.5.4 the bonds referred to in CS2.4.2 shall be

2.5.4.1 made payable to bearer, or

2.5.4.2 accompanied by a duly executed instrument of transfer of the bonds to the Receiver General for Canada in the form prescribed by the Domestic Bonds of Canada Regulations, or

2.5.4.3 registered, as to principal or as to principal and interest in the name of the Receiver General for Canada pursuant to the Domestic Bonds of Canada Regulations, and

2.5.4.4 provided on the basis of their market value current at the date of the contract.

Government of Canada / Gouvernement du Canada

Contract Number / Numéro du contrat
905512
Security Classification / Classification de sécurité UNCLASSIFIED

SECURITY REQUIREMENTS CHECK LIST (SRCL)
LISTE DE VÉRIFICATION DES EXIGENCES RELATIVES À LA SÉCURITÉ (LVERS)

PART A - CONTRACT INFORMATION / PARTIE A - INFORMATION CONTRACTUELLE

1. Originating Government Department or Organization / Ministère ou organisme gouvernemental d'origine	2. Branch or Directorate / Direction générale ou Direction
NRC	Your C/B/I RPPM

3. a) Subcontract Number / Numéro du contrat de sous-traitance	3. b) Name and Address of Subcontractor / Nom et adresse du sous-traitant
905512	Name TBD Address

4. Brief Description of Work / Brève description du travail

Work under this contract covers chiller and heat pump replacements of Building M07 located on the Montreal Road Campus of the National Research Council of Canada

5. a) Will the supplier require access to Controlled Goods? Le fournisseur aura-t-il accès à des marchandises contrôlées?	☑ No / Non	☐ Yes / Oui
5. b) Will the supplier require access to unclassified military technical data subject to the provisions of the Technical Data Control Regulations? Le fournisseur aura-t-il accès à des données techniques militaires non classifiées qui sont assujetties aux dispositions du Règlement sur le contrôle des données techniques?	☑ No / Non	☐ Yes / Oui
6. Indicate the type of access required / Indiquer le type d'accès requis		
6. a) Will the supplier and its employees require access to PROTECTED and/or CLASSIFIED information or assets? Le fournisseur ainsi que les employés auront-ils accès à des renseignements ou à des biens PROTÉGÉS et/ou CLASSIFIÉS? (Specify the level of access using the chart in Question 7. c) (Préciser le niveau d'accès en utilisant le tableau qui se trouve à la question 7. c)	☑ No / Non	☐ Yes / Oui
6. b) Will the supplier and its employees (e.g. cleaners, maintenance personnel) require access to restricted access areas? No access to PROTECTED and/or CLASSIFIED information or assets is permitted. Le fournisseur et ses employés (p. ex. nettoyeurs, personnel d'entretien) auront-ils accès à des zones d'accès restreintes? L'accès à des renseignements ou à des biens PROTÉGÉS et/ou CLASSIFIÉS n'est pas autorisé.	☐ No / Non	☑ Yes / Oui
6. c) Is this a commercial courier or delivery requirement with **no** overnight storage? S'agit-il d'un contrat de messagerie ou de livraison commerciale **sans** entreposage de nuit?	☑ No / Non	☐ Yes / Oui

7. a) Indicate the type of information that the supplier will be required to access / Indiquer le type d'information auquel le fournisseur devra avoir accès

Canada ☑	**NATO / OTAN** ☐	**Foreign / Étranger** ☐

7. b) Release restrictions / Restrictions relatives à la diffusion

No release restrictions Aucune restriction relative à la diffusion ☑	All NATO countries Tous les pays de l'OTAN ☐	No release restrictions Aucune restriction relative à la diffusion ☐
Not releasable À ne pas diffuser ☐		
Restricted to: / Limité à : ☐	Restricted to: / Limité à : ☐	Restricted to: / Limité à : ☐
Specify country(ies): / Préciser le(s) pays :	Specify country(ies): / Préciser le(s) pays :	Specify country(ies): / Préciser le(s) pays :

7. c) Level of information / Niveau d'information

PROTECTED A / PROTÉGÉ A ☐	NATO UNCLASSIFIED / NATO NON CLASSIFIÉ ☐	PROTECTED A / PROTÉGÉ A ☐
PROTECTED B / PROTÉGÉ B ☐	NATO RESTRICTED / NATO DIFFUSION RESTREINTE ☐	PROTECTED B / PROTÉGÉ B ☐
PROTECTED C / PROTÉGÉ C ☐	NATO CONFIDENTIAL / NATO CONFIDENTIEL ☐	PROTECTED C / PROTÉGÉ C ☐
CONFIDENTIAL / CONFIDENTIEL ☐	NATO SECRET / NATO SECRET ☐	CONFIDENTIAL / CONFIDENTIEL ☐
SECRET / SECRET ☐	COSMIC TOP SECRET / COSMIC TRÈS SECRET ☐	SECRET / SECRET ☐
TOP SECRET / TRÈS SECRET ☐		TOP SECRET / TRÈS SECRET ☐
TOP SECRET (SIGINT) / TRÈS SECRET (SIGINT) ☐		TOP SECRET (SIGINT) / TRÈS SECRET (SIGINT) ☐

Government of Canada / Gouvernement du Canada

Contract Number / Numéro du contrat
905512
Security Classification / Classification de sécurité UNCLASSIFIED

PART A *(continued)* / PARTIE A *(suite)*

8. Will the supplier require access to PROTECTED and/or CLASSIFIED COMSEC information or assets? — ☑ No / Non ☐ Yes / Oui
Le fournisseur aura-t-il accès à des renseignements ou à des biens COMSEC désignés PROTÉGÉS et/ou CLASSIFIÉS?
If Yes, indicate the level of sensitivity:
Dans l'affirmative, indiquer le niveau de sensibilité :

9. Will the supplier require access to extremely sensitive INFOSEC information or assets? — ☑ No / Non ☐ Yes / Oui
Le fournisseur aura-t-il accès à des renseignements ou à des biens INFOSEC de nature extrêmement délicate?

Short Title(s) of material / Titre(s) abrégé(s) du matériel :
Document Number / Numéro du document :

PART B - PERSONNEL (SUPPLIER) / PARTIE B - PERSONNEL (FOURNISSEUR)

10. a) Personnel security screening level required / Niveau de contrôle de la sécurité du personnel requis

☑ RELIABILITY STATUS COTE DE FIABILITÉ	☐ CONFIDENTIAL CONFIDENTIEL	☐ SECRET SECRET	☐ TOP SECRET TRÈS SECRET
☐ TOP SECRET– SIGINT TRÈS SECRET – SIGINT	☐ NATO CONFIDENTIAL NATO CONFIDENTIEL	☐ NATO SECRET NATO SECRET	☐ COSMIC TOP SECRET COSMIC TRÈS SECRET
☐ SITE ACCESS ACCÈS AUX EMPLACEMENTS			

Special comments:
Commentaires spéciaux : _____

NOTE: If multiple levels of screening are identified, a Security Classification Guide must be provided.
REMARQUE : Si plusieurs niveaux de contrôle de sécurité sont requis, un guide de classification de la sécurité doit être fourni.

10. b) May unscreened personnel be used for portions of the work? — ☐ No / Non ☑ Yes / Oui
Du personnel sans autorisation sécuritaire peut-il se voir confier des parties du travail?

If Yes, will unscreened personnel be escorted? — ☐ No / Non ☑ Yes / Oui
Dans l'affirmative, le personnel en question sera-t-il escorté?

PART C - SAFEGUARDS (SUPPLIER) / PARTIE C - MESURES DE PROTECTION (FOURNISSEUR)

INFORMATION / ASSETS / RENSEIGNEMENTS / BIENS

11. a) Will the supplier be required to receive and store PROTECTED and/or CLASSIFIED information or assets on its site or premises? — ☑ No / Non ☐ Yes / Oui
Le fournisseur sera-t-il tenu de recevoir et d'entreposer sur place des renseignements ou des biens PROTÉGÉS et/ou CLASSIFIÉS?

11. b) Will the supplier be required to safeguard COMSEC information or assets? — ☑ No / Non ☐ Yes / Oui
Le fournisseur sera-t-il tenu de protéger des renseignements ou des biens COMSEC?

PRODUCTION

11. c) Will the production (manufacture, and/or repair and/or modification) of PROTECTED and/or CLASSIFIED material or equipment occur at the supplier's site or premises? — ☑ No / Non ☐ Yes / Oui
Les installations du fournisseur serviront-elles à la production (fabrication et/ou réparation et/ou modification) de matériel PROTÉGÉ et/ou CLASSIFIÉ?

INFORMATION TECHNOLOGY (IT) MEDIA / SUPPORT RELATIF À LA TECHNOLOGIE DE L'INFORMATION (TI)

11. d) Will the supplier be required to use its IT systems to electronically process, produce or store PROTECTED and/or CLASSIFIED information or data? — ☑ No / Non ☐ Yes / Oui
Le fournisseur sera-t-il tenu d'utiliser ses propres systèmes informatiques pour traiter, produire ou stocker électroniquement des renseignements ou des données PROTÉGÉS et/ou CLASSIFIÉS?

11. e) Will there be an electronic link between the supplier's IT systems and the government department or agency? — ☑ No / Non ☐ Yes / Oui
Disposera-t-on d'un lien électronique entre le système informatique du fournisseur et celui du ministère ou de l'agence gouvernementale?

PART C - *(continued)* / PARTIE C - *(suite)*

For users completing the form **manually** use the summary chart below to indicate the category(ies) and level(s) of safeguarding required at the supplier's site(s) or premises.
Les utilisateurs qui remplissent le formulaire **manuellement** doivent utiliser le tableau récapitulatif ci-dessous pour indiquer, pour chaque catégorie, les niveaux de sauvegarde requis aux installations du fournisseur.

For users completing the form **online** (via the Internet), the summary chart is automatically populated by your responses to previous questions.
Dans le cas des utilisateurs qui remplissent le formulaire **en ligne** (par Internet), les réponses aux questions précédentes sont automatiquement saisies dans le tableau récapitulatif.

SUMMARY CHART / TABLEAU RÉCAPITULATIF

Category Catégorie	PROTECTED PROTÉGÉ			CLASSIFIED CLASSIFIÉ			NATO				COMSEC					
	A	B	C	CONFIDENTIAL CONFIDENTIEL	SECRET	TOP SECRET TRÈS SECRET	NATO RESTRICTED NATO DIFFUSION RESTREINTE	NATO CONFIDENTIAL NATO CONFIDENTIEL	NATO SECRET	COSMIC TOP SECRET COSMIC TRÈS SECRET	PROTECTED PROTÉGÉ A	PROTECTED PROTÉGÉ B	PROTECTED PROTÉGÉ C	CONFIDENTIAL CONFIDENTIEL	SECRET	TOP SECRET TRES SECRET
Information / Assets Renseignements / Biens																
Production																
IT Media / Support TI																
IT Link / Lien électronique																

12. a) Is the description of the work contained within this SRCL PROTECTED and/or CLASSIFIED?
La description du travail visé par la présente LVERS est-elle de nature PROTÉGÉE et/ou CLASSIFIÉE?

☑ No / Non ☐ Yes / Oui

If Yes, classify this form by annotating the top and bottom in the area entitled "Security Classification".
Dans l'affirmative, classifier le présent formulaire en indiquant le niveau de sécurité dans la case intitulée « Classification de sécurité » au haut et au bas du formulaire.

12. b) Will the documentation attached to this SRCL be PROTECTED and/or CLASSIFIED?
La documentation associée à la présente LVERS sera-t-elle PROTÉGÉE et/ou CLASSIFIÉE?

☑ No / Non ☐ Yes / Oui

If Yes, classify this form by annotating the top and bottom in the area entitled "Security Classification" and indicate with attachments (e.g. SECRET with Attachments).
Dans l'affirmative, classifier le présent formulaire en indiquant le niveau de sécurité dans la case intitulée « Classification de sécurité » au haut et au bas du formulaire et indiquer qu'il y a des pièces jointes (p. ex. SECRET avec des pièces jointes).

Government of Canada / Gouvernement du Canada

Contract Number / Numéro du contrat
905512
Security Classification / Classification de sécurité UNCLASSIFIED

PART D - AUTHORIZATION / PARTIE D - AUTORISATION

13. Organization Project Authority / Chargé de projet de l'organisme

Name (print) - Nom (en lettres moulées)	Title - Titre	Signature
Kirk Williams	Construction Project Manager	

Telephone No. - N° de téléphone	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel	Date

14. Organization Security Authority / Responsable de la sécurité de l'organisme

Name (print) - Nom (en lettres moulées)	Title - Titre	Signature
Tori Pelletier	Analyst, Security in Contracting	

Telephone No. - N° de téléphone	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel	Date
		Tori.Pelletier@nrc-cnrc.gc.ca	

15. Are there additional instructions (e.g. Security Guide, Security Classification Guide) attached?
Des instructions supplémentaires (p. ex. Guide de sécurité, Guide de classification de la sécurité) sont-elles jointes?
☑ No / Non ☐ Yes / Oui

16. Procurement Officer / Agent d'approvisionnement

Name (print) - Nom (en lettres moulées)	Title - Titre	Signature
Collin Long Senior	Contracting Officer	

Telephone No. - N° de téléphone	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel	Date
		Collin.Long@nrc-cnrc.gc.ca	

17. Contracting Security Authority / Autorité contractante en matière de sécurité

Name (print) - Nom (en lettres moulées)	Title - Titre	Signature

Telephone No. - N° de téléphone	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel	Date