NRC·CNRC Real Property Planning and Management

SPECIFICATIONS

SOLICITATION #:	**22-58038**
BUILDING:	**S77, 100 Sussex Drive, Ottawa, Ontario**
PROJECT:	**S77 AHU 159 Replacement**
PROJECT #:	**5992**
Date:	**August, 2022**

National Research Council Canada | Conseil national de recherches Canada

Canada

SPECIFICATION

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Construction Tender Form

Project Identification S77 AHU 159 Replacement

Tender No.: **22-58038**

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

S77 AHU 159 Replacement

The National Research Council Canada, 100 Sussex Drive Ottawa, has a requirement for a project that includes:

Work under this contract covers the replacement of AHU159 of Building S77 located at 100 Sussex Drive, Ottawa of the National Research Council of Canada.

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 August 17th and August 18th, 2022 at 9:00am. Meet Allan Smith at Building S77, Main Entrance, 100 Sussex Drive Ottawa, ON. Bidders who, for any reason, cannot attend one of the specified dates 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 September 8th, 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.Smith@nrc-cnrc.gc.ca
Telephone: 613-852-1357

Contracting Authority for this project is: Alain Leroux
Alain.Leroux@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
Alain Leroux, Team Lead

alalin.leroux@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 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

alain.leroux@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 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_____

National Research Council Canada

Building S77 – 100 Sussex Drive, Ottawa, ON

AHU 159 Replacement

Specifications 7516-000-00

June 1st, 2022

Issued for Tender

Mechanical **Electrical**

This document should not be used for construction purposes

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	5992-E04	Electrical – Multidisciplinary / Électricité Multidisciplinaire
	5992-E05	Electrical – Multidisciplinary / Électricité Multidisciplinaire

END OF TABLE

1. SCOPE OF WORK

.1 Work under this contract covers the replacement of Air Handling Unit AHU 159 in the Building S77 of the National Research Council.

2. DRAWINGS

.1 The drawings listed in the table of contents illustrate the work and form part of the contract documents.

3. COMPLETION

.1 Complete all work within six (6) weeks of receipt of all material.

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 ten (10) 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 ten (10) 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. 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.

9. SUB-TRADES

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

10. 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.

11. 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.

12. SCHEDULE

.1 In accordance with Section 01 32 16.19 - Construction Progress Schedule – Bar (Gantt) Chart.

.2 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.

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

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

13. PROJECT MEETINGS

.1 In accordance with Section 01 31 19 Project Meetings.

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

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

.4 Departmental Representative will set times for project meetings.

.5 Contractor to assume responsibility for recording and distributing minutes.

14. SHOP DRAWINGS

.1 Submit to Departmental Representative for review, shop drawings, product data and samples specified within two (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 two (2) weeks 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.

15. 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.

16. 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.

17. 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.

18. 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.

19. 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.

20. 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.

21. SITE OFFICE & TELEPHONE

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

22. SANITARY FACILITIES

.1 Obtain permission from the Departmental Representative to use the existing washroom facilities in the building.

23. 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.

24. 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.

25. 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.

26. 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.

27. 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.

28. 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.

29. 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.

30. 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.

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

.6 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.

32. 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.

33. 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.

34. 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.

35. ENCLOSURE OF STRUCTURES

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

.2 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.

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

36. 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.

37. 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.

38. INSPECTION OF 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.

39. 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.

40. DISPOSAL OF WASTES

.1 In accordance with Section 01 74 19 – Waster Management and Disposal.

.2 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.

41. CLEAN-UP DURING CONSTRUCTION

.1 In accordance with Section - 01 74 00 Cleaning.

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

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

42. FINAL CLEAN-UP

.1 In accordance with Section 01 74 00 Cleaning.

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

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

43. 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.

44. MAINTENANCE MANUALS

.1 In accordance with Section 01 78 00 Closeout Submittals.

.2 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.

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

.4 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

Part 1 General

1.1 REFERENCE STANDARDS

.1 Refer to laws, by laws, ordinances, rules, regulations and orders of authority having jurisdictions, and other legally enforceable requirements applicable to Work at that area; or become in force during Work performance.

.2 Comply with specified standards and regulations to ensure safe operations at site containing hazardous or toxic materials.

.1 Canadian Environmental Protection Act, 1999 (CEPA 1999)

.2 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations

.3 Province of Ontario

.1 Occupational Health and Safety Act and Regulations for Construction Projects, R.S.O. 1990, c.0.1, as amended and O. Reg. 213/91 as amended – current edition.

1.2 DEFINITIONS

.1 Designated Substances: Are those substances designated as hazardous by the Ministry of Labour under the Occupational Health and Safety Act. The following substances have been identified as designated substances:

.1 Acrylonitrile

.2 Arsenic

.3 Asbestos

.4 Benzene

.5 Coke Oven Emissions

.6 Ethylene Oxide

.7 Isocyanates

.8 Lead

.9 Mercury

.10 Silica

.11 Vinyl Chloride

.12 Polychlorinated Biphenyls (PCBs)

.13 Halocarbons

.14 Mould and Water Damage

.15 Other Hazardous Materials; such as formaldehyde, cadmium, styrene, nickel and coal tar products

.2 Hazardous Materials: dangerous substances, dangerous goods, hazardous commodities, and hazardous products, including but not limited to: corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or other material which has the potential to cause harm to humans, animals, or the environment, either by itself or through interaction with other factors.

.3 Polychlorinated Biphenyls (PCBs): includes chlorobiphenyls referred to in Column I of item 1 of the List of Toxic Substances in Schedule I of Canadian Environmental Protection Act (CEPA).

.4 Toxic: substance is considered toxic if it is listed on Toxic Substances List found in Schedule 1 of CEPA.

.5 List of Toxic Substances: found in Schedule 1 of CEPA, lists substances that have been assessed as toxic. Federal Government can make regulations with respect to a substance specified on List of Toxic Substances. Column II of this list identifies type of regulation applicable to each substance.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Before start of Work arrange for Site visit with NRC Representative to examine existing Site conditions.

.2 NRC Representative will ensure that Contractor has received a copy of the Site specific DSR before binding on supplying Work for this project.

1.4 DESIGNATED SUBSTANCES

.1 Confirm with the NRC Representative that no additional designated substances have been brought to the project area prior to beginning work.

.2 Additional designated substances may exist outside the accessible survey areas but are beyond the scope of this project.

.3 Should any additional material, suspected to be a designated substance, be encountered within the project area, any disturbance of such material must be stopped, precautionary measures taken, and the NRC Representative must be notified immediately. Do not proceed until written instructions have been received.

.4 Existing Hazardous Substances: NRC Representative has performed a hazardous substances assessment and identified materials requiring abatement as follows:

.1 Acrylonitrile: Not Identified.

.2 Arsenic: Not Identified.

.3 Asbestos: Not Identified.

.4 Benzene: Not Identified.

.5 Coke Oven Emissions: Not Identified.

.6 Ethylene Oxide: Not Identified.

.7 Isocyanates: Not Identified.

.8 Lead: Identified

.1 Lead in paints present as follows.

.1 Lead-containing off-white paint on the walls of Room 161l.

.2 Lead-containing gray paint on the floor of Room B159A.

.3 Low-lead contained white paint on walls of Room B159A.

.4 Lead-containing paint on ductwork in Room B159A.

.2 Lead within batteries of emergency lights.

.3 Lead caulking on cast iron pipe joints (bell and spigot).

.9 Mercury: Identified.

.1 Mercury vapour is present in lamp tubes and liquid mercury is present in air handling unit instrumentation ampules.

.10 Silica: Identified.

.1 Crystalline silica is present in concrete, mortar, masonry and plaster.

.11 Vinyl Chloride: Not Identified.

.12 Polychlorinated Biphenyls (PCBs): Identified.

.1 Based on the date of construction, PCBs may be present in light ballasts.

.13 Halocarbons: Not Identified.

.14 Mould and Water Damage: Not Identified.

.15 Other Hazardous Materials: Not Identified.

.5 A Complete, site specific, designated substance report will be provided upon contract award).

1.5 RESPONSIBILITY

.1 Contractor shall be responsible for reading and evaluating the information provided in the Hazardous Building Materials Assessment (HBMA) for the Site.

.2 Contractor shall incorporate any recommendations in the Site HBMA as they pertain to the health and safety of workers on Site, in accordance with Section 01 35 29.06 - Health and Safety Requirements, and in compliance with authority having jurisdictions for that area.

.3 Contractor shall ask NRC Representative should they have any questions related to the Site-specific HMBA.

.4 Contractor shall exercise every reasonable precaution for the protection of each worker on Site.

.5 Contractor shall furnish the Site-specific HBMA to all subcontractors who will be performing Work on Site.

1.6 REGULATORY REQUIREMENTS

.1 Do Work in accordance with Section 01 41 00 - Regulatory Requirements.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit Site-specific Health and Safety Plan, within seven (7) days after date of Notice to proceed and before mobilization to Site. List relevant hazardous or contaminated materials or substances required by the authority having jurisdiction which need to be included in the Contractor's Health and Safety Plan.

Part 2 Products

2.1 NOT USED

.1 NOT USED

Part 3 Execution

3.1 NOT USED

.1 NOT USED

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 subcontractors 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 NRC 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 NRC 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, inclimate 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 subcontractors.
- .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 subcontractors under its jurisdiction.

.10 The NRC 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 subcontractors removed from the site.

.11 The Contractor will report to the NRC 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 subcontractors regarding lab safety requirements and procedures, as provided by the Researcher or the NRC 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, "NRC 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:
    a. Standard No. 301 - June 1982 "Standard for Construction Operations";
    b. 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 NRC Representative.

.2 Prior to commencement of "Hot Work", review the area of hot Work with the NRC 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 NRC REPRESENTATIVE.

.2 WHEN ANY FIRE PROTECTION EQUIPMENT IS TEMPORARILY SHUT DOWN, ALTERNATIVE MEASURES AS PRESCRIBED BY THE NRC 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 AUTHORIZATION FROM THE NRC REPRESENTATIVE. THE NRC 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 AUTHORIZED BY NRC 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 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.

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

.7 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.

.8 Fire Watch

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

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

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

.1 Advise the NRC 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 NRC Representative, who will ensure that adequate alternative routes are maintained.

.3 The NRC 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.

.10 Rubbish and Waste Materials

.1 Keep rubbish and waste materials to a minimum.

.2 Do not burn rubbish on site.

.3 Rubbish Containers:

.1 Consult with the NRC 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 Work day or shift, or as directed.

.11 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 NRC Representative.

.3 Transfer of flammable liquids is prohibited within buildings.

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

.5 Do not use flammable liquids having a flash point below 38^{o}C (100^{o}F) such as naphtha or gasoline as solvents or cleaning agents.

.6 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.

.7 Where flammable liquids, such as lacquers or urethane are used, ensure proper ventilation and eliminate all sources of ignition. Inform the NRC 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 NRC Representative.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

.1 Schedule and administer project meetings throughout the progress of the work at the call of NRC Representative.

.2 Prepare agenda for meetings.

.3 Distribute written notice of each meeting four days in advance of meeting date to NRC Representative.

.4 Provide physical space and make arrangements for meetings.

.5 Preside at meetings.

.6 Record the meeting minutes. Include significant proceedings and decisions. Identify actions by parties.

.7 Reproduce and distribute copies of minutes within three days after meetings and transmit to meeting participants, affected parties not in attendance and NRC Representative.

.8 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

1.2 PRECONSTRUCTION MEETING

.1 Within 15 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.

.2 NRC Representative, Contractor, major Subcontractors, field inspectors and supervisors will be in attendance.

.3 Establish time and location of meeting and notify parties concerned minimum 5 days before meeting.

.4 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.

.5 Agenda to include:

.1 Appointment of official representative of participants in the Work.

.2 Schedule of Work: in accordance with Section 01 32 16.19 - Construction Progress Schedule - Bar (GANTT) Chart.

.3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.

.4 Delivery schedule of specified equipment.

.5 Proposed changes, change orders, procedures, approvals required, markup percentages permitted, time extensions, overtime, administrative requirements.

.6 Owner provided products.

.7 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.

.8 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.

.9 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.

.10 Monthly progress claims, administrative procedures, photographs, hold backs.

.11 Appointment of inspection and testing agencies or firms.

.12 Insurances, transcript of policies.

1.3 PROGRESS MEETINGS

.1 During course of Work and 2 weeks prior to project completion, schedule progress meetings monthly.

.2 Contractor, major Subcontractors involved in Work and NRC Representative are to be in attendance.

.3 Notify parties minimum four days prior to meetings.

.4 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within three days after meeting.

.5 Agenda to include the following:

.1 Review, approval of minutes of previous meeting.

.2 Review of Work progress since previous meeting.

.3 Field observations, problems, conflicts.

.4 Problems which impede construction schedule.

.5 Review of off-site fabrication delivery schedules.

.6 Corrective measures and procedures to regain projected schedule.

.7 Revision to construction schedule.

.8 Progress schedule, during succeeding work period.

.9 Review submittal schedules: expedite as required.

.10 Maintenance of quality standards.

.11 Review proposed changes for affect on construction schedule and on completion date.

.12 Other business.

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 DEFINITIONS

.1 Activity: element of Work performed during course of Project. Activity normally has expected duration, and expected cost and expected resource requirements. Activities can be subdivided into tasks.

.2 Bar Chart (GANTT Chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity duration are shown as date-placed horizontal bars. Generally, Bar Chart should be derived from commercially available computerized project management system.

.3 Baseline: original approved plan (for project, Work package or activity), plus or minus approved scope changes.

.4 Construction work Week: Monday to Friday, inclusive, will provide five days' work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.

.5 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.

.6 Master Plan: summary-level schedule that identifies major activities and key milestones.

.7 Milestone: significant event in project, usually completion of major deliverable.

.8 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.

.9 Project Planning, Monitoring and Control System: overall system operated by NRC Representative to enable monitoring of project Work in relation to established milestones.

1.2 REQUIREMENTS

.1 Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.

.2 Plan to complete Work in accordance with prescribed milestones and time frame.

.3 Limit activity duration to maximum of approximately ten (10) working days, to allow for progress reporting.

.4 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of the essence of this contract.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 MASTER PLAN

.1 Structure schedule to allow orderly planning, organizing and execution of Work as Bar Chart (GANTT).

.2 NRC Representative will review and return revised schedules within five (5) working days.

.3 Revise impractical schedule and resubmit within five (5) working days.

.4 Accepted revised schedule will become Master Plan and be used as baseline for updates.

1.5 PROJECT SCHEDULE

.1 Develop detailed Project Schedule derived from Master Plan.

.2 Ensure detailed Project Schedule includes as minimum milestone and activity types as follows:

.1 Award.
.2 Shop Drawings, Samples.
.3 Permits.
.4 Mobilization.
.5 Demolition
.6 Preparation works (paint, housekeeping pad).
.7 Sprinklers
.8 Lighting.
.9 Electrical.
.10 Controls.
.11 Heating, Ventilating, and Air Conditioning.
.12 Testing and Commissioning.
.13 Supplied equipment long delivery items.

1.6 PROJECT SCHEDULE REPORTING

.1 Update Project Schedule on weekly basis reflecting activity changes and completions, as well as activities in progress.

.2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.

1.7 PROJECT MEETINGS

.1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.

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 ADMINISTRATIVE

.1 Submit to NRC Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Do not proceed with Work affected by submittal until review is complete.

.3 Present shop drawings, product data, samples and mock-ups in SI Metric units.

.4 Where items or information is not produced in SI Metric units converted values are acceptable.

.5 Review submittals prior to submission to NRC Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.

.6 Notify NRC Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.7 Verify field measurements and affected adjacent Work are co-ordinated.

.8 Contractor's responsibility for errors and omissions in submission is not relieved by NRC Representative's review of submittals.

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by NRC Representative review.

.10 Keep one reviewed copy of each submission on site.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

.2 When required, submit drawings stamped and signed by a professional engineer registered or licensed in Ontario, Canada.

.3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.4 Allow five (5) days for NRC Representative's review of each submission.

.5 Adjustments made on shop drawings by NRC Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to NRC Representative prior to proceeding with Work.

.6 Make changes in shop drawings as NRC Representative may require, consistent with Contract Documents. When resubmitting, notify NRC Representative in writing of revisions other than those requested.

.7 Accompany submissions with transmittal letter, containing:

.1 Date.

.2 Project title and number.

.3 Contractor's name and address.

.4 Identification and quantity of each shop drawing, product data and sample.

.5 Other pertinent data.

.8 Submissions include:

.1 Date and revision dates.

.2 Project title and number.

.3 Name and address of:

.1 Subcontractor.

.2 Supplier.

.3 Manufacturer.

.4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.

.5 Details of appropriate portions of Work as applicable:

.1 Fabrication.

.2 Layout, showing dimensions, including identified field dimensions, and clearances.

.3 Setting or erection details.

.4 Capacities.

.5 Performance characteristics.

.6 Standards.

.7 Operating weight.

.8 Wiring diagrams.

.9 Single line and schematic diagrams.

.10 Relationship to adjacent Work.

.9 After NRC Representative's review, distribute copies.

.10 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as NRC Representative may reasonably request.

.11 Submit electronic copy of product data sheets or brochures for requirements requested in specification Sections and as requested by NRC Representative where shop drawings will not be prepared due to standardized manufacture of product.

.12 Submit electronic copy of test reports for requirements requested in specification Sections and as requested by NRC Representative.

.1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.

.2 Testing must have been within three (3) years of date of contract award for project.

.13 Submit electronic copy of certificates for requirements requested in specification Sections and as requested by NRC Representative.

.1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.

.2 Certificates must be dated after award of project contract complete with project name.

.14 Submit electronic copy of manufacturers instructions for requirements requested in specification Sections and as requested by NRC Representative.

.1 Pre-printed material describing installation of product, system or material, including special notices and Safety Data Sheets concerning impedances, hazards and safety precautions.

.15 Submit electronic copy of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by NRC Representative.

.16 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

.17 Submit electronic copy of Operation and Maintenance Data for requirements requested in specification Sections and as requested by NRC Representative.

.18 Delete information not applicable to project.

.19 Supplement standard information to provide details applicable to project.

.20 If upon review by NRC Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

.21 The review of shop drawings by NRC Representative is for sole purpose of ascertaining conformance with general concept.

.1 This review shall not mean that NRC Representative approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.

.2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

1.3 CERTIFICATES AND TRANSCRIPTS

.1 Immediately after award of Contract, submit Workers' Compensation Board status.

.2 Submit transcription of insurance immediately after award of Contract.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Province of Ontario

.1 Occupational Health and Safety Act and Regulations for Construction Projects, R.S.O. 1990, c.0.1, as amended and O. Reg. 213/91 as amended – current edition.

.2 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations

.3 National Building Code 2015 (NBC)

.1 NBC 2015, Division B, Part 8 Safety Measures at Construction and Demolition Sites.

.4 National Fire Code 2015 (NFC)

.1 NFC 2015, Division B, Part 5 Hazardous Processes and Operation, subsection 5.6.1.3 Fire Safety Plan.

.5 Treasury Board of Canada Secretariat (TBS)

.1 TBS, Fire Protection Standard, April 1, 2010

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit specific Health and Safety Plan: Within 10 days after award. Health and Safety Plan must include:

.1 Results of site-specific safety hazard assessment.

.2 Results of safety and health risk or hazard analysis for site tasks and operation found in Work plan.

.3 Submit electronic copy of Contractor's authorized representative's Work site health and safety inspection reports to NRC Representative.

.4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors to the NRC Representative within 24 hrs and as soon as practicable.

.5 Submit copies of any Notice required by legislation, or of any incident/accident reports to the NRC Representative within 24 hours and as soon as practicable.

.6 The Contractor shall advise the NRC Representative of any accident, injury, near-miss incident, fire, explosion or chemical spill occurring at the Work site and any visit to the site by a governmental enforcement official.

.7 The Contractor shall provide a written report within 24 hours of any accident, injury, near-miss incident, fire, explosion or chemical spill.

.8 NRC Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within ten (10) days after receipt of plan. Revise plan as appropriate and resubmit plan to NRC Representative within 5 days after receipt of comments from NRC Representative.

.9 Submit two (2) complete Hazard Assessment Site-Specific Health and Safety plans (HASSSP's) in a three-ring binder, in an indexed format. Maintain a copy on site. The other copy will be given to the NRC Representative.

.10 NRC Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.

.11 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to NRC Representative.

.12 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

1.3 FILING OF NOTICE

.1 File Notice of Project with Provincial authorities prior to beginning of Work.

.2 Contractor shall agree to install proper site separation and identification in order to maintain time and space at all times throughout life of project.

1.4 SAFETY ASSESSMENT

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

1.5 MEETINGS

.1 Schedule and administer Health and Safety meeting with NRC Representative five (5) days after contract award.

1.6 REGULATORY REQUIREMENTS

.1 Do Work in accordance with Section 01 10 00 - General Instructions.

1.7 PROJECT/SITE CONDITIONS

.1 Refer to site condition and assessment reports for any noted hazardous or contaminated materials or substances present at project site

1.8 GENERAL REQUIREMENTS

.1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.

.2 NRC Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.9 RESPONSIBILITY

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

.2 Contractor will be responsible and assume the role Constructor as described in the Ontario Occupational Health and Safety Act and Regulations for Construction Projects.

.3 Ensure the site supervisor is an employee of the Contractor and that this person is present and available at all-time throughout the life of the project.

1.10 COMPLIANCE REQUIREMENTS

.1 Comply with Ontario Occupational Health and Safety Act, R.S.O. 1990, c. 0.1 and Ontario Regulations for Construction Projects, O. Reg. 213/91.

.2 Comply with the Health and Safety requirements of CSA Z462 – Workplace Electrical Safety.

.3 Comply with the Health and Safety requirements of CSA Z460 – Control of Hazardous Energy.

1.11 UNFORESEEN HAZARDS

.1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, advise Health and Safety co-ordinator and follow procedures in accordance with Acts and Regulations of Province having jurisdiction and advise NRC Representative verbally and in writing.

1.12 POSTING OF DOCUMENTS

.1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province having jurisdiction, and in consultation with NRC Representative.

1.13 CORRECTION OF NON-COMPLIANCE

.1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by NRC Representative.

.2 Provide NRC Representative with written report of action taken to correct non-compliance of health and safety issues identified.

.3 NRC Representative may stop Work if non-compliance of health and safety regulations is not corrected.

1.14 BLASTING

.1 Blasting or other use of explosives is not permitted without prior receipt of written instruction by NRC Representative.

1.15 POWDER ACTUATED DEVICES

.1 Use powder actuated devices only after receipt of written permission from NRC Representative.

1.16 WORK STOPPAGE

.1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 REFERENCES TO REGULATORY REQUIREMENTS

.1 Department of Justice Canada (Jus)

.1 SOR/2018-196 Prohibition of Asbestos and Products Containing Asbestos Regulations.

.2 Perform Work in accordance with National Building Code of Canada (NBC) 2015 including amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.

.3 Specific design and performance requirements listed in specifications or indicated on drawings may exceed minimum requirements established by referenced Building Code; these requirements will govern over the minimum requirements listed in Building Code

.1 Meet or exceed requirements of:

.1 Contract documents.

.2 Specified standards, codes and referenced documents.

1.2 HAZARDOUS MATERIAL DISCOVERY

.1 Asbestos: demolition of spray or trowel-applied asbestos is hazardous to health. Stop Work immediately when material resembling spray or trowel-applied asbestos is encountered during demolition Work. Notify NRC Departmental Representative.

.2 PCB: Polychlorinated Biphenyl: stop Work immediately when material resembling Polychlorinated Biphenyl is encountered during demolition Work. Notify NRC Departmental Representative.

.3 Mould: stop Work immediately when material resembling mould is encountered during demolition Work. Notify NRC Departmental Representative.

1.3 BUILDING SMOKING ENVIRONMENT

.1 Comply with smoking restrictions and municipal by-laws.

1.4 QUALITY ASSURANCE

.1 Regulatory Requirements: Except as otherwise specified, Constructor shall apply for, obtain, and pay fees associated with, permits, licenses, certificates, and approvals required by regulatory requirements and Contract Documents, based on General Conditions of Contract and the following:

.1 Regulatory requirements and fees in force on date of Bid submission, and

.2 A change in regulatory requirements or fees scheduled to become effective after date of tender submission and of which public notice has been given before date of tender submission.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 INSPECTION

.1 Allow NRC Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.

.2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by NRC Representative instructions, or law of Place of Work.

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

.4 NRC Representative will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such Work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, NRC Representative will pay cost of examination and replacement.

1.2 ACCESS TO WORK

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

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

1.3 PROCEDURES

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

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

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

1.4 REJECTED WORK

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

.2 Make good other Contractor's Work damaged by such removals or replacements promptly.

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

1.5 REPORTS

.1 Submit electronic copy of inspection and test reports to NRC Representative.

.2 Provide copies to subcontractor of Work being inspected or tested.

1.6 TESTS AND MIX DESIGNS

.1 Furnish test results and mix designs as requested.

.2 Cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work will be appraised by NRC Representative and may be authorized as recoverable.

1.7 EQUIPMENT AND SYSTEMS

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

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

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

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

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

1.2 QUALITY

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

.2 Procurement policy is to acquire, in cost-effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of Work.

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

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

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

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

1.3 AVAILABILITY

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

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

1.4 STORAGE, HANDLING AND PROTECTION

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

.2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.

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

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

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

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

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

.8 Remove and replace damaged products at own expense and to satisfaction of NRC Representative.

.9 Touch-up damaged factory finished surfaces to NRC Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.5 TRANSPORTATION

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

1.6 MANUFACTURER'S INSTRUCTIONS

.1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.

.2 Notify NRC Representative in writing, of conflicts between specifications and manufacturer's instructions, so that NRC Representative will establish course of action.

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

1.7 QUALITY OF WORK

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

.2 Do not employ anyone unskilled in their required duties. NRC Representative reserves right to require dismissal from site, workers deemed incompetent or careless.

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

1.8 CO-ORDINATION

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

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

1.9 CONCEALMENT

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

.2 Before installation, inform NRC Representative if there is interference. Install as directed by NRC Representative.

1.10 REMEDIAL WORK

.1 Refer to Section 01 73 00 - Execution.

.2 Perform remedial Work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.

.3 Perform remedial Work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.11 LOCATION OF FIXTURES

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

.2 Inform NRC Representative of conflicting installation. Install as directed.

1.12 FASTENINGS

.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.

.2 Prevent electrolytic action between dissimilar metals and materials.

.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior Work unless stainless steel or other material is specifically requested in affected specification Section.

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

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

.6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.13 FASTENINGS - EQUIPMENT

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

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

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

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

1.14 PROTECTION OF WORK IN PROGRESS

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

1.15 EXISTING UTILITIES

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

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

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

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

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

- .1 Structural integrity of elements of project.
- .2 Integrity of weather-exposed or moisture-resistant elements.
- .3 Efficiency, maintenance, or safety of operational elements.
- .4 Visual qualities of sight-exposed elements.
- .5 Work of Owner or separate contractor.

.3 Include in request:

- .1 Identification of project.
- .2 Location and description of affected Work.
- .3 Statement on necessity for cutting or alteration.
- .4 Description of proposed Work, and products to be used.
- .5 Alternatives to cutting and patching.
- .6 Effect on Work of Owner or separate contractor.
- .7 Written permission of affected separate contractor.
- .8 Date and time work will be executed.

1.2 MATERIALS

.1 Required for original installation.

.2 Change in Materials: Submit request for substitution in accordance with Section 01 33 00 - Submittal Procedures.

1.3 PREPARATION

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

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

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

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

.5 Provide protection from elements for areas which are to be exposed by uncovering Work; maintain excavations free of water.

1.4 EXECUTION

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

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

.3 Uncover Work to install ill-timed Work.

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

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

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

.7 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.

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

.9 Restore Work with new products in accordance with requirements of Contract Documents.

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

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

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

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Recycle and dispose waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

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 PROJECT CLEANLINESS

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by NRC Representative.

.2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by NRC Representative. Do not burn waste materials on site, unless approved by NRC Representative.

.3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.4 Provide on-site waste containers for collection of waste materials and debris.

.5 Dispose of waste materials and debris off site.

.6 Clean interior areas prior to start of finishing Work, and maintain areas free of dust and other contaminants during finishing operations.

.7 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

.8 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

.9 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

.10 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.2 FINAL CLEANING

.1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.

.2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.

.3 Prior to final review remove surplus products, tools, construction machinery and equipment.

.4 Remove waste products and debris other than that caused by NRC Representative.

.5 Remove waste materials from site at regularly scheduled times or dispose of as directed by NRC Representative. Do not burn waste materials on site, unless approved by NRC Representative.

.6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.7 Clean and polish hardware, stainless steel, chrome, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.

.8 Remove stains, spots, marks and dirt from electrical and mechanical fixtures, walls, floors and ceilings.

.9 Clean lighting reflectors, lenses, and other lighting surfaces.

.10 Vacuum clean and dust building interiors, behind grilles, louvres and screens.

.11 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.

.12 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.

.13 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Recycle and dispose waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

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 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 02 41 19.16 – Selective Interior Demolition

.2 Section 23 05 05 – Selective Demolition for HVAC-R Equipment

.3 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 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.

.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.

Part 4 APPENDIX: WASTE MANAGEMENT FORMS

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 accordingly

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)	For Project Planning Purposes (i.e. number of bins required) Volume (cubic yards)
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	0.00	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	0.00	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	0
Project Type (Construction, Renovation or Demolition)	0
Area (sq. m)	0
Site Address	0
Contact Person & Telephone	0
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 ADMINISTRATIVE REQUIREMENTS

.1 Acceptance of Work Procedures:

.1 NRC Representative's Inspection:

.1 NRC Representative and Contractor to inspect Work and identify defects and deficiencies.

.2 Contractor to correct Work as directed.

.2 Completion Tasks: submit written certificates in English that tasks have been performed as follows:

.1 Work: completed and inspected for compliance with Contract Documents.

.2 Defects: corrected and deficiencies completed.

.3 Equipment and systems: tested, balanced, adjusted and fully operational.

.4 Operation of systems: demonstrated to Departmental Represetative's personnel.

.5 Work: complete and ready for final inspection.

.3 Final Inspection:

.1 When completion tasks are done, request final inspection of Work by NRC Representative and Contractor.

.2 When Work incomplete according to NRC Representative, complete outstanding items and request re-inspection.

.4 Declaration of Substantial Performance: when NRC Representative considers deficiencies and defects corrected and requirements of Contract substantially performed, make application for Certificate of Substantial Performance.

.5 Commencement of Lien and Warranty Periods: date of NRC Representative's acceptance of submitted declaration of Substantial Performance to be date for commencement for warranty period and commencement of lien period unless required otherwise by lien statute of Place of Work.

.6 Final Payment:

.1 When NRC Representative considers final deficiencies and defects corrected and requirements of Contract met, make application for final payment.

.7 Payment of Holdback: after issuance of Certificate of Substantial Performance of Work, submit application for payment of holdback amount in accordance with contractual agreement.

1.2 FINAL CLEANING

.1 Clean in accordance with Section 01 74 00 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Recycle and dispose waste materials in accordance with Section 01 74 19 – Waste Management and Disposal.

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 ADMINISTRATIVE REQUIREMENTS

.1 Pre-warranty Meeting:

.1 Convene meeting one (1) week prior to contract completion with NRC Representative, in accordance with Section 01 31 19 - Project Meetings to:

.1 Verify Project requirements.

.2 Review warranty requirements.

.2 NRC Representative to establish communication procedures for:

.1 Notifying construction warranty defects.

.2 Determine priorities for type of defects.

.3 Determine reasonable response time.

.3 Contact information for bonded and licensed company for warranty work action: provide name, telephone number and address of company authorized for construction warranty work action.

.4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.

.3 Provide evidence, if requested, for type, source and quality of products supplied.

1.3 FORMAT

.1 Organize data as instructional manual.

.2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.

.3 When multiple binders are used correlate data into related consistent groupings.

.1 Identify contents of each binder on spine.

.4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.

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

.6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

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

.8 Drawings: provide with reinforced punched binder tab.

.1 Bind in with text; fold larger drawings to size of text pages.

.9 Provide scaled CAD files in dwg format on CD.

1.4 CONTENTS - PROJECT RECORD DOCUMENTS

.1 Table of Contents for Each Volume: provide title of project;

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

.2 For each product or system:

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

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

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

.5 Typewritten Text: as required to supplement product data.

- .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.

.6 Training: refer to Section 01 79 00 - Demonstration and Training.

1.5 AS -BUILT DOCUMENTS AND SAMPLES

.1 Maintain, in addition to requirements in General Conditions, at site for NRC Representative one record copy of:

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

.2 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.

- .1 Label each document "PROJECT RECORD" in neat, large, printed letters.

.3 Maintain record documents in clean, dry and legible condition.

- .1 Do not use record documents for construction purposes.

.4 Keep record documents and samples available for inspection by NRC Representative.

1.6 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

.1 Record information on set of black line opaque drawings provided by NRC Representative.

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

.3 Record information concurrently with construction progress.

.1 Do not conceal Work until required information is recorded.

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

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

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

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

.4 Field changes of dimension and detail.

.5 Changes made by change orders.

.6 Details not on original Contract Drawings.

.7 Referenced Standards to related shop drawings and modifications.

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

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

.2 Changes made by Addenda and change orders.

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

.7 Provide digital photos, if requested, for site records.

1.7 EQUIPMENT AND SYSTEMS

.1 For each item of equipment and each system include description of unit or system, and component parts.

.1 Give function, normal operation characteristics and limiting conditions.

.2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

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

.3 Include installed colour coded wiring diagrams.

.4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.

.1 Include regulation, control, stopping, shutdown, and emergency instructions.

.2 Include summer, winter, and any special operating instructions.

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

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

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

.8 Include sequence of operation by controls manufacturer.

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

.10 Provide installed control diagrams by controls manufacturer.

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

.12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

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

.14 Include test and balancing reports as specified in Section 01 45 00 - Quality Control.

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

1.8 MATERIALS AND FINISHES

.1 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations.

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

.3 Moisture-protection and weather-exposed products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.4 Additional requirements: as specified in individual specifications sections.

1.9 MAINTENANCE MATERIALS

.1 Spare Parts:

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

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

.3 Deliver to site; place and store.

.4 Receive and catalogue items.

.1 Submit inventory listing to NRC Representative.

.2 Include approved listings in Maintenance Manual.

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

.2 Extra Stock Materials:

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

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

.3 Deliver to site; place and store.

.4 Receive and catalogue items.

.1 Submit inventory listing to NRC Representative.

.2 Include approved listings in Maintenance Manual.

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

.3 Special Tools:

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

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

.3 Deliver to site; place and store.

.4 Receive and catalogue items.

.1 Submit inventory listing to NRC Representative.

.2 Include approved listings in Maintenance Manual.

1.10 DELIVERY, STORAGE AND HANDLING

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

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

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

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

.5 Remove and replace damaged products at own expense and for review by NRC Representative.

1.11 WARRANTIES AND BONDS

.1 Develop warranty management plan to contain information relevant to Warranties.

.2 Submit warranty management plan, thirty (30) days before planned pre-warranty conference, to NRC Representative approval.

.3 Warranty management plan to include required actions and documents to assure that NRC Representative receives warranties to which it is entitled.

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

.5 Submit, warranty information made available during construction phase, to NRC Representative for approval prior to each monthly pay estimate.

.6 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:

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

.2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

.3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten (10) days after completion of applicable item of work.

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

.5 Co-execute submittals when required.

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

.7 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.

.8 Conduct joint 6 months and 10 months warranty inspection, measured from time of acceptance, by NRC Representative.

.9 Include information contained in warranty management plan as follows:

.1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.

.2 Listing and status of delivery of Certificates of Warranty for extended warranty items, to include motors and HVAC balancing.

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

.1 Name of item.

.2 Model and serial numbers.

.3 Location where installed.

.4 Name and phone numbers of manufacturers or suppliers.

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

.6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.

.7 Cross-reference to warranty certificates as applicable.

.8 Starting point and duration of warranty period.

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

.10 Cross-Reference to specific pertinent Operation and Maintenance manuals.

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

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

.4 Contractor's plans for attendance at 6 and 10 months post-construction warranty inspections.

.5 Procedure and status of tagging of equipment covered by extended warranties.

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

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

.11 Written verification to follow oral instructions.

.1 Failure to respond will be cause for the NRC Representative to proceed with action against Contractor.

1.12 WARRANTY TAGS

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

.2 Attach tags with copper wire and spray with waterproof silicone coating.

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

.4 Indicate following information on tag:

.1 Type of product/material.
.2 Model number.
.3 Serial number.
.4 Contract number.
.5 Warranty period.
.6 Inspector's signature.
.7 Construction Contractor.

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 SECTIONS

.1 Section 01 91 13 – General commissioning requirements

.2 Section 01 91 13.13 – Commissioning plan

.3 Section 01 91 13.16 – Commissioning forms

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Demonstrate operation and maintenance of equipment and systems to NRC Representative's personnel two (2) weeks prior to date of interim completion.

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

.3 Preparation:

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

.2 Verify designated personnel are present.

.3 Ensure equipment has been inspected and put into operation in accordance with Division 23, 25 and 26.

.4 Ensure testing, adjusting, and balancing has been performed in accordance with Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS and equipment and systems are fully operational.

.4 Demonstration and Instructions:

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

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

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

.4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.

.5 Time Allocated for Instructions: ensure amount of time required for instruction of each item of equipment or system as follows:

.1 Division 23 - Cooling and Ventilation System: 2 hours of instruction.

.2 Division 25 - Control System: 2 hours of instruction.

.3 Division 26 - Electrical System: 1 hours of instruction.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

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

.3 Submit reports within one (1) week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.

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

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

1.4 QUALITY ASSURANCE

.1 When specified in individual Sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:

.1 Instruct Operation staff. NRC Representative will ensure that the building operation staff will be present.

.2 Provide written report that demonstration and instructions have been completed.

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 SECTIONS

.1 Section 01 79 00 – Demonstration and training.

.2 Section 01 91 13.13 – Commissioning plan..

.3 Section 01 91 13.16 – Commissioning forms

.1 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 to hire a third party independent Commissioning Agent to manage the entire commissioning process.

.3 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.

.4 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 13.13 - Commissioning Plan.

.2 For Cx responsibilities refer to Section 01 91 13.13 - Commissioning 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 are 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 ACTION AND INFORMATIONAL SUBMITTALS

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

.1 Submit no later than 8 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 2 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 13.16 - Commissioning 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.

.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 and 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. Commissioning Agent 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 the Commissioning 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 7 days notice prior to commencement.

.2 Departmental Representative reserves the right 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 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.

.2 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.

.3 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.

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 21 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 reserves the right 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 EXTENT OF VERIFICATION

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

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

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

.4 Review and repeat commissioning of systems if inconsistencies found in more than 20 % of reported results.

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

1.24 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.

1.25 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.

1.26 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.

1.27 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.

1.28 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.

1.29 TRAINING

.1 In accordance with Section 01 79 00 - Demonstration and Training.

1.30 OCCUPANCY

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

1.31 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.

1.32 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.

1.33 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 RELATED SECTIONS

.1 Section 01 79 00 – Demonstration and Training.

.2 Section 01 91 13 – General commissioning requirements.

.3 Section 01 91 13.16 – Commissioning forms.

1.2 REFERENCE STANDARDS

.1 National Fire Protection Association (NFPA)

.1 NFPA-13, Installation of Sprinkler Systems Handbook.

.2 Public Works and Government Services Canada (PWGSC)

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

.3 Underwriters' Laboratories of Canada (ULC).

1.3 GENERAL

.1 Provide a fully functional installation:

.1 Systems, equipment and components meet user's functional requirements before date of acceptance, and operate consistently at peak efficiencies and within specified design criteria under normal loads.

.2 Facility user and O&M personnel have been fully trained in aspects of installed systems.

.3 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 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 (SDS).

.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 Draft Cx Plan is included in the specifications.

.2 Cx Plan to be 100% completed by contractor within 12 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 NRC 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 month during construction phase. At each revision, indicate revision number and date.

.3 Submit each revised Cx Plan to NRC 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 NRC Representative to maintain overall responsibility for project and is sole point of contact between members of commissioning team.

.2 NRC Representative will select Cx Team consisting of following members:

.1 NRC Quality Assurance Commissioning Manager: ensures Cx activities are carried out to ensure delivery of a fully operational project including:

.1 Review of Cx documentation from operational perspective.

.2 Review for performance, reliability, durability of operation, accessibility, maintainability, operational efficiency under conditions of operation.

.3 Protection of health, safety and comfort of occupants and O&M personnel.

.4 Work closely with members of Cx Team.

.2 NRC Representative is responsible for:

.1 Monitoring of Cx activities, training, development of Cx documentation.

.2 Ensuring implementation of final Cx Plan.

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

.4 Verification of Training Plan.

.3 Construction Team: contractor, subcontractors, 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 Implementation of Training Plan

.5 Delivery of training and Cx documentation.

.6 Assigning one person as point of contact with the Contractor's Cx agent and NRC Representative for administrative and coordination purposes.

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

.1 Organizing Cx.

.2 Monitoring operations Cx activities.

.3 Demonstrations.

.4 Training.

.5 Testing.

.6 Preparation, submission of test reports.

.7 Witnessing, certifying accuracy of reported results.

.8 Witnessing and certifying TAB and other tests.

.5 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.

.2 Ensure that Cx participant:

.1 Could complete work within scheduled time frame.

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

.1 Modify ventilation rates to meet changes.

.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.

.3 Provide names of participants to NRC Representative and details of instruments and procedures to be followed for Cx 1 month prior to starting date of Cx for review and approval.

1.8 EXTENT OF CX

.1 Commission mechanical systems and associated equipment:

.1 Plumbing systems:

.1 Domestic cold system.

.2 Regular sanitary waste systems.

.2 HVAC systems:

.1 HVAC systems:

.1 New air handling unit 77AHU159.

.2 New exhaust air fan 77RAF50005.

.3 New VAV terminal unit.

.4 New chilled water pumps 77CWP159A, 77CWP159B.

.5 New humidifier 77HUM159.

.3 EMCS:

.1 All control systems for new components and existing modified.

.2 Commission electrical systems and equipment:

.1 Low voltage below 750 V:

.1 Low voltage equipment.

.2 Low voltage distribution systems.

.2 Lighting systems:

.1 Interior lighting: Operation

.2 Emergency lighting systems, including battery packs.

.3 Fire alarm systems, equipment:

.1 Fire alarm devices

1.9 DELIVERABLES RELATING TO O&M PERSPECTIVES

.1 General requirements:

.1 Compile English or French documentation, to contract language.

.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 WHMIS Safety Data Sheets (SDS).

.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 Training Plans.

.10 Cx Reports.

.11 Prescribed activities during warranty period.

.4 NRC 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 NRC Representative prior to permission to start up and rectification of deficiencies to NRC Representative's satisfaction.

.2 NRC Representative will monitor some of these pre-start-up inspections.

.3 Include completed documentation with Cx report.

.4 Conduct pre-start-up tests: conduct pressure, static, flushing, cleaning, and “bumping” during construction as specified in technical sections.

.5 NRC Representative will monitor some of these inspections and tests.

.6 Include completed documentation in Cx report.

.2 Pre-Cx activities - MECHANICAL:

.1 Plumbing systems:

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

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

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

.2 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 NRC Representative.

.3 EMCS:

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

.2 Perform point-by-point testing in parallel with start-up.

.3 Carry out point-by-point verification.

.4 Demonstrate performance of systems, to be witnessed by NRC Representative prior to start of 30 day Final Acceptance Test period.

.5 Perform final Cx and operational tests during demonstration period and 30 day test period.

.6 Only additional testing after foregoing have been successfully completed to be "Off-Season Tests".

.3 Pre-Cx activities - LIFE SAFETY SYSTEMS

.1 Include equipment and systems identified above.

.4 Pre-Cx activities - ELECTRICAL:

.1 Lighting systems:

.1 Emergency lighting systems:

.1 Tests to include verification of lighting levels and coverage, initially by disrupting normal power.

.2 Fire alarm systems: test after other safety and security systems are completed. Testing to include a complete verification in accordance with ULC requirements. NRC Representative has witnessed and certified report, demonstrate devices and zones to NRC Representative.

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 System 77AHU159.

.2 EMCS System.

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

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

.4 Performance Verification (PV):

.1 Approved Contractor’s Cx Agent to perform.

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

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

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

.4 NRC Representative to approve completed PV reports and provide to NRC Representative.

.5 NRC Representative reserves right to verify up to 30 % 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 NRC Representative.

.2 NRC Representative to monitor Cx activities.

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

.4 NRC 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 Agent, using procedures developed by NRC Representative.

.2 Tests to be documented on approved report forms.

.3 Upon satisfactory completion, Cx Agent to prepare Cx Report and submit to NRC Representative for review.

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

.5 Integrated systems to include:

.1 77AHU159

.2 77RAF50005.

.3 Building Management System (EMCS).

.4 Fire alarm systems.

.5 Emergency lighting systems.

1.15 INSTALLATION CHECK LISTS (ICL)

.1 Contractor's Cx Agent to provide for approval by NRC Representative all Installation Check List Forms. Forms are to be approved by NRC Representative prior to use.

1.16 PRODUCT INFORMATION (PI) REPORT FORMS

.1 Contractor's Cx Agent to provide for approval by NRC Representative all Installation Check List Forms. Forms are to be approved by NRC Representative prior to use.

1.17 PERFORMANCE VERIFICATION (PV) REPORT

.1 Refer to Section 01 91 13.16 - Commissioning Forms: Performance Verification (PV) Forms. Contractor's Cx Agent to provide for approval by NRC Representative all required forms. Forms are to be approved by NRC Representative prior to use.

1.18 CX SCHEDULES

.1 Contractor's Cx Agent to prepare detailed Cx Schedule and submit to NRC 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: 60 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 Submission of list of instrumentation with relevant certificates: 21 days before start of Cx.

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

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

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

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

.11 Identification of deferred Cx.

.12 Implementation of training plans.

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

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

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

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

1.19 CX REPORTS

.1 Submit reports of tests, witnessed and certified by Cx Agent to NRC 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 NRC Representative.

1.20 TRAINING PLANS

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

1.21 FINAL SETTINGS

.1 Upon completion of Cx to satisfaction of NRC 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

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END OF SECTION

Cx List of Participants In- Executing (E), Verifying (V) and Approving (A) the Tests

	Authority / Company	Participant Name	Activity	Signature	Date
Plumbing					
Ventilation					
BAS					
Electrical					
Balancing					
Witness (General Contractor)					
Commissioning Agent					

Cx SIGN-OFF SHEET

Project Name: _____

Project Number: _____

Building Number: _____

PMO/WBS Element: _____

Equipment Information	**Completed (Y/N):**	**Supervised by:**
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____

Prerequisite	**Completed (Y/N):**	**Supervised by:**
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____

Equipment Items to be Verified	**Completed (Y/N):**	**Supervised by:**
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____

Elements to be Measured for Design Validation	**Completed (Y/N):**	**Supervised by:**
1. _____	_____	_____
2. _____	_____	_____

3. _____	_____	_____
Control Systems Items to be Verified	**Completed (Y/N):**	**Supervised by:**
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____
Control System Pre-Functional Checks	**Completed (Y/N):**	**Supervised by:**
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____
Control System Functional Performance Tests	**Completed (Y/N):**	**Supervised by:**
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____

_____	_____
Project Manager	**Design Engineer**
_____	_____
Control Specialist	**O&M Supervisor**

O&M acceptance of the project:	**Person handing over the project:**
Name: _____	Name: _____

Signature: _____	Signature: _____
Date: _____	Date: _____

COMMISSIONING GENERAL CLOSE-OUT CHECKLIST

Category	Item	Y/N	NRC Initials
O&M:	SAP equipment ID created.		
	Relevant equipment information added to SAP equipment ID.		
	O&M notified of season specific maintenance requirements (i.e. draining cooling coils for winter, manual switchover of water side chiller economizers (HEX), etc.).		
	A list of subtrades and suppliers and all required contact information provided to O&M.		
	As-builts drawings and O&M manuals are available for O&M reference.		
	O&M has access via project specific O&M manuals to details such		
	O&M has participated in project knowledge transfer with E&C and/or Cx Agent.		
	Building Automation System Specialists have participated in knowledge transfer and all Cx activities with E&C, Ainsworth and/or Cx Agent.		
Asbestos Management Plan (AMP):	AMP data updated to indicate removal of any designated substances.		
	AMP data updated to include identification of any additonal designated substances.		
Fume Hood Management Plan (FMP):	Fume Hood information incorporated into SAP.		
	Fume Hood added to FMP.		
Energy Check-In:	Approximate increase or decrease in energy consumption with new or replacement equipment reported to RPPM energy team.		
Project Directory Clean-Up:	Un-used folders within structure are deleted.		
	Relevant information is stored in correct directory.		
	.pst email files from all project team saved in project directory.		

	Any paper files requested are submitted to records.		
Client Hand-Over:	O&M/E&C walk through with client completed.		
Additional Comments:			

AHU (BUILT-UP) COMMISSIONING CHECKLIST

Equipment Information

SAP Equipment ID:		
Project No:		
Drawing No:		
Manufacturer:		
Model No.:		
Serial No.:		
Area Served:		
Installed Location (Room Number):		
Supply Fan HP:		
Return/Exhaust Fan HP:		
Energy Recovery Wheel Motor HP:		
Unit description:		
Cooling Coil:	Y - N	□ Water □ DX
	For DX Coils Only:	
	Refrigerant Type:	
	Refrigerant Volume:	
	Subcooling adjustment (^{o}F - ^{o}C) - Refrigerant liquid pressure converted to temperature minus the liquid line temperature	

	Suction superheat adjustment via TXV (^{o}F - ^{o}C) - Suction temperature minus the suction pressure converted to temperature	
Heating Coil:	Y - N	□ Glycol □ Electric
Humidifier:	Y - N	□ Direct Steam □ Electric

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	Control Valve(s) □ Yes (specification(s) attached) □ No
Comments:	

Equipment Items to be Verified

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

Equipment Items	Y/N	Comments
Cabinet and General Installation		
Casing condition good: no dents, leaks, door gaskets installed. No missing screws.		
Access doors close tightly and open easily - no leaks.		

Vibration isolation equipment installed and released from shipping locks.		
Abnormal noise and vibration.		
Maintenance access acceptable for unit and components.		
Thermal insulation properly installed.		
Instrumentation installed according to specification (thermometers, pressure guages, flow meters, etc.).		
Filters installed and replacement type and efficiency permanently affixed to housing - construction filters removed.		
Equipment identification label has been applied and adheres to NRC naming convention.		
Viewing windows installed in sizes and location as specified. Maintenance lights inside unit installed as specified.		
No leakage between unit's outlet and ductwork connection. Flexible connection propeerly installed with slack.		
Unit installed on baserail as specified to ensure proper condensate drainage.		
Valves, Piping and Coils		
Pipe fittings complete and pipes properly suppported.		
Pipes properly labeled.		
Pipes properly insulated.		
Strainers in place and clean.		
Piping system properly installed and flushed.		

No leaking apparent around fittings.		
All coils are clean and fins are in good condition.		
All condensate drain pans clean and slope to drain.		
Valves properly labeled.		
Valves installed in proper direction.		
BAS sensors properly located and secure.		
P/T plugs and isolation valves installed per drawings.		
Control, balancing and isolation valves verified and are accessible for maintenance.		
Enough clearance for coil removal.		
Energy Recovery Wheel		
Unit on separate power circuit.		
Power circuit labelled.		
No visible damage on face or housing.		
The wheel's purge side is correctly facing the building side supply air stream.		
Ductwork correctly matched direction and locations of airflow.		
Access doors installed immediately adjacent to the unit on all four ducts as specified.		
All access doors are large enough to allow a person easy access to all seals and bearings.		
Ductwork is self-supporting and does NOT use the unit as structural support.		
Ductwork is attached to the unit's frame only and NOT to the unit's sheet metal.		

Filters are incorporated into the outside and return air streams.		
Filters have restraints to keep them from blowing out should they become wet.		
Any indication of leakage (pay particular attention to the partition seal).		
Fans and Dampers		
Supply/exhaust/return fans and motor alignment correct.		
Supply/exhaust/return fans belt tension & condition good.		
Supply/exhaust/return fans protective shrouds for belts in place and secure.		
Supply/exhaust/return fans area clean.		
Supply/exhaust/return fans and motor properly lubricated.		
Fan motor base vibration isolators type and quantity as per specifications.		
Supply/exhaust/return accessible for replacement.		
Interlocks installed as per specifications.		
Filters clean and tight fitting.		
Filter pressure differential measuring device installed and functional, per specification.		
Smoke and fire dampers installed properly per contract documents (proper location, access doors, appropriate ratings verified).		
All dampers close tightly.		
All damper linkages have minimum play.		

Low limit freeze stat sensor located to deal with stratification & bypass.		
Blade orientation as specified - Opposed/Parallel		
Verify loss of power position (N.O., N.C.) as specified.		
Humidifer		
Casing condition good: no dents, leaks, door gaskets installed. No missing screws.		
Unit's nameplate permanently affixed to the humidifer.		
Humidifier is leveled and properly secured (floor stand or wall supports bolted to ther floow/walls).		
Piping system properly installed and water isolation valve is provided at the supply piping.		
Condensate piping properly sloped and trapped as per manufacturer's instructions.		
Manifold is clean and has no damage.		
Internal drain cooler is provided to maintain discharge temperature as per city's by-law requirements.		
Humidity sensor located as per manufacturer's instructions.		
High-humidity cut-out sensor located as per manufacturer's instructions and tested. Must be hard-wired.		
DX Coil (if applicable)		
Equipment and refrigerant piping components installed as per drawings.		
Refrigerent line sizes, slope, trapping, support, insulation as per manufacturer's instructions.		

TXV bulb and equalizer line positioned and installed as per manufacturer's instructions.		
Refrigerent pipeing leaked checked and evacuated down to 500 microns or in accordance with manufacturer's instructions.		
System charged with total system refrigerant charge (including condensing unit, DX Coil and piping).		
Minimum face velocity of 350fpm.		
Ducts		
Balancing report submitted.		
Sound attenuation installed.		
Duct joint sealant properly installed.		
No apparent severe duct restrictions.		
Turning vanes in square elbows as per drawings.		
Fresh air intakes located away from pollutant sources & exhaust outlets.		
Pressure leakage tests completed.		
Branch duct control dampers operable.		
Ducts cleaned as per specifications.		
Balancing dampers installed as per drawings and TAB's site visit.		
Electrical and Controls		
Pilot lights are functioning.		
Power disconnects in place and labeled.		
All electric connections tight.		

Proper grounding installed for components and unit.		
Safeties in place and operable.		
Starter overload breakers installed and correct size.		
Control system interlocks hooked up and functional.		
Smoke detectors in place.		
All control devices and wiring complete.		
Controls, interlocks and sequence are functional.		
VFD		
VFD powered (wired to controlled equipment).		
VFD interlocked to control system.		
Static pressure sensor or other controlling sensor properly located and per drawings and calibratedy.		
Drive location not subject to excessive moisture or dirt.		
Drive location not subject to excessive temperatures.		
Drive size matches motor size.		
Internal settings designating the model is correct.		
Input of FLA represents 100% to 105% of motor FLA rating.		
Appropriate Volts and Hz curve is being used.		
Accel and decel times are around 10-50 seconds, except for special applications. Actual decel = _____ Actual accel = _____		
Lower frequency limit at 0 for VAV fans and around 10-30% for chilled water pumps. Actual = _____		

Upper frequency set at 100%, unless explained otherwise.		
Unit is programmed with full written programming record on site.		
Final		
Smoke and fire dampers and unpowered TUs are open.		
Startup report completed with this checklist attached.		
Safeties installed and safe operating ranges for this equipment provided to the commissioning agent.		
Alarms and local protection are functional.		
If unit is started and will be running during construction: have quality filters on RA grills, etc. to minimize dirt in the ductwork and coils in any finished areas. Verify moisture migration is not a problem, due to improper pressures between spaces.		
Comments:		

Elements to be Measured for Design Validation

This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.				
Measured Element	**Instrument (portable/BAS/ local)**	**Design**	**Measured 1**	**Measured 2**
Supply Fan CFM				
Return/Exhaust Fan CFM				

Supply Fan Amperage				
Return/Exhaust Fan Amperage				
Fuse/Breaker rating				
Supply Fan RPM from balancing report				
Supply motor RPM from balancing report				
Return/Exhaust Fan RPM from balancing report				
Return/Exhaust Motor RPM from balancing report				
Supply/Return/Exhaust Fan External static pressure (ESP) from balancing report				
Supply/Return/Exhaust Fan Total Static Pressure (TSP) from balancing report				
Heating Coil (Airside)				
Airflow (l/s - CFM)				
Entering Air Temperature (^{o}C - ^{o}F)				
Leaving Air Temperature (^{o}C - ^{o}F)				
Temperature Difference (^{o}C - ^{o}F)				
Airside Pressure Drop (Pa - "H_2O)				
Airflow Velocity (m/s - fps)				
Capacity (kW - BTU/h)				

Heating Coil (Fluidside)				
Fluid Flow (l/s - GPM)				
Entering Fluid Temperature (^{o}C - ^{o}F)				
Leaving Fluid Temperature (^{o}C - ^{o}F)				
Fluid Temperature Drop (^{o}C - ^{o}F)				
Fluid Pressure Drop (Pa - "H_20)				
Number of rows in coil				
Fins Per Inch (FPI)				
Capacity (kW - BTU/h)				
Heating Coil (Electric)				
Amperage				
Voltage				
Capacity (kW - BTU/h)				
Cooling Coil (chilled water)				
Airflow (l/s - CFM)				
Entering Air Temperature (^{o}C - ^{o}F)				
Leaving Air Temperature (^{o}C - ^{o}F)				
Temperature Difference (^{o}C - ^{o}F)				
Airside Pressure Drop (Pa - "H_2O)				
Airflow Velocity (m/s - fps)				
Capacity (kW - BTU/h)				
Fluid Flow (l/s - GPM)				

Entering Fluid Temperature (^{o}C - ^{o}F)				
Leaving Fluid Temperature (^{o}C - ^{o}F)				
Fluid Temperature Drop (^{o}C - ^{o}F)				
Fluid Pressure Drop (Pa - "H_20)				
Capacity (kW - BTU/h)				
Number of rows in coil				
Fins Per Inch (FPI)				
Cooling Coil (DX)				
Airflow (l/s - CFM)				
Entering Air Temperature (^{o}C - ^{o}F)				
Leaving Air Temperature (^{o}C - ^{o}F)				
Temperature Difference (^{o}C - ^{o}F)				
Pressure Drop (Pa - "H_2O)				
Capacity (kW - BTU/h)				
Refrigerent suction line pressure (kPa)				
Refrigerent liquid line pressure (kPa)				
Humidifer				
Entering Dry Bulb Temperature (^{o}C - ^{o}F)				
Entering Wet Bulb Temperature (^{o}C - ^{o}F)				
Entering Relative Humidity %				

Leaving Dry Bulb Temperature (^{o}C - ^{o}F)				
Leaving Wet Bulb Temperature (^{o}C - ^{o}F)				
Leaving Relative Humidity %				
Filters				
Static Pressure Drop				
Type				
Efficiency				
Size				
Quantity				
Energy Recovery Wheel				
Wheel size (nominal CFM)				
Total effectiveness				
Exhaust air transfer ratio (EATR)				
Outside air correction factor (OACF)				
Pressure drop (supply to exhaust air)				
Comments:				

Control System Items to be Verified

Control System Items	Y/N	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		
Has AHU been programmed for GTA		
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 AHU and BAS control points installed		
Wiring inside BAS panel labelled to identify BAS point names		
Input/output points sheet for controller updated to include new equipment		
BAS Controller labelled		
Power source labelled on controller		
Comments:		

Control System Pre-Functional Checks - TBC

	Observations, Notes & Comments

Initial Conditions:	
As-Found Outside Temp/Hum	
As-Found Supply Set Point - Temp/Hum	
As-Found Supply Temp/Hum	
As-Found Return Temp/Hum	
As-Found Position HV/CV/Damper	
As-Found HumVlv	
Total Pressure drop across fan	
Mixed air chamber pressure	
Pressure drop across OAD and MAD	
Manually override the dampers to obtain:	
0% (Fully Closed on OA)	
10% (Min)	
50%	
100% (Fully Open on OA)	
50%	
Back to Automatic	
Note travel time.	
Manually override the HV to obtain:	
0% (Fully Closed)	

50%	
100% (Fully Open)	
Back to Automatic	
Note travel time. Verify if temperature is coherent with valve setting.	
Manually override the CV to obtain:	
0% (Fully Closed)	
50%	
100% (Fully Open)	
Back to Automatic.	
Note travel time. Verify if temperature is coherent with valve setting.	
Manually override the HumVlv to obtain:	
0% (Fully Closed)	
50%	
100% (Fully Open)	
Back to Automatic	
Note travel time. Verify that steam is injected when valve is open.	
Calculate Energy Recovery Wheel effectiveness:	

Supply airflow (CFM)	
Return airflow (CFM)	
Calculate the energy recovery wheel effectiveness according to ASHRAE Standard 84-2020 and note if different from design	
Modify schedule for the system to go in unoccupied mode:	
Verify that fan stops.	
Verify damper positions.	
Verify HV setting.	
Back to normal schedule.	
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.

FAN COMMISSIONING CHECKLIST

Equipment Information

SAP Equipment ID:	
Project No:	
Drawing No:	
Manufacturer:	
Model No.:	
Serial Number:	
Area Served:	
Location:	
Supply/Exhaust:	
Type:	
Constant/Variable Volume:	
Vibration Isolators	
Motor HP	
Electrical: V/ φ/ Hz	
Filter Type and Quantity:	
Filter Size:	
SAP Equipment IDs of all systems linked to fan (i.e. 50SAF01 is linked with 50XAF01, 50RAF01):	

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 startup procedures or report.		
Equipment Items	**Y/N**	**Comments**
Equipment identification label has been applied and follows NRC naming convention.		
Fan installation & start-up completed and form/report attached		
Local protection/interlocks/alarms are functional		
Verification of abnormal noise and vibration		
Verification of isolation/spring deflection on start-up & shutdown		
Comments:		

Elements to be Measured for Design Validation

This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.				
Measured Element	**Instrument (portable/BAS /local)**	**Design**	**Measured 1**	**Measured 2**
Airflow (l/s - CFM)				
Differential Pressure (kPa - "H_20)				
Voltage (T_1-T_{2-}, T_2-T_3, T_3-T_1)				
Amperage (I_1, I_2, I_3)				
Fuse/Breaker Rating				
O/L Protection - Adjustment				
Comments:				

Control System Items to be Verified

Control System Items	**Y/N**	**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		
Has fan been programmed for GTA		
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 fan 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 fan to obtain:	
From BAS, command fan ON	Record mA:
	Physically check fan in ON (Y/N):
From BAS, command fan OFF	Record mA:
	Physically check fan in OFF (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:		
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.

HUMIDIFIER COMMISSIONING CHECKLIST

Equipment Information

SAP Equipment ID:	
Project No:	
Drawing No:	
Manufacturer:	
Model No.:	
Serial Number:	
Area Served:	
Location:	
Humidifier Type:	□ Direct Steam □ Electric □ Steam-to-Steam
Installed Location (Room Number):	
Supply Water:	□ DI □ RO □ Soft □ Potable
Incoming Water Pressure (Pa - psi):	
Fuel Source:	□ Steam □ Electric □ Gas □ Other (Specify):_____
Power Vent Location:	
Steam Piping Outlet Size (mm - in):	
Steam Piping Outlet Type:	□ flange □ hard pipe □ Insulated
Barometric Damper Location:	
Gas Fuels Source Humidifiers:	
Gas Supply:	□ Natural □ LP

Gas Pressure:	
Flue Piping: Class / Size / Rise / Run	
Flue Piping Termination Point:	□ Capped and □ Covered

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	Control Valve □ Yes (specification attached) □ No
Comments:	

Equipment Items to be Verified

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

Equipment Items	Y/N	Comments
Manufacturer's start-up report received and reviewed.		
Equipment identification label has been applied and adheres to NRC naming convention.		
Casing condition good: no dents, leaks, door gaskets installed. No missing screws.		
Humidifier is leveled and properly secured (floor stand or wall supports bolted to ther floow/walls).		

Piping system properly installed and water isolation valve is provided at the supply piping.		
Condensate piping properly sloped and trapped as per manufacturer's instructions.		
Manifold is clean and has no damage.		
Internal drain cooler is provided to maintain discharge temperature as per city's by-law requirements.		
Absorption distance respected? (Document distance)		
Airflow proving switch		
Humidity sensor located as per manufacturer's instructions.		
High-humidity cut-out sensor located as per manufacturer's instructions. Must be hard-wired.		
Safety testing:		
Low water test		
High humidity limit test		
Airflow test		
Aquastat test		
Comments:		

Elements to be Measured for Design Validation

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

Measured Element	Instrument (portable/BAS /local)	Design	Measured 1	Measured 2
Entering Dry Bulb Temperature (^{o}C - ^{o}F)				
Entering Wet Bulb Temperature (oC - oF)				
Entering Relative Humidity %				
Leaving Dry Bulb Temperature (oC - oF)				
Leaving Wet Bulb Temperature (oC - oF)				
Leaving Relative Humidity %				
Steam flow (lbs/hr)				
Pressure (psi - kPa)				
Airflow (CFM - L/s)				
Amperage draw				
Comments:				

Control System Items to be Verified

Control System Items	Y/N	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 humidifier and BAS control points installed		
Wiring inside BAS panel labelled to identify BAS point names		
Input/output points sheet for controller updated to include new equipment		
BAS Controller labelled		
Power source labelled on controller		
Comments:		

Control System Pre-Functional Checks - TBC

	Observations, Notes & Comments
Initial Conditions:	
As-Found Outside Hum	
As-Found Supply Set Point - Hum	

As-Found Supply Hum	
As-Found Return Hum	
As-Found HumVlv	
Manually override the HumVlv to obtain:	
0% (Fully Closed)	
50%	
100% (Fully Open)	
Note travel time. Verify that steam is injected when valve is open.	
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.

VAV & FPMB COMMISSIONING CHECKLIST

Equipment Information

SAP Equipment ID:	
Project No:	
Drawing No:	
Manufacturer:	
Model No.:	
Serial No.:	
Area Served:	
Location:	
Size: (mm - inches)	
Fan Powered: (Y - N)	
Fan Volume: (L/s - CFM)	
Electrical: V/ φ/ Hz	
Actuator Model No.:	
Actuator Serial No.:	
Actuator Fail-Safe Position:	□ N.O. □ N.C.

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 startup procedures or report.		
Equipment Items	**Y/N**	**Comments**
Equipment identification label has been applied and adheres to NRC naming convention.		
Unit installed to manufacturer's recommendations.		
Unit installation & start-up completed and form/report attached.		
All maintenance access requirements met.		
Internal acoustic insulation installed.		
System ductwork installation complete.		
Ductwork thermal installation complete.		
Motorized dampers installed and wired.		
Actuator moves freely with no noise or obstruction.		
System ductwork cleaning complete.		
Flow grid tube installed and connected.		
No unusual noise or vibration.		
Fan Powered VAV Box		

Unit transit bolts removed.		
Unit interior clean and free of debris.		
Return air clean filters installed.		
Seismic bracing installed and approved by seismic Engineer.		
Comments:		

Elements to be Measured for Design Validation

This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.				
Measured Element	**Instrument (portable/BAS/ local)**	**Design**	**Measured 1**	**Measured 2**
Maximum volume (L/s - CFM)				
Minimum volume (L/s - CFM)				
Pressure drop at maximum airflow (w.g. - Pa)				
Pressure drop at minimum airflow (w.g. - Pa)				
Amperage draw (fan-powered only)				
Comments:				

Control System Items to be Verified

Control System Items	Y/N	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.		
Has Global Temperature Adjustment (GTA) been incorporated into the program		
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 VAV/FPMB 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:	
Space temperature (^{o}C):	BAS reading: Thermocouple reading:
Space temperature setpoint (^{o}C):	
Minimum Position (%):	
As-Found Temperature Set Point (^{o}C):	
As-found damper position (%):	
As-found airflow (CFM - L/s):	
Override space temperature setpoint to test heating:	
Cooling Mode: Heating enabled when damper is at minimum position (Y/N):	
Back to automatic.	
Override airflow damper to obtain:	
From BAS, command VAV closed	Record Airflow (CFM - L/s):
	Physically check damper is closed (Y/N):
From BAS, command VAV open	Record Airflow (CFM - L/s):
	Physically check damper is open (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:		
Cooling Mode - Adjust the schedule so that the unit will be in warmup mode. Adjust the space temperature setpoint to be 5°C below the space temperature.	Damper goes to cooling maximum.	
Cooling Mode - Adjust the schedule so that the unit will be in warmup mode. Adjust the space temperature setpoint to be 5°C above the space temperature.	Damper goes to cooling minimum.	
Heating Mode - Adjust the schedule so that the unit will be in warmup mode. Adjust the space temperature setpoint to be 5°C below the space temperature.	Damper goes to heating minimum.	

Heating Mode - Adjust the schedule so that the unit will be in warmup mode. Adjust the space temperature setpoint to be 5°C above the space temperature.	Damper goes to heating maximum.	
Normal mode:		
Cooling Mode - Increase space temperature setpoint by 10°C and document CFM	Damper goes to minimum airflow. Verify that there is little or no overshoot of space temperature or hunting of the damper.	
Cooling Mode - Decrease space temperature setpoint by 10°C and document CFM	Damper goes to maximum airflow. Verify that there is little or no overshoot of space temperature or hunting of the damper.	
Heating Mode - Increase space temperature setpoint by 10°C and document CFM	Damper goes to maximum airflow. Verify that there is little or no overshoot of space temperature or hunting of the damper.	
Heating Mode - Decrease space temperature setpoint by 10°C and document CFM	Damper goes to minimum airflow. Verify that there is little or no overshoot of space temperature or hunting of the damper.	
Control points:		
Local protection:		
Alarms:		
Return all changed control parameters and conditions to their pre-functional performance test values.		
Comments:		

PUMP COMMISSIONING CHECKLIST

Equipment Information

SAP Equipment ID:	
Project No:	
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 startup procedures or report.		
Equipment Items	**Y/N**	**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 startup 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 Verified

Control System Items	Y/N	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		

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 damper is open (Y/N):
From BAS, command damper closed	Record (mA):

From BAS, command damper closed	Physically 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.

NRC BAS Field Equipment Checklist

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

Item	Qty	Y/N	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.

Item	Building Name					
	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 ASPM 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.						

NRC BAS Sequence Standard Checklist

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

Item	Building Name					
	System Name	89AHU05	System Name		System Name	
Enthalpy for all applicable systems. The economizer flag is used to signal the damper economizer so that the outdoor air is not to be used as a cooling source. Calculate the value of the Outdoor Enthalpy using the current Outdoor Air Temperature and relative humidity. Calculate the Enthalpy for the Indoor condition of 72F and 45%RH. This is the Indoor Enthalpy Setpoint. Set the economizer flag to OFF when the outdoor enthalpy is greater than the Indoor Enthalpy Setpoint. Set the Economizer flag to ON when the outdoor enthalpy is less than the (Indoor Setpoint * 0.9) OAEnth = 9+ 0.27*(Site_Oat-35) + 0.5* (Site_Oat-35)*(Site_Oah/100) Btu/lb OAEnthSp = based on a space setpoint of 72F and RH of 45% = 8+0.27*(72-35)+0.5*(72-35)*45/100) = 26.3 Btu/lb Enthalpy = ((OaEnth >= Oa EnthSp) or (Enthalpy and (OaEnth >= (OaEnthsp*0.9)))						
SSTO - Start Stop Time Optimization. Identify occupancy time and use BAS to calculate the required system start time. Systems to operate in full recirculation until occupancy time unless free cooling is available. During the heating season, when system is heated solely via perimeter radiation/reheats, system occupancy will be the system start time.						
Occupied/Unoccupied Set Points - Occupied: Summer — Temperature (Occupied): 24 +/-1C; Temperature (Unoccupied): 28C Occupied: Winter — Temperature (Occupied): 22 +/-1C; Temperature (Unoccupied): 18C Humidity: 60% - 25% Essentially we would have a winter set-point (22C) and a summer set-point (24C) that are toggled when we move from cooling to heating season and vice versa. The individual room controls would allow local control up or down 1C. During unoccupied hours, system to operate in full recirculation to maintain the unoccupied setpoints unless free cooling is available.						
GTA - Global Temperature Adjustment. Systems to be programmed to allow for GTA that can be used on a call for curtailment.						
SAT Reset - Implement a supply air temperature reset based on the return or outside air temperature.						
MAD - Mixing air dampers to be controlled by SAT. Mixed air dampers to modulate to maintain supply air temperature at set point. If the unit goes into enthalpy mode, MAD will go to minimum position.						
PHC - Preheat coil reset based on outside air temperature. OAT °F: 30 → PHC %: 100 OAT °F: 53 → PHC %: 0						
CO_2 - The MAD minimum will be overriden if the return or floor CO_2 sensor is above the setpoint. If there is more than one floor CO_2 sensor, the MAD will be overridden by the maximum CO_2 sensed on the floors.						
RAH - Return air humidity - The humidifier valve will modulate to maintain the return air humidity RAH at setpoint.						
APL - All Points Log - Scheduled BAS points to be added to the APL in order to capture equipment left on that should be off.						

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 23 05 05– Selective Demolition for HVAC.

.2 Section 26 05 05– Selective Demolition for Electrical.

1.2 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI)

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

.2 CSA Group (CSA)

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

.3 Department of Justice Canada (Jus)

.1 Canadian Environmental Assessment Act (CEAA), 2012.

.2 Canadian Environmental Protection Act (CEPA), 2012.

.1 SOR/2003-2, On-Road Vehicle and Engine Emission Regulations.

.2 SOR/2006-268, Regulations Amending the On-Road Vehicle and Engine Emission Regulations.

.3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

.4 Motor Vehicle Safety Act (MVSA), 1995.

.5 Hazardous Materials Information Review Act, 1985.

.4 National Fire Protection Association (NFPA)

.1 NFPA 241 13, Standard for Safeguarding Construction, Alteration, and Demolition Operations.

1.3 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 NRC Representative.

.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 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.

.6 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.

.7 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.

.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.

1.4 ADMINISTRATIVE REQUIREMENTS

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

.1 Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain NRC 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.

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

1.5 ACTION AND INFORMATION SUBMITTALS

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

.1 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. NRC Representative reserves the right to make modifications where proposed methods interfere with the NRC 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 hazardous wastes by a landfill facility licensed to accept hazardous wastes.

.4 Pre demolition Photographs: Submit photographs indicating existing conditions of adjoining construction and site improvements prior to starting Work. Include finish surfaces that may be misconstrued as damage caused by selective demolition operations.

1.6 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.

1.7 SITE CONDITIONS

.1 NRC 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 NRC Representative as far as practical.

.2 Hazardous Substances: Hazardous Substances are present in building to be selectively demolished. A report on the presence of Hazardous Substances is attached as an information document to this Section for review and use:

.1 Examine report to become aware of locations where hazardous materials are present.

.2 Coordinate with Section 02 81 01.

.3 Do not disturb Hazardous Substances or items suspected of containing Hazardous Substances.

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 All material from demolition shall be removed from site immediately with no salvage, selling, sorting or burning permitted on site

.3 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.

.4 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.

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 Perform surveys as the work progresses to detect hazards resulting from selective demolition activities.

3.2 PREPARATION

.1 Identify and mark all equipment and materials identified to be retained by NRC 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 Do not disrupt active or energized utilities crossing the demolition site.

.4 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.

.5 Mark all materials required to be re used, store in a safe place until ready for re installation.

.6 Adjust all junction boxes, receptacles and switch boxes flush with new wall construction where additional layers to existing construction are indicated.

.7 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.

3.3 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 Engineer where slab features interfere with core drilling.

.3 Notify the Engineer immediately for further instructions where coring or cutting will damage existing slab features.

3.4 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 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.

.7 Patch and repair all walls, floor and ceilings damaged during demolition with material matching adjacent walls, prepare ready for new finishes.

3.5 PATCHING AND REPAIRING

.1 Floors and Walls:

.1 Provide a level and smooth surface having uniform finish colour, texture, and appearance.

.2 Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform colour and appearance.

.3 Patch with durable seams that are as invisible as possible.

.4 Provide materials and comply with installation requirements specified in other Sections of these Specifications.

.5 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.

.6 Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

3.6 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 Arrange demolition and shoring work so that interference with the use of adjoining areas by the NRC Representative and users is minimized.

.3 Maintain safe access to and egress from occupied areas adjoining.

.4 Provide and maintain fire prevention equipment and alarms accessible during demolition.

3.7 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 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 to site approved Representative Consultant.

.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 listed in CWM Plan and in accordance with applicable regulations.

.1 Written authorization from Representative Consultant is required to deviate from facilities listed in CWM Plan.

.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 Representative Consultant is required to deviate from disposal facilities listed in CWM Plan.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 ASTM International (ASTM)

.1 ASTM C920- 14a Standard Specification for Elastomeric Joint Sealants.

.2 CSA Group (CSA)

.1 CSA A23.1/A23.2- 19, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CAN/CSA A3000- 18, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

.3 CAN/CSA G30.18- 09 (R2014), Billet-Steel Bars for Concrete Reinforcement.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation Meetings: in accordance with Section 01 10 00, convene pre-installation meeting one week prior to beginning concrete works.

.1 Ensure key personnel, site supervisor and NRC Representative attend.

.2 Verify project requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for proprietary materials used in Cast-In-Place Concrete and additives and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Provide testing results reports for review by NRC Representative and do not proceed without written approval when deviations from mix design or parameters found.

.4 Quality Assurance Submittals:

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

1.4 QUALITY ASSURANCE

.1 Provide to NRC Representative, two (2) week s minimum prior to starting concrete work, valid and recognized certificate from plant delivering concrete.

.2 Quality Control Plan: provide written report to NRC Representative verifying compliance concrete in place meets performance requirements.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements:

.1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.

.2 Modifying maximum time limit without receipt of prior written agreement from NRC Representative and concrete producer as described in CSA A23.1/A23.2is prohibited.

.2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

Part 2 PRODUCTS

2.1 DESIGN CRITERIA

.1 Alternative 1 - Performance: to CSA A23.1/A23.2, and as described in MIXES of PART 2 - PRODUCTS.

2.2 MATERIALS

.1 Portland Cement: to CAN/CSA A3001, Type GU.

.2 Blended hydraulic cement: Type GUb to CAN/CSA A3001.

.3 Water: to CSA A23.1/A23.2.

.4 Aggregates: to CSA A23.1/A23.2.

.5 Reinforcing bars:

.1 Billet steel, grade 400 deformed bars to CSA G30.18, unless indicated otherwise.

.6 Joint sealer/filler: grey to ASTM C920, Type M, Grade NS.

.7 Sealer: proprietary poly-siloxane resin blend.

.8 Other concrete materials: to CSA A23.1/A23.2.

2.3 MIXES

.1 Alternative 1 - Performance Method for specifying concrete: to meet NRC Representative performance criteria to CSA A23.1/A23.2.

.1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as described in PART 3 - VERIFICATION.

.2 Provide concrete mix to meet following hard state requirements:

.1 Durability and class of exposure: N.

.2 Compressive strength at 28-day age: 15 MPa minimum.

.3 Intended application: Housekeeping pad.

.4 Aggregate size: 20 mm maximum.

.3 Provide quality management plan to ensure verification of concrete quality to specified performance.

Part 3 EXECUTION

3.1 PREPARATION

.1 Provide 48 hours notice before each concrete pour.

.2 Place concrete reinforcing in accordance with instructions.

.3 During concreting operations:

.1 Development of cold joints not allowed.

.2 Concrete delivery and handling to facilitate placing with minimum of rehandling, and without damage to existing structure or Work.

.4 Protect previous Work from staining.

.5 Clean and remove stains prior to application of concrete finishes.

3.2 INSTALLATION/APPLICATION

.1 Do cast-in-place concrete work in accordance with CSA A23.1/A23.2.

3.3 FINISHES

.1 Equipment pads: provide smooth trowelled surface.

3.4 CURING

.1 Use curing compounds compatible with applied finish on concrete surfaces free of bonding agents and to CSA A23.1/A23.2.

3.5 SEALING APPLICATION

.1 After curing complete, apply poly-siloxane resin blend sealer at 4 m^2/L.

3.6 SITE TOLERANCES

.1 Concrete floor slab finishing tolerance to CSA A23.1/A23.2.

3.7 CLEANING

.1 Clean in accordance with Section 01 74 00 - Cleaning.

.2 Use trigger operated spray nozzles for water hoses.

.3 Designate cleaning area for tools to limit water use and runoff.

.4 Cleaning of concrete equipment in accordance with Section 01 35 43 Environmental Procedures.

.5 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 Green Seal Environmental Standards (GS)

.1 GS-11-2008, 2nd Edition, Paints and Coatings.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Safety Data Sheets (SDS).

.3 The Master Painters Institute (MPI)

.1 Architectural Painting Specification Manual - current edition.

.2 Maintenance Repainting Manual - current edition.

.4 National Research Council Canada (NRC)

.1 National Building Code of Canada 2015 (NBC).

.5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1113-A2007, Architectural Coatings.

.6 NACE International

.1 NACE International

.2 ANSI/NACE No. 13/SSPC-ACS-1-2016 -SG, Industrial Coating and Lining Application Specialist Qualification and Certification.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for paint and coating products and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 Provide and maintain dry, temperature controlled, secure storage.

.2 Store painting materials and supplies away from heat generating devices.

.3 Store materials and equipment in well ventilated area within temperature as recommended by manufacturer.

.4 Fire Safety Requirements:

.1 Supply fire extinguisher adjacent to storage area.

.2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.

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

.5 Waste Management: separate waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

1.4 SITE CONDITIONS

.1 Heating, Ventilation and Lighting:

.1 Provide minimum lighting level of 323 Lux on surfaces to be painted.

.2 Temperature, Humidity and Substrate Moisture Content Levels:

.1 Apply paint finishes when ambient air and substrate temperatures at location of installation can be satisfactorily maintained during application and drying process, within MPI and paint manufacturer's prescribed limits.

.2 Test concrete, masonry and plaster surfaces for alkalinity as required.

.3 Apply paint to adequately prepared surfaces, when moisture content is below paint manufacturer's prescribed limits.

.3 Additional application requirements:

.1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.

.2 Apply paint in occupied facilities during silent hours only. Schedule operations to approval of NRC Representative such that painted surfaces will have dried and cured sufficiently before occupants are affected.

Part 2 PART 2 PRODUCTS

2.1 MATERIALS

.1 Supply paint materials for paint systems from single manufacturer.

.2 Conform to latest MPI requirements for painting work including preparation and priming

.3 Materials in accordance with MPI – Architectural Painting Specification Manual "Approved Product" listing.

.1 Use MPI listed materials having E3 rating where indoor air quality requirements exist.

.2 Primer: VOC limit 100 g/L maximum.

.3 Paint: VOC limit 100 g/L maximum.

.4 Colours:

.1 Submit proposed Colour Schedule to NRC Representative for review.

.5 Interior painting:

.1 Concrete horizontal surfaces: floors.

.1 INT 3.2C – Epoxy – Gloss level 5 MPI #177.

.2 Plaster walls.

.1 Int 9.2A – Latex – Gloss level 2.

Part 3 PART 3 EXECUTION

3.1 GENERAL

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

.2 Perform preparation and operations for interior painting in accordance with MPI Architectural Painting Specifications Manual except where specified otherwise.

3.2 EXAMINATION

.1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to NRC Representative damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.

.2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.

3.3 PREPARATION

.1 Protection of in-place conditions:

.1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by NRC Representative

.2 Protect items that are permanently attached such as Fire Labels on doors and frames.

.3 Protect factory finished products and equipment.

.2 Surface Preparation:

.1 Remove electrical cover plates, light fixtures, surface hardware on doors and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.

.2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.

.3 Place "WET PAINT" signs in occupied areas as painting operations progress. Signs to approval of NRC Representative

.4 Clean and prepare surfaces in accordance with MPI Architectural Painting Specifications Manual specific requirements and coating manufacturer's recommendations.

.5 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications

of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.

.6 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.

.7 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements

.8 Touch up of shop primers with primer as specified.

3.4 APPLICATION

.1 Paint only after prepared surfaces have been accepted by NRC Representative

.2 Use method of application approved by NRC Representative.

.1 Conform to manufacturer's application recommendations.

.3 Apply coats of paint in continuous film of uniform thickness.

.1 Repaint thin spots or bare areas before next coat of paint is applied.

.4 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.

.5 Sand and dust between coats to remove visible defects.

.6 Mechanical/Electrical Equipment:

.1 Paint conduits, piping, hangers, ductwork and other mechanical and electrical equipment exposed in finished areas, to match adjacent surfaces, except as indicated.

.2 Do not paint over nameplates.

.3 Keep sprinkler heads free of paint.

.4 Paint fire protection piping red.

.5 Paint both sides and edges of backboards for controls and electrical equipment before installation.

.1 Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: separate waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 23 05 48 – Vibration and Seismic Controls for HVAC.

.2 Section 23 05 53 – Identification for HVAC Piping and Equipment.

.3 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.4 Section 23 05 15 – Hangers and Supports for HVAC Piping and Equipment.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.

.2 Indicate on drawings:

.1 Mounting arrangements.

.2 Operating and maintenance clearances.

.3 Shop drawings and product data accompanied by:

.1 Detailed drawings of bases, supports, and anchor bolts.

.2 Acoustical sound power data, where applicable.

.3 Points of operation on performance curves.

.4 Certification of compliance to applicable codes.

.4 Provide shop drawings of all fireproofing systems used. These drawings must include for each system:

.1 System number and ULC and/or FM approval.

.2 Specifications of each product used.

.5 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

.1 Operation and maintenance manual approved by, and final copies deposited with, NRC Representative before final inspection.

.2 Operation data to include:

.1 Control schematics for systems including environmental controls.

.2 Description of systems and their controls.

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

.4 Operation instruction for systems and component.

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

.6 Valves schedule and flow diagram.

.7 Colour coding chart.

.3 Maintenance data to include:

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

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

.4 Performance data to include:

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

.2 Equipment performance verification test results.

.3 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.5 Approvals:

.1 Submit electronic copy of draft Operation and Maintenance Manual to NRC Representative for approval. Submission of individual data will not be accepted unless directed by NRC Representative.

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

.6 Additional data:

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

.7 Site records:

.1 NRC Representative will provide electronic mechanical drawings. Provide sets of prints as required for each phase of work. Mark changes as work progresses and as changes occur.

.2 Include changes to existing mechanical systems, control systems and low voltage control wiring.

.3 Make available for reference purposes and inspection.

.8 As-Built drawings:

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

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

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

.4 Perform testing, adjusting and balancing for HVAC using as-built drawings.

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

.9 Submit copies of as-built drawings for inclusion in final TAB report.

1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.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 Visually inspect substrate in presence of NRC Representative.

.2 Inform NRC 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 NRC Representative.

3.2 COORDINATION WITH OTHER DIVISION

.1 The drawings show the general arrangement of the systems. Plan and coordinate the works with that of other Divisions to prevent any interference and to insure ultimate use of space.

.2 The material and equipment shown on the drawings shall be installed in conjunction with pipes, conduits, ventilation ducts and material shown on drawings of other Divisions in order to prevent conflicts.

.3 If an issue occurs because of faulty coordination with other Divisions specified in the tender documents, the Contractor shall suggest one or multiple solutions to resolve the issue without cost to the NRC Representative. The NRC Representative may accept or not the solutions and/or

suggest an alternative. This alternative does not relieve the Contractor from his contractual responsibilities.

.4 Any conduit or material incorrectly installed because of faulty coordination, which conflict with piping, conduits, ducts or equipment of other Divisions specified in the tender documents shall be removed and properly installed without cost to the NRC Representative.

.5 When an equipment or article is shown on a detail or elevation drawing from an other Division, they shall be installed as shown. No monetary compensation will be allowed to relocate these incorrectly installed parts due to not consulting such detail or elevation drawing before the installation.

.6 Electromechanical documents are not limited to the installation and testing requirements related to other Divisions. The Contractor is responsible for the validation of all requirements related to the installation of equipment indicated in other Division's drawings and specifications. Those requirements may not be limited to a single Division.

3.3 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.

3.4 IDENTIFICATION

.1 Do identification of Division 21, 22, 23 and 25 works in accordance with Section 23 05 53 – Identification for HVAC Piping and Equipment.

3.5 THERMAL INSULATION

.1 Do thermal insulation of Division 22 and 23 works in accordance with:

.1 Section 23 07 13 – Duct Insulation.

.2 Section 23 07 19 – HVAC Piping Insulation.

3.6 SYSTEM CLEANING

.1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.7 SUPPORTS OF PIPING AND EQUIPMENT

.1 Division 21, 22 and 23 works: to Section 23 05 15 – Hangers and Supports for HVAC Piping and Equipment.

3.8 SEISMIC CONTROL MEASURES

.1 Divisions 21, 22, 23 and 25 shall install seismic control measures as required by Section 23 05 48 – Vibration and Seismic Controls for HVAC.

3.9 PENETRATIONS OF ASSEMBLY WITH A FIRE RESISTANCE RATING

.1 Any penetration in walls and floors with a fire resistance rating must be sealed after the passage of pipes, ducts, conduits or cables in order to restore or maintain the integrity of the fire walls and floors. Refer to architectural drawings for the location of walls and floors with a fire resistance rating.

.2 The openings and penetrations should be sealed with the products according to an authorized sealing systems by ULC or any other organization approved by codes and standards.

.3 Retain the services of a specialist in fireproofing or demonstrate that the proposed personnel for installation has been formed and is accredited by the sealant manufacturer for fireproofing all the work.

3.10 PROTECTION OF HVAC EQUIPMENT AND DUCTWORK

.1 HVAC equipment and ductwork must be well protected during transportation. The transport packaging can be removed only at the time of installation of the equipment and conduits. If not, precautions should be taken to avoid contamination by dust or odors during storage.

.2 The system must be isolated from its environment. Duct openings in place, air intakes and diffusers should be sealed with plastic to prevent the introduction of pollutant into the system until it is put into service. Following commissioning, the elements must be cleaned and sealed again.

.3 Except for start-up activities, the entire HVAC system must be shut down during construction activities, unless previously agreed with the NRC Representative.

.4 If the system is started during work or commissioning, temporary filters with minimum efficiency of MERV 8 must be set up and checked regularly. All filters must be replaced by new filters immediately upon completion of the work. All temporary or permanent filters must be approved by the engineer prior to installation.

.5 Mechanical or electrical rooms can not be used for storage of products or materials.

3.11 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: separate waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.12 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 21 05 00 - Common Work Results for Mechanical.

1.2 REFERENCE STANDARDS

.1 National Fire Prevention Association (NFPA).

.1 NFPA 13-2019, Standard for the Installation of Sprinkler Systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Test reports:

.1 Submit certified test reports for wet pipe fire protection sprinkler systems from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

.4 Certificates:

.1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 CLOSEOUT SUBMITTALS

.1 Field Test Reports:

.1 Preliminary tests on piping system.

.2 Records:

.1 As-built drawings of each system.

.1 After completion, but before final acceptance, submit complete set of as-built drawings of each system for record purposes.

.3 Operation and Maintenance Manuals:

.1 Provide Material and Test Certificate for aboveground piping and other documentation for incorporation into manual in accordance with NFPA 13.

1.5 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: company or person specializing in wet sprinkler systems with documented experience.

.2 Supply grooved joint couplings, fittings, valves, grooving tools and specialties from a single manufacturer. Use date stamped castings for coupling housings, fittings, valve bodies, for quality assurance and traceability.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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.

.3 Storage and Protection:

.1 Store materials indoors.

.2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

.4 Packaging Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 PIPE, FITTINGS AND VALVES

.1 Pipe:

.1 Ferrous: to NFPA 13

.2 Fittings and joints to NFPA 13:

.1 Ferrous: screwed, welded, flanged or roll grooved.

.1 Grooved joints designed with two ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts. Cast with offsetting angle-pattern bolt pads for rigidity and visual pad-to-pad offset contact.

.2 Provide, threaded, fittings into which sprinkler heads, sprinkler head riser nipples, or drop nipples are threaded.

.3 Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to bite into pipe when pressure is applied will not be permitted.

.4 Rubber gasketted grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 32 mm and larger.

.5 Fittings: ULC approved for use in wet pipe sprinkler systems

.6 Ensure fittings, mechanical couplings, and rubber gaskets are supplied by same manufacturer.

.7 Side outlet tees using rubber gasketted fittings are not permitted.

.8 Sprinkler pipe and fittings: metal.

.3 Pipe hangers:

.1 ULC listed for fire protection services in accordance with NFPA

2.2 SPRINKLER HEADS

.1 General: to NFPA 13 and ULC listed for fire services

.2 Sprinkler Head Type:

.1 Type A: upright bronze with protective guard.

.3 Provide nominal 1.2 cm orifice sprinkler heads.

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, inspect and test to acceptance in accordance with NFPA 13 and NFPA 25

3.3 PIPE INSTALLATION

.1 Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings.

.2 Keep interior and ends of new piping and existing piping thoroughly cleaned of water and foreign matter.

.3 Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter.

.4 Inspect piping before placing into position.

3.4 CONNECTIONS TO EXISTING WATER SUPPLY SYSTEMS

.1 Notify Contracting Officer in writing at least 5 days prior to connection date.

.2 Use tapping or drilling machine valve and mechanical joint type sleeves for connections to be made under pressure.

.3 Bolt sleeves around main piping.

.4 Bolt valve to branch connection. Open valve, attach drilling machine, make tap, close valve, and remove drilling machine, without interruption of service.

.5 Furnish materials required to make connections into existing water supply systems, and perform excavating, backfilling, and other incidental labour as required.

3.5 FIELD PAINTING

.1 Clean, pretreat, prime, and paint new systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories.

.2 Apply coatings to clean, dry surfaces, using clean brushes.

.3 Clean surfaces to remove dust, dirt, rust, and loose mill scale.

.4 Immediately after cleaning, provide metal surfaces with 1 coat of pretreatment primer applied to minimum dry film thickness of 0.3 ml, and one coat of zinc chromate primer applied to minimum dry film thickness of 1.0 ml.

.5 Shield sprinkler heads with protective covering while painting is in progress.

.6 Upon completion of painting, remove protective covering from sprinkler heads.

.7 Remove sprinkler heads which have been painted and replace with new sprinkler heads.

.8 Provide primed surfaces with following:

.1 Piping in Finished Areas:

.1 Provide primed surfaces with 2 coats of red paint.

.2 Provide piping with self-adhering red plastic bands spaced at maximum of 6 m intervals throughout piping systems.

3.6 FIELD QUALITY CONTROL

.1 Site Test, Inspection:

.1 Perform test to determine compliance with specified requirements in presence of NRC Representative.

.2 Test, inspect, and approve piping before covering or concealing.

.3 Preliminary Tests:

.1 Hydrostatically test each system at 200 psig for a 2-hour period with no leakage or reduction in pressure.

.2 Flush piping with potable water in accordance with NFPA 13

.4 Formal Tests and Inspections:

.1 Do not submit request for formal test and inspection until preliminary test and corrections are completed and approved.

.2 Submit written request for formal inspection at least 5 days prior to inspection date.

.3 Repeat required tests as directed.

.4 Correct defects and make additional tests until systems comply with contract requirements.

3.7 CLEANING

.1 Clean in accordance with Section 01 74 00 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 21 05 00 – Common Work Results for Mechanical.

.2 Section 23 05 15 - Common Installation Requirements for HVAC Pipework.

1.2 REFERENCE STANDARDS

.1 National Research Council Canada (NRC).

.1 National Plumbing Code of Canada 2015 (NPC).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for plumbing products and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for plumbing specialties and accessories for incorporation into manual.

.1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect plumbing materials from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 HOSE BIBBS AND SEDIMENT FAUCETS

.1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.

2.2 STRAINERS

.1 860 kPa, Y type with 20 mesh, monel, lead free, bronze or stainless steel removable screen.

.2 NPS 2 and under, bronze body, screwed ends, with brass cap.

2.3 CONDENSATE SUMP PUMP

.1 Submersible pump with collection tank.

.2 Automatic operation with integrated floats.

.3 System consist of:

- .1 3.78 Litres ABS tank.
- .2 On-off floats.
- .3 13 mm pump discharge with replacable check valve.
- .4 13 mm piping.
- .5 Power cord with 3 prongs.

.4 Dimensions:

- .1 305 mm x 152 mm x 257 mm.
- .2 Inlet: 16 mm ID grommet, 32 mm hole.
- .3 Outlet: 15 mm compression fitting.

.5 Performance:

- .1 Power requirement: 360 W @ 120V/1/60 Hz. 4 Amp.
- .2 0.38 L/s @ 3 m head (6.15 GPM @ 10 ft).

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 plumbing specialities and accessories installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of NRC Representative.
- .2 Inform NRC 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 NRC 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 data sheet.

3.3 INSTALLATION

.1 Install in accordance with National Plumbing Code of Canada (NPC).

.2 Install in accordance with manufacturer's instructions and as specified.

3.4 STRAINERS

.1 Install with sufficient room to remove basket for maintenance.

3.5 CONDENSATE SUMP PUMP

.1 Pipe discharge of sump pump to nearest open drain.

3.6 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

3.7 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by plumbing specialties and accessories installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 21 05 00 – Common Work Results for Mechanical.

.2 Section - 23 05 15 - Common Installation Requirements for HVAC Pipework.

.3 Section - 23 05 23.01 - Valves – Bronze.

1.2 REFERENCE STANDARDS

.1 American Society of Mechanical Engineers International (ASME).

.1 ANSI/ASME B16.15-13, Cast Cooper Alloy Threaded Fittings, Classes 125 and 250.

.2 ANSI/ASME B16.18-12, Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ANSI/ASME B16.22-13, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

.2 ASTM International (ASTM)

.1 ASTM B 32-08(2014), Standard Specification for Solder Metal.

.2 ASTM B 88M-14, Standard Specification for Seamless Copper Water Tube (Metric).

.3 National Research Council (NRC)

.1 National Plumbing Code of Canada (NPC) 2015.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data

.1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Packaging Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

.2 Place materials defined as hazardous or toxic in designated containers.

Part 2 Products

2.1 PIPING

.1 Domestic cold system, within building.

.1 Above ground:

.1 Copper tube, hard drawn, type L: to ASTM B 88M.

2.2 FITTINGS

.1 Cast bronze threaded fittings, Class 125: to ANSI/ASME B16.15.

.2 Cast copper, solder type: to ANSI/ASME B16.18.

.3 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.

.4 NPS 1 ½ and smaller:

.1 Wrought copper to ANSI/ASME B16.22, cast copper to ANSI/ASME B16.18; Suitable for operating pressure to 1380 kPa.

2.3 JOINTS

.1 Solder: tin-antimony-silver-copper.

.2 Teflon tape: for threaded joints.

2.4 BALL VALVES

.1 NPS 2 and under, screwed:

.1 Class 150.

.2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle as specified Section 23 05 23.01 - Valves - Bronze.

.2 NPS 2 and under, soldered:

.1 To ANSI/ASME B16.18, Class 150.

.2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper adaptors as specified Section 23 05 23.01 – Valves - Bronze

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 INSTALLATION

.1 Install in accordance with NPC.

.2 Install pipe work in accordance with Section 23 05 15 - Common Installation Requirements for HVAC Pipework, supplemented as specified herein.

.3 Assemble piping using fittings manufactured to ANSI and Standard Council of Canada (SCC) standards

.4 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

.5 Valves

.1 Isolate equipment, fixtures and branches with ball valves.

3.3 PRESSURE TESTS

.1 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.

3.4 CLEANING

.1 Clean in accordance with Section 01 74 00 - Cleaning.

.2 Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 21 05 00 – Common Work Results for Mechanical.

1.2 DEFINITIONS

.1 HVAC System: complete air duct system from outside air intake louvers to furthest air supply terminal unit and including:

.1 Rigid supply and return ductwork.
.2 Flexible ductwork.
.3 Mixing plenum boxes.
.4 Return air plenums including ceiling plenums.
.5 Acoustically insulated duct linings.
.6 Diffusers, registers and terminal units.
.7 Dampers and controls.

1.3 REFERENCE STANDARDS

.1 National Air Duct Cleaners Association (NADCA)

.1 ACR Standard, 2006 edition: Assessment, Cleaning and Restoration of HVAC Systems.

.2 North American Insulation Manufacturers Association (NAIMA)

.1 NAIMA 2005, Cleaning Fibrous Glass Insulated Duct Systems - Recommended Practices.

.3 United States Environmental Protection Agency (US EPA)

.1 US EPA 1999, 40 CFR Parts 152 and 156.

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Site Evaluation: conduct site visit 2 weeks before start of work to establish cleaning plan determining how areas of facility and HVAC systems will be protected during cleaning operations.

.1 Organize and lay out plan for video survey and identify camera and cleaning apparatus insertion points.
.2 NRC representative to review video survey and cleaning plan 1 week minimum prior to start of work.
.1 Proceed with survey and cleaning work only after receiving written approval from NRC representative.

.2 Damaged or broken equipment and components found during initial testing and inspection will be repaired or replaced by NRC representative.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit cleaning plan developed during site evaluation.

.1 Ensure plan includes sequence of operation, identification of camera and cleaning apparatus insertion points and schedule for work.

.3 Product Data:

.1 Submit manufacturer's printed product literature and data sheets for antimicrobial agents and include product characteristics, performance criteria and limitations.

.4 Testing Laboratory Services: submit name and address of laboratory engaged for work of this Section.

.1 Submit laboratory analysis report of particulate collection indicating:

.1 Location of collection.

.2 Particulate grade.

.3 Particulate size.

.4 Percentage concentration of individual particulates in each sample.

1.6 CLOSEOUT SUBMITTALS

.1 Provide submittals in accordance with Section 01 78 00 - Closeout Submittals.

.2 Post Cleaning Inspection Report: submit electronic copy of Final Inspection Report, including data collected, observations and recommendations as well as following information:

.1 Name and address of facility.

.2 Name and address of HVAC cleaning contractor.

.3 Description of HVAC systems with sketches identifying systems cleaned.

.4 Identification scheme for location points in systems that were inspected with accompanying notes describing methods of inspection or tests used.

.5 Identification of points where samples were collected and type of analysis used for each collection.

.6 Identification of each sample collected.

.7 Comments complete with photographs of each sampling location and other observed system features.

.8 Identify systems tested, observations, actions taken and recommendations for future maintenance.

1.7 QUALITY ASSURANCE

.1 Contractor: member accredited and membership in good standing with NADCA.

Part 2 Products

2.1 ACCESS DOORS AND PANELS

.1 Equipment Access Doors and Panels: construct from same materials as equipment panelling complete with sealing gasket and positive locking device.

.1 Size access doors and panels in equipment to allow for inspection and cleaning.

.2 Ductwork Access Doors: construct access doors from 1.27 mm minimum galvanized sheet steel with gasketted seal.

.1 Ensure access door is 25 mm greater in every dimension than access opening.

.2 Access door size 200 mm x 200 mm minimum.

.3 Secure access doors with sheet metal screws on 75 mm centres minimum. Ensure 3 screws per side minimum.

.3 Access Doors and Panels Acoustic Lining:

.1 Install acoustic lining to match existing.

.2 Self-adhesive glass fibre tape capable of adhering to both acoustic lining and metal access door or panel materials.

.3 Water-based duct sealer for repairing cut acoustic lining.

2.2 ANTIMICROBIAL AGENT

.1 Use antimicrobial agents registered with US EPA-40 CFR

2.3 AIR DUCT CLEANING EQUIPMENT

.1 Manually propelled full contact brushes:

.1 Ensure brushes are specifically manufactured and shaped to fit individual ducts, equipment and components of HVAC system.

.1 Ensure brushes are sized to fit various duct sizes in HVAC system.

.2 Ensure brushes make scrubbing motion and full contact with HVAC system interior surfaces to be cleaned.

.2 Brushes: manually propelled with integrally-mounted drive and nylon or other non-metallic material bristles.

.1 Ensure motor has capacity to continue to push brush after bristles are distorted.

.2 Replace worn and ineffective brushes when required.

2.4 HEPA FILTER EVACUATION FAN

.1 Evacuation Fan: includes fan, HEPA filter, flexible hose and motor capable of maintaining debris and particulates airborne in airstream until they reach evacuation fan and maintaining system under negative pressure.

.1 Ensure HEPA filters are clean and maintain evacuation fan and HEPA filter to run efficiently.

2.5 HEPA VACUUM UNIT

.1 Vacuum Unit: includes vacuum fan, integral HEPA filter, suction hose and vacuum head, capable of maintaining HVAC System debris and particulates airborne in air stream until they reach vacuum unit and maintaining system under negative pressure.

.1 Ensure HEPA filters are clean and maintain vacuum unit and HEPA filter to run efficiently.

Part 3 Execution

3.1 PREPARATION

.1 Close down HVAC system.

.2 Locate and identify externally visible HVAC system features which may affect cleaning process including:

- .1 Control devices.
- .2 Fire and smoke control dampers.
- .3 Balancing dampers: indicate and record positions for resetting.
- .4 Fire alarm devices.
- .5 Monitoring devices and controls.

.3 Cut openings in equipment panels and ductwork for access to system interior.

- .1 Square or rectangular opening sizes: 200 mm minimum each side.
- .2 Circular opening sizes: 200 mm minimum diameter.

.4 Installation of Access Doors and Panels: install access doors and panels for equipment where required to facilitate system inspection and cleaning.

- .1 Install access doors and panels for inspection and cleaning of equipment as follows:
  - .1 Heating and cooling coils.
  - .2 Fan units.
  - .3 Filters.
  - .4 Dampers.
  - .5 Sensors.

.5 Installation of Access Doors in Ductwork: install access doors in ductwork where required to facilitate system inspection and cleaning.

- .1 Access door installation is not permitted in flexible ductwork.
  - .1 Inspect flexible ductwork only by disconnecting from main duct and inspecting from open end.

.6 When acoustically lined duct is cut for access, repair cut edges of acoustic lining using self-adhesive fibre glass tape and water based duct sealer.

- .1 Adhere new acoustic lining to match existing to inside of access panel or door to ensure continuity of acoustic properties of system.

3.2 EXAMINATION / PRE-CLEANING INSPECTION

.1 Verification of Conditions:

- .1 Make visual inspection of interior of HVAC system using remote controlled robotic camera.
- .2 Insert camera at pre-established strategic locations to evaluate condition and cleanliness of HVAC systems and components.

.2 Evaluation and Assessment:

.1 Identify location and type of internal components.

.2 Identify extent of potential problems.

.3 If toxic or hazardous materials or deposits are suspected after initial inspection immediately stop work and inform NRC Representative.

.1 Do not proceed further with inspection operations until written approval from NRC Representative.

3.3 DUCT CLEANING

.1 Do duct cleaning in accordance with NADCA ACR Standard

.2 Isolate and clean sections in zones to ensure that dirt deposits and debris from zone being cleaned does not pass through another zones which has already been cleaned.

.1 Isolate zone of duct before cleaning.

.3 Ensure vacuum units and evacuation fans are securely in place before starting cleaning operation of isolated section of HVAC air duct system.

.4 Install HEPA filter evacuation fan at one end of zone section and insert full contact brushes at other end.

.5 Clean HVAC supply air duct system and components where particulate sample collected from surfaces is greater than 75 mg of particulate per 0.01 square metres.

.6 Clean exhaust, return, transfer ductwork and plenums, equipment and components where particulate sample collected from surfaces is greater than 75 mg of particulate per 0.01 square metres.

.7 Energize brushes to travel from insertion point to HEPA filter evacuation fan.

.1 Pass brushes through sections as often as necessary to achieve required cleanliness.

.2 Change brush sizes as required to ensure positive contact with duct and component interiors.

.3 Clean corners and pockets where dirt and debris can accumulate.

.8 Clean equipment, components and other features in isolated zone before moving to next zone of HVAC air duct system.

.9 Clean diffusers, registers, louvers and other terminal units.

.10 Advise NRC Representative 72 hours minimum before deactivation of fire alarm and smoke detectors duct cleaning operations.

.1 NRC Representative will pay for costs of deactivation of fire alarm and smoke detector system.

3.4 ACOUSTICALLY LINED DUCTWORK CLEANING

.1 Clean glass fibre acoustically insulated ducts to NAIMA recommended practices

.1 Use specifically designed robotic apparatus that has been demonstrated not to damage acoustic glass fibre lining.

.2 Monitor cleaning process progress by onboard camera.

3.5 FIELD QUALITY CONTROL/FINAL INSPECTIONS

.1 Post Cleaning Inspection: carry out final inspection using robotic camera and other visual inspection methods after final cleaning has been completed.

.1 Carry out video survey as directed by NRC Representative.

.2 Include in final survey areas inspected by NRC Representative prior to cleaning.

.3 Identify on HVAC system record drawings access points used for inspection and cleaning.

.4 Re-collect and analyse particulates collected at same locations where original samples were collected before cleaning.

.5 Reset components including dampers and sensors, which have been disturbed during cleaning operations.

3.6 SYSTEM STARTUP

.1 Cover each inspection opening with access door or panel and secure in place after inspection and cleaning are completed.

.2 Restart each HVAC system.

3.7 CLEANING

.1 Clean in accordance with Section 01 74 00 - Cleaning.

.2 Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 02 41 19.16 – Selective Interior Demolition.

.2 Section 21 05 00 – Common Work Results for Mechanical.

.3 Section 26 05 05 - Selective Demolition for Electrical

1.2 REFERENCE STANDARDS

.1 CSA Group (CSA)

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

1.3 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 mechanical and 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 NRC Representative ready for reuse.

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

.6 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.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Action Submittals: Provide the following in accordance with Section 01 33 00 - Submittal Procedures before starting work of this Section:

.2 Landfill Records: Indicate receipt and acceptance of selective demolition waste and hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.5 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.

1.6 SITE CONDITIONS

.1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition on date that tender is accepted.

.2 Existing Hazardous Substances: NRC Representative has performed a hazardous substances assessment and it is not expected that hazardous substances will be encountered in the Work.

.3 Discovery of Hazardous Substances: It is not expected that Hazardous Substances will be encountered in the Work; immediately notify NRC Representative if materials suspected of containing hazardous substances are encountered and perform the following activities:

.1 Refer to Section 01 41 00 - Regulatory Requirements for directives associated with specific material types.

.2 Hazardous substances will be as defined in the Hazardous Products Act.

.3 Stop work in the area of the 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 Contractor] under a separate contract or as a change to the Work.

.6 Proceed only after written instructions have been received from NRC Representative.

1.7 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 Owner'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

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; NRC 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 debris from blocking drainage inlets.

.2 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 Owner and users is minimized and as follows:

.1 Prevent debris from endangering the safe access to and egress from occupied buildings.

.2 Notify NRC 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 Do not disrupt active or energized utilities without approval of the Owner.

.2 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.

.3 Demolish parts of existing building to accommodate new construction and remedial work as indicated.

.4 At end of each day's work, leave worksite in safe condition.

.5 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.

3.4 CLOSEOUT ACTIVITIES

.1 DemolitionWaste Disposal: Arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle centre).

END OF SECTION

Part 1 General

1.1 Related Requirements

.1 Section 21 05 00 – Common Work Results for Mechanical.

1.2 REFERENCE STANDARDS

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE 90.1-2019, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.3 Closeout Submittals

.1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Waste Management and Disposal: in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

.1 Motors: high efficiency, in accordance with local Hydro company standards and to ASHRAE 90.1

2.2 MOTORS

.1 Provide motors for mechanical equipment as specified.

.2 Motors under 373 W (1/2 HP): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.

.3 Motors 373 W (1/2 HP) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 600 V, unless otherwise indicated.

2.3 DRIVE GUARDS

.1 Unprotected fan inlets or outlets:

.1 Wire or expanded metal screen, galvanized, 19 mm mesh.

.2 Net free area of guard: not less than 80% of fan openings.

.3 Securely fasten in place.

.4 Removable for servicing.

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 Fasten securely in place.

.2 Make removable for servicing, easily returned into, and positively in position.

3.3 CLEANING

.1 Proceed in accordance with Section 01 74 00 - Cleaning.

.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 21 05 00 – Common Work Results for Mechanical.

.2 Section 23 05 48 – Vibration and Seismic Controls for HVAC.

.3 Section 22 11 16 – Domestic Water Piping.

.4 Section 23 21 13.02 – Hydronic Systems: Steel.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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.

.3 Packaging Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 MATERIAL

.1 Not used.

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.

.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 manual air vents to at high points in piping systems.

.2 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 Screwed fittings jointed with Teflon tape.

.2 Protect openings against entry of foreign material.

.3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.4 Assemble piping using fittings manufactured to ANSI standards

.5 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.

.1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.

.6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.7 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

.8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.9 Install, except where indicated, to permit separate thermal insulation of each pipe.

.10 Group piping wherever possible and as indicated.

.11 Ream pipes, remove scale and other foreign material before assembly.

.12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.13 Provide for thermal expansion as indicated.

.14 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 Use ball or butterfly valves at branch take-offs for isolating purposes except where specified.
.6 Install butterfly valves between weld neck flanges to ensure full compression of liner.
.7 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.

.15 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 FLUSHING OUT OF PIPING SYSTEMS

.1 Before start-up, clean interior of piping systems.

.2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.9 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise 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 NRC Representative.

.6 Pay costs for repairs or replacement, retesting, and making good. NRC Representative to determine whether repair or replacement is appropriate.

.7 Insulate or conceal work only after approval and certification of tests by NRC Representative.

3.10 EXISTING SYSTEMS

.1 Connect into existing piping systems at times approved by NRC Representative.

.2 Request written approval by 5 days minimum, prior to commencement of work.

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

3.11 CLEANING

.1 Clean in accordance with Section 01 74 00 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 21 05 00 – Common Work Results for Mechanical

1.2 REFERENCE STANDARDS

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B40.100-2005, Pressure Gauges and Gauge Attachments.

.2 ASME B40.200-2008, Thermometers, Direct Reading and Remote Reading.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-14.4-M88, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.

.2 CAN/CGSB-14.5-M88, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for thermometers and pressure gauges 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 01 61 00 - Common Product Requirements.

.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 thermometers and pressure gauges indoors and in accordance with the manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect thermometers and pressure gauges from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 GENERAL

.1 Design point to be at mid-point of scale or range.

.2 Extension collars clearing the insulation thickness.

2.2 DIRECT READING THERMOMETERS

.1 Industrial, variable angle type, liquid filled, 228 mm scale length: to CAN/CGSB-14.4.

.2 Resistance to shock and vibration.

2.3 THERMOMETER WELLS

.1 Copper Pipe: Copper or bronze.

.2 Steel Pipe: brass or stainless steel.

2.4 PRESSURE GAUGES

.1 112 mm, dial type: to ASME B40.100, Grade 2A, 0.5% accuracy full scale unless otherwise specified.

.2 Provide:

.1 Snubber for pulsating operation.
.2 Gasketted pressure relief back with solid front.
.3 Bronze stop cock.
.4 Oil filled for high vibration applications (pumps).

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 NRC 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 NRC Representative.

3.2 GENERAL

.1 Install thermometers and gauges so they can be easily read from floor or platform.

.2 Install between equipment and first fitting or valve.

3.3 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 Cooling coils.

.3 Install wells as indicated for balancing purposes.

.4 Use extensions where thermometers are installed through insulation.

3.4 PRESSURE GAUGES

.1 Install in locations as follows:

.1 Suction and discharge of pumps.

.2 Inlet and outlet of coils.

.3 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.

3.5 NAMEPLATES

.1 Install engraved lamicoid nameplates in accordance with Section 23 05 53 - Identification For HVAC Piping and Equipment, identifying medium.

3.6 CLEANING

.1 Progress Cleaning: Clean in accordance with Section 01 74 00 - Cleaning.

.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

3.7 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 RELATED REQUIREMENTS

.1 Section 21 05 00 – Common Work Results for Mechanical.

.2 Section 22 11 16 – Domestic Water Piping.

.3 Section 23 21 13.01 – Hydronic Systems: Copper.

.4 Section 23 21 13.02 – Hydronic Systems: Steel.

1.2 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

.1 ANSI/ASME B1.20.1-2013, Pipe Threads, General Purpose.

.2 ANSI/ASME B16.18-2018, Cast Copper Alloy Solder Joint Pressure Fittings.

.2 ASTM International (ASTM)

.1 ASTM A276-17, Standard Specification for Stainless Steel Bars and Shapes.

.2 ASTM B62-17, Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 ASTM B283-19a, Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).

.4 ASTM B505/B505M-18, Standard Specification for Copper-Base Alloy Continuous Castings.

.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)

.1 MSS-SP-25-2018, Standard Marking System for Valves, Fittings, Flanges and Unions.

.2 MSS-SP-80-2019, Bronze Gate Globe, Angle and Check Valves.

.3 MSS-SP-110-2010, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

.4 NSF International

.1 NSF 61-2019 - Drinking Water System Components - Health Effects.

.2 NSF 372-2016 - Drinking water system components - Lead content.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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.

.3 Packaging Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

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 (NPS 2 and smaller): screwed ends to ANSI/ASME B1.20.1.

.2 Steel pipe systems (NPS 2-1/2 and larger): flanged ends.

.3 Copper tube systems: solder ends to ANSI/ASME B16.18.

.3 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.

.4 Silent Check Valves:

.1 NPS 2 and under:

.1 Body: cast high tensile bronze to ASTM B62 with integral seat.

.2 Pressure rating: Class 125.

.3 Connections: screwed ends to ANSI B1.20.1 and with hex. shoulders.

.4 Disc and seat: renewable rotating disc.
.5 Stainless steel spring, heavy duty.
.6 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 150.
.3 Connections: solder ends to ANSI.
.4 Stem: tamperproof ball drive.
.5 Stem packing nut: external to body.
.6 Ball and seat: replaceable stainless steel solid ball and Teflon seats.
.7 Stem seal: PTFE with external packing nut.
.8 Operator: removable lever handle.

.6 Balancing for TAB:

.1 NPS 2 and under: calibrated balancing valve, globe style, Y pattern, equal percentage.
.2 Multi-turn high strength resin handwheel with indicator and memory feature to lock valve position.
.3 Body, steam and plug: brass.
.4 Built in venturi for flow balancing with two (2) 6 mm threaded metering ports with check valves and gasketted caps.

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 01 74 00 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 21 05 00 – Common Work Results for Mechanical.

1.2 REFERENCE STANDARDS

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B31.1-2018, Power Piping.

.2 ASTM International

.1 ASTM A125-96-2018, Standard Specification for Steel Springs, Helical, Heat-Treated.

.2 ASTM A307-14, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.3 ASTM A563-07-2013, Standard Specification for Carbon and Alloy Steel Nuts.

.3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)

.1 MSS SP58-2018, Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.

.3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.

.4 Underwriter's Laboratories of Canada (ULC)

.5 National Research Council Canada (NRC)

.1 National Plumbing Code of Canada [2015] (NPC).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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.

.3 Packaging Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

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 as specified Section 23 05 48.

2.2 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with MSS SP 58. ANSI B31.1 and

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 SP69.

.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.

.1 Adjustable clevis: material to MSS SP69 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

.1 Ensure "U" has hole in bottom for riveting to insulation shields.

.2 U-bolts: carbon steel to MSS SP 69 with 2 nuts at each end to ASTM A 563

.1 Finishes for steel pipework: galvanized.

.2 Finishes for copper pipework: black, with formed portion epoxy coated.

2.4 RISER CLAMPS

.1 Steel or cast iron pipe: galvanized carbon steel to MSS SP58, type 42, UL listed.

.2 Copper pipe: carbon steel copper plated to MSS SP 58, type 42

.3 Bolts: to ASTM A 307

.4 Nuts: to ASTM A 563

2.5 INSULATION PROTECTION SHIELDS

.1 Insulated cold piping:

.1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP 69, 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 69

2.6 CONSTANT SUPPORT SPRING HANGERS

.1 Springs: alloy steel to ASTM A 125, 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 A 125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install in accordance with:

.1 Manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

.1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.

.3 Clamps on riser piping:

.1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.

.2 Bolt-tightening torques to industry standards.

.3 Steel pipes: install below coupling or shear lugs welded to pipe.

.4 Cast iron pipes: install below joint.

.4 Clevis plates:

.1 Attach to concrete with 4 minimum concrete inserts, one at each corner.

.5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

.6 Use approved constant support type hangers where:

.1 Vertical movement of pipework is 13 mm or more,

.2 Transfer of load to adjacent hangers or connected equipment is not permitted.

.7 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 Plumbing piping: to National Plumbing Code of Canada (NPC)

.2 Fire protection: to applicable fire code.

.3 Copper piping: up to NPS 1/2: every 1.5 m.

.4 Within 300 mm of each elbow.

.5 To following table:

Maximum Pipe Size: NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 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.

.4 For piping having an operating fluid temperature of 18°C or less, install saddles or hangers on top of insulation over prefabricated insulation shields for each saddle and/or support.

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.

3.7 CLEANING

.1 Clean in accordance with Section 01 74 00 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 21 05 00 – Common Work Results for Mechanical.

1.2 REFERENCE STANDARDS

.1 National Fire Protection Association (NFPA)

.1 NFPA 13-2019, Standard for the Installation of Sprinkler Systems.

.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 01 33 00 - Submittal Procedures.

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Shop drawings

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada and hired by the Contractor.

.3 The shop drawings must include a report on the evaluation and mitigation of seismic effects related to the seismic force resisting systems.

.4 The report shall include, at least, the following information:

.1 General data for the project:

.1 Location of the building.

.2 General description of the building including height of the building (h_n).

.3 Site class at the location of the building.

.4 Importance category of the building.

.5 Value of S_a (0.2).

.6 Value of F_a.

.7 Value of I_e.

.2 List of all technical components included in the contract which need to be have an evaluation of the seismic effects. The following components shall be included:

.1 Air handling unit 77AHU159.

.2 Exhaust air fan 77RAF50005.

.3 Chilled water pumps 77CWP159A, 77CWP159B.

.4 Air terminal unit 77VAV159-1.

.5 Ductwork connecting to new equipment.

.6 Chilled water piping.

.7 Hot water heating piping.

.8 Sprinkler piping.

.3 List of all technical components which may be exempted with the justifications.

.4 For each technical component (TC) the evaluation of the seismic effect and the seismic force resisting system applied. Include following elements:

.1 Identification of the TC.

.2 Location of the TC including height (h_x).

.3 Description of TC including:

.1 Type of equipment.

.2 Make and model.

.3 Dimensions.

.4 Weight.

.5 Category and values of Cp, Ar and Rp.

.4 Calculation of lateral force Vp, and forces on building structure;

.5 Description of the resisting system applied, including:

.1 Make and model of chosen material.

.2 Installation drawing specific for this project.

.3 Drawing showing the location of the seismic resisting systems.

.5 For each TC located on the ground, on a slab or on an equipment base, the overturn force calculation and description of the resisting system. Included following elements:

.1 Identification of the TC.

.2 Location of the TC including height (h_x).

.3 Description of TC including:

.1 Type of equipment.

.2 Make and model.

.3 Dimensions.

.4 Weight.

.5 Location of gravity center.

.4 Calculation of the overturn force.

.5 Description of the resisting system applied, including:

.1 Mark and model of chosen material.

.2 Installation drawing specific for this project.

.3 Drawing showing the location of the seismic resisting systems.

.5 The hired Professional Engineer shall demonstrate recognized expertise in seismic protection. Contractor shall provide his contract details no more than two (2) weeks after contract signature.

.6 Provide separate shop drawings for each isolated system shop drawings complete with performance and product data.

.7 Provide detailed drawings of seismic control measures for equipment and piping.

1.4 QUALITY ASSURANCE

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

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 The Professional Engineer who prepared the evaluation and mitigation of seismic effects report shall inspect the work related to the seismic force resisting systems.

.3 Obtain from the seismic protection engineer a written and signed certification indicating that the seismic force resisting systems have been installed as per the report and the amendments to the report. Submit this certification before submitting the work certificate of compliance.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Waste Management and Disposal: in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

.1 Size and shape of bases type and performance of vibration isolation as indicated.

2.2 DESIGN CRITERIAS

.1 Site class of the building is E – Unknown.

.2 Importance category of building is Normal.

.3 Height of building:

.1 Height of the floor of the lowest level: 55 m.

.2 Height of the floor of the highest level: 77 m.

.3 Height of the project level is: 55 m.

.4 Evaluation and mitigation of seismic effects

.1 Evaluation of seismic effects shall be done as per requirements of sub-section 4.1.8 of the National Building Code of Canada - 2015.

.5 Seismic force resisting systems shall be designed as per following standards:

.1 NFPA 13-2016.
.2 SMACNA – Seismic Restraint Manual Guidelines for Mechanical System.
.3 ASHRAE – Seismic and Wind Design.

2.3 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 firestopping.

.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.

.4 Piping systems:

.1 Fire protection systems: to NFPA 13.
.2 Piping systems: hangers longer than 300 mm; brace at each hanger.
.3 Compatible with requirements for anchoring and guiding of piping systems.

.5 Bracing methods:

.1 Approved by NRC 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.

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 Contractor is responsible to evaluate, furnish and install seismic protection for all technical components installed under his responsibility.

.3 Install seismic force resisting system as per the indications of the evaluation and mitigation of seismic effects report.

.4 Any modification to the seismic force resisting system for any reason, shall be subject to a new calculation by the Engineer responsible for the seismic protection, and issued as an amendment to the report.

.5 The Engineer who prepared the evaluation and mitigation of seismic effects report shall inspect the work related to the seismic force resisting systems.

3.3 INSTALLATION – VIBRATION ISOLATION EQUIPMENT

.1 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.

.2 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.

.3 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 DN 100: first 1 point of support. DN 125 to DN 200: first 2 points of support.

.2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.

.4 Where isolation is bolted to floor use vibration isolation rubber washers.

.5 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.

3.4 FIELD QUALITY CONTROL

.1 Obtain from the seismic protection engineer a written and signed certification indicating that the seismic force resisting systems have been installed as per the report and, if applicable, amendments to the report.

3.5 CLEANING

.1 Proceed in accordance with Section 01 74 00 - Cleaning.

.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 21 05 00 – Common Work Results for Mechanical.

1.2 REFERENCE STANDARDS

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.

.2 CAN/CGSB-24.3-92, Identification of Piping Systems.

.2 National Fire Protection Association (NFPA)

.1 NFPA 13-2019, Standard for the Installation of Sprinkler Systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

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

.2 Submittal:

.1 Submit list of proposed legend and identifications for approval by NRC Representative.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Waste Management and Disposal: in accordance with Section 01 74 19 - Waste Management and Disposal.

.2 Do not dispose of unused paint material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

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 NRC will provide equipment nameplates/labels in accordance with their standard for installation by the contractor.

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.

2.4 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:

.1 Sprinklers: to NFPA 13

2.5 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 NRC 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
Hot water heating supply	Green	HEATING SUPPLY
Hot water heating return	Green	HEATING RETURN
Domestic cold water supply	Green	DOM. CW
Non potable cold water supply	Mauve	NON POTABLE CWS
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Sprinklers	Red	SPRINKLERS

2.6 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.

2.7 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.

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 and or CSA 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 01 74 00 - Cleaning.

.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 21 05 00 – Common Work Results for Mechanical.

1.2 QUALIFICATIONS OF TAB PERSONNEL

.1 Submit names of personnel to perform TAB to within 30 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-2015.

.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 NRC 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 NRC 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 NRC Representative for verification of TAB reports.

1.9 START OF TAB

.1 Notify NRC Representative 7 days prior to start of TAB.

.2 Start TAB when building is essentially completed, including:

.3 Provisions for TAB installed and operational.

.4 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 HVAC systems: plus 5%, minus 0 %.

.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 NRC 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 NRC 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 TAB REPORT

.1 Format in accordance with referenced standard.

.2 TAB report to show results in SI units and to include:

.1 Details of instruments used.
.2 Details of TAB procedures employed.
.3 Calculations procedures.
.4 Summaries.
.5 Project record drawings.
.6 System schematics.

.3 Submit electronic copy of TAB Report to NRC Representative for verification and approval.

1.15 VERIFICATION

.1 Reported results subject to verification by NRC Representative.

.2 Provide personnel and instrumentation to verify up to 20 % of reported results.

.3 Number and location of verified results as directed by NRC Representative.

.4 Pay costs to repeat TAB as required to satisfaction of NRC Representative.

1.16 SETTINGS

.1 After TAB is completed to satisfaction of, 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.

1.17 COMPLETION OF TAB

.1 TAB considered complete when final TAB Report received and approved by NRC Representative.

1.18 AIR SYSTEMS

.1 Standard: TAB to most stringent of this section.

.2 Do TAB of systems, equipment, components, controls specified Division 23

.3 Qualifications: personnel performing TAB qualified to standards of AABC or NEBB.

.4 Quality assurance: perform TAB under direction of supervisor qualified to standards of AABC or NEBB.

.5 Measurements: to include as appropriate for systems, equipment, components, controls:

.1 Air velocity.
.2 Static pressure.

.3 Flow rate.
.4 Pressure drop (or loss).
.5 Temperatures (dry bulb, wet bulb, dewpoint).
.6 Duct cross-sectional area.
.7 RPM.
.8 Electrical power.
.9 Voltage.

.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).

1.19 HYDRONIC SYSTEMS

.1 Standard: TAB to most stringent of this section.

.2 Hydronic systems to be balanced are the followings:
.1 Chilled water.

.3 Qualifications: personnel performing TAB qualified to standards of AABC, NEBB.

.4 Quality assurance: perform TAB under direction of supervisor qualified to standards of AABC, NEBB.

.5 Locations of equipment measurements: to include as appropriate:
.1 Coils.
.2 Pumps.
.3 Control valves.
.4 Any other equipment which can modify flow or fluid conditions.

.6 Use the same calibrated instrument for all gauging point readings.

.7 For variable flow systems, set balancing valves according to design requirements. Then, run the systems at minimum load conditions and report flow and pressure readings in order to guarantee that the system can operate at a part load as expected.

.8 Calibrate minimum and maximum flows for variable speed pumps.

1.20 POST-OCCUPANCY TAB

.1 Measure DBT, WBT (or % RH) in occupied zone of following areas: auditorium served by AHU 159.

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 21 05 00 – Common Work Results for Mechanical.

.2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.2 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.

1.3 REFERENCE STANDARDS

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE/IESNA 90.1-2019, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 ASTM International (ASTM)

.1 ASTM C553-13, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.2 ASTM C612-14, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.3 ASTM C921-10(2015), Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.4 ASTM C1136-17, Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

.5 ASTM C1290-16, Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.

.3 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).

.4 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102-10, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701.1:2017, Standard for Thermal Insulation, Polystyrene Boards.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.

1.5 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, member of TIAC.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

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 Thermal conductivity (k factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.

.2 TIAC Code C-1: Rigid fiberglass panel for air ducts, density 48 kg/m3 according to ASTM C612, FSK vapor barrier to ASTM C1136, maximum K factor: 0.034 W/m °C at 24°C.

.3 TIAC Code C-2: Fiberglass blanket for air ducts according to ASTM C1290 and ASTM C553, (type 1), maximum K factor 0.04 W/m at 24 °C (75 °F), with FSK vapor barrier to ASTM C1136.

2.3 JACKETS

.1 Self adhesive jacket:

.1 Multi-ply self-adhesive material.

.2 Zero permeability vapor barrio.

.3 UV resistant.

.4 Maximum flame spread rating: 25, to CAN/ULC-S102.

.5 Maximum smoke developed rating: 50 to CAN/ULC-S102.

.6 Material thickness: 0.177 mm

.7 Service temperature: -40°C to 149°C.

2.4 ACCESSORIES

.1 Vapour retarder lap adhesive :

.1 Adhesive for joints and lap sealing of vapor barriers. Flame spread 10, smoke development 0.

.2 Indoor Vapour Retarder Finish:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.3 Tape: self-adhesive, 100 mm wide minimum.

.4 Contact adhesive: quick-setting, non-flammable fire resistant adhesive to bond fiberglass to ducts. Flame spread 15, smoke development 0.

.5 Pins

.1 Weld pins 4 mm diameter, with 35 mm diameter head for installation through the insulation. Length to suit thickness of insulation.

.2 Weld pins 2 mm for installation prior to applying insulation. Length to suit thickness of insulation. Nylon retain clips 32 mm square.

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 PREINSTALLATION 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)
77AHU159			
Outdoor air - from louver to air handling unit	C-1	Yes	2x 25
Supply air ducts (rectangular)	C-1	Yes	25
Return air ducts	None	-	-
77RAF50005			
Exhaust air duct, 3000 mm from building envelope	C-1	Yes	25
OTHERS			
Outdoor air plenum	C-1	Yes	2x 25
Exhaust plenum	C-1	Yes	25

.2 Finishes: conform to following table:

	TIAC Code	
	Rectangular	Round
Indoor, concealed	none	none
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3

3.5 CLEANING

.1 Clean in accordance with Section 01 74 00 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 21 05 00 – Common Work Results for Mechanical.

1.2 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 Codes:

.1 CRF: Code Rectangular Finish.

.2 CPF: Code Piping Finish.

1.3 REFERENCE STANDARDS

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE 90.1-2019 -SI Edition, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 ASTM International (ASTM)

.1 ASTM C335/C335M-17, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.2 ASTM C449-07(2019), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.3 ASTM C547-19, Mineral Fiber Pipe Insulation.

.4 ASTM C921-10(2015), Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB 51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.

.4 Thermal Insulation Association of Canada (TIAC)

.1 National Insulation Standards 2005.

.5 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102-10, Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.3 CAN/ULC-S702, Thermal Insulation, Mineral Fibre, for Buildings.

.4 CAN/ULC-S702.2, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

1.5 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, member of TIAC.

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 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Storage and Protection:

.1 Protect from weather, construction traffic.

.2 Protect against damage.

.3 Store at temperatures and conditions required by manufacturer.

.3 Waste Management and Disposal:

.1 Waste Management and Disposal: in accordance with Section 01 74 19 - Waste Management and Disposal.

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 Thermal conductivity (k factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.

.2 TIAC Code A-1: rigid moulded mineral fibre (fibreglass) without factory applied vapour retarder jacket.

.1 Rigid fiberglass sleeving for piping according to ASTM C547 without vapor barrier and all purpose jacket according to CGSB 51 GP 52Ma.

.2 Maximum thermal conductivity (k-factor) 0.040 W/m °C at 93 °C to ASTM C553.

.3 TIAC Code A-3: rigid moulded mineral fibre (fibreglass) with factory applied vapour retarder jacket.

.1 Rigid fiberglass sleeving for piping according to ASTM C547 with vapor barrier and all purpose jacket according to CGSB 51 GP 52Ma.

.2 Maximum thermal conductivity (k-factor) 0.040 W/m °C at 93 °C to ASTM C553.

.4 TIAC Code A-6: flexible unicellular tubular elastomer

.1 Insulation: with vapour retarder jacket.

.2 Jacket: to CGSB 51-GP-52

.3 Maximum "k" factor.

.4 Certified by manufacturer free of potential stress corrosion cracking corrodents.

2.3 REMOVABLE INSULATION

.1 Flexible fiberglass insulation blanket for pipe fittings, easily removable for maintenance.

.2 Thickness: 25 mm (1").

.3 Attachment system with Velcro closure.

2.4 INSULATION SECUREMENT

.1 Tape: self-adhesive, aluminum, 50 mm wide minimum.

.2 Contact adhesive: quick setting.

.3 Canvas adhesive: washable.

.4 Tie wire: 1.5 mm diameter stainless steel.

.5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

2.5 CEMENT

.1 Thermal insulating and finishing cement:

.1 Tto ASTM C 449/C 449M

2.6 VAPOUR RETARDER LAP ADHESIVE

.1 Water based, fire retardant type, compatible with insulation.

2.7 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.8 JACKETS

.1 PVC

.1 One-piece moulded type to CAN/CGSB-51.53 with pre-formed shapes as required.

.2 Colours: To be confirmed by CNRC Representative.

.3 Minimum service temperatures: -20 degrees C.

.4 Maximum service temperature: 65 degrees C.

.5 Moisture vapour transmission: 0.02 perm.

.6 Thickness: 0.5 mm.

.7 Fastenings:

.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.

.2 Tacks.

.3 Pressure sensitive vinyl tape of matching colour.

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 PIPING INSULATION SCHEDULES

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 TIAC Code: A-1.

.1 Securements: Tape.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code 1501-H.

.3 TIAC Code: A-3.

.1 Securements: Tape.

.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.

Abbreviation	Application	Temp degrees C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)				
				to 1	1 1/4 to 2	2 1/2 to 4	5 to 6	8 & over
	Run out			-	-	-	-	-
PLUMBING								
DCW	Domestic cold water		A-3	13	25	25	-	-
S, DI	Cooling coil cond. Drain		A-3	25	25	25	-	-
HVAC								
CWS, CWR	Chilled Water	4 - 13	A-3	38	38	38	-	-
HWS, HWR	Heating Hot Water		A-1	38	38	50	-	-
Steam	Steam		A-1	65	65	80	-	-

.5 Finishes:

.1 Exposed indoors: PVC.

.2 Exposed in mechanical rooms: PVC jacket.

.3 Concealed, indoors: No finish.

.4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.

.5 Finish attachments: SS bands, at 150 mm on centre. Seals: closed.

.6 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.5 EQUIPMENT INSULATION SCHEDULE

.1 Chilled water pumps: TIAC code A-6, 25 mm.

3.6 REMOVABLE INSULATION

.1 Provide removable insulation for the following components:

.1 Strainers, union and check valve, balancing valve on chilled water system.

3.7 CLEANING

.1 Proceed in accordance with Section 01 74 00 - Cleaning.

.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 21 05 00 – Common Work Results for Mechanical.

.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 21 16 – Hydronic Specialties.

1.2 REFERENCE STANDARDS

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B16.1-2015, Gray 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 B16.5-2017, Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric 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. Lobed Head and Lag Screws.

.6 ASME B18.2.2-2015, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts.

.2 ASTM International (ASTM)

.1 ASTM A53/A53M-18, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

.3 CSA Group (CSA)

.1 CSA W48-18, Filler Metals and Allied Materials for Metal Arc Welding.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for hydronic systems and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect hydronic systems from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 PIPE

.1 Steel pipe: to ASTM A 53/A 53M, Grade B, as follows:

.1 To NPS 6: Schedule 40.

2.2 PIPE JOINTS

.1 NPS 2 and under: screwed fittings with PTFE tape or lead-free pipe dope.

.2 NPS 2-1/2 and over: welding fittings and flanges to CSA W48.

.3 Flanges: raised face, slip-on to ANSI/AWWA C111/ A21.11.

.4 Orifice flanges: slip-on raised face, 2100 kPa.

.5 Flange gaskets: to ANSI/AWWA C111/ A21.11.

.6 Pipe thread : taper.

.7 Bolts and nuts: to ASME B18.2.1 or ASME B18.2.2.

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 A 47/A 47M and ASME B16.3.

2.4 VALVES

.1 Connections:

.1 NPS 2 and smaller: screwed ends.

.2 NPS 2-1/2 and larger: flanged ends.

.2 Ball valves :

.1 NPS 2 and under: as specified Section 23 05 23.01 - Valves - Bronze.

.3 Balancing, for TAB :

.1 Calibrated balancing valve, globe style, Y pattern, equal percentage.

.2 Multiturn high strength resin handwheel with indicator and memory feature to lock valve position.

.3 Body, stem and plug: cast iron body with integrated cast iron flanges, bronze stem and plug.

.4 Built in venturi for flow balancing with two 6 mm threaded metering ports with check valves and gasketted caps.

.4 Drain valves: ball valve, bronze body with hose thread, with cap and chain, as specified Section 23 05 23.01 - Valves - Bronze.

.5 Swing check valves: to MSS-SP-71.

.1 NPS 2 and under:

.1 Class 125, swing, 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 NRC Representative.

.2 Inform NRC 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 NRC 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 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 BALANCING

.1 In accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 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 RELATED REQUIREMENTS

.1 Section 21 05 00 – Common Work Results for Mechanical.

1.2 REFERENCE STANDARDS

.1 ASME

.1 ASME Boiler and Pressure Vessel Code (BPVC), Section VII-2013.

.2 ASTM International (ASTM)

.1 ASTM A 278/A 278M-2011, Standard Specification for Grey Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).

.2 ASTM B 62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.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.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 indoors 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.

.4 Packaging Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 PIPE LINE STRAINER

.1 DN15 to 50: bronze body to ASTM B62, screwed connections, Y pattern.

.2 Blowdown connection.

.3 Screen: stainless steel with 1.6 mm perforations up to DN100.

.4 Working pressure : 860 kPa.

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 NRC Representative.

.2 Inform NRC 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 NRC 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 STRAINERS

.1 Install in horizontal or down flow lines.

.2 Ensure clearance for removal of basket.

.3 Install ahead of each pump.

.4 Install ahead of each automatic control valve larger than NPS 1 and as indicated.

3.4 AIR VENTS

.1 Install at high points of systems.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

.4 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 21 05 00 – Common Work Results for Mechanical.

1.2 REFERENCE STANDARDS

.1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE/IES Standard 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 CSA Group (CSA)

.1 CAN/CSA-B214-12, Installation Code for Hydronic Heating Systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.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.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for hydronic pumps for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 indoors 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.

.4 Packaging Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 HORIZONTAL IN-LINE CIRCULATOR

.1 Volute: cast iron, radially split, flanged suction and discharge, tapped openings for venting and gauge connections.

.2 Rotor: brass or cast bronze.

.3 Shaft: steel alloy, equipped with bronze bushing and integral thrust collar.

.4 Tightness: mechanical seal, adequate for hot water up to 107 °C (225 °F).

.5 Coupling: flexible, self-aligning.

.6 Motor: resilient mount, protected ventilation openings, bearings.

.7 Capacity: as indicated.

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 NRC Representative.

.2 Inform NRC 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 NRC 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 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.

.2 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.

.3 Install volute venting pet cock in accessible location.

.4 Check rotation prior to start-up.

.5 Install pressure gauge test cocks.

3.4 START-UP

.1 General:

.1 In accordance with Section 01 91 13 - General Commissioning Requirements: General Requirements; 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 Run-in pumps for 12 continuous hours minimum.

.5 Verify operation of over-temperature and other protective devices under low- and no-flow condition.

.6 Eliminate air from scroll casing.

.7 Adjust alignment of piping and conduit to ensure true flexibility.

.8 Eliminate cavitation, flashing and air entrainment.

.9 Adjust pump shaft seals, stuffing boxes, glands.

.10 Measure pressure drop across strainer when clean and with flow rates as finally set.

.11 Replace seals if pump used to degrease system or if pump used for temporary heat.

.12 Verify lubricating oil levels.

3.5 PERFORMANCE VERIFICATION (PV)

.1 General:

.1 Verify performance in accordance with Section 01 91 13 - General Commissioning Requirements: General Requirements, 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 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.

.5 Commissioning Reports: in accordance with Section 01 91 13 - General Commissioning Requirements reports 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 01 91 13 - General Commissioning Requirements: Report Forms and Schematics.

.3 Pump performance curves (family of curves).

3.6 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

.4 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 21 05 00 – Common Work Results for Mechanical.

.2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment

1.2 REFERENCE STANDARDS

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

.2 ASTM International (ASTM)

.1 ASTM A653/A653M-19a, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

.3 National Fire Protection Association (NFPA)

.1 NFPA 90A-2018, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.2 NFPA 90B-2018, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

.4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.

.2 SMACNA HVAC Air Duct Leakage Test Manual, 2012.

.3 IAQ Guideline for Occupied Buildings Under Construction 2007.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for metal ducts 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 01 61 00 - Common Product Requirements 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect metal ducts from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 SEAL CLASSIFICATION

.1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
0 to 500	A

.2 Seal classification:

.1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

2.2 SEALANT

.1 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 fiberglass tape, 50 mm wide.

2.4 DUCT LEAKAGE

.1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.5 FITTINGS

.1 Fabrication: to SMACNA.

.2 Radiused elbows:

.1 Rectangular: centreline radius: 1.5 times width of duct.

.2 Rectangular, over 600 mm: 1.5 times width of duct, with one splitter vane.

.3 Round: five piece, 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 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.

.5 Transitions:

.1 Diverging: 30 degrees maximum included angle.

.2 Converging: 30 degrees maximum included angle.

.6 Offsets:

.1 As indicated or Full radiused elbows.

.7 Obstruction deflectors: maintain full cross-sectional area.

.1 Maximum included angles: as for transitions.

2.6 GALVANIZED STEEL

.1 Lock forming quality: to ASTM A 653/A 653M, G90 zinc coating.

.2 Thickness, fabrication and reinforcement: to SMACNA.

.3 Joints: to SMACNA.

2.7 HANGERS AND SUPPORTS

.1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.2 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.

.1 Maximum size duct supported by strap hanger: 500.

.3 Hanger configuration: to SMACNA.

.4 Hangers: galvanized steel angle with galvanized steel rods to SMACNA and the following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

.5 Upper hanger attachments:

.1 For concrete: manufactured concrete inserts.

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 NRC Representative.

.2 Inform NRC 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 NRC Representative.

3.2 GENERAL

.1 Do work in accordance with SMACNA.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.

.1 Insulate strap hangers 100 mm beyond insulated duct.

.3 Support risers in accordance with SMACNA.

.4 Install breakaway joints in ductwork on sides of fire separation.

.5 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 SMACNA and as follows:

Duct Size	Spacing
(mm)	(mm)
to 1500	3000
1501 and over	2500

3.4 WATERTIGHT DUCT

.1 Provide watertight duct for:

.1 Fresh air intake.

.2 Minimum 1000 mm from duct mounted humidifier in all directions.

.3 As indicated.

.2 Form bottom of horizontal duct without longitudinal seams.

.1 Solder or weld joints of bottom and side sheets.

.2 Seal other joints with duct sealer.

3.5 SEALING AND TAPING

.1 Apply sealant in accordance with SMACNA.

.2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers recommendations.

3.6 SEISMIC CONTROL MEASURES

.1 Install seismic control measures as required by Section 23 05 48 – Vibration and Seismic Controls for HVAC.

3.7 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management : in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 21 05 00 – Common Work Results for Mechanical.

1.2 REFERENCE STANDARDS

.1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible - 2005.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for air duct accessories and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Indicate:

.1 Flexible connections.

.2 Duct access doors.

.3 Turning vanes.

.4 Instrument test ports.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect air duct accessories from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

.1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 FLEXIBLE CONNECTIONS

.1 Provide where indicated, at fans and at air handling units, factory fabricated flexible connectors, not more than 150 mm long between metal parts to be joined and installed with just sufficient slack to prevent vibration transmission. Allow 100 mm movement for high pressure fans and 50 mm movement for low pressure fans.

.2 Conforms to the requirements of UL, ULC and NFPA 90A.

.3 Neoprene coated fibreglass fabric, of 1017 g./m2 minimum density, and heat resistant up to 93 °C.

2.3 ACCESS DOORS IN DUCTS

.1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.

.2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.

.3 Gaskets: neoprene.

.4 Hardware:

- .1 Up to 300 x 300 mm: two sash locks.
- .2 301 to 450 mm: four sash locks complete with safety chain.
- .3 451 to 1000 mm: piano hinge and minimum two sash locks.

2.4 TURNING VANES

.1 Factory or shop fabricated single thickness or double thickness as indicated, to recommendations of SMACNA and as indicated

2.5 INSTRUMENT TEST

.1 1.6 mm thick steel zinc plated after manufacture.

.2 Cam lock handles with neoprene expansion plug and handle chain.

.3 28 mm minimum inside diameter. Length to suit insulation thickness.

.4 Neoprene mounting gasket.

2.6 SPIN-IN COLLARS

.1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.

.2 Sheet metal thickness to co-responding round duct standards.

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 air duct accessories installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Representative.

.2 Inform NRC 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 NRC Representative.

3.2 INSTALLATION

.1 Flexible Connections:

.1 Install in following locations:

.1 Inlets and outlets to supply air units and fans.

.2 Inlets and outlets of exhaust and return air fans.

.3 As indicated.

.2 Length of connection: 100 mm.

.3 Install in accordance with recommendations of SMACNA

.4 When fan is running:

.1 Ducting on sides of flexible connection to be in alignment.

.2 Ensure slack material in flexible connection.

.2 Access Doors and Viewing Panels:

.1 Size:

.1 600 x 600 mm for person size entry.

.2 450 x 450 mm for servicing entry.

.3 300 x 300 mm for viewing.

.4 As indicated.

.2 Locations:

.1 Fire and smoke dampers.

.2 Control dampers.

.3 Electrical heating coils.

.4 Duct mounted humidifiers.

.5 Duct smoke detector (see division 26 for location).

.6 Humidifier manifold.

.7 Upsteam of all elbows equipped with turning vanes.

.8 Upstream and downstream of fans.

.9 Any other devices requiring maintenance.

.10 Elsewhere as indicated on drawings.

.3 Instrument Test Ports:

.1 General:

.1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions

.2 Locate to permit easy manipulation of instruments.

.3 Install insulation port extensions as required.

.4 Locations:

.1 For traverse readings:

.1 Inlets and outlets of other fan systems.

.2 Main and sub-main ducts.

.3 And as indicated.

.2 For temperature readings:

.1 At outside air intakes.

.2 In mixed air applications in locations as approved by NRC Representative.

.3 At inlet and outlet of coils.

.4 Downstream of junctions of two converging air streams of different temperatures.

.5 And as indicated.

.4 Turning Vanes:

.1 Install in accordance with recommendations of SMACNA and as indicated

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

.4 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 21 05 00 – Common Work Results for Mechanical.

1.2 REFERENCE STANDARDS

.1 Sheet Metal and Air Conditioning National Association (SMACNA).

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-2013.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for dampers and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect dampers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

.1 Manufacture to SMACNA standards

2.2 SINGLE BLADE DAMPERS

.1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.

.2 Size and configuration to recommendations of SMACNA, except maximum height 300 mm.

.3 Locking quadrant with shaft extension to accommodate insulation thickness.

.4 Inside and outside nylon end bearings.

.5 Channel frame of same material as adjacent duct, complete with angle stop.

2.3 MULTI-BLADED DAMPERS

.1 Factory manufactured of material compatible with duct.

.2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.

.3 Maximum blade height: 300 mm.

.4 Bearings: self-lubricating nylon.

.5 Linkage: shaft extension with locking quadrant.

.6 Channel frame of same material as adjacent duct, complete with angle stop.

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 damper installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Representative.

.2 Inform NRC 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 NRC Representative.

3.2 INSTALLATION

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions

.3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.

.4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.

.5 Dampers: vibration free.

.6 Ensure damper operators are observable and accessible.

.7 Corrections and adjustments conducted by NRC Representative.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

.4 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 21 05 00 – Common Work Results for Mechanical.

.2 Section 23 33 00 – Air Duct Accessories.

.3 Section 25 30 02 – EMCS: Field Control Devices.

.4 Section 23 73 00.13 – Air Handling – Built-Up.

1.2 REFERENCE STANDARDS

.1 ASTM International (ASTM)

.1 ASTM A 653/A 653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for dampers and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect dampers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 MUTLI-LEAF DAMPERS

.1 Opposed blade for flow balancing application and parallel blade for open/close application type as indicated.

.2 Construction: blades, 152 mm wide, 1219 mm long, maximum. Modular maximum size, 1219 mm wide x 1219 mm high. Three or more sections to be operated by jack shafts.

.3 Materials:

.1 Frame: 2.03 mm minimum thickness extruded aluminum. For outdoor air and exhaust air applications, frames to be insulated.

.2 Blades: extruded aluminum. For outdoor air/exhaust air applications, blades to be internally insulated.

.3 Bearings: maintenance free, synthetic type of material.

.4 Linkage and shafts: aluminum, zinc and nickel plated steel.

.5 Seals: synthetic type, mechanically locked into blade edges.

.6 Frame seals: synthetic type, mechanically locked into frame sides.

.4 Performance: minimum damper leakage meet or exceed AMCA Standard 500-D ratings.

.1 Size/Capacity: refer to damper schedule

.2 25 L/s/m^2maximum allowable leakage against 1000 Pa static pressure for outdoor air and exhaust air applications.

.3 Temperature range: -40 degrees C to plus 100 degrees C.

.4 Arrangements: dampers mixing warm and cold air to be parallel blade, mounted at right angles to each other, with blades opening to mix air stream.

.5 Jack shafts:

.1 25 mm diameter solid shaft, constructed of corrosion resistant metal complete with required number of pillow block bearings to support jack shafts and operate dampers throughout their range.

.2 Include corrosion resistant connecting hardware to accommodate connection to damper actuating devices.

.3 Install using manufacturers installation guidelines.

.4 Use same manufacturer as damper sections.

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 damper installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Representative.

.2 Inform NRC 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 NRC Representative.

3.2 INSTALLATION

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions

.3 Seal multiple damper modules with silicon sealant.

.4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.

.5 Ensure dampers are observable and accessible.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 21 05 00 – Common Work Results for Mechanical.

.2 Section 23 33 00 – Air Duct Accessories.

1.2 REFERENCE STANDARDS

.1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)

.1 ANSI/AMCA Standard 99-2010, Standards Handbook.

.2 ANSI/ASHRAE 51-07 (ANSI/AMCA 210-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.3 ANSI/AMCA Standard 300-2008, Reverberant Room Method for Sound Testing of Fans.

.4 ANSI/AMCA Standard 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 10 00 – General Instructions.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for HVAC fans and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Provide:

.1 Fan performance curves showing point of operation, kW bhp and efficiency.

.2 Sound rating data at point of operation.

.2 Indicate:

.1 Minimum performance achievable with variable speed controllers.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 – General 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01 10 00 – General Instructions.

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.

.2 Capacity: flow rate, static pressure, bhp, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.

.3 Fans: statically and dynamically balanced, constructed in conformity with ANSI/AMCA Standard 99.

.4 Sound ratings: comply with ANSI/AMCA Standard 301, tested to ANSI/AMCA Standard 300.

.5 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210.

2.2 DIRECT DRIVE SQUARE IN LINE CENTRIFUGAL FAN

.1 Fan housing of square design, constructed of heavy gauge galvanized steel and includes square duct mounting collars. Two (2) removable access panels located perpendicular to the motor mounting panel permit easy access to all interior components. Centrifugal wheel is backward inclined design, statically and dynamically balanced, constructed of aluminum and includes a wheel cone carefully matched to the inlet cone.

.1 Electronically commutated permanently lubricated motors are carefully matched to the fan loads and are readily accessible for maintenance.

.2 Provide a safety switch and handy box with factory wiring done between motor and handy box. When solid-state speed controllers are specified, these are to be mounted on the fan casing and factory wired to the handy box unless indicated otherwise.

.3 Accessories and options

.1 Insulated fan housing lined with a fibreglass duct liner.

.2 As specified in schedule.

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 Visually inspect substrate in presence of NRC Representative.

.2 Inform NRC 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 NRC Representative.

3.2 FAN INSTALLATION

.1 Install fans as indicated, complete with spring hangers as specified, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.

.2 Access doors and access panels to be easily accessible.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 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 01 74 00 – General Instructions.

.3 Waste Management: separate waste materials for recycling in accordance with in accordance with Section 01 74 19 – Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 21 05 00 – Common Work Results for Mechanical

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for air terminal units and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for air terminal units 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.

2.2 MANUFACTURED UNITS

.1 Terminal units of the same type to be product of one manufacturer.

2.3 VARIABLE VOLUME BOXES

.1 General

.1 Single duct terminal unit with volume control, for variable volume operation.

.2 Pressure independent operation to maintain required flow.

.3 Electronic actuator.

.2 Construction

.1 Casing: 0.8 mm thick galvanized steel, fully insulated with 12 mm thick thermal and acoustic insulation, with metal damper, installed on a steel shaft pivoted in self-lubricating bearings.

.2 Filler material for thermal and acoustic insulation: inert, vermine and moisture proof, glass fiber or mineral wool of density required for acoustic performance, standard to manufacturer and protected from air flow by neoprene.

.3 Air flow sensor, cross configuration, located at the inlet of the assembly, accuracy within 5%.

.4 Actuator and electronic controller, refer to Division 25.

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 air terminal units installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Representative.

.2 Inform NRC 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 NRC Representative.

3.2 INSTALLATION

.1 Install in accordance with manufacturers recommendations.

.2 Support independently of ductwork.

.3 Install with a minimum of four duct diameters of straight inlet duct, same size as inlet.

.4 Locate controls, dampers and access panels for easy access.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: separate waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 21 05 00 – Common Work Results for Mechanical.

.2 Section 23 33 15 – Dampers – Operating.

.3 Section 25 05 60 – EMCS: Field Installation for specifications.

.4 Section 25 30 02 - EMCS: Field Control Devices.

1.2 DEFINITIONS

.1 Catalogued or published ratings: ratings obtained from tests carried out by manufacturer or manufacturer's designated independent testing agency which signify adherence to codes and standards in force.

1.3 REFERENCE STANDARDS

.1 American National Standards Institute/American Society of Heating, Refrigeration and Air Condition Engineers/Illuminating Engineering Society (ANSI/ASHRAE/IES)

.1 ANSI/ASHRAE 52.2-2017, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

.2 ANSI/ASHRAE/IES 90.1-2019, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)

.3 Underwriters' Laboratories (UL)

.1 UL-900-15. Standard for Air Filter Units.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Construction details, dimensions, weights and equipment or material characteristics together with supplementary information such as bulletins, illustrations and exploded views of constituting parts.

.2 Graphs, curves, capacities, efficiency and other technical data submitted by the manufacturer.

.3 Wiring diagrams, single line diagrams, principle diagrams, control diagrams, operating sequences and all interconnections with other systems.

.4 Electrical load calculation.
.5 Actual cooling and heating fluid entering and leaving conditions for stated air side requirements.
.6 Acoustic performances.

1.5 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for air handling equipment for incorporation into manual.

1.6 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

.3 Spare filters: in addition to filters installed immediately prior to acceptance by Departmental Representative, supply 1 complete set of filters for each air handling unit.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect air handling equipment from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

.1 Provide field assembled sections to form air handling units in configuration as indicated on drawings. The unit shall be designed to be supported by a house keeping pad.

.2 Shipping splits, are constructed of 12-gauge G-90 galvanized steel in a mating angle design on unit interior walls, roofs, and base. Unit sections shall be fastened together with 10 mm bolts 450 mm on centers. All fasteners caulk, and gaskets required shall be supplied and shipped with unit in a separate box.

.3 Lifting lugs shall be located and designed to properly support the loads within. Manufacturers shall provide a load point calculation along with detailed lifting lug information as part of the shop drawing package. Lifting lug distance shall not exceed a distance of 2500 mm on center.

.4 Acoustical Performance:

.1 The casing shall have been tested for acoustical performance by an independent laboratory that is accredited. Manufacturers shall submit sound data in compliance with the following:

.2 Test methods and facilities used to establish sound transmission loss values shall conform explicitly with the ASTM designation E90-85 and E413-73.

.3 Sound Transmission Loss in dB to ASTM E-90 & E413-73.

	1	2	3	4	5	6	7	8	
50mm wall	18	19	27	33	43	52	52	52	STC=37

.4 Test methods and facilities used to establish sound absorption values shall conform explicitly with the requirements of the ASTM Standard Test Method for Sound Absorption Coefficients by the Reverberation Method: ASTM C423-84A and E795-83.

.5 Sound Absorption to ASTM C423-84A & E795-83.

	1	2	3	4	5	6	7	8	
50mm wall	.10	.23	.75	1.08	1.05	.99	.97	.95	STC=37

.5 Casing:

.1 Walls and roofs shall be constructed of 16 gauge galvanized steel 50 mm thick acoustic thermal panels.

.2 The inner liner shall be 22-gauge solid galvanized steel.

.3 The liner shall be 22 gauge washdown stainless steel for the cooling coil sections.

.4 Insulation shall be 50 mm thick 72 kg/m3 density fiberglass.

.5 Provide neoprene liner to seal insulation in sections with perforated panels.

.6 All permanently joined flanged panel surfaces shall be sealed with an individual strip of 3.2 X 9.5 mm tape sealer.

.7 Wall (and roof) seams shall be turned inward to provide a clean flush exterior finish. All panel seams shall be sealed during assembly to produce an airtight unit.

.6 Structural Base Construction:

.1 Units shall be constructed from a minimum C6x8.2 channel structural steel perimeter base, with 50mm x 50mm x 6.4mm intermediate structural steel channel and angle iron supports. Perimeter structural steel base shall be designed to directly support the weight of the walls. Intermediate structural steel and angle iron shall support the weight of all internal components (i.e. fans, coils, enthalpy wheels, etc.). Maximum base deflection shall be 6.4 mm on unsupported spans of 3658 mm. Structural steel base shall be designed so that it can be point loaded or set on an unlevel surface and shimmed by the contractor within 3658 mm spans without deflecting more than 6.4 mm. The structural steel base shall be either I-beam construction or C-channel (not box channel) so that the base will shed all water. Base shall be provided with lifting lugs, minimum four (4) per shipping split. Formed metal bases formed from sheet metal will not be acceptable.

Base shall prevent wall panel joints from separating during lifting, transportation and rigging.

.2 A 3.0 mm thick aluminum checker plate floor shall be installed on the base. Floor seams shall be continuously welded providing a completely flat unit floor. Steel checker plate floor shall be coated with grey epoxy paint. A 38 mm perimeter collar shall be provided to ensure the unit is internally watertight. The collar shall be alternately screwed down and tack welded to the unit base on 300 mm centers. Caulk joint to be watertight.

.3 The base shall be insulated with 76 mm thick, 24 kg/m³ density fibreglass insulation and sheeted with a 22 gauge galvanized steel liner. The base liner shall be tack welded and sealed for rigidity and vapour barrier integrity.

.7 Test Ports:

.1 Provide 25 mm diameter test ports in each access section between each component within the AHU. Test ports shall have a tube that extends between the inside and outside of the unit and a screwed cap on the exterior to allow access. The test ports shall have been flanged on the exterior to allow air seal and shall be flanged on the interior to cover the penetration of the casing.

.8 Fans

.1 General

.1 All fans shall be tested in accordance with AMCA Standards 210-70 and 310 Test Codes for Air Moving Devices.

.2 Direct drive fan shall be single width, single inlet, airfoil type direct drive wheel.

.3 Fan inlet cone shall be of steel construction.

.4 Fan and motor shall be dynamically balanced as an assembly at the factory to balance value BV-3 per AMCA 204 or 0.15 IPS.

.5 On the inlet of the plenum fan shall be a minimum of 150 mm flexible ducting, rigidly fastened to the blower and the blower inlet closure.

.6 Plenum fan assembly must have an enclosed safety screen as per OSHA Standards.

.2 Fan Motors

.1 Direct drive fan motors shall be NEMA premium efficient, TEFC, inverter rated.

.2 To Section 23 05 13 – Common Motor Requirements for HVAC Equipment.

.3 Vibration Isolation:

.1 An integral all weld steel vibration isolation base shall be provided for the fan and motor.

.2 Provide open spring mounts with sound deadening pads and leveling bolts.

.3 Horizontal stiffness shall be equal to vertical stiffness.

.4 Spring deflection shall be 50 mm.

.5 Isolators shall have earthquake restraints.

.4 Piezometer flow measurement

.1 A piezometer flow measurement system shall be provided on all fans. It shall have pressure taps plumbed to the exterior of the unit for proper system balancing, flow rate adjustment and troubleshooting.

.5 Variable Frequency Drives (VFD)

.1 Refer to section 25 30 02 – EMCS Field Control Devices for VFD description.

.2 For fans with variable frequency drives:

.1 Mount the VFD on the unit.

.2 Factory wire between the VFD and fan motors. Ensure all casing penetrations are sealed to be air tight.

.3 Provide a terminal block within the VFD for field termination of line side wiring.

.6 Motorized Dampers:

.1 Provide factory installed electric damper operators with all linkage and hardware internally mounted.

.2 Ensure operators are mounted in easily accessible sections of the air handling unit.

.3 Dampers: to Section 23 33 15 – Dampers – Operating.

.4 Actuators: to Section 25 30 02 – EMCS: Field Control Devices.

.9 Pre-filters – Pleated type, MERV 8:

.1 Media:

.1 Synthetic blend, lofted to a uniform depth of 4 mm, and formed into a uniform radial pleat.

.2 A welded wire grid, spot-welded on 25 mm centers and treated for corrosion resistance shall be bonded to the downstream side of the media to maintain radial pleats and prevent media oscillation.

.2 Holding frame: Galvanized steel with bracing.

.3 Media support: Welded wire grid.

.4 Performance:

.1 Average atmospheric dust spot efficiency MERV 8 to ANSI/ASHRAE 52.2.

.2 Maximum operating pressure : 500 Pa without media pack failure.

.3 Fire rated: to UL-900.

.10 Filters – Cartridge type, MERV 13

.1 Media:

.1 Micro fine glass laminated to a reinforced backing to form a uniform lofted media blanket.

.2 The media blanket shall be formed into uniform tapered radial pleats and bonded to a stiffened backing that is bonded to the downstream side of the media to preclude media oscillation.

.3 The media shall be mechanically and chemically bonded within the frame to prevent air bypass.

.2 Media support:

.1 The enclosing frame shall be constructed of corrosion resistant galvanized steel.

.2 The media pleats shall be maintained by bridge style plastic contour stabilizers, There shall be a minimum of four contour stabilizers on the air entering side and four on the air exiting side. All-metal diagonal support members shall enhance filter pack rigidity and a durable filter enclosure.

.3 Performance:

.1 The filter shall have a Minimum Efficiency Reporting Value of MERV 14 when evaluated under the guidelines of ASHRAE Standard 52.2.

.2 Maximum operating pressure : 2500 Pa without media pack failure.

.3 Fire rated: to UL-900.

.11 Pre-filter and Filter Gauges:

.1 Provide magnehelic gauges.

.2 Magnehelic gauges shall be accurate to +/- 2% of full range.

.3 Provide sensing probes and shut off valves for each gauge.

.4 Provide one gauge flush mounted into the casing for each filter bank.

.12 Cooling Coils

.1 Coil performance data shall be certified in accordance with ARI Standard 410 where applicable.

.2 Coils shall be fully enclosed within casing and mounted on angle frames manufactured to allow coils to be individually removed. Cooling coil racks shall be 12 Ga. 304 stainless steel.

.3 Removable coil access panels shall be provided to remove coils through casing wall. Coil covers shall be double wall construction with all exposed edges of insulation covered with sheet metal including holes through the cover for coil header stub outs. Coils shall be individually removable towards (away from) the access side.

.4 All drain pans shall be double wall continuously welded 304 stainless steel. Intermediate drain pans shall be interconnected with stainless steel 25 mm down pipes. Condensate drain shall be a minimum 32 mm diameter stainless steel tube extending 25 mm out from unit for solder connection to trap. Drain pans shall be sloped within unit and fully drainable.

.5 Coils shall be certified in accordance with ARI Standard 410.

.6 Coils shall be circuited drainable with a vent connection at the highest point and a drain connection at the lowest point. Coil headers shall be copper with steel male pipe connections.

.7 Construction:

.1 Tubes: Horizontal, copper.

.2 Fins: Aluminum (copper where coils are sprayed) mechanically bonded to tubes.

.3 Headers: Seamless copper or carbon steel, with vent and drain connections.

.4 Casing:16 gauge, galvanized steel channels with 16-gauge center and end supports.

.5 Connections: Same end, counterflow, with vent, drain, supply and return stubs extended to outside of unit casing with grommets for airtight casing.

.13 Electric heaters

.1 Heating elements shall be open coil type A resistance wire for long service life.

.2 Coils shall be supported by ceramic bushings staked into supporting brackets.

.3 Heater frames and terminal boxes shall be corrosion resistant steel.

.4 Heater shall be furnished with over temperature protection and airflow detection.

.5 A safety high temperature limit and airflow proving system shall also be provided.

.6 An SCR type controller with analog input signal capability shall be provided for heater output modulation.

.7 Factory wired between element terminal block and control panel.

.8 Provide non-fusible disconnect for electric heat section.

.14 Insulation:

.1 All insulation used in air handling unit walls, roof and base shall have a Flame spread rating of less than 25 and a Smoke Developed rating of less than 50 per ASTM E84 and UL 723 and Can/ULC S102-M88.

.2 Insulation shall meet NFPA 90A and 90B.

.15 Access

.1 Access sections shall be 610 mm deep.

.2 Doors.

.1 Access door construction and insulation shall match the rest of the unit casing.

.2 Corners shall be welded for rigidity.

.3 A 254 x 254 mm (double pane) tempered glass window shall be provided in each door.

.4 Provide high pressure latches operable from either side of the door.

.5 Hinges shall be continuous piano type stainless steel.

.6 Door openings shall be fully gasketed with continuous 13 mm closed cell hollow round black gasket with a metal encapsulated reinforced backing that mechanically fastens to the door opening perimeter.

.7 Door frames shall be framed from 16 gauge galvanized steel with the outside of the door flush to the unit.

.8 Minimum door width shall be as shown on the plans but in no case shall an access door be less than 457 mm.

.9 Door height shall be the maximum permitted by the height of the unit up to 1828 mm.

.10 Doors shall open against positive pressure.

.16 Drains:

.1 Provide 32 mm capped floor drain connections on the side of the unit for complete drainability of the base pan for the following sections:

.1 Fresh Air / mixing plenum.

.2 Fan Sections.

.3 Sections upstream and downstream of coils.

.17 Electrical:

.1 Factory wire and test all air handling units. Have units approved by CSA or ETLc.

.2 Provide necessary circuit breakers and/or fuses for each type of electric device.

.3 A bonding wire shall be provided between the motor loads and the electrical panel. Use of the air handling unit casing for a bond will not be accepted.

.4 Label and number code all wiring and electrical devices in accordance with the unit electrical diagram. Mount the devices in a control panel inside the unit's service enclosure or on the outside. Ensure the control panel meets the CSA or Canadian Electrical Code (CEC) standard for the specific installation.

.5 Provide a system of motor control including all necessary terminal blocks, motor contactors, motor overload protection, grounding lugs, auxiliary contactors and terminals for the connection of external control devices or relays. Individually fuse all fan and branch circuits.

.6 Wire from the motors to the motor control in accordance with the local electrical code and contained by EMT conduit with liquid tight connections. Seal the casing penetrations in a manner that eliminates air leaks. At all split sections, provide a 300 mm long piece of flexible conduit, with the extra wire spooled, for reconnection on site by the installing contractor.

.7 Provide one disconnect switch in a NEMA 3 enclosure.

.8 Disconnects must be interlocked with the electrical panels for added personnel safety.

.18 Lights:

.1 Marine lights with protective cast metal cage and glass globes complete with duplex receptacles shall be installed on the wall across from the access doors, in each access section.

.2 One (1) switch with an indicator light shall be installed on the exterior of the unit.

.3 Factory wire from switch to all lights in EMT conduit with liquid tight connections. At all split sections, provide a 300 mm length of flexible conduit, with the extra wire spooled, for reconnection on site by the installing contractor.

.4 Electrical power shall be 120V/1/60.

.19 Finish

.1 Unit shall be finished painted with two components, etch bond primer and finish painted with alkyd enamel, color as selected by NRC Representative. All uncoated steel shall be painted with grey enamel. All metal surfaces shall be pre-painted with vinyl wash primer to ensure paint bonds to metal.

.20 Desiccant dehumidification system (77DHU159)

.1 Desiccant Rotor

.1 The desiccant rotor shall be assembled and installed by the unit manufacturer in the same facility to control quality.

.2 The desiccant shall be made "in-the-flute" encapsulating the fiberglass substrate.

.3 The rotor shall be both washable and non-shedding. Rotors shall be capable of withstanding cleaning by vacuum cleaner, with a water or, water and detergent wash.

.4 The substrate shall be manufactured with a fiberglass matrix meeting the International Agency for Research on Cancer (IARC) standards for non-respirable fibers.

.5 The fiberglass substrate shall provide the structural support for the desiccant. The fiberglass substrate shall be combined with desiccant to form the dehumidifier rotor. The desiccant shall be self-bonding to the substrate and to itself through the substrate voids filling in all the voids in the substrate and shall totally encapsulate the fiber.

.6 The desiccant dehumidification rotor shall be assembled from smooth and corrugated sheets of fiberglass substrate interleaved in a winding to form the rotor creating a large number of axial passages through which the air flows

.7 Where a face and by-pass damper arrangement is indicated the performance shall meet the dew point values of the mixed air downstream of the face and by-pass section.

.8 Rotor surfaces shall be ground smooth and coated for long seal life.

.9 Rated lifetime shall not be less than (87,600) hours and shall be defined by media performance meeting >90% of original specification.

.10 Desiccant media is to have a Smoke Developed Index of 0 and a Flame Spread Index of 0 as tested according to ASTM E84.

.11 Rotors that are 1370 mm and larger shall have field adjustable a media tightening mechanism.

.2 Desiccant Rotor – Variable Frequency Drive

.1 The desiccant rotor shall be controlled by a Variable Frequency Drives with circuit breaker style overload protection.

.2 Refer to section 25 30 02 – EMCS Field Control Devices for VFD description.

.3 Mount the VFD on the unit.

.4 Factory wire between the VFD and fan motors. Ensure all casing penetrations are sealed to be air tight.

.5 Provide a terminal block within the VFD for field termination of line side wiring.

.3 Desiccant Rotor – Cassette Frame

.1 DH rotor cassette frames shall be manufactured from 304 tubular stainless steel. All welds shall be reasonably ground and dressed for appearance. Structural welds shall be continuous and non-structural welds shall be on 100 mm centers.

.2 Cassette face panels and other sheet steel components shall be manufactured from 304 stainless steel material.

.4 Desiccant Rotor – Drive System

.1 DH Rotor Drives shall be equipped with harden carbon steel ANSI drive sprocket, nickel plated corrosion resistant drive chain and spring type automatic chain tension device.

.2 For ease of maintenance and chain alignment the gear motor shall be fastened to a 304 stainless steel gear motor plate which is fastened onto the cassette frame with standard hardware.

.3 The drive assembly shall be equipped with a rotation detection circuit which shuts down the dehumidifier and signals the operator through an indicating light on the control cabinet if the wheel is not rotating.

.5 Desiccant Rotor – Seals

.1 Seals are to be extruded Viton. Rotor seals are rated for lifetime use (87,600 hours). Rotor seals shall be rated for 205°C continuous temperature rating. Bulb type seals are not allowed.

.2 Low friction tape is to be used as the complementary seal material to the seal mentioned above. The tape shall have an operating temperature range from -53°C to 260°C.

.3 If additional sealing material is needed in the rotor assembly it is to be made of 100% Pure RTV silicone is a one-component caulking material that has temperature ranges of -45°C to 232°C.

.4 Rotor dividing seals contact the face of the Desiccant Rotor media to seal between the process and reactivation airstreams. Standard hardware shall fasten the dividing seals flanges to the cassette frame partitions and pop rivets shall not be used.

.5 All other areas that have a potential for air bypass shall be RTV silicone sealed, this shall eliminate and ensure that no air bypasses the rotor cassette assembly.

2.2 Specific requirements for System 77AHU159

.1 Unit type: triple deck desiccant dehumidification unit, variable flow operation.

.2 Unit composed of the following sections (listed in airstream direction):

.1 Mixed air tunnel section (span on three decks)

.1 1175 x 350 side inlet with motorized damper (77MD159-1) – outdoor air.

.2 1175 x 350 top inlet with motorized damper (77MD159-2) – return air.

.3 Access section with door.

.2 Pre-filter section (1st deck)

.1 MERV 8 pre-filters (77PF159).

.3 Electric heat section (1st deck)

.1 Electric heating coil (77EHC159).

.2 Access section with door.

.4 Dessicant wheel section (span on two decks)

.1 Desiccant dehumidification systems (77DHU159).

.2 Motorized bypass damper (77MD159-3, 77MD159-4).

.5 Filter section (1st deck)

.1 Filter/rotor access section with door.

.2 MERV 13 filters (77FI159).

.3 Access section with door.

.6 Cooling coil section (2nd deck)

.1 Cooling coil (77CC159-1).

.2 Access section with door.

.7 Dessicant wheel section (span on two decks).

.1 See above

.8 Cooling coil section (2nd deck)

.1 Access section with door.

.2 Cooling coil (77CC159-2).

.3 Double height access section with door.

.9 Supply fan section (3rd deck)

.1 Supply fan (77SAF159).

.2 Access section with door.

.3 Overall unit dimensions:

.1 Mixed air tunnel: 1460 x 712 x 3430.

.2 Air handling unit: 1842 x 3380 x 3430.

.4 Electrical:

.1 Electrical connections

.1 Supply fan: 575/3/60, MCA: 14 A, MOP: 20A.

.2 Electric heat coil: 575/3/60, MCA: 57 A, MOP: 80A.

.3 Desiccant wheel: 575/3/60, MCA: 1 A, MOP: 1 A.

.4 Lights, receptacles: 120/1/60, MCA: 15 A, MOP: 15 A.

.2 Supply fan to be supplied with variable frequency drive (VFD), mounted on unit. Field connection by division 26.

.3 Dessicant wheel rotor to be supplied with variable frequency drive (VFD) mounted on unit. Field connection by division 26.

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 air handling equipment installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Representative.

.2 Inform NRC 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 NRC Representative.

3.2 INSTALLATION

.1 Provide appropriate protection apparatus.

.2 Fabricate to provide smooth air flow through components.

.1 Limit air leakage to 1% of rated air flow at 2.5 kPa suction pressure.

.3 Apply sealer into seams prior to assembly.

3.3 FANS

.1 Provide sheaves and belts required for final air balance.

.2 Install flexible connections at air handling unit inlets and outlets.

.1 Ensure metal bands of connectors are parallel and not touching.

.2 Ensure that fan outlet and duct are aligned when fan is running.

3.4 REPLACEMENT MEDIA

.1 Replace media with new upon acceptance.

.2 Filter media new and clean, as indicated by pressure gauge, at time of acceptance.

3.5 DRIP PAN

.1 Install copper, deep seal P trap on drain lines.

3.6 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

.4 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 21 05 00 – Common Works Results for Mechanical.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for humidifiers and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Include rated capacities, operating weights, furnished specialties, and accessories.

.3 Submit manufacturer's installation instructions.

.4 Submit operation and maintenance data.

.5 Submit water pressure requirements.

.3 Shop Drawings:

.1 Submit shop drawings to indicate project layout, dimensions and extent of humidification system.

.2 Submit wiring diagrams including power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

.4 Manufacturer's Field Reports:

.1 Submit manufacturer's field reports specified.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for [humidifiers] for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect humidifiers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 PACKAGED ELECTRODE STEAM GENERATING TYPE (77HUM159)

.1 General:

.1 Components housed in factory fabricated cabinet with factory enameled finish.

.2 Durable powder coated steel cabinet with zero side clearance requirement for minimal footprint.

.3 Insulating air gap between plumbing and electrical compartment for increased electronic reliability.

.4 Factory sealed disposable steam cylinder complete with factory installed electrodes to suit water condition.

.5 Cylinder optimized for humidifier capacity and supply voltage. Cylinder must have welded seam to ensure watertight and have high water sensor to prevent overfilling.

.6 Standard internal drain water tempering to ensure maximum 60 °C drain water. External drain water cooler not acceptable.

.7 Integral fill cup with minimum 25 mm air gap to prevent back siphoning.

.8 Full cylinder indication and pre-notification of automatic shutdown at end of cylinder life.

.9 Automatic pulse feature to clean any obstruction from the drain solenoid valve if required.

.10 Automatic off-season shut-down. After 3 days of "no call" will completely drain the cylinders and automatically restart on call for humidity. Adjustable on/off and time sequence. Provides extended cylinder life, while ensuring stagnant water does not remain in the system.

.2 Controller:

.1 Intuitive touchscreen control with color graphic user interface.

.2 Control mode: 0-10V modulation signal from EMCS.

.3 Standard building automation communication protocols BACnet MS/TP.

.4 Embedded web interface for easy configuration and remote monitoring from any computer with a web browser over a local area network (LAN) connection.

.5 USB interface for new software/feature upload and download of operational information.

.6 Single or dual channel analog signal acceptance, supporting both demand and transducer control. Ability to control setpoint from humidifier control when using transducer controls.

.3 Steam distributors

.1 Duct mounted, stainless steel header with rubber grommet seals for easy installation of distribution tubes.

.2 Tubes constructed of 38 mm 304 stainless steel tubing.

.3 Each distributor has 14 stainless steel nozzles to evenly disperse steam into the duct.
.4 Short absorption distance.
.5 4000 mm flexible steam hose (exact length to be determined on site).

.4 Certifications:

.1 CSA certified and ULC listed.

.5 Performances:

.1 Rated power: 18.7 kW.
.2 Voltage: 600/3/60.
.3 Rated current : 18 A.
.4 Maximum current: 25 A.
.5 Cylinders: 1.
.6 Nominal capacity: 22 kg/h.
.7 Modulating output between 20 % and 100 % of rated capacity.
.8 Duct mounted steam distributor absorption distance: see schedule.

.6 Options:

.1 Air flow switch
.2 High limit humidity switch
.3 Condensate hose 7.5 meter.

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 humidifiers installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of NRC Representative.
.2 Inform NRC 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 NRC Representative.

3.2 INSTALLATION

.1 Install in accordance with manufacturers instructions.

.2 Humidifier media to be new and clean when project is accepted.

.3 Water service overflow drain: as indicated.

.4 When installing in ducting, provide waterproof duct up and downstream in accordance with Section 23 31 13.01- Metal Ducts - Low Pressure to 500 Pa.

.5 Install capped drain connection at low point in duct.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its product and submit written reports, in acceptable format, to verify compliance of Work with Contract.

.2 Manufacturer's Field Services: provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Obtain reports, within 3 days of review, and submit immediately to NRC Representative.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

.4 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 25 05 01 - EMCS: General Requirements.

.2 Section 25 05 02 - EMCS: Submittals and Review Process.

.3 Section 25 05 03 - EMCS: Project Record Documents.

.4 Section 25 30 02 – EMCS: Field Control Devices.

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 fulfill 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 restart of components were 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 NRC 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 01 33 00 - Submittal Procedures.

.2 Final Report: submit report to NRC 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 NRC 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 NRC Representative in accordance with Section 01 78 00 - Closeout Submittals.

.5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.5 CLOSEOUT SUBMITTALS

.1 Provide documentation, O&M Manuals, and training of O&M personnel for review of NRC Representative before interim acceptance in accordance with Section 01 78 00 - Closeout Submittals.

1.6 COMMISSIONING

.1 Carry out commissioning under direction of NRC Representative and in presence of NRC Representative.

.2 Inform, and obtain approval from, NRC 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.

.3 Correct deficiencies, re-test in presence of NRC Representative until satisfactory performance is obtained.

.4 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.

.5 Load system with project software.

.6 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 NRC 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 two (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 Commissioning Agent.

.3 Commission integrated systems using procedures prescribed by Commissioning Agent.

.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 NRC Representative.
- .3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and two (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 and to BECC.

.7 After setting, test zero and span in 10 % increments through entire range while both increasing and decreasing pressure.

.8 NRC 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 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 NRC 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 NRC Representative and provide:

.1 Two (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 NRC Representative's acceptance signature to be on executive and applications programs.

.4 Commissioning to commence during final start-up testing.

.5 O&M personnel to assist in commissioning procedures as part of training.

.6 Commissioning to be supervised by qualified supervisory personnel and NRC 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 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-hours per 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 NRC Representative to verify reported results.

3.3 ADJUSTING

.1 Final adjusting: upon completion of commissioning as reviewed by NRC Representative, set and lock devices in final position and permanently mark settings.

3.4 DEMONSTRATION

.1 Demonstrate to NRC 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 01 79 00 - Demonstration and Training.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning.

.2 Section 25 05 02 - EMCS: Submittals and Review Process.

.3 Section 25 05 03 - EMCS: Project Record Documents.

.4 Section 25 05 54 - EMCS: Identification.

.5 Section 25 08 20 - EMCS: Warranty and Maintenance.

.6 Section 25 30 01 – EMCS: Building Controllers.

.7 Section 25 30 02 – EMCS: Field Control Devices.

1.2 DESIGNATED CONTRACTOR

.1 Hire the services of Ainsworth or its authorized representative to complete the work of all EMCS sections.

1.3 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 260.1-1993, 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-R2001, BACNET - Data Communication Protocol for Building Automation and Control Network.

.4 CSA Group (CSA).

.1 CAN/CSA-Z234.1-89 (R1995), Canadian Metric Practice Guide.

1.4 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.

1.5 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 are 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.

1.6 SYSTEM DESCRIPTION

.1 Refer to control schematics for system architecture.

.2 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following:

.1 Building Controllers.

.2 Control devices as indicated in control schematics.

.3 Data communications equipment necessary to effect EMCS data transmission system.

.4 Field control devices.

.5 Software/Hardware complete with full documentation.

.6 Complete operating and maintenance manuals.

.7 Training of personnel.

.8 Acceptance tests, technical support during commissioning, full documentation.

.9 Wiring interface co-ordination of equipment supplied by others.

.10 Miscellaneous work as specified in these sections and as indicated.

.3 Design Requirements:

.1 Design and provide conduit and wiring linking elements of system.

.2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by NRC Representative prior to installation.

.3 Location of controllers as reviewed by NRC Representative prior to installation.

.4 Provide utility power to EMCS as indicated.

.5 Metric references: in accordance with CAN/CSA Z234.1.

.4 Language Operating Requirements:

.1 Provide English operator selectable access codes.

.2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in English.

.3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English.

.4 System manager software: include in English system definition point database, additions, deletions or modifications, control loop statements, use of high-level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.

.5 Include, in English:

.1 field-related changes, alarms, input and output commands and messages from operator-initiated functions as defined in CDL's or assigned limits (i.e., commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definements).

.2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in English at specified OWS and to be able to operate one terminal in English and second in French. Point name expansions in both languages.

.3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

.1 Make submittals in accordance with Sections 25 05 02 - EMCS: Submittals and Review Process and 01 33 00 - Submittal Procedures.

.2 Submit for review:

.1 Equipment list and systems manufacturers within 10 days after award of contract.

.3 Quality Control:

.1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.

.2 Where CSA certified equipment is not available to submit such equipment to inspection authorities for special inspection and approval before delivery to site.

.3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 - EMCS: Submittals and Review Process. Label or listing of specified organization is acceptable evidence.

.4 In lieu of such evidence, submit certificate from testing organization, approved by NRC Representative, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.

.5 For materials whose compliance with organizational standards/codes/specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.

.6 Permits and fees: in accordance with general conditions of contract.

.7 Submit certificate of acceptance from authority having jurisdiction to NRC Representative.

.8 Existing devices intended for re-use: submit test report.

1.8 QUALITY ASSURANCE

.1 Provide record of successful previous installations submitting tender showing experience with similar installations utilizing computer-based systems.

.2 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.

.3 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.9 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide NRC Representative with schedule within two (2) weeks after award of Contract.

1.10 EXISTING- CONTROL COMPONENTS

.1 Utilize existing control wiring and piping as indicated.

.2 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 NRC Representative.

.2 Provide for new, properly designed device where re-usability of components is uncertain.

.3 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 NRC Representative.

.2 Failure to produce test report will constitute acceptance of existing devices by Contractor.

.4 Non-functioning items:

.1 Provide with report specification sheets or written functional requirements to support findings.

.2 NRC Representative will repair or replace existing items judged defective yet deemed necessary for EMCS.

.5 Submit written request for permission to disconnect controls and to obtain equipment downtime before proceeding with Work.

.6 Assume responsibility for controls to be incorporated into EMCS after written receipt of approval from NRC Representative.

.1 Be responsible for items repaired or replaced by NRC Representative.

.2 Be responsible for repair costs due to negligence or abuse of equipment.

.3 Responsibility for existing devices terminates upon final acceptance of EMCS as approved by NRC Representative.

.7 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

Part 2 Products

2.1 MATERIALS

.1 There is an existing system managed by Ainsworth presently installed in the building. All materials must be selected to ensure compatibility with the existing system.

2.2 EQUIPMENT

.1 Control Network Protocol: to 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.

2.3 ADAPTORS

.1 Provide adaptors between metric and imperial components.

Part 3 Execution

3.1 MANUFACTURER'S RECOMMENDATIONS

.1 Installation: to manufacturer's recommendations.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS:

.1 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

.2 Section 25 05 01 - EMCS: General Requirements.

.3 Section 25 05 03 - EMCS: Project Record Documents.

.4 Section 25 30 01 – EMCS: Building Controllers.

.5 Section 25 30 02 – EMCS: Field Control Devices.

1.2 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.3 DESIGN REQUIREMENTS

.1 Preliminary Design Review: to contain following contractor and systems information.

.1 Location of local office.

.2 Description and location of installing and servicing technical staff.

.3 Location and qualifications of programming design and programming support staff.

.4 List of spare parts.

.5 Location of spare parts stock.

.6 Names of subcontractors and site-specific key personnel.

.7 Sketch of site-specific system architecture.

.8 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.

.9 Descriptive brochures.

.10 Sample CDL and graphics (systems schematics).

.11 Response time for each type of command and report.

.12 Item-by-item statement of compliance.

.13 Proof of demonstrated ability of system to communicate utilizing BACnet.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures and coordinate with requirements in this Section.

.2 Submit preliminary design document within five (5) working days after contract award, for review by NRC Representative.

.3 Shop Drawings to consist of three (3) hard copies and one (1) soft copy of design documents, shop drawings, product data and software.

.4 Hard copy to be completely indexed and coordinated package to assure compliance with contract requirements and arranged in same sequence as specification and cross-referenced to specification section and paragraph number.

.5 Soft copy to be in Autocad - latest version and Microsoft Word latest version format, structured using menu format for easy loading and retrieval on OWS.

1.5 PRELIMINARY SHOP DRAWING REVIEW

.1 Submit electronic copy of preliminary shop drawings within 30 working days of award of contract and include following:

.1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.

.2 Detailed system architecture showing all points associated with each controller including, signal levels, pressures where new EMCS ties into existing control equipment.

.3 Spare point capacity of each controller by number and type.

.4 Controller locations.

.5 Auxiliary control cabinet locations.

.6 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.

.7 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).

.8 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.

.9 Flow measuring stations: complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at design flow rate, manufacturer, model and range of velocity transmitter.

1.6 DETAILED SHOP DRAWING REVIEW

.1 Submit detailed shop drawings within 60 working days after award of contract and before start of installation and include following:

.1 Wiring diagrams.

.2 Piping diagrams and hook-ups.

.3 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.

.4 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:

.1 Sensing element type and location.

.2 Transmitter type and range.

.3 Associated field wiring schematics, schedules and terminations.

.4 Complete Point Name Lists.

.5 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.

.6 Software and programming details associated with each point.

.7 Manufacturer's recommended installation instructions and procedures.

.8 Input and output signal levels or pressures where new system ties into existing control equipment.

.5 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.

.6 Graphic system schematic displays of air systems with point identifiers and textual description of system, as specified.

.7 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.

.8 Listing and example of specified reports.

.9 Listing of time of day schedules.

.10 Mark up to-scale construction drawing to detail control room showing location of equipment and operator work space.

.11 Type and size of memory with statement of spare memory capacity.

.12 Full description of software programs provided.

.13 Sample of "Operating Instructions Manual" to be used for training purposes.

.14 Outline of proposed start-up and verification procedures. Refer to Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.7 QUALITY ASSURANCE

.1 NRC Representative retains right to revise sequence or subsequent CDL prior to software finalization without cost to NRC Representative.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Related Requirements

.1 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

.2 Section 25 05 01 - EMCS: General Requirements.

.3 Section 25 05 02 - EMCS: Submittals and Review Process.

.4 Section 25 30 01 – EMCS: Building Controllers.

1.2 DEFINITIONS

.1 BECC - Building Environmental Control Centre.

.2 OWS - Operator Work Station.

.3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 01 78 00 - Closeout Procedures, supplemented and modified by requirements of this Section.

.2 Submit As-built drawings to NRC Representative in English.

.3 Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders.

.1 Binders to be 2/3 maximum full.

.2 Provide index to full volume in each binder.

.3 Identify contents of each manual on cover and spine.

.4 Provide Table of Contents in each manual.

.5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

1.4 AS-BUILT

.1 Provide 1 copy of detailed shop drawings generated in Section 25 05 02 - EMCS: Submittals and Review Process and include:

.1 Changes to Contract Documents as well as addenda and contract extras.

.2 Changes to interface wiring.

.3 Routing of conduit, wiring and control airlines associated with EMCS installation.

.4 Locations of obscure devices to be indicated on drawings.

.5 Listing of alarm messages.

.6 Panel/circuit breaker number for sources of normal/emergency power.

.7 Names, addresses, telephone numbers of each subcontractor having installed equipment, local representative for each item of equipment, each system.

.8 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports as specified in Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

.9 Basic system design and full documentation on system configuration.

.2 Submit for final review by NRC Representative.

.3 Provide before acceptance four (4) hard and one (1) soft copy incorporating changes made during final review.

1.5 O&M MANUALS

.1 Custom design O&M Manuals (both hard and soft copy) to contain material pertinent to this project only and to provide full and complete coverage of subjects referred to in this Section.

.2 Provide two (2) complete sets of hard and soft copies prior to system or equipment tests

.3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.

.4 Functional description to include:

.1 Functional description of theory of operation.

.2 Design philosophy.

.3 Specific functions of design philosophy and system.

.4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.

.5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.

.6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented or planned for implementation in automatic mode.

.5 System operation to include:

.1 Complete step-by-step procedures for operation of system including required actions at each OWS.

.2 Operation of computer peripherals, input and output formats.

.3 Emergency, alarm and failure recovery.

.4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including key strokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.

.6 Software to include:

.1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.

.2 Detailed descriptions of program requirements and capabilities.

.3 Data necessary to permit modification, relocation, reprogramming and to permit new and existing software modules to respond to changing system functional requirements without disrupting normal operation.

.4 Software modules, fully annotated source code listings, error-free object code files ready for loading via peripheral device

.5 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, program execution.

.6 Software for each Controller and single section referencing Controller common parameters and functions.

.7 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including calibration, maintenance, repair of sensors, transmitters, transducers, controller and interface firmware's, plus diagnostics and repair/replacement of system hardware.

.8 System configuration document:

.1 Provisions and procedures for planning, implementing and recording hardware and software modifications required during operating lifetime of system.

.2 Information to ensure co-ordination of hardware and software changes, data link or message format/content changes, sensor or control changes in event that system modifications are required.

.9 Programmer control panel documentation: provide where panels are independently interfaced with BECC, including interfacing schematics, signal identification, timing diagrams, fully commented source listing of applicable driver/handler.

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 25 05 01 - EMCS: General Requirements.

.2 Section 25 05 60 - EMCS: Field Installation.

.3 Section 25 30 02 – EMCS: Field Control Devices.

1.2 REFERENCE STANDARDS

.1 CSA Group (CSA).

.1 CSA C22.1-02, The Canadian Electrical Code, Part I (19th Edition), Safety Standard for Electrical Installations.

1.3 DEFINITIONS

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

1.4 SYSTEM DESCRIPTION

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

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures supplemented and modified by requirements of this Section.

.2 Submit to NRC Representative for approval samples of nameplates, identification tags and list of proposed wording.

Part 2 Products

2.1 NAMEPLATES FOR PANELS

.1 Identify by Plastic laminate, 3 mm thick matt white finish, black core, square corners, lettering accurately aligned and engraved into core.

.2 Sizes: 25 x 67 mm minimum.

.3 Lettering: minimum 7 mm high, black.

.4 Inscriptions: machine engraved to identify function.

2.2 NAMEPLATES FOR FIELD DEVICES

.1 Identify by plastic encased cards attached by chain.

.2 Sizes: 50 x 100 mm minimum.

.3 Lettering: minimum 5 mm high produced from laser printer in black.

.4 Data to include: point name and point address.

.5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

2.3 NAMEPLATES FOR ROOM SENSORS

.1 Identify by stick-on labels using point identifier.

.2 Location: as directed by NRC Representative.

.3 Letter size: to suit, clearly legible.

2.4 WARNING SIGNS

.1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.

.2 Sign to read: Caution: This equipment is under automatic remote control of EMCS" as reviewed by NRC Representative's.

2.5 WIRING

.1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.

.2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.

.3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

2.6 CONDUIT

.1 Colour code EMCS conduit.

.2 Pre-paint box covers and conduit fittings.

.3 Coding: use fluorescent orange paint and confirm colour with NRC Representative during "Preliminary Design Review".

Part 3 Execution

3.1 NAMEPLATES AND LABELS

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

3.2 EXISTING PANELS

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 25 05 54 - EMCS: Identification.

.2 Section 25 08 20 - EMCS: Warranty and Maintenance.

1.2 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI)

.1 ANSI C2-1990, National Electrical Safety Code.

.2 ANSI/NFPA 70-1990, National Electrical Code.

.2 CSA Group (CSA)

.1 CSA C22.1-12.

.2 CAN/CSA-C22.3 No. 7-10, Underground Systems.

1.3 SYSTEM DESCRIPTION

.1 Electrical:

.1 Provide power wiring from existing power panels to EMCS field panels. Circuits to be for exclusive use of EMCS equipment. Panel breakers to be identified on panel legends tagged and locks applied to breaker switches.

.2 Hard wiring between field control devices and EMCS field panels.

.3 Communication wiring between EMCS field panels and OWS's including main control centre BECC.

.2 Mechanical:

.1 Installation of airflow stations, dampers, and other devices requiring sheet metal trades to be mounted by Division 23. Costs to be carried by designated trade.

.3 VAV Terminal Units.

.1 Airflow probe for vav boxes to be supplied and installed under Section 23 36 00-Air Terminal Units, clause. Airflow dp sensor, actuator and associated vav controls to be supplied and installed by EMCS contractor. Tubing from air probe to dp sensor as well as installation and adjustment of air flow sensors and actuators to be the responsibility of EMCS contractor. Coordinate airflow adjustments with balancing trade.

1.4 PERSONNEL QUALIFICATIONS

.1 Qualified supervisory personnel to:

.1 Continuously direct and monitor all work.

.2 Attend site meetings.

1.5 EXISTING CONDITIONS

.1 Cutting and Patching: refer to Section 01 73 00 - Execution supplemented as specified herein.

.2 Repair all surfaces damaged during execution of work.

.3 Turn over to NRC Representative existing materials removed from work not identified for re-use.

Part 2 Products

2.1 SPECIAL SUPPORTS

.1 Structural grade steel, primed and painted after construction and before installation.

2.2 WIRING

.1 As per requirements of Division 26.

.2 For 70V and above copper conductors with chemically cross-linked thermosetting polyethylene insulation rated RW90 and 600V. Colour code to CSA 22.1.

.3 For wiring under 70 volts use FT6 rated wiring where wiring is not run in the conduit. All other cases use FT4 wiring.

.4 Sizes :

.1 120V Power supply: to match or exceed the breaker, size #12 minimum.

.2 Wiring for safeties/interlocks for starters, motor control centres, to be stranded, #14 minimum.

.3 Field wiring to digital devices: #18 AWG.

.4 Analog input and output: shielded #18 minimum solid copper. Wiring must be continuous without joints.

.5 More than 4 conductors: #22 minimum solid copper.

.5 Terminations:

.1 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

2.3 CONDUIT

.1 As per requirements of Division 26. EMCS conduits to be bronze color.

.2 Electrical metallic tubing to CAN/CSA C22.2 No. 83. Flexible and liquid tight flexible metal conduit to CAN/CSA C22.2 No. 56. Rigid steel threaded conduit to CAN/CSA C22.2 No. 45.1.

.3 Junction and pull boxes: welded steel.

.1 Surface mounting cast FS: screw-on flat covers.

.2 Flush mounting: covers with 25 mm minimum extension all round.

.4 Cabinets: sheet steel, for surface mounting, with hinged doors, latch lock, 2 keys, complete with perforated metal mounting backboard. Panels to be keyed alike for similar functions and or entire contract as approved.

.5 Outlet boxes: 100 mm minimum, square.

.6 Conduit boxes, fittings:

.1 Bushings and connectors: with nylon insulated throats.

.2 With push pennies to prevent entry of foreign materials.

.7 Fittings for rigid conduit :

.1 Couplings and fittings: threaded type steel.

.2 Double locknuts and insulated bushings: use on sheet metal boxes.

.3 Use factories “ells”; where 90 degree bends required for 25 mm and larger conduits.

.8 Fittings for the thin wall conduit:

.1 Connectors and couplings: steel, set screw type.

2.4 WIRING DEVICES, COVER PLATES

.1 Conform to CSA.

.2 Receptacles:

.1 Duplex: CSA type 5-15R.

.2 Single: CSA type 5-15R.

.3 Cover plates and blank plates: finish to match other plates in area.

2.5 SUPPORTS FOR CONDUIT, FASTENINGS, EQUIPMENT

.1 Solid masonry, tile and plastic surfaces: lead anchors or nylon shields.

.1 Hollow masonry walls, suspended drywall ceilings: toggle bolts.

.2 Exposed conduits or cables:

.1 50 mm diameter and smaller: one-hole steel straps.

.2 Larger than 50 mm diameter: two-hole steel straps.

.3 Suspended support systems:

.1 Individual cable or conduit runs: support with 6 mm diameter threaded rods and support clips.

.2 Two (2) or more suspended cables or conduits: support channels supported by 6 mm diameter threaded rod hangers.

Part 3 Execution

3.1 INSTALLATION

.1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

3.2 SUPPORTS

.1 Install special supports as required and as indicated.

3.3 ELECTRICAL GENERAL

.1 Do complete installation in accordance with requirements of:

.1 Division 26, this specification.

.2 CSA 22.1 Canadian Electrical Code.

.3 ANSI/NFPA 70.

.4 ANSI C2.

.2 Fully enclose or properly guard electrical wiring, terminal blocks, high voltage above 70 V contacts and mark to prevent accidental injury.

.3 Do underground installation to CAN/CSA-C22.3 No.7, except where otherwise specified.

.4 Conform to manufacturer's recommendations for storage, handling and installation.

.5 Check factory connections and joints. Tighten where necessary to ensure continuity.

.6 Install electrical equipment between 1000 and 2000 mm above finished floor wherever possible and adjacent to related equipment.

.7 Protect exposed live equipment such as panel, mains, outlet wiring during construction for personnel safety.

.8 Shield and mark live parts "LIVE 120 VOLTS" or other appropriate voltage.

.9 Install conduits, and sleeves prior to pouring of concrete.

.10 Holes through exterior wall and roofs: flash and make weatherproof.

.11 Make necessary arrangements for cutting of chases, drilling holes and other structural work required to install electrical conduit, cable, pull boxes, outlet boxes.

.12 Install cables, conduits and fittings which are to be embedded or plastered over, neatly and closely to building structure to minimize furring.

3.4 CONDUIT SYSTEM

.1 Communication wiring shall be installed in conduit. Provide complete conduit system to link Building Controllers to BECC. Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems. Maximum conduit fill not to exceed 40%. Design drawings do not show conduit layout.

.2 Install conduits parallel or perpendicular to building lines, to conserve headroom and to minimize interference.

.3 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Obtain approval from NRC Representative before starting such work. Provide complete conduit system to link field panels and devices with main control centre. Conduit size to match conductors plus future expansion capabilities as specified.

.4 Locate conduits at least 150 mm from parallel steam or hot water pipes and at least 50 mm at crossovers.

.5 Bend conduit so that diameter is reduced by less than 1/10th original diameter.

.6 Field thread on rigid conduit to be of sufficient length to draw conduits up tight.

.7 Limit conduit length between pull boxes to less than 30 m.

.8 Use conduit outlet boxes for conduit up to 32 mm diameter and pull boxes for larger sizes.

.9 Fastenings and supports for conduits, cables, and equipment:

.1 Provide metal brackets, frames, hangers, clamps and related types of support structures as indicated and as required to support cable and conduit runs.

.2 Provide adequate support for raceways and cables, sloped vertically to equipment.

.3 Use supports or equipment installed by other trades for conduit, cable and raceway supports only after written approval from NRC Representative.

.10 Install polypropylene fish cord in empty conduits for future use.

.11 Where conduits become blocked, remove and replace blocked sections.

.12 Pass conduits through structural members only after receipt of NRC Representative's written approval.

.13 Conduits may be run in flanged portion of structural steel.

.14 Group conduits wherever possible on suspended or surface channels.

.15 Pull boxes:

.1 Install in inconspicuous but accessible locations.

.2 Support boxes independently of connecting conduits.

.3 Fill boxes with paper or foam to prevent entry of construction material.

.4 Provide correct size of openings. Reducing washers not permitted.

.5 Mark location of pull boxes on record drawings.

.6 Identify AC power junction boxes, by panel and circuit breaker.

.16 Install terminal blocks or strips indicated in cabinets.

.17 Install bonding conductor for 120 volts and above in conduit.

3.5 WIRING

.1 Install multiple wiring in ducts simultaneously.

.2 Do not pull spliced wiring inside conduits or ducts.

.3 Use CSA certified lubricants of type compatible with insulation to reduce pulling tension.

.4 Tests: use only qualified personnel. Demonstrate that:

.1 Circuits are continuous, free from shorts, unspecified grounds.

.2 Resistance to ground of all circuits is greater than 50 Megohms.

.5 Provide NRC Representative with test results showing locations, circuits, results of tests.

.6 Remove insulation carefully from ends of conductors and install to manufacturer's recommendations. Accommodate all strands in lugs. Where insulation is stripped in excess, neatly tape so that only lug remains exposed.

.7 Wiring in main junction boxes and pull boxes to terminate on terminal blocks only, clearly and permanently identified. Junctions or splices not permitted for sensing or control signal covering wiring.

.8 Do not allow wiring to come into direct physical contact with compression screw.

.9 Install ALL strands of conductor in lugs of components. Strip insulation only to extent necessary for installation.

3.6 WIRING DEVICES, COVER PLATES

.1 Receptacles:

.1 Install vertically in gang type outlet box when more than one receptacle is required in one location.

.2 Cover plates:

.1 Install suitable common cover plate where wiring devices are grouped.

.2 Use flush type cover plates only on flush type outlet boxes.

3.7 STARTERS, CONTROL DEVICES

.1 Install and make power and control connections as indicated.

.2 Install correct over-current devices.

.3 Identify each wire, terminal for external connections with permanent number marking identical to diagram.

.4 Performance Verification:

.1 Operate switches and controls to verify functioning.

.2 Perform start and stop sequences of contactors and relays.

.3 Check that interlock sequences, with other separate related starters, equipment and auxiliary control devices, operate as specified.

3.8 GROUNDING

.1 Install complete, permanent, continuous grounding system for equipment, including conductors, connectors and accessories.

.2 Install separate grounding conductors in conduit within building.

.3 Install ground wire in all PVC ducts and in tunnel conduit systems.

.4 Tests: perform ground continuity and resistance tests, using approved method appropriate to site conditions.

3.9 TESTS

.1 General:

.1 Perform following tests in addition to tests specified Section 25 08 20 - EMCS: Warranty and Maintenance.

.2 Give 14 days written notice of intention to test.

.3 Conduct in presence of NRC Representative and authority having jurisdiction.

.4 Conceal work only after tests satisfactorily completed.

.5 Report results of tests to NRC Representative in writing.

.6 Preliminary tests:

.1 Conduct as directed to verify compliance with specified requirements.

.2 Make needed changes, adjustments, replacements.

.3 Insulation resistance tests:

.1 Megger all circuits, feeders, equipment for 120 - 600V with 1000V instrument. Resistance to ground to be more than required by Code before energizing.

.2 Test insulation between conductors and ground, efficiency of grounding system to satisfaction of NRC Representative and authority having jurisdiction.

3.10 IDENTIFICATION

.1 Refer to Section 25 05 54 - EMCS: Identification.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 25 05 01 - EMCS: General Requirements.

.2 Section 25 05 60 - EMCS: Field Installation.

1.2 REFERENCE STANDARDS.

.1 CSA Group (CSA).

.1 CSA Z204-94 (R1999), Guidelines for Managing Indoor Air Quality in Office Buildings.

1.3 DEFINITIONS

.1 BC(s) - Building Controller(s).

.2 OWS - Operator Work Station.

.3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit detailed preventative maintenance schedule for system components to NRC Representative.

.3 Submit detailed inspection reports to NRC Representative.

.4 Submit dated, maintenance task lists to NRC Representative and include the following sensor and output point detail, as proof of system verification:

.1 Point name and location.

.2 Device type and range.

.3 Measured value.

.4 System displayed value.

.5 Calibration detail.

.6 Indication if adjustment required.

.7 Other action taken or recommended.

.5 Submit network analysis report showing results with detailed recommendations to correct problems found.

.6 Records and logs: in accordance with Section 01 78 00 - Closeout Submittals.

.1 Maintain records and logs of each maintenance task on site.

.2 Organize cumulative records for each major component and for entire EMCS chronologically.

.3 Submit records to NRC Representative, after inspection indicating that planned and systematic maintenance have been accomplished.

.7 Revise and submit to NRC Representative in accordance with Section 01 78 00 - Closeout Submittals "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

1.5 MAINTENANCE SERVICE DURING WARRANTY PERIOD

.1 Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.

.2 Emergency Service Calls:

.1 Initiate service calls when EMCS is not functioning correctly.

.2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.

.3 Furnish NRC Representative with telephone number where service personnel may be reached at any time.

.4 Service personnel to be on site ready to service EMCS within two (2) hours after receiving request for service.

.5 Perform Work continuously until EMCS restored to reliable operating condition.

.3 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.

.4 Work requests: record each service call request, when received separately on approved form and include:

.1 Serial number identifying components involved.

.2 Location, date and time call received.

.3 Nature of trouble.

.4 Names of personnel assigned.

.5 Instructions of work to be done.

.6 Amount and nature of materials used.

.7 Time and date work started.

.8 Time and date of completion.

.5 Provide system modifications in writing.

.1 No system modification, including operating parameters and control settings, to be made without prior written approval of NRC Representative.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

.1 Perform as minimum (3) three minor inspections and one (1) major inspection (more often if required by manufacturer) per year. Provide detailed written report to NRC Representative as described in Submittal article.

.2 Perform inspections during regular working hours, 08h00 to 16h30, Monday through Friday, excluding statutory holidays.

.3 Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:

.1 Perform calibrations using test equipment having traceable, certifiable accuracy at minimum 50 % greater than accuracy of system displaying or logging value.

.2 Calibrate each field input/output device in accordance with CSA Z204.

.3 Provide dated, maintenance task lists, as described in Submittal article, as proof of execution of complete system verification.

.4 Minor inspections to include, but not limited to:

.1 Perform visual, operational checks to BC's, peripheral equipment, interface equipment and other panels.

.2 Check equipment cooling fans as required.

.3 Visually check for mechanical faults, air leaks and proper pressure settings on pneumatic components.

.4 Review system performance with NRC Representative to discuss suggested or required changes.

.5 Major inspections to include, but not limited to:

.1 Minor inspection.

.2 Clean OWS(s) peripheral equipment, BC(s), interface and other panels, micro-processor interior and exterior surfaces.

.3 Check signal, voltage and system isolation of BC(s), peripherals, interface and other panels.

.4 Verify calibration/accuracy of each input and output device and recalibrate or replace as required.

.5 Provide mechanical adjustments, and necessary maintenance on printers.

.6 Run system software diagnostics as required.

.7 Install software and firmware enhancements to ensure components are operating at most current revision for maximum capability and reliability.

.1 Perform network analysis and provide report as described in Submittal article.

.6 Rectify deficiencies revealed by maintenance inspections and environmental checks.

.7 Continue system debugging and optimization.

.8 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.

.9 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 25 05 01 - EMCS: General Requirements.

.2 Section 25 05 02 - EMCS: Submittals and Review Process.

.3 Section 25 05 03 - EMCS: Project Record Documents.

.4 Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

1.2 REFERENCE STANDARDS

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).

.1 ASHRAE 2003, Applications Handbook, SI Edition.

.2 CSA Group (CSA).

.1 C22.2 No.205-M1983 (R1999), Signal Equipment.

.3 Institute of Electrical and Electronics Engineers (IEEE).

.1 IEEE C37.90.1-02, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.

.4 Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services.

.1 MD13800-September 2000, Energy Management and Control Systems (EMCS) Design Manual. English: ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanical/me214-e.pdf

1.3 DEFINITIONS

.1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.4 DESCRIPTION

.1 General: Network of controllers comprising of MCU('s), LCU('s), ECU('s) or TCU('s) to be provided as indicated in System Architecture Diagram to support building systems and associated sequence(s) of operations as detailed in these specifications.

.1 Provide sufficient controllers to meet intents and requirements of this section.

.2 Controller quantity and point contents to be approved by NRC Representative at time of preliminary design review.

.2 Controllers: stand-alone intelligent Control Units.

.1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.

.2 Incorporate communication interface ports for communication to LANs to exchange information with other Controllers.

.3 Capable of interfacing with operator interface device.

.4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controller. Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

.1 Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

.3 Interface to include provisions for use of dial-up modem for interconnection with remote modem.

.1 Dial-up communications to use 56 Kbit modems and voice grade telephone lines.

.2 Each stand-alone panel may have its own modem or group of stand-alone panels may share modem.

1.5 DESIGN REQUIREMENTS

.1 To include:

.1 Scanning of AI and DI connected inputs for detection of change of value and processing detection of alarm conditions.

.2 Perform On-Off digital control of connected points, including resulting required states generated through programmable logic output.

.3 Perform Analog control using programmable logic (including PID) with adjustable dead bands and deviation alarms.

.4 Control of systems as described in sequence of operations.

.5 Execution of optimization routines as listed in this section.

.2 Total spare capacity for MCUs and LCUs: at least 25 % of each point type distributed throughout the MCUs and LCUs.

.3 Field Termination and Interface Devices:

.1 To: CSA C22.2 No.205.

.2 Electronically interface sensors and control devices to processor unit.

.3 Include, but not be limited to, following:

.1 Programmed firmware or logic circuits to meet functional and technical requirements.

.2 Power supplies for operation of logics devices and associated field equipment.

.3 Lockable wall cabinet.

.4 Required communications equipment and wiring (if remote units).

.5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.

.6 Input Output interface to accept as minimum AI, AO, DI, DO functions as specified.

.7 Wiring terminations: use conveniently located screw type or spade lug terminals.

.4 AI interface equipment to:

.1 Convert analog signals to digital format with 10 bit analog-to-digital resolution.

.2 Provide for following input signal types and ranges:

.1 4 - 20 mA.

.2 0 - 10 V DC.

.3 100/1000 ohm RTD input.

.3 Meet IEEE C37.90.1 surge withstand capability.

.4 Have common mode signal rejection greater than 60 dB to 60 Hz.

.5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.

.5 AO interface equipment:

.1 Convert digital data from controller processor to acceptable analog output signals using 8 bit digital-to-analog resolution.

.2 Provide for following output signal types and ranges:

.1 4 - 20 mA.

.2 0 - 10 V DC.

.3 Meet IEEE C37.90.1 surge withstand capability.

.6 DI interface equipment:

.1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.

.2 Meet IEEE C37.90.1 surge withstand capability.

.3 Accept pulsed inputs up to 2 kHz.

.7 DO interface equipment:

.1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 V AC.

.2 Switch up to 5 amps at 220 V AC using optional interface relay.

.4 Controllers and associated hardware and software: operate in conditions of 0 degrees C to 44 degrees C and 20 % to 90 % non-condensing RH.

.5 Controllers (MCU, LCU): mount in a wall-mounted cabinet with hinged, keyed-alike locked door.

.1 Provide for conduit entrance from top, bottom or sides of panel.

.2 ECUs and TCUs to be mounted in equipment enclosures or separate enclosures.

.3 Mounting details as approved by NRC Representative for ceiling mounting.

.6 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.

.7 Provide surge and low-voltage protection for interconnecting wiring connections.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and Section 25 05 02 - EMCS: Submittals and Review Process.

.1 Submit product data sheets for each product item proposed for this project.

1.7 MAINTENANCE

.1 Provide manufacturers recommended maintenance procedures for insertion in Section 25 05 03 - EMCS: Project Record Documents.

Part 2 Products

2.1 MASTER CONTROL UNIT (MCU)

.1 General: primary function of MCU is to provide co-ordination and supervision of subordinate devices in execution of optimization routines such as demand limiting or enthalpy control.

.2 Include high-speed communication LAN Port for Peer to Peer communications with OWS(s) and other MCU level devices.

.1 MCU must support BACnet.

.3 MCU local I/O capacity as follows:

.1 MCU I/O points as allocated in I/O Summary Table referenced in MD13800.

.2 LCUs may be added to support system functions.

.4 Central Processing Unit (CPU).

.1 Processor to consist of minimum 16 bit microprocessor capable of supporting software to meet specified requirements.

.2 CPU idle time to be more than 30 % when system configured to maximum input and output with worst case program use.

.3 Minimum addressable memory to be at manufacturer's discretion but to support at least performance and technical specifications to include but not limited to:

.1 Non-volatile EEPROM to contain operating system, executive, application, sub-routine, other configurations definition software. Tape media not acceptable.

.2 Battery backed (72 hours minimum capacity) RAM (to reduce the need to reload operating data in event of power failure) to contain CDLs, application parameters, operating data or software that is required to be modifiable from operational standpoint such as schedules, setpoints, alarm limits, PID constants and CDL and hence modifiable on-line through operator panel or remote operator's interface. RAM to be downline loadable from OWS.

.4 Include uninterruptible clock accurate to plus or minus 5 secs/month, capable of deriving year/month/day/hour/minute/second, with rechargeable batteries for minimum 72 hours operation in event of power failure.

2.2 LOCAL CONTROL UNIT (LCU)

.1 Provide multiple control functions for typical built-up and package HVAC systems, hydronic systems and electrical systems.

.2 Minimum of 16 I/O points of which minimum be 4 AOs, 4 AIs, 4 DIs, 4 DOs.

.3 Points integral to one Building System to be resident on only one controller.

.4 Microprocessor capable of supporting necessary software and hardware to meet specified requirements as listed in previous MCU article with following additions:

.1 Include minimum two (2) interface ports for connection of local computer terminal.

.2 Design so that shorts, opens or grounds on input or output will not interfere with other input or output signals.

.3 Physically separate line voltage (70V and over) circuits from DC logic circuits to permit maintenance on either circuit with minimum hazards to technician and equipment.

.4 Include power supplies for operation of LCU and associated field equipment.

.5 In event of loss of communications with, or failure of, MCU, LCU to continue to perform control. Controllers that use defaults or fail to open or close positions not acceptable.

.6 Provide conveniently located screw type or spade lug terminals for field wiring.

2.3 TERMINAL/EQUIPMENT CONTROL UNIT (TCU/ECU)

.1 Microprocessor capable of supporting necessary software and hardware to meet TCU/ECU functional specifications.

.1 TCU/ECU definition to be consistent with those defined in ASHRAE HVAC Applications Handbook section 45.

.2 Controller to communicate directly with EMCS through EMCS LAN and provide access from EMCS OWS for setting occupied and unoccupied space temperature setpoints, flow setpoints, and associated alarm values, permit reading of sensor values, field control values (% open) and transmit alarm conditions to EMCS OWS.

.3 VAV Terminal Controller.

.1 Microprocessor based controller with integral flow transducer, including software routines to execute PID algorithms, calculate airflow for integral flow transducer and measure temperatures as per I/O Summary required inputs. Sequence of operation to ASHRAE HVAC Applications Handbook.

.2 Controller to support point definition; in accordance with Section 25 05 01 - EMCS: General Requirements.

.3 Controller to operate independent of network in case of communication failure.

.4 Controller to include damper actuator and terminations for input and output sensors and devices.

2.4 SOFTWARE

.1 General.

.1 Include as minimum: operating system executive, communications, application programs, operator interface, and systems sequence of operation - CDL's.

.2 Include "firmware" or instructions which are programmed into ROM, EPROM, EEPROM or other non-volatile memory.

.3 Include initial programming of Controllers, for entire system.

.2 Program and data storage.

.1 Store executive programs and site configuration data in ROM, EEPROM or other non-volatile memory.

.2 Maintain CDL and operating data including setpoints, operating constants, alarm limits in battery-backed RAM or EEPROM for display and modification by operator.

.3 Programming languages.

.1 Program Control Description Logic software (CDL) using English like or graphical, high level, general control language.

.2 Structure software in modular fashion to permit simple restructuring of program modules if future software additions or modifications are required. GO TO constructs not allowed unless approved by NRC Representative.

.4 Operator Terminal interface.

.1 Operating and control functions include:

.1 Multi-level password access protection to allow user/manager to limit workstation control.

.2 Alarm management: processing and messages.

.3 Operator commands.

.4 Reports.

.5 Displays.

.6 Point identification.

.5 Pseudo or calculated points.

.1 Software to provide access to value or status in controller or other networked controller in order to define and calculate pseudo-point. When current pseudo-point value is derived, normal alarm checks must be performed or value used to totalize.

.2 Inputs and outputs for process: include data from controllers to permit development of network-wide control strategies. Processes also to permit operator to use results of one process as input to number of other processes (e.g., cascading).

.6 Control Description Logic (CDL):

.1 Capable of generating on-line project-specific CDLs which are software based, programmed into RAM or EEPROM and backed up to OWS. Owner must have access to these algorithms for modification or to be able to create new ones and to integrate these into CDLs on BC(s) from OWS.

.2 Write CDL in high-level language that allows algorithms and interlocking programs to be written simply and clearly. Use parameters entered into system (e.g. setpoints) to determine operation of algorithm. Operator to be able to alter operating parameters on-line from OWS and BC(s) to tune control loops.

.3 Perform changes to CDL on-line.

.4 Control logic to have access to values or status of points available to controller including global or common values, allowing cascading or inter-locking control.

.5 Energy optimization routines including enthalpy control, supply temperature reset, to be LCU or MCU resident functions and form part of CDL.

.6 MCU to be able to perform following pre-tested control algorithms:

.1 Two (2) positions control.

.2 Proportional Integral and Derivative (PID) control.

.7 Control software to provide ability to define time between successive starts for each piece of equipment to reduce cycling of motors.

.8 Provide protection against excessive electrical-demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.

.9 Power Fail Restart: upon detection of power failure system to verify availability of Emergency Power as determined by emergency power transfer switches and analyse controlled equipment to determine its appropriate status under Emergency power conditions and start or stop equipment as defined by I/O Summary. Upon resumption of normal power as determined by emergency power transfer switches, MCU to analyse status of controlled equipment, compare with normal occupancy scheduling, turn equipment on or off as necessary to resume normal operation.

.7 Event and Alarm management: use management by exception concept for Alarm Reporting. This is system wide requirement. This approach will ensure that only principal alarms are reported to OWS. Events which occur as direct result of primary event to be suppressed by system and only events which fail to occur to be reported. Such event sequence to be identified in I/O Summary and sequence of operation. Examples of above are, operational temperature alarms limits which are exceeded when main air handler is stopped, or General Fire condition shuts air handlers down, only Fire alarm status shall be reported. Exception is, when air handler which is supposed to stop or start fails to do so under event condition.

.8 Energy management programs: include specific summarizing reports, with date stamp indicating sensor details which activated and or terminated feature.

.1 MCU in coordination with subordinate LCU, TCU, ECU to provide for the following energy management routines:

.1 Time of day scheduling.

.2 Calendar based scheduling.

.3 Holiday scheduling.

.4 Temporary schedule overrides.

.5 Optimal start stop.

.6 Night setback control.

.7 Enthalpy (economizer) switchover.

.8 Temperature compensated load rolling.

.9 Fan speed/flow rate control.

.2 Programs to be executed automatically without need for operator intervention and be flexible enough to allow customization.

.3 Apply programs to equipment and systems as specified or requested by the NRC Representative.

.9 Function/Event Totalization: features to provide predefined reports which show daily, weekly, and monthly accumulating totals and which include high rate (time stamped) and low rate (time stamped) and accumulation to date for month.

.1 MCUs to accumulate and store automatically run-time for binary input and output points.

.2 MCU to automatically sample, calculate and store consumption totals on daily, weekly or monthly basis for user-selected analog or binary pulse input-type points.

.3 MCU to automatically count events (number of times pump is cycled off and on) daily, weekly or monthly basis.

.4 Totalization routine to have sampling resolution of 1 min or less for analog inputs.

.5 Totalization to provide calculations and storage of accumulations up to 99,999.9 units (eg. kWH, litres, tonnes, etc.).

.6 Store event totalization records with minimum of 9,999,999 events before reset.

.7 User to be able to define warning limit and generate user-specified messages when limit reached.

2.5 LEVELS OF ADDRESS

.1 Upon operator's request, EMCS to present status of any single 'point', 'system' or point group, entire 'area', or entire network on printer or OWS as selected by operator.

.1 Display analog values digitally to one 1 place of decimals with negative sign as required.

.2 Update displayed analog values and status when new values received.

.3 Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm.

.4 Updates to be change-of-value (COV)-driven or if polled not exceeding 2 second intervals.

2.6 POINT NAME SUPPORT

.1 Controllers (MCU, LCU) to support PWGSC point naming convention as defined in Section 25 05 01 - EMCS: General Requirements.

Part 3 Execution

3.1 LOCATION

.1 Location of Controllers to be approved by NRC Representative.

3.2 INSTALLATION

.1 Install Controllers in secure locking enclosures as directed by NRC Representative.

.2 Provide necessary power from local 120 V branch circuit panel for equipment.

.3 Install tamper locks on breakers of circuit breaker panel.

.4 Use uninterruptible Power Supply (UPS) and emergency power when equipment must operate in emergency and co-ordinating mode.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning.

.2 Section 25 05 01 - EMCS: General Requirements.

.3 Section 25 05 02 - EMCS: Submittals and Review Process.

.4 Section 25 05 54 - EMCS: Identification.

.5 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

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

1.2 DEFINITIONS

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 02 - EMCS: Submittals and Review Process.

.2 Pre-Installation Tests.

.1 Submit samples at random from equipment shipped, as requested by NRC Representative, for testing before installation. Replace devices not meeting specified performance and accuracy.

.3 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions for specified equipment and devices.

1.4 EXISTING CONDITIONS

.1 Cutting and Patching: in accordance with Section 01 73 00 - Execution supplemented as specified herein.

.2 Repair surfaces damaged during execution of Work.

.3 Turn over to NRC Representative existing materials removed from Work not identified for re-use.

Part 2 Products

2.1 GENERAL

.1 Control devices of each category to be of same type and manufacturer.

.2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight assembly.

.3 Operating conditions: 0 - 32 degrees C with 10 - 90 % RH (non-condensing) unless otherwise specified.

.4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.

.5 Transmitters and sensors to be unaffected by external transmitters including walkie-talkies.

.6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

.7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.

.8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.

.9 Range: including temperature, humidity, pressure, as indicated in I/O summary in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

2.2 TEMPERATURE SENSORS

.1 General: except for room sensors to be resistance or thermocouple type to following requirements:

.1 Thermocouples: limit to temperature range of 200 degrees C and over.

.2 RTD's: 100 or 1000 ohm at 0 degrees C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm degrees C.

.3 Sensing element: hermetically sealed.

.4 Stem and tip construction: copper or type 304 stainless steel.

.5 Time constant response: less than 3 seconds to temperature change of 10 degrees C.

.6 Immersion wells: NPS 3/4, stainless steel spring-loaded construction, with heat transfer compound compatible with sensor. Insertion length 100 mm as indicated.

.2 Room temperature sensors and display wall modules.

.1 Reuse existing.

.3 Duct temperature sensors:

.1 General purpose duct type: suitable for insertion into ducts at various orientations, insertion length 460 mm.

.2 Averaging duct type: incorporates numerous sensors inside assembly which are averaged to provide one reading. Minimum insertion length 6096 mm. Bend probe at field installation time to 100 mm radius at point along probe without degradation of performance.

2.3 TEMPERATURE TRANSMITTERS

.1 Requirements:

.1 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0 degrees C, platinum resistance detector type sensors.

.2 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01 degrees C per volt change.

.3 Output signal: 4 - 20 mA into 500 ohm maximum load.

.4 Input and output short circuit and open circuit protection.

.5 Output variation: less than 0.2 % of full scale for supply voltage variation of plus or minus 10%.

.6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5 % of full-scale output.

.7 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.

.8 Integral zero and span adjustments.

.9 Temperature effects: not to exceed plus or minus 1.0 % of full scale/50 degrees C.

.10 Long term output drift: not to exceed 0.25 % of full scale/six 6 months.

.11 Transmitter ranges: select narrowest range to suit application from following:

.1 Minus 50 degrees C to plus 50 degrees C, plus or minus 0.5 degrees C.

.2 0 to 100 degrees C, plus or minus 0.5 degrees C.

.3 0 to 50 degrees C, plus or minus 0.25 degrees C.

.4 0 to 25 degrees C, plus or minus 0.1 degrees C.

.5 10 to 35 degrees C, plus or minus 0.25 degrees C.

2.4 TEMPERATURE SWITCHES

.1 Requirements:

.1 Operate automatically. Reset automatically, except as follows:

.1 Low temperature detection: manual reset.

.2 Adjustable setpoint and differential.

.3 Accuracy: plus or minus 1 degrees C.

.4 Snap action rating: as required. Switch to be DPST for hardwire and EMCS connections.

.5 Type as follows:

.1 Duct, general purpose: insertion length = 460 mm.

.2 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.

.3 Low temperature detection: continuous elements with 6096 mm insertion length, duct mounting, to detect coldest temperature in any 30 mm length.

.4 Strap-on: with helical screw stainless steel clamp.

2.5 HUMIDITY SENSORS

.1 Duct Requirements:

.1 Range: 5 - 90 % RH minimum.

.2 Operating temperature range: 0 – 60 degrees C.

.3 Absolute accuracy:

.1 Duct sensors: plus or minus 3 %.

.4 Sheath: stainless steel with integral shroud for specified operation in air streams of up to 10 m/s.

.5 Maximum sensor non-linearity: plus or minus 2% RH with defined curves.

.6 Duct mounted sensors: locate so that sensing element is in airflow in duct.

2.6 HUMIDITY TRANSMITTERS

.1 Requirements:

.1 Input signal: from RH sensor.

.2 Output signal: 4 - 20 mA onto 500 ohm maximum load.

.3 Input and output short circuit and open circuit protection.

.4 Output variations: not to exceed 0.2 % of full-scale output for supply voltage variations of plus or minus 10 %.

.5 Output linearity error: plus or minus 1.0 % maximum of full-scale output.

.6 Integral zero and span adjustment.

.7 Temperature effect: plus or minus 1.0 % full scale/6 months.

.8 Long term output drift: not to exceed 0.25 % of full-scale output/six 6 months.

2.7 ROOM AIR QUALITY SENSORS

.1 Requirements:

.1 Air quality sensing and display wall module.

.2 CO2, Humidity and Temperature sensing

.3 LCD display to show measured space conditions and setpoints.

.4 Buttons for occupant selection of temperature setpoint and occupied/unoccupied mode.

.5 Jack connection for plugging in laptop personal for access to zone bus.

.6 Temperature measuring range: 0-50°C, +/- 0.3 K at 23°C.

.7 CO2 measuring range: 0-2000 ppm, +/- (50 ppm + 2 % of measured value).

.8 Separate mounting base for ease of installation.

2.8 DIFFERENTIAL PRESSURE TRANSMITTERS

.1 Requirements:

.1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.

.2 Output signal: 4 - 20 mA into 500 ohm maximum load.

.3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.

.4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full-scale output over entire range.

.5 Integral zero and span adjustment.

.6 Temperature effects: not to exceed plus or minus 1.5 % full scale/50 degrees C.

.7 Over-pressure input protection to at least twice rated input pressure.

.8 Output short circuit and open circuit protection.

.9 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.9 STATIC PRESSURE SENSORS

.1 Requirements:

.1 Multipoint element with self-averaging manifold.

.1 Maximum pressure loss: 160 Pa at 10 m/s. (Air stream manifold).

.2 Accuracy: plus or minus 1 % of actual duct static pressure.

2.10 STATIC PRESSURE TRANSMITTERS

.1 Requirements:

.1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.

.2 Calibrated span: not to exceed 150 % of duct static pressure at maximum flow.

.3 Accuracy: 0.4 % of span.

.4 Repeatability: within 0.5 % of output.

.5 Linearity: within 1.5 % of span.

.6 Deadband or hysteresis: 0.1 % of span.

.7 External exposed zero and span adjustment.

.8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.11 CURRENT TRANSDUCERS

.1 Requirements:

.2 Purpose: combined sensor/transducer, to measure line current and produce proportional signal in one of following ranges:

.1 4-20 mA DC.

.2 0-1 volt DC.

.3 0-10 volts DC.

.4 0-20 volts DC.

.3 Frequency insensitive from 10 - 80 hz.

.4 Accuracy to 0.5 % full scale.

.5 Zero and span adjustments. Field adjustable range to suit motor applications.

.6 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

2.12 CURRENT SENSING RELAYS

.1 Requirements:

.1 Suitable to detect belt loss or motor failure.

.2 Trip point adjustment, output status LED.

.3 Split core for easy mounting.

.4 Induced sensor power.

.5 Relay contacts: capable of handling 0.5 amps at 30 VAC/DC. Output to be NO solid state.

.6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.

.7 Adjustable latch level.

2.13 ELECTRONIC CONTROL DAMPER ACTUATORS

.1 Requirements:

.1 Direct mount proportional type as indicated.

.2 Spring return for “fail-safe” in Normally Open or Normally Closed position as indicated.

.3 Operator: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.

.4 Power requirements: 24 V AC.

.5 Operating range: 0 - 10 V DC or 4 - 20 mA DC.

.6 For VAV box applications floating control type actuators may be used.

.7 Damper actuators to drive damper from full open to full closed in less than 120 seconds.

.8 Provide auxiliary contacts to confirm full opening and closing of dampers.

2.14 CONTROL VALVES

.1 Body: characterized ball.

.1 Flow characteristic as indicated on control valve schedule: equal percentage.

.2 Flow factors (KV) as indicated on control valve schedule: CV in imperial units.

.3 Normally closed or normally open, as indicated.

.4 Two or three ports, as indicated.

.5 Leakage rate ANSI class IV, 0.01% of full open valve capacity.

.6 Packing easily replaceable.

.7 Stem, stainless steel.

.8 Plug and seat, stainless steel

.9 Disc, replaceable, material to suit application.

.10 NPS 2 and under:

.1 Screwed National Pipe Thread (NPT) tapered female connections.

.2 Valves to ANSI Class 250, valves to bear ANSI mark.

.3 Rangeability 50:1 minimum.

2.15 ELECTRONIC VALVE ACTUATORS

.1 Requirements:

.1 Construction: steel, cast iron, aluminum.

.2 Control signals: 4-20 mA DC or 0-10V DC.

.3 Positioning time: to suit application. 90 sec maximum.

.4 Fail to normal position as indicated.

.5 Scale or dial indication of actual control valve position.

.6 Size actuators to meet requirements and performance of control valve specifications.

.7 For interior and perimeter terminal heating and cooling applications floating control actuators is acceptable.

.8 Minimum shut-off pressure: as required by operations.

2.16 AIR FLOW MEASURING SENSOR (DUCT MOUNTED)

.1 Requirements:

.1 Airflow measuring stations shall contain multiple total and static pressure sensors positioned in a log-Tchebycheff pattern. Rectangular stations having a cross section than 0,37 m2 will have a minimum, of 25 points of measurement. For stations having less the 460mm, locate the points of measurement at the centre of equal areas not more than 150mm apart, and use a minimum of 2 measuring points per side. For a station having a dimension greater than 140 mm, the maximum distance between measurement points will be 200 mm. For circular ducts having a diameter of 460 mm or greater, locate measurement points on 3 equally placed diameters. For stations smaller than 460 mm in diameter, locate the measurement points on 2 perpendicular diameters.

.2 Airflow measuring stations shall be fabricated of a minimum of 14 ga. galvanized steel, welded casing in 200 mm depth with 90° connecting flanges in a configuration and size equal to that of the duct it is mounted into. Each station shall be complete with an open parallel cell air straightener-equalizer honeycomb mechanically fastened to the casing and external connection fittings.

.3 Airflow stations shall be AMCA certified and be capable of measuring the airflow rates with the accuracy of 2%. The maximum allowable unrecovered pressure drop caused by the station shall not exceed 20 Pa at 10 m/s.

2.17 VARIABLE FREQUENCY DRIVE

.1 Certifications
.1 Variable speed controllers shall be CSA or cUL approved.
.2 The complete unit including the cabinet, the speed controller and other components shall be CSA approved.

.2 Manufacturer’s shop drawings shall include:
.1 Dimensions and weights;
.2 Technical specifications;
.3 Wiring diagrams.

.3 Type of load
.1 The load is made up of variable torque centrifugal fans.
.2 The speed controller shall operate adequately at all speeds. Verify the motor starting torque and running torque at different speeds.
.3 The speed controller shall be capable of starting the system when the system is in forward or reverse rotation, at any speed. Should the controller not be capable of starting the unit when in reverse rotation, install breaking resistors on the D.C. bus to prevent system rotation when not energized.

.4 Cabinet
.1 Speed controllers and bypass shall be installed in a NEMA 12 enclosure.
.2 The cabinet shall have ventilation slots with replaceable filters to eliminate the internal heat build-up.
.3 The cabinet shall be wall mount.
.4 It shall have hinged doors with handle and lock and key.
.5 Equipped with disconnect switch completely with the possibility to lock the lever in the “open” position with padlocks.

.6 2-way selectors “AUTO-OFF” which allows operation to be set as automatic control, or off-line for servicing.

.7 The following components shall be shown on LCD display on the outer face of the door:

.1 “CONTROLLER RUNNING”.

.2 “CONTROLLER FAULT”.

.3 “MOTOR FAULT”.

.5 Disconnect switch

.1 Each VFD to have lockable disconnect switch.

.6 Speed controller

.1 Input characteristics:

.1 Voltage: 600 V a.c. ± 10 %.

.2 Number of phases: 3.

.3 Frequency: 60 Hz ± 2 Hz.

.4 Input power factor minimum at any speed: 0.95.

.5 Efficiency: 0.95.

.2 Output characteristics

.1 Power : HP according to indications.

.2 Voltage : 600 V.

.3 Frequency: 0 to 120 Hz.

.4 Maximum carrier frequency: 2 kHz.

.5 Waveform type: PWM.

.6 Direct current: 100 %.

.7 One minute peak current: 110 %.

.3 The unit to be of the programmable microprocessor type with a control panel and alphanumeric display.

.4 The following functions to be programmable:

.1 Starting and running frequencies.

.2 V/Hz ratio.

.3 Acceleration/deceleration.

.4 Overvoltage.

.5 Speed.

.5 The following information to be displayed:

.1 Output voltage.

.2 % load.

.3 % speed.

.4 Ready to start.

.5 Operation in automatic mode or local mode.

.6 Unit protected against the following events which are displayed on the alphanumeric panel:

.1 Loss of phases.

.2 Under voltage.

.3 Over voltage.

.4 Overload.

.5 Short circuit.

.6 Ground fault.

.7 Overheating;

.8 Internal component failure.

.7 Environmental operating conditions:
.1 Ambient temperature: 0 to 40 °C.
.2 Relative humidity (non condensing): 20 to 90 % R.H.
.3 Altitude: 1000 m.

.7 Inductors
.1 A 3 % smoothing inductor on the d.c. bus and a 5 % input inductance shall be supplied on all variable speed drives. Shunt type filters shall not be accepted. The total current harmonic distortion not to exceed 30 % at the a.c. input of each speed controller.
.2 In order to reduce the wave reflexion between the controller and the motor, a 3 % inductor shall be installed at the output of the speed controller if the motor is installed more than 10 m away from speed controllers. Make standing wave tests and supply a written report showing the wave shapes on an oscilloscope with or without the inductor.

.8 Control signals
.1 The following control elements stop the motor when the speed controller drives it. Provide the necessary control circuits:
.1 Signal from the control panel:
.1 Start/stop signal.
.2 Protection elements directly connected to the speed controller:
.1 Motor thermistors (Thermistor trip circuits to be compatible with the motor thermistors).
.2 Fire alarm contact.
.3 Other external protections (frost detection, disconnect auxiliary contact closing).
.3 The speed controller accepts the 0 to 10 V d.c. or 4 to 20 mA speed signal from the control panel and communicates with the control panel according to the BACnet Ethernet IP protocol.
.4 The following signals shall be transmitted to the control panel:
.1 Speed.
.2 Output frequency.
.3 Unit fault contact.
.2 Proof of operation contact obtained by a current reading on one phase of the motor circuit.

.9 Approved product: ABB ACH580.

2.18 PANELS

.1 Wall mounted enamelled steel cabinets with hinged and key-locked front door.

.2 Multiple panels as required to handle requirements with additional space to accommodate 25% additional capacity as required by NRC Representative without adding additional cabinets.

.3 Panels to be lockable with the same key.

2.19 WIRING

.1 In accordance with Division 26.

.2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.

.3 Wiring must be continuous without joints.

.4 Sizes:

.1 Field wiring to digital device: #18AWG.

.2 Analog input and output: shielded #20 minimum stranded twisted pair.

Part 3 Execution

3.1 INSTALLATION

.1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

.2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.

.3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.

.4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.

.5 Electrical:

.1 Complete installation in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.

.3 Refer to electrical control schematics included as part of control design schematics on drawings. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by NRC Representative before beginning Work.

.4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

.5 Install communication wiring in conduit.

.1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).

.2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.

.3 Maximum conduit fill not to exceed 40%.

.4 Design drawings do not show conduit layout.

.6 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. NRC Representative to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.

3.2 TEMPERATURE AND HUMIDITY SENSORS

.1 Stabilize to ensure minimum field adjustments or calibrations.

.2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.

.3 Duct installations:

- .1 Do not mount in dead air space.
- .2 Locate within sensor vibration and velocity limits.
- .3 Securely mount extended surface sensor used to sense average temperature.
- .4 Thermally isolate elements from brackets and supports to respond to air temperature only.
- .5 Support sensor element separately from coils, filter racks.

.4 Averaging duct type temperature sensors.

- .1 Install averaging element horizontally across the ductwork starting 305 mm from top of ductwork. Each additional horizontal run to be no more than 305 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.
- .2 Wire multiple sensors in series for low temperature protection applications.
- .3 Wire multiple sensors separately for temperature measurement.
- .4 Use software averaging algorithm to derive overall average for control purposes.

.5 Thermowells: install for piping installations.

- .1 Locate well in elbow where pipe diameter is less than well insertion length.
- .2 Thermowell to restrict flow by less than 30 %.
- .3 Use thermal conducting paste inside wells.

3.3 VARIABLE FREQUENCY DRIVES

.1 Installation

- .1 The VFD must be installed according to the manufacturer’s recommendations, as stated in the installation guide.
- .2 Electrical cable must be installed according to the VFD manufacturer recommendations, as stated in the installation guide.
- .3 Install the wall-mounted variable frequency drive on plywood mounted on steel profiles attached to the floor and to the building structure.
- .4 Attach the variable frequency drives to the floor with 40 mm (1½") steel profiles.
- .5 Connect all the required control circuits to the drives.
- .6 Connect all interlocks and local protections to ensure that they are functional both under normal operation and on bypass operation.
- .7 Program and adjust the drive settings according to the Departmental Representative recommendations, including the "COAST-TO-STOP" stop mode instead of using a stop ramp.
- .8 Provide a means to lock out near the motor if the speed controller’s installation safe distance with the motor is exceeded.
- .9 Program the input for the auxiliary contact on the safety switch to deactivate the VFD controller when an opening operation is performed on the safety switch located near the motor.

.10 Provide AutoCad plans of the connections of the speed controllers to the existing infrastructure. Permanently number all wires which are related to the control diagrams.

.2 Tests

.1 The Contractor will include all necessary costs and make arrangements with the distributor to proceed with the verification and commissioning of the speed controllers for every motor according to the "Variable frequency drive test" table found in the appendix.

.2 Test all binary inputs such as: auxiliary contact from the safety switch, freeze protection, high or low pressure protection or others.

.3 Prior to testing, the NRC Representative must be provided with the calibration certificates of every equipment to be used. Tests will be cancelled and new ones will need to be done to the Contractor's charge if there is a default in providing the certificates.

.4 All tests must be coordinated with the sub contractors of divisions 23, 25 and 26.

.1 During testing, for each VFD, the Contractor must use a tachymeter and must be able to compare the requested speed on the VFD with the actual motor speed when the motor is under rated mechanical load. To do so, the tests must be done on each motor by varying the speeds as follows: 30%, 50%, 65%, 80% and 100%. The results obtained must be included in the test report.

.2 Once all tests are completed, a report will need to be prepared and signed. The report must include a conclusion covering the results obtained and the corrections made, and must certify the installations as well as the speed controllers' compliance with the manufacturer's requirements. An electronic copy must be provided to the NRC Representative.

3.4 PANELS

.1 Arrange for conduit and tubing entry from top, bottom or either side.

.2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.

.3 Identify wiring and conduit clearly.

3.5 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES AND SENSORS

.1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.

.1 Protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor.

3.6 IDENTIFICATION

.1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.

3.7 AIR FLOW MEASURING STATIONS

.1 Protect airflow measuring assembly until cleaning of ducts is completed.

3.8 TESTING AND COMMISSIONING

.1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 25 30 01 – EMCS: Building Controllers.

.2 Section 25 30 02 – EMCS: Field Control Devices.

1.2 SEQUENCING

.1 General

.1 Overrides

.1 The BMS shall allow the operator to override any BMS output on a temporary basis. Interlocks shall be maintained. The system shall remain in alarm until all overrides have been cancelled.

.2 The set points stated in this Section are given as working assumptions. They shall be fully editable within the EMCS according to actual building operation and experience.

.3 Set point ramping

.1 Upon a start of the system or on any changes of set point provide a control algorithm to gradually bring the set point from its start value to its desired value.

.2 The ramping progression speed must be adjustable.

.4 Auditorium room temperature and humidity set points

.1 Heating setpoint shall be 22°C (adjustable).

.2 Cooling setpoint shall be 22°C (adjustable).

.3 Heating humidity set point shall be 30% RH +/- 5% (adjustable).

.4 Summer humidity set point shall be 45% RH +/- 5% (adjustable).

.5 Program relative humidity set point ramp to limit humidity fluctuations throughout the year. Allow a change of 1% per day.

Month	**RH set point (%)**
January	30 %
February	30 %
March	30 %
April	30 %
May	40 %
June	45 %
July	45 %
August	45 %
September	40 %
October	35 %
November	30 %
December	30 %

.2 Air Handling Unit 77AHU159

.1 System off:

.1 The supply fan 77SAF159 is off.

.2 The exhaust fan 77RAF50005 is off.

.3 The desiccant wheel 77DHU159 is stopped.

.4 The desiccant wheel bypass dampers are open.

.5 The outdoor air motorized damper is closed.

.6 The electric heat coil 77EHC159 is off.

.7 The humidifier 77HUM159 is off.

.8 The chilled water pumps 77CWP159A and 77CWP 159B are off.

.9 The cooling coils 3-way control valves are open to the bypass.

.2 System Start-up:

.1 Under normal operation, the system runs 24/7, all year long.

.2 On a start command from the MCU, the system is started, the supply fan 77SAF159 starts.

.3 Upon confirmation of the supply fan 77SAF159 operation

.1 The auditorium exhaust fan 77RAF50005 is started.

.2 The chilled water pumps 77CWP159A and 77CWP 159B are allowed to start.

.3 The desiccant wheel 77DHU159 is allowed to start.

.4 The electric heat coil 77EHC159 is allowed to start.

.5 The humidifier 77HUM159 is allowed to start.

.3 Normal mode:

.1 The supply fan 77SAF159 speed is modulated by the MCU to maintain a minimum flow rate of 1800 L/s (adjustable), corresponding to 4 Air Changes per hours. The flow rate is read by the fan piezometric ring and the speed constantly adjusted to account for filter loading and operation of the bypass dampers at the desiccant wheel.

.2 The air terminal unit 77VAV159-1 modulates to maintain the rooms temperature set point.

.3 During the occupied period:

.1 The operation of the outdoor air and return dampers is modulated to maintain the CO2 level in the rooms (auditorium 1002, 159 and 159B) to 800 ppm.

.2 The exhaust fan 77RAF50005 speed is modulated to offset the amount of fresh air that enters 77AHU159. The 77RAF50005 flow rate is read by the fan piezometric ring. The outdoor air flow is calculated by the MCU (difference between the return and supply air flow rates).

.4 During the unoccupied period:

.1 The outdoor air damper is closed

.2 The exhaust fan 77RAF50005 is stopped.

.5 Cooling / dehumidification mode:

.1 Stage 1:

.1 The MCU starts the chilled water pump 77CWP159A.

.2 The MCU modulates cooling coil 77CC159-1 valve to maintain the room temperature set point. The room humidity level is within the authorized range and do not need additional dehumidification.

.3 When the opening of the cooling coil control valve reach 90%, the MCU starts to ramp up the speed of 77SAF159 to maintain the room temperature set point.

.4 The desiccant wheel 77DHU159 rotation is off. The bypass dampers are open.

.2 Stage 2:

.1 The MCU starts the chilled water pump 77CWP159B.

.2 The desiccant wheel 77DHU159 rotation starts and is maintained at a constant flow rate. The bypass dampers are closed.

.3 The MCU modulates cooling coil 77CC159-1 valve to maintain a discharge temperature of 13°C.

.4 The MCU modulate the operation of the electric heat to maintain the room relative humidity set point. As the measured value climbs above the set-point the reactivation outlet temperature (ROT) set-point will be raised to increase the drying capacity of the desiccant rotor. As the measured value falls below set point the ROT set-point will be lowered reducing the drying capacity of the desiccant rotor.

.5 The desiccant reactivation temperature shall be limited to prevent rotor overheat. The maximum discharge temperature is 45°C.

.6 The MCU modulates cooling coil 77CC159-2 valve to maintain the room temperature set point.

.6 Heating / humidification mode:

.1 The desiccant wheel rotation is off. The bypass dampers are open.

.2 The chilled water pumps 77CWP159A and 77CWP159B are stopped.

.3 The MCU modulate the operation of the electric heater 77EHC159 to maintain the room temperature set point.

.4 The MCU modulate the speed of 77SAF159 to maintain the air discharge temperature at a maximum of 32°C.

.5 The MCU modulate the operation of the humidifier to maintain the room humidity set point.

.4 Local protection

.1 The unit shall be shut down whenever a freeze condition (FL < 4°C) is detected by the low temperature limit switch (LTS). This shall be accomplished by hard-wired interlock.

.2 The unit shall be shut down whenever a fire condition is detected by the fire alarm panel or duct smoke detector. This shall be accomplished by hard-wired interlock to the fire alarm panel.

.3 The humidifier shall be shut down whenever a high humidity or no flow condition is detected in the return air duct. This shall be accomplished by hard-wired interlock to the humidifier control panel.

.4 The electric heating coil has airflow differential pressure proving switch and manual reset high temperature limit switch.

.5 Desiccant rotor rotation is proven via magnetic proximity switch input to the MCU controller. Fault occurs if rotation is not detected within programmed time.

.5 Alarms

.1 All alarms shall be logged.

.2 The fan status is sent to the MCU.

.3 The start command shall be turned off when the run status is lost for more than two (2) minutes on the fans.

.4 The fan variable frequency drive fault shall be sent to the MCU.

.5 The filter status shall be sent to the MCU.

.6 The electrical heaters status shall be sent to the MCU.

.7 The desiccant wheel status shall be sent to the MCU.

.8 Lack of desiccant rotor rotation shall be detected and sent to the MCU.

.9 Alarms are generated for the following conditions:

.1 Room air temperature : SP ± 2°C.

.2 Room air humidity : SP ± 10 % R.H.

.3 Supply air temperature : SP ± 2°C.

.4 Supply air humidity : > 90 % R.H.

.5 High filter differential pressure.

.6 Trends

.1 Supply air temperature and humidity.

.2 Return air temperature and humidity.

.3 Return air CO2.

.4 Fan status.

.5 Desiccant wheel operation

.6 Electric heat operation.

.7 Cooling coil valves opening %.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

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 01 10 00 & 01 15 45.

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.

3 START-UP

.1 Instruct the NRC Departmental Representative and operating personnel in the operation, care and maintenance of equipment supplied under this contract.

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.

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.

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.

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.

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.

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.

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 conduits 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

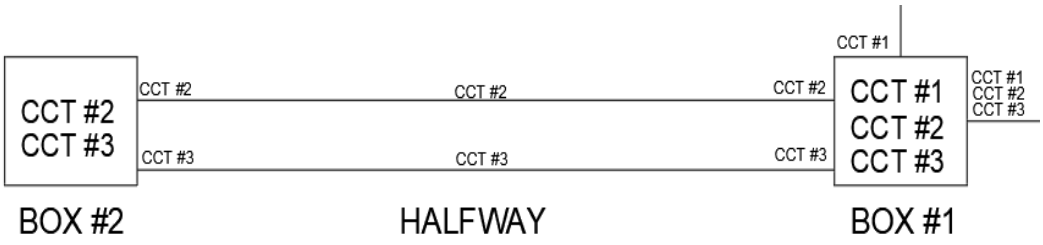
.3 For system running with cable, half-lap wrap with dedicated coloured PVC tape to 100 mm width, tape every 5 m and both sides where cable penetrates a wall.

.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 lamacoid 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:



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.

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.

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.

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.

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.

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.

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.

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 components including removal of wiring, conduit, junction boxes and incidentals required to complete work described in this Section.

1.2 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 reinstall 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.

.6 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 Federal Hazardous Products Act (RSC 1985) including latest amendments.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.

1.5 QUALITY ASSURANCE

.1 Regulatory Requirements: Perform work of this Section in accordance with:

.1 Federal Workers' Compensation Service and Provincial Workers' Compensation Boards/Commissions

.2 Government of Canada, Labour Program: Workplace Safety and Provincial Occupational Health and Safety Standards and Programs

1.6 SITE CONDITIONS

.1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition on date that tender is accepted.

.2 Discovery of Hazardous Substances: It is not excluded that non previously identified 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 Section 01 41 00- Regulatory Requirements for directives associated with specific material types.

.2 Hazardous substances will be as defined in the Hazardous Products Act.

.3 Stop work in the area of the 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 under a separate contract or as a change to the Work.

.6 Proceed only after written instructions have been received from Departmental Representative.

1.7 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.

PART 2 PRODUCTS

2.1 MATERIALS

.1 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.

.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 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 as follows:

.1 Disconnect electrical circuits and panel feeders; 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 Perform demolition work in a neat and workmanlike manner:

.1 Remove tools or equipment after completion of work, and leave site clean and ready for subsequent renovation work.

.2 Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.

.5 Disconnect panel feeders back to main distribution panel and re label respective circuit breaker as “SPARE”.

.6 Place weatherproof blank cover plates on exterior outlet boxes remaining after demolition and removal activities.

.7 Remove existing conduits, boxes, cabling and wiring associated with removed luminaires, electrical devices and equipment.

.8 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.

.9 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).

.2 Hazardous Substances Disposal: Arrange for disposal of hazardous substances.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 CSA Group (CSA)

.1 CAN/CSA-C22.2 No.18.1, Outlet Boxes, Conduit Boxes and Fittings.

.2 CAN/CSA-C22.2 No.65, Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).

.2 National Electrical Manufacturers Association (NEMA)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect wire and box connectors from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

.1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.

.2 Clamps or connectors for TECK cable and flexible conduit as required to: CAN/CSA-C22.2 No.18.

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 wire and box connectors 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 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 CAN/CSA-C22.2 No.65

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling] in accordance with Section 01 74 19 - Waste Management and Disposal.

.4 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Common Work Results - Electrical Section 26 05 00

1.2 MATERIALS

.1 Provide only new equipment and materials, without blemish or defect, bearing Canadian Standards Association or Authorized Electrical Inspection Department labels, and subject to the approval of the NRC Departmental Representative.

.2 After a contract is awarded, utilize alternative methods and/or materials only after receiving the NRC Departmental Representative's approval.

Part 2 Products

2.1 BUILDING WIRES AND GENERAL REQUIREMENTS

.1 Conductor material for branch circuit wiring and grounding:

- .1 Stranded copper.
- .2 Neutral wire: continuous throughout its length without breaks.
- .3 Separate insulated green grounding conductors in all electrical conduits.
- .4 All wire and cable insulation shall meet the C.S.A. Standards for the types and services hereinafter specified. Colours as per section 4-036 of Electrical Code.
- .5 Unless otherwise specified, use wire and cable types as follows:
  - .1 Type R90 XLPE cross-link polyethylene stranded for applications using wires sized No. 8 and larger.
  - .2 Type T90 stranded for applications using wires sized No. 10 and smaller.
  - .3 For fire alarm wiring refer to Section 283100.
  - .4 Approved heat resistant wire for wiring through and at lighting and heating fixtures. Where insulation types are shown on the drawings other types shall not be used unless the specification is more restrictive.
- .6 Use AC90 (BX) cable **only** under the following conditions:
  - .1 Wiring from a junction box to a recessed lighting fixture in suspended ceilings. Cable length not to exceed 1.5 m (5'), or
  - .2 Wiring switches or receptacles in existing or new hollow gypsum partitions, vertical runs only with cable length not to exceed 3.5m (12'), or
  - .3 When specifically called for on drawings or approved in writing by departmental representative.
  - .4 AC90 shall not be used in isolated walls or masonry walls.
  - .5 Only AC90 cable of No. 12 AWG will be accepted.
- .7 Use stranded wire no smaller than No. 12 AWG for lighting and power and no smaller than No. 16 AWG for control wiring.

.8 Conductors shall be soft copper properly refined and tinned having a minimum conductivity of 98%.

Part 3 Execution

3.1 BUILDING WIRES

.1 Install building wires as follows:

.1 Make joints, taps and splices in approved boxes with solderless connectors. Joints and/or splices are not acceptable inside a panelboard.

.2 Ensure the lugs accommodate all the strands of the conductor.

.3 Replace any wire or cable showing evidence of mechanical injury.

.4 Use No. 10 AWG for branch circuit wiring extending more than 30 m (100 ft.) to farthest outlet from panel.

.5 Circuit numbers indicated on the drawing are intended as a guide for the proper connection of multi-wire circuits at the panel.

.6 Take care to keep the conductors free from twisting.

.7 Use an approved lubricant for pulling in conduit.

.8 Leave sufficient slack on all runs to permit proper splicing and connection of electrical devices.

.9 Branch circuit wiring of 120 volts applications to be multi-wire utilizing common neutrals. Under no condition shall any switch break a neutral conductor.

.10 Provide and install an approved fire- retardant wrap or coating for PVC jacketed cables installed in a grouped configuration of two or more.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 CSA Group

.1 CSA C22.1-21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

.2 CSA C22.2 No.41, Grounding and Bonding Equipment (Tri-National Standard, with NMX-J-590ANCE and UL 467).

.3 CSA C22.2 No.65, Wire connectors (Tri-National Standard, with UL 486A-486B NMX-J-543-ANCE).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for connectors and terminations and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for connectors and terminations for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect connectors and terminations from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 CONNECTORS AND TERMINATIONS

.1 Long barrel cooper compression connectors to CSA C22.2 No.65 as required sized for conductors.

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 connectors and terminations 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 terminations, and splices in accordance with manufacturer's instructions.

.2 Bond and ground as required to CSA C22.2 No.41.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

.4 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 26 05 00 - Common Work Results for Electrical

1.2 REFERENCE STANDARDS

.1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)

.1 ANSI/IEEE 837-14, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for grounding equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for grounding equipment for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect grounding equipment from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials as specified in in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 EQUIPMENT

.1 Insulated grounding conductors: green, copper conductors, size as indicated.

.2 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

- .1 Grounding and bonding bushings.
- .2 Bonding jumpers, straps.
- .3 Pressure wire connectors.

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 grounding equipment 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 GENERAL

.1 Install complete permanent, continuous grounding system including conductors, connectors and accessories. Where EMT is used, run ground wire in conduit.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Use mechanical connectors for grounding connections to equipment provided with lugs.

.5 Soldered joints not permitted.

.6 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.7 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

3.3 SYSTEM AND CIRCUIT GROUNDING

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

3.4 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list: transformers, frames of motors, starters and distribution panels.

3.5 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 and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

3.6 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect hangers and supports from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

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 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hangers and supports 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 Secure equipment to poured concrete with expandable inserts.

.2 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.3 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.

.4 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.

.5 For surface mounting of two or more conduits use channels at 1000 mm on centre spacing.

.6 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.7 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.8 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.9 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.

.10 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

.4 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 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.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

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 covers.

Part 3 Execution

3.1 JUNCTION, PULL BOXES AND CABINETS 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

3.2 IDENTIFICATION

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

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 CSA Group (CSA)

.1 CSA C22.121, Canadian Electrical Code, Part 1, 25th Edition.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

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.

.5 347 V outlet boxes for 347 V switching devices.

.6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 GALVANIZED STEEL OUTLET BOXES

.1 One-piece electro-galvanized construction.

.2 Single 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.

2.3 CONDUIT BOXES

.1 Cast FS or FD 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 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.

.4 Vacuum clean interior of outlet boxes before installation of wiring devices.

.5 Identify systems for outlet boxes as required.

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 CAN/CSA C22.2 No. 18.1, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.

.2 CSA C22.2 No. 56-17, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

.3 CSA C22.2 No. 83-M1985 (R2017), Electrical Metallic Tubing.

.4 CSA C22.1-21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product data: submit manufacturer's printed product literature, specifications and datasheets.

.1 Submit cable manufacturing data.

.3 Quality assurance submittals:

.1 Test reports: submit certified test reports.

.2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.3 Instructions: submit manufacturer's installation instructions.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

Part 2 Products

2.1 CABLES AND REELS

.1 Provide cables on reels or coils.

.1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.

.2 Each coil or reel of cable to contain only one continuous cable without splices.

2.2 CONDUITS

.1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.

.2 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

2.3 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 Channel type supports for two or more conduits as per code requirements.

.3 Threaded rods, 6 mm diameter, to support suspended channels.

2.4 CONDUIT FITTINGS

.1 Fittings: to CAN/CSA C22.2 No. 18, 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.

2.5 FISH CORD

.1 Polypropylene.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits except in mechanical and electrical service rooms and unfinished areas.

.3 Use electrical metallic tubing (EMT) above 2.4 m not subject to mechanical injury.

.4 Use flexible metal conduit for connection to motors in dry areas and connection to surface or recessed lighting fixtures.

.5 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.

.6 Minimum conduit size for lighting and power circuits: 21mm.

.7 Bend conduit cold:

.1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.8 Mechanically bend steel conduit over 19 mm diameter.

.9 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.10 Install fish cord in empty conduits.

.11 Remove and replace blocked conduit sections.

.1 Do not use liquids to clean out conduits.

.12 Dry conduits out before installing wire.

3.3 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 channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

.3 Do not install conduits in terrazzo or concrete toppings.

3.5 CLEANING

.1 Proceed in accordance with Section 01 74 00 - Cleaning.

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

.2 26 28 16.02 - Moulded Case Circuit Breakers.

1.2 REFERENCE STANDARDS

.1 CSA Group (CSA)

.1 CSA C22.2 No.29-15(R2019), Panelboards and Enclosed Panelboards.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for panelboards and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.

.2 Include on drawings:

.1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for panelboards for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect panelboards from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 PANELBOARDS

.1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.

.1 Install circuit breakers in panelboards before shipment.

.2 600 V panelboards: bus and breakers rated for 25 000 A (symmetrical) interrupting capacity or as indicated.

.3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.5 Minimum of 2 flush locks for each panel board.

.6 Copper bus with neutral of same ampere rating of mains.

.7 Mains: suitable for bolt-on breakers.

.8 Trim with concealed front bolts and hinges.

.9 Trim and door finish: in accordance with Section 26 05 00.

2.2 BREAKERS

.1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.

.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

2.3 EQUIPMENT IDENTIFICATION

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

.2 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

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 panelboards 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 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Mount panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.

.3 Connect loads to circuits.

.4 Connect neutral conductors to common neutral bus.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by panelboards installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCE STANDARDS

.1 CSA Group (CSA)

.1 CSA C22.2 No.42-15, General Use Receptacles, Attachment Plugs and Similar Devices.

.2 CAN/CSA C22.2 No.42.1-00 (R2013), Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).

.3 CSA C22.2 No.55-M1986 (R2015), Special Use Switches.

.4 CSA C22.2 No.111-15, General-Use Snap Switches (Bi-national standard, with UL 20).

.5 CSA C22.2 No.144.1 (2016), Ground-Fault Circuit Interrupters (Tri-national standard, with UL943).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for wiring devices for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect wiring devices from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 SWITCHES

.1 15 A or 20 A, 120 V, single pole switches to: CSA C22.2 No.55 and CSA C22.2 No.111.

.2 Manually-operated general purpose AC switches with following features:

- .1 Terminal holes approved for No. 10 AWG wire.
- .2 Silver alloy contacts.
- .3 Urea or melamine moulding for parts subject to carbon tracking.
- .4 Suitable for back and side wiring.
- .5 White toggle.

.3 Switches of one manufacturer throughout project.

2.2 RECEPTACLES

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

- .1 White 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.

2.3 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 Stainless steel, cover plates, thickness 2.5 mm.

.4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

2.4 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 Switches:

.1 Install single throw switches with handle in "UP" position when switch closed.

.2 Install switches in gang type outlet box when more than one switch is required in one location.

.3 Mount toggle switches as indicated.

.2 Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Mount receptacles as indicated.

.3 Install GFI type receptacles as indicated.

.3 Cover plates:

.1 Install suitable common cover plates where wiring devices are grouped.

.2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.3 Repair damage to adjacent materials caused by wiring device installation.

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 (Tri-national standard with UL 489, and NMX-J-266-ANCE-2010).

.2 CSA C22.1-21 version, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for circuit breakers and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Certificates:

.1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit 3 copies of a production certificate of origin from the manufacturer. Production certificate of origin must be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet standards and regulations.

.1 Production certificate of origin must be submitted to Departmental Representative for approval.

.2 Delay in submitting production of certificate of origin will not justify any extension of contract and additional compensation.

.3 Any work of manufacturing, assembly or installation to begin only after acceptance of production certificate of origin by Departmental Representative. Unless complying with this requirement, Departmental Representative reserves the right to mandate manufacturer listed on circuit breakers to authenticate new circuit breakers under the contract, and to Contractor's expense.

.4 Production certificate of origin must contain:

.1 Manufacturer's name and address and person responsible for authentication. Person responsible must sign and date certificate.

.2 Licensed dealer's name and address and person of distributor responsible for Contractor's account.

.3 Contractor's name and address and person responsible for project.

.4 Local manufacturer's representative name and address. Local manufacturer's representative must sign and date certificate.

.5 Name and address of building where circuit breakers will be installed:

.1 Project title.

.2 End user's reference number.

.3 List of circuit breakers.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 circuit breakers off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect circuit breakers from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 BREAKERS GENERAL

.1 Moulded-case circuit breakers and ground-fault circuit-interrupters: 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.

.6 Circuit breakers to have minimum symmetrical rms interrupting capacity rating as indicated on the drawings.

.7 New circuit breakers provided in an existing panel shall be compatible with the panel.

2.2 THERMAL MAGNETIC BREAKERS

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

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 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 circuit breakers as indicated.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

.4 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCE STANDARDS

.1 CSA Group

.1 CAN/CSA-C22.2 No.4-04(R2014), Enclosed and Dead-Front Switches (Tri-National Standard, with ANCE NMX-J-162-2004 and UL 98).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for disconnect switches - fused and non-fused 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 01 61 00 - Common Product Requirements 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 off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect disconnect switches - fused and non-fused from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 DISCONNECT SWITCHES

.1 Non-fusible, disconnect switch in CSA enclosure to CAN/CSA-C22.2 No.4 size as indicated.

.2 Provision for padlocking in on-off switch position by 3 locks.

.3 Mechanically interlocked door to prevent opening when handle in ON position.

.4 Quick-make, quick-break action.

.5 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 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for disconnect switches - fused and non-fused 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.

3.2 INSTALLATION

.1 Install disconnect switches.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

.4 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

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 International Electrotechnical Commission (IEC)

.1 IEC 60947-4-1, Part 4: Electromechanical contactors and motor-starters.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.

.2 Provide shop drawings for each type of starter to indicate:

.1 Mounting method and dimensions.

.2 Starter size and type.

.3 Layout and components.

.4 Enclosure types.

.5 Wiring diagram.

.6 Interconnection diagrams.

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Submit operation and maintenance data for each type and style of motor starter for incorporation into maintenance manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse and return of packaging materials, padding, crates and pallets in accordance with Section 01 74 19 – Waste Management and Disposal.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Starters: to IEC 60947-4 with AC4 utilization category.

2.2 FULL VOLTAGE MAGNETIC STARTERS

.1 Magnetic of size, type, rating and enclosure type as indicated with components as follows:

.1 Contactor solenoid operated, rapid action type.

.2 Motor overload protective device in each phase, manually reset from outside enclosure.

.3 Solenoid: 24V.

.4 Wiring and schematic diagram inside starter enclosure in visible location.

.5 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.2 Accessories:

.1 AUTO/ON/OFF selectors.

.2 Pushbuttons: standard.

.3 Indicating lights: standard type.

.4 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

2.3 ACCESSORIES

.1 Pushbutton: heavy duty, oil tight as required.

.2 Selector switches: heavy duty, oil tight as required.

.3 Indicating lights: heavy duty, oil tight, standard type and colour.

2.4 FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.5 EQUIPMENT IDENTIFICATION

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

.2 Magnetic starter designation label, white plate, black letters, engraved as indicated.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install starters and control devices in accordance with manufacturer's instructions.

.2 Install and wire, starters and controls as indicated.

.3 Ensure correct fuses installed.

.4 Confirm motor nameplate and adjust overload device to suit.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and manufacturer's instructions.

.2 Operate switches and contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

3.3 CLEANING

.1 Clean in accordance with Section 01 74 00 - Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling. in accordance with Section 01 74 19 – Waste Management and Disposal.

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 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)

.1 ANSI/IEEE C62.41-2002, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.

.2 ASTM International Inc.

.1 ASTM F1137/F1137M-19, Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.

.3 CSA Group (CSA)

.1 CSA C22.1-21 version, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

.4 ICES-005-2009, Radio Frequency Lighting Devices.

.5 Underwriters' Laboratories of Canada (ULC)

.6 IES LM-79 – Electrical and Photometric Measurements of Solid-State Lighting.

.7 IES LM-80 - Measuring Lumen Maintenance of LED Light Sources.

.8 IES TM-21 - Projecting Long Term Lumen Maintenance of LED Light Sources.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Quality Control: Provide in accordance with Section 01 45 00 - Quality Control.

.1 Manufacturer's Instructions: Submit manufacturer's written installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store, and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: Remove for reuse and return of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

.4 Divert unused metal materials from landfill to metal recycling facility.

Part 2 Products

2.1 LIGHT EMITTING DIODE DEVICES (LED)

.1 Reference Standards - Devices

.1 Photometric tests in accordance with IES LM-79 Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products.

.2 Light depreciation determined according to IES LM-80 Approved Method: Measuring Lumen Maintenance of LED Light Sources.

.3 Long-term light depreciation determined according to IES TM-21 Projecting Long Term Lumen Maintenance of LED Light Sources.

.2 Reference Standards – Power Supplies

.1 UL 1310 Class 2 Power Units or equivalent from CSA

.2 ANSI C62.41 Category A IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits

.3 All LED devices and their components must, at minimal meet all reference standards listed above.

.4 Each fixture must be equipped with a compatible factory installed power supply. Everything must be approved for plenum use.

.5 Power supply units shall be equipped with colour connectors determined in accordance with the standard requirements ANSI C82.11.

.6 Power supply technical data:

.1 Power factor: 90% minimum

.2 Total harmonic distortions: 20% maximum.

.3 Class A nominal sound volume

.4 Operation ambient temperatures: 10 to 40 °C, 90 % R.H.

.5 The housing temperature: 0 at 62 ºC, 90 % R.H.

.6 Must tolerate without damage a condition of open circuit or short circuit without any fuses or other external protection devices.

.7 Must not contain any PCB.

2.2 FINISHES

.1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.3 LUMINAIRES

.1 As indicated in luminaire schedule.

Part 3 Execution

3.1 INSTALLATION

.1 Locate and install luminaires as indicated.

.2 Coordinate exact mounting height and final location with the physical constraints on site prior to commencement of work.

.3 Provide adequate support to suit ceiling system.

3.2 WIRING

.1 Connect luminaires to lighting circuits:

.1 Install flexible conduit for luminaires as indicated.

3.3 CLEANING

.1 Clean in accordance with Section 01 74 00 - Cleaning.

.2 Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 26 05 21 - Wires and Cables (0-1000 V).

.2 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCE STANDARDS

.1 CSA group (CSA)

.1 CSA C22.2 No. 141-15, Emergency lighting equipment.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for emergency lighting and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for emergency lighting for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect emergency lighting from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

1.6 WARRANTY

.1 For batteries in this Section 26 52 13.13 - Emergency Lighting, 12 months warranty period is extended to 120 months.

Part 2 Products

2.1 EQUIPMENT

.1 Emergency lighting equipment: to CSA C22.2 No.141

.2 Supply voltage: 120 V, AC.

.3 Output voltage: 12 V DC.

.4 Operating time: 60 minutes.

.5 Battery: sealed, maintenance free.

.6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.

.7 Solid state transfer circuit.

.8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.

.9 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.

.10 Lamp heads: integral on unit and remote, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: LED, 6 W, minimum.

.11 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.

.12 Finish: White.

2.2 WIRING OF REMOTE HEADS

.1 Conduit: type EMT, in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

.2 Conductors: T90 stranded type in accordance with Section 26 05 21 - Wires and Cables (0-1000 V), sized in accordance with manufacturer's 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 emergency lighting 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 unit equipment and remote mounted fixtures.

.2 Direct heads.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by emergency lighting installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCE STANDARDS

.1 National Research Council Canada (NRC)

.1 National Building Code of Canada 2015 (NBC).

.2 Treasury Board of Canada (TBS), Occupational Safety and Health (OSH)

.1 Fire Protection Standard-10.

.3 Underwriter's Laboratories of Canada (ULC)

.1 CAN/ULC-S524-19, Standard for the Installation of Fire Alarm Systems.

.2 CAN/ULC-S529-16, Smoke Detectors for Fire Alarm Systems.

.3 CAN/ULC-S537-19, Standard for the Verification of Fire Alarm Systems.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Storage and Handling Requirements:

.1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect materials from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 DESCRIPTION

.1 The system is existing and is a fully supervised, microprocessor-based, fire alarm system, utilizing digital techniques for data control and digital, and multiplexing techniques for data transmission.

.2 The system is a 4100 from Simplex. The location of the control panel is in the basement, room B-146 (Node #1).

.3 Addressable, single stage.

.4 Modifications to the system include:

.1 Remove and reinstall an existing duct smoke detector.

.2 Wiring.

.5 Regulatory Requirements:

.1 System components: listed by ULC and comply with applicable provisions of NBC and Ontario Building Code, and meet requirements of local authority having jurisdiction.

2.2 WIRING

.1 Twisted copper conductors: rated 300 V.

.2 To initiating circuits: 18 AWG minimum, and in accordance with manufacturer's requirements.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for fire alarm 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 systems in accordance with CAN/ULC-S524.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and CAN/ULC-S537

.2 Tests, adjustments and calibration shall be done under the supervision of a representative from the manufacturer of the system, with all required specialized tools and instruments. The Engineer reserves the right to be present.

.3 Verify all connections on each component and ensure that:

.1 The system is installed according to prescriptions;

.2 Supervision current circuits specifications are satisfied (each conductor shall be disconnected for verification);

.3 Each device is put into alarm state;

.4 Each detector is properly calibrated on site with an appropriate calibration device or directly to the panel.

.4 Check all components (new, existing and relocated) on circuits where there has been an addition, relocation or removal of components according to CAN / ULC-S537 and produce a detailed results report.

.5 Provide the manufacturer with a qualified electrician for the duration of the calibration and verification test period.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by fire alarm system installation.

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.

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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
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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
PR906733
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 **NRC**	2. Branch or Directorate / Direction générale ou Direction RPPM
3. a) Subcontract Number / Numéro du contrat de sous-traitance 5992	3. b) Name and Address of Subcontractor / Nom et adresse du sous-traitant Tender

4. Brief Description of Work / Brève description du travail
S77 Air Handler 159 Replacement- Tender

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) ☐

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	 B	 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
PR906733
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
Allan Smith	Project Manager	

Telephone No. - N° de téléphone	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel	Date
991-9873		allan.smith@nrc-cnrc.gc.ca	

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