NRC·CNRC Real Property Planning and Management

SPECIFICATIONS

SOLICITATION #: **20-58135**

BUILDING: **M-50**
1200 Montreal Road
Ottawa, Ontario

PROJECT: **M50- Epitaxy Lab- HVAC Replacement and New Exhaust System**

PROJECT #:

Date:
March 2021

National Research Council Canada
Conseil national de recherches Canada
Canada

SPECIFICATION

TABLE OF CONTENTS

Construction Tender Form

Project Identification **M50- Epitaxy Lab-HVAC Replacement and New Exhaust System**

Tender No.: **20-58135**

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.

1.11 List of Major Subcontractors

Indicate below the business name of each of the following subcontractors:

Mechanical Contractor _____

Electrical Contractor _____

Failure to include these names may result in your bid being disqualified. Any attempt to change the named subs after award may result in the contract being canceled, going to the next lowest bidder.

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

M50 Epitaxy Lab- HVAC Replacement and New Exhaust System

Work under this contract covers Epitaxy Lab- HVAC Replacement and New Exhaust System of building M50 of the National Research Council Canada.

Complete bid packages will only be accepted via email to:

alain.leroux@nrc-cnrc.gc.ca

1. GENERAL

Questions regarding any aspect of the project are to be addressed to and answered only by 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 **March 22nd and March 23rd, 2021 at 9:30.** Meet Allan Smith at Building M50, Main Entrance, 1200 Montreal Rd 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.**

* Due to COVID-19, we are taking additional measures to protect you and our employees at the site visits.

- To allow NRC to prepare for the site visits, all proponents are asked to pre-register preferably 48 hours ahead of the job showing and identify their preferred site visit date. Please register by emailing Mark.O'Connor@nrc-cnrc.gc.ca. Proponents shall provide contact name, email and phone number of person attending.

- At the site visit, to limit contact and risks:

    - The proponents will sanitize their hands at the hand sanitizing station.

- The proponents will be asked to sign the Attendance Form. It is the responsibility of all proponents to verify information on the Attendance Form.

- The site visit will proceed with a maximum of four (4) proponents at a time. The site visit will continue with the next group of four (4) proponents until each one has had a chance to review the site.

- The site visits could take longer than usual, therefore anticipate a longer meeting duration.

- Physical distancing: keeping a distance of at least 2 arms-length (approximately 2 metres) from others may not be possible at all times, therefore the use of NRC issued disposable face coverings to reduce the risk of transmission of COVID-19 is mandatory.

- The proponents shall not impede safe access to and from the facility.

- Depending on the anticipated amount of pre-registration, the NRC may decide to schedule time slots for every group of four (4) proponents. The time slot for your site visit will be confirmed by the NRC Departmental Representative by email upon pre-registration. That time will supersede the site visit meeting time specified above.

- Proposals submitted by bidders who have not attended the site visit or failed to submit their identification and contact information at the site visit will be deemed non-responsive.

3. CLOSING DATE

Closing date is April 15th, 2021 at 14:00

4. TENDER RESULTS

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

5.1 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: http://ssi-iss.tpsgc-pwgsc.gc.ca/ssi-iss-services/eso-oss-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.

6.0 WSIB (WORKPLACE SAFETY AND INSURANCE BOARD)

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

7.0 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 Clauses -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.

3) Contract clause -Contract Administration

he 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.

The Departmental Representative or his designate for this project is: Allan Smith
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, Senior Contracting Officer

alain.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

of

on the_____

day of_____

Seal

DIVISIONS / SECTIONS ..... Pages

Division 21 - FIRE SUPPRESSION

Division 23 - HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

Division 25 - Energy Monitoring and Control System (EMCS)

Division 26 – ELECTRICAL

ARCHITECTURAL

STRUCTURAL

MECHANICAL

ELECTRICAL

END OF TABLE OF CONTENTS

1. SCOPE OF WORK

.1 Work under this contract covers the Epitaxy Lab- HVAC Replacement and New Exhaust System in the Council's Building M50 of the National Research Council.

2. DRAWINGS

.1 The following drawings illustrate the work and form part of the contract documents: 5746-A0-A3, 5746-S01, 5746-M01-M06, 5746-E01

3. COMPLETION

.1 Complete all work within 16 week(s) after receipt of notification of acceptance of tender. Contractor construction will be limited to 6 weeks on site, all work must be completed during this time frame, including commissioning and client operational at completion.

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. REQUIREMENTS OF BILL 208, SECTION 18(a)

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

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

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

.2 Arsenic is known to have been present in Lab 295 and 295B, extra precautions are required for all work in these areas (including gloves disposable outer coveralls, booties, and N95 disposable respirators) and all exhaust duct is to be removed and disposed of as hazardous material.

9. COST BREAKDOWN

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

.2 The breakdown is to include a breakout of 5% of the value of the contract from a minimum of $5,000 to a maximum of $25,000 for contract closeout documentation.

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

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

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

10. SUB-TRADES

.1 If not requested as part of tended, submit no later than 72 hours after tender closing, a complete list of sub trades for the Departmental Representative's review.

11. PERSONNEL SECURITY AND IDENTIFICATION

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

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

12. WORKING HOURS AND SECURITY

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

.2 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with NRC Departmental Representative to facilitate work as stated.

.3 Any work to be performed by the general Contractor and/or its sub-contractors requiring shutdowns, generating excessive noise, odors and/or any kind of discomfort to building occupants shall be executed outside of the NRC normal business hours, at the discretion of the Departmental Representative. If unsure, check with Departmental Representative prior to performing any work that may cause a disturbance to building users.

.4 The contractor will be held responsible to compensate NRC for any financial losses as a result of non-compliance with this section.

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

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

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

13. SCHEDULE

.1 The Contractor shall prepare a detailed schedule, fixing the date for commencement and completion of the various parts of the work and update the said schedule. Such schedule shall be made available to the Departmental Representative not later than two weeks after the award of the contract and prior to commencement of any work on site for review and approval. Contractor construction will be limited to 6 weeks on site, all work must be completed during this time frame, including commissioning and client operational at completion.

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

.3 5 day(s) before the scheduled completion date, arrange to do an interim inspection with the Departmental Representative.

14. PROJECT MEETINGS

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

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

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

15. SHOP DRAWINGS

.1 Submit to Departmental Representative for review, shop drawings, product data and samples specified within 1 week(s) 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 1 week basis and any changes to the list shall be immediately notified in writing to the Departmental Representative.

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

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

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

16. SAMPLES AND MOCK-UPS

.1 Submit samples in sizes and quantities as specified.

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

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

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

17. MATERIALS AND WORKMANSHIP

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

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

18. WORK & MATERIALS SUPPLIED BY OWNER

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

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

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

.4 General Contractor's duties:

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

19. SITE ACCESS

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

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

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

.4 Provide and maintain access to site.

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

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

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

20. USE OF SITE

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

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

.3 THE GENERAL CONTRACTOR TO COORDINATE PROTECTION OF ALL EXISTING EQUIPMENT & FURNISHINGS IN ROOMS AFFECTED BY SCOPE OF WORK. GENERAL CONTRACTOR TO ENSURE AND OBTAIN APPROVAL (FROM NRC REPRESENTATIVE/OCCUPANTS) ON PROTECTION SETUP FOR ALL ITEMS IN THESE ROOMS. G.C. TO OBTAIN GO-AHEAD FROM NRC REPRESENTATIVE PRIOR TO COMMENCEMENT OF ANY DEMOLITION/NEW WORK AND ON SEQUENCE AND PROTECTION METHODS.

21. ACCEPTANCE OF SITE

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

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

22. SITE OFFICE & TELEPHONE

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

.2 Install and maintain a telephone, if necessary.

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

23. SANITARY FACILITIES

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

24. TEMPORARY SERVICES

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

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

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

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

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

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

25. DOCUMENTS REQUIRED AT WORK SITE

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

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

26. CO-OPERATION

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

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

.3 Have schedule approved by the Departmental Representative.

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

27. PROTECTION AND WARNING NOTICES

.1 Provide all materials required to protect existing equipment.

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

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

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

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

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

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

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

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

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

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

28. BILINGUALISM

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

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

29. LAYOUT OF WORK

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

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

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

30. DISCREPANCIES & INTERFERENCES

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

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

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

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

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

31. MANUFACTURER'S INSTRUCTIONS

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

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

32. TEMPORARY HEATING AND VENTILATING

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

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

.3 Furnish and install temporary heat and ventilation in enclosed areas as required to:

.1 Facilitate progress of work.

.2 Protect work and products against dampness and cold.

.3 Reduce moisture condensation on surfaces to an acceptable level.

.4 Provide ambient temperature and humidity levels for storage, installation and curing of materials.

.5 Provide adequate ventilation to meet health regulations for a safe working environment.

.4 Maintain minimum temperature of 10°C (50°F) or higher where specified as soon as finishing work is commenced and maintain until acceptance by the Departmental Representative.

.1 Maintain ambient temperature and humidity levels as required for comfort of NRC personnel.

.5 Prevent hazardous or unhealthy accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction including also, storage areas and sanitary facilities.

.1 Dispose of exhaust materials in a manner that will not result in a harmful or unhealthy exposure to persons.

.6 Maintain strict supervision of operation of temporary heating and ventilating equipment.

.1 Enforce conformance with applicable codes and standards.

.2 Comply with instructions of the Departmental Representative including provision of full-time watchman services when directed.

.3 Enforce safe practices.

.4 Vent direct-fired combustion units to outside.

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

.8 After award of contract, Departmental Representative may permit use of the permanent system providing agreement can be reached on:

.1 Conditions of use, special equipment, protection, maintenance, and replacement of filters.

.2 Methods of ensuring that heating medium will not be wasted and in the case of steam, agreement on what is to be done with the condensate.

.3 Saving on contract price.

.4 Provisions relating to guarantees on equipment.

33. CONNECTIONS TO AND INTERRUPTIONS TO EXISTING SERVICES

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

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

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

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

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

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

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

34. CUTTING AND PATCHING

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

.2 Remove all items as shown or specified.

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

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

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

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

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

35. FASTENING DEVICES

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

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

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

36. OVERLOADING

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

37. DRAINAGE

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

38. ENCLOSURE OF STRUCTURES

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

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

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

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

.5 Provide keys to NRC security personnel when required.

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

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

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

39. STORAGE

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

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

40. GENERAL REVIEW

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

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

41. INSPECTION OF BURIED OR CONCEALED SERVICES

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

42. TESTING

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

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

43. PARTIAL OCCUPANCY

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

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

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

44. DISPOSAL OF WASTES

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

45. CLEAN-UP DURING CONSTRUCTION

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

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

46. FINAL CLEAN-UP

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

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

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

47. WARRANTY AND RECTIFICATION OF DEFECTS IN WORK

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

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

48. MAINTENANCE MANUALS

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

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

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

END OF SECTION

1. GENERAL CONSTRUCTION SAFETY REQUIREMENTS

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

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

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

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

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

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

.7 Following a project and site hazard assessment, the Contractor shall develop a Site Specific Safety Plan based on the following minimum requirements. Site Specific Safety Plans must also be robust enough to address any abnormal occurrences, such as, but not limited to: pandemics (COVID-19 or a similar), fire, flooding, 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 sub-contractors.
.7 Any related MSDS sheets.
.8 NRC Emergency phone number.

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

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

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

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

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

COVID-19 Construction Site Protocol

To help prevent the spread of COVID-19, NRC requires contractors who are managing construction sites within our buildings or on our grounds to include a COVID-19 Construction Site Protocol as part of their Site Specific Health and Safety Plan. Below you will find the expected actions and requirements that should be included in this protocol. For further information and guidance on prevention of the spreading of the COVID-19 virus on construction sites, please refer to the Canadian Construction Association website (https://www.cca-acc.com/).

All NRC contractors and service providers have a responsibility to report to the NRC departmental representative any confirmed COVID-19 in the workplace.

NRC Contractors must provide their COVID-19 Plan as part of their site specific safety plan

Part 2 HYGIENE PRACTICES:

- Clean your hands with soap and water for 20 seconds – before you eat, at the end of the workday, during the work shift whenever possible, and when you get home from work.
- Practice physical distancing of two metres (six feet).
- Do not shake hands; avoid physical contact.
- Do not share food, drinks, cigarettes, and personal hand tools.
- Do not touch your face, eyes, nose, and/or mouth with unwashed hands (i.e. when smoking, drinking water, eating, etc.).
- Follow good respiratory etiquette by covering your mouth and nose with a tissue or the crease of your elbow when you sneeze or cough.
- Regularly clean and disinfect commonly touched surfaces and tools.

Part 3 PROJECT MEETINGS AND ONSITE PRACTICES:

- Maintain a sign-in sheet to record attendance on site each day (sign-in, sign-out)

- Communicate to personnel a muster point with the Departmental Representative in case of building evacuation.
- Limit the number of persons in meetings (kick off meetings, health and safety talks, etc.)
- Ensure there is at least 2 metres one chair spacing between workers. This may require hosting video conferences or teleconferences more often. Where practical, move meetings outdoors and reinforce social distancing.
- Disinfect used pens, tables, chairs, after each meeting.
- Post signage at multiple locations on site.
- During subcontractor orientation meetings, discuss:
  - Muster point location in case of evacuation as determined by the supervisor and the Departmental Representative.
  - Physical distancing of two metres (six feet) at all times.
  - Hygiene and location of hand washing and hand sanitization stations.
  - What the company is doing at the site to promote a safe workplace and remind them that their health is important to you.
  - Where the safety posters are located.
  - The importance of reporting to their supervisor if they are feeling unwell and leaving the project.

Part 4 HEALTH VERIFICATION OF PERSONNEL:

- Question all site visitors on the current status of their health. At the start of shifts, the supervisor is to confirm the health status of contractor personnel through discussions and notify the Departmental Representative of any issues.
- Document the conversation. This could be as simple as recording answers to the following questions:
  - Have you traveled internationally in the past 14 days?
  - Have you been in contact with someone who has traveled internationally in the past 14 days?
  - In the past 14 days, have you come into close contact (within two metres) with someone who has received a laboratory-confirmed COVID-19 diagnosis?
  - Do you feel ill in any way – sore throat, coughing, fever,runny nose, muscle ache,headache and difficulty breathing ?
- The supervisor, each day, is to ask for updates from workers who have left the site for self-isolation. Document any changes.
- At the end of shifts, the contractor shall confirm the health status of personnel through discussion with the sub-contractor supervisors and notify the Departmental Representative of any issues.

Part 5 RESPONSE TO SUSPECTED OR CONFIRMED COVID-19 CASES:

- Should an employee develop symptoms of respiratory illness (fever, cough or difficulty breathing), **they should isolate themselves from others as quickly as possible**.

- The employee's direct supervisor should send the employee home (avoiding the use of public transportation) and ask them to follow the advice of the local public health authorities.
- The following actions must immediately be taken by the supervisor if a positive COVID-19 case has been confirmed with an employee::
  - Report the occurrence immediately to the RPPM Departmental Representative on site.
  - Report the occurrence to their management team or appropriate authority representing the contractor of service provider.
  - Report to the local Public Health Authorities.
- The NRC is requiring all Contractors and Service Providers to take this consistent approach when dealing with suspected or confirmed cases of COVID-19 in the workplace.

PLEASE NOTE: This will now become an appendix of the Site Specific Health and Safety plan that the National Research Council requires prior to the start of projects.

2. FIRE SAFETY REQUIREMENTS

.1 Authorities

1. The Fire Commissioner of Canada (FC) is the authority for fire safety at NRC.
2. For the purpose of this document, "Departmental Representative" will be deemed as the NRC person in charge of the project and who will enforce these Fire Safety Requirements.
3. Comply with the following standards as published by the Office of the Fire Commissioner of Canada:
   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 Departmental Representative.

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

.4 Reporting Fires

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

.2 REPORT immediately, all fire incidents as follows:

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

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

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

.5 Interior and Exterior Fire protection & Alarm Systems

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

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

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

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

.6 Fire Extinguishers

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

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

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

.3 Provide fire extinguishers equipped as below:

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

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

.7 Roofing Operations

.1 Kettles:

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

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

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

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

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

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

.2 Mops:

.1 Use only glass fibre roofing mops.

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

.3 Torch Applied Systems:

.1 DO NOT USE TORCHES NEXT TO WALLS.

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

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

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

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

.8 Welding / Grinding Operations

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

.9 **Fire Watch**

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

.2 For temporary heating, refer to General Instructions Section 00 010 00.

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

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

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

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

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

.11 Rubbish and Waste Materials

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

.2 Do not burn rubbish on site.

.3 Rubbish Containers:

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

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

.4 Storage:

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

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

.12 Flammable Liquids

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

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

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

.4 Transfer of flammable liquids is prohibited within buildings.

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

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

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

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

3. QUESTINONS OR CLARIFICATIONS

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

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

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

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

1.2 GENERAL

.1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:
- .1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
- .2 Ensure appropriate documentation is compiled into the BMM.
- .3 Effectively train O&M staff.

.2 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.
- .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.
- .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.

.3 Design Criteria: To meet Project functional and operational requirements.

1.3 COMMISSIONING OVERVIEW

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

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

.3 Cx to be a line item of Contractor's cost breakdown, **with Cx of delayed weather and seasonal sensitive systems as a separate line item.**

.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 system 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.

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, and systems is complete.
- .3 Fully understand Cx requirements and procedures.
- .4 Have Cx documentation shelf-ready.
- .5 Understand completely design criteria and intent and special features.
- .6 Submit complete start-up documentation to Departmental Representative.
- .7 Have Cx schedules up-to-date.
- .8 Ensure systems have been cleaned thoroughly.

.9 Complete TAB procedures on systems, submit TAB reports to Departmental Representative for review and approval.
.10 Ensure "As-Built" system schematics are available.

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

1.6 CONFLICTS

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

1.7 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
.1 Submit no later than 4 weeks after award of Contract:
.1 Name of Contractor's Cx agent.
.2 Draft Cx documentation.
.3 Preliminary Cx schedule.
.2 Request in writing to Departmental Representative for changes to submittals and obtain written approval at least 4 weeks prior to start of Cx.
.3 Submit proposed Cx procedures to Departmental Representative where not specified and obtain written approval at least 4 weeks prior to start of Cx.
.4 Provide additional documentation relating to Cx process required by Departmental Representative.

1.8 COMMISSIONING DOCUMENTATION

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

.2 Departmental Representative to review and approve Cx documentation.

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

1.9 COMMISSIONING SCHEDULE

.1 Provide detailed Cx schedule as part of construction schedule.

.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 80% construction completion stage. Departmental Representative to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
- .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
- .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.

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

.6 Meeting will be chaired by Departmental Representative who will record and distribute minutes.

.7 Ensure subcontractors and relevant manufacturer representatives are present at 80% 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 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 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 to Departmental Representative for approval before implementation.

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

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

1.17 TEST RESULTS

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

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

1.18 START OF COMMISSIONING

.1 Notify Departmental Representative at least 7 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 accepted simulated operating conditions, over entire operating range, in all modes.
- .2 On independent systems and interacting systems.

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

.3 Follow equipment manufacturer's operating instructions.

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

1.21 WITNESSING COMMISSIONING

.1 Departmental Representative, DCC Representative, and designers to witness activities and verify results.

1.22 AUTHORITIES HAVING JURISDICTION

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

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

.3 Provide copies to Departmental Representative within 5 days of test and with Cx report.

1.23 COMMISSIONING CONSTRAINTS

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

1.24 EXTRAPOLATION OF RESULTS

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

1.25 EXTENT OF VERIFICATION

.1 Laboratory areas:
  .1 Provide manpower and instrumentation to verify up to 100 % of reported results.

.2 Elsewhere:
  .1 Provide manpower and instrumentation to verify up to 50 % of reported results, unless specified otherwise in other sections.

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

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

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

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

1.26 REPEAT VERIFICATIONS

.1 Assume costs incurred for third and subsequent verifications where:
- .1 Verification of reported results fail to receive Departmental Representative's approval.
- .2 Repetition of second verification again fails to receive approval.
- .3 Departmental Representative deems Contractor's request for second verification was premature.

1.27 SUNDRY CHECKS AND ADJUSTMENTS

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

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

1.28 DEFICIENCIES, FAULTS, DEFECTS

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

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

1.29 COMPLETION OF COMMISSIONING

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

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

.3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by Departmental Representative.

1.30 ACTIVITIES UPON COMPLETION OF COMMISSIONING

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

1.31 TRAINING

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

1.32 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

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

1.33 OCCUPANCY

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

1.34 INSTALLED INSTRUMENTATION

.1 Use instruments installed under Contract for TAB and PV if:
- .1 Accuracy complies with these specifications.
- .2 Calibration certificates have been deposited with Departmental Representative.

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

1.35 PERFORMANCE VERIFICATION TOLERANCES

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

.2 Instrument accuracy tolerances:
- .1 To be of higher order of magnitude than equipment or system being tested.

.3 Measurement tolerances during verification:
- .1 Unless otherwise specified actual values to be within ±5% of recorded values.

1.36 OWNER'S PERFORMANCE TESTING

.1 Performance testing of equipment or system by Departmental Representative will not relieve Contractor from compliance with specified start-up and testing procedures.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 Section Includes:
- .1 Description of overall structure of Cx Plan and roles and responsibilities of Cx team.

.2 Related Requirements
- .1 Section [_____].

1.2 REFERENCES

.1 Public Works and Government Services Canada (PWGSC)
- .1 PWGSC - Commissioning Guidelines CP.4 -3rd edition.

.2 Underwriters' Laboratories of Canada (ULC)

1.3 GENERAL

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

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

.3 Use this Cx Plan as master planning document for Cx:
- .1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.
- .2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.
- .3 Sets out deliverables relating to O&M, process and administration of Cx.
- .4 Describes process of verification of how built works meet design requirements.
- .5 Produces a complete functional system prior to issuance of Certificate of Occupancy.
- .6 Management tool that sets out scope, standards, roles and responsibilities, expectations,

deliverables, and provides:
.1 Overview of Cx.
.2 General description of elements that make up Cx Plan.
.3 Process and methodology for successful Cx.

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

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

1.4 DEVELOPMENT OF 100% CX PLAN

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

.2 Cx Plan to be 100% completed within 8 weeks of award of contract to take into account:
.1 Approved shop drawings and product data.
.2 Approved changes to contract.
.3 Contractor's project schedule.
.4 Cx schedule.
.5 Contractor's, sub-contractor's, suppliers' requirements.
.6 Project construction team's and Cx team's requirements.

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

1.5 REFINEMENT OF CX PLAN

.1 During construction phase, revise, refine and update Cx Plan to include:
.1 Changes resulting from Client program modifications.
.2 Approved design and construction changes.

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

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

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

1.6 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM

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

.2 Cx Team consists of following members:

- .1 Departmental Representative is responsible for:
  - .1 Monitoring operations Cx activities.
  - .2 Witnessing, certifying accuracy of reported results.
  - .3 Witnessing and certifying TAB and other tests.
  - .4 Ensuring implementation of final Cx Plan.
  - .5 Performing verification of performance of installed systems and equipment.
  - .6 Implementation of Training Plan.
- .2 Construction Team: contractor, sub-contractors, suppliers and support disciplines, including BAS(DDC) contractor is responsible for construction/installation in accordance with contract documents, including:
  - .1 General contractor is responsible for organizing Cx.
  - .2 Testing.
  - .3 TAB.
  - .4 Performance of Cx activities.
  - .5 Delivery of training and Cx documentation.
  - .6 Assigning one person as point of contact with Departmental Reprensetative for administrative and coordination purposes.
- .3 Operation and Maintenance Team: represents lead role in Operation Phase and onwards and is responsible for:
  - .1 Receiving system.
  - .2 Day-To-Day operation and maintenance of system.

1.7 CX PARTICIPANTS

.1 Equipment manufacturer: equipment specified to be started by manufacturer.

- .1 To include performance verification.

.2 Specialist subcontractor:

- .1 Building Automation System (DDC) subcontractor.

.3 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

.4 General contractor to ensure all required sub-contractors and manufacturer’s representative are present to complete the Cx activities. Required sub-contractors include but not limited to

- .1 Mechanical contractor.
- .2 Building Automation System (DDC) sub-contractor.
- .3 TAB sub-contractor.
- .4 Manufacturer’s representative.

.5 Provide names of participants to Departmental Representative and details of instruments and procedures to

be followed for Cx 4 weeks prior to starting date of Cx for review and approval.

1.8 EXTENT OF CX

.1 Commission mechanical systems and associated equipment:
- .1 HVAC and exhaust systems:
- .2 Existing make-up air unit 50AHU01 with new DDC controls.
- .3 New rooftop unit for room 295, RTU2; 50PAC19.
- .4 New lab exhaust fans on roof, EXF1, EXF2; 50XAF134 and 50XAF135.
- .5 New inline exhaust fan EXF3; 50XAF136.
- .6 New 31kW duct electric Heater related to RTU2. 50UNH43.

.2 EMCS:
- .1 Building Automation System (DDC).
- .2 Control system related to room 295.

1.9 DELIVERABLES RELATING TO O&M PERSPECTIVES

.1 General requirements:
- .1 Compile English documentation.
- .2 Documentation to be in PDF format

.2 Provide deliverables to be included in operating and maintenance manual:
- .1 Warranties.
- .2 Project record documentation.
- .3 Inventory of spare parts, special tools and maintenance materials.
- .4 Maintenance Management System (MMS) identification system used.
- .5 WHMIS information.
- .6 MSDS data sheets.

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 Startup, pre-Cx activities and documentation for systems, and equipment.
- .2 Completed installation checklists (ICL).
- .3 Completed product information (PI) report forms.
- .4 Completed performance verification (PV) report forms.
- .5 Results of Performance Verification Tests and Inspections.
- .6 Description of Cx activities and documentation.
- .7 Description of Cx of integrated systems and documentation.
- .8 Training Plans.
- .9 Cx Reports.
- .10 Prescribed activities during warranty period.

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

.5 Departmental Representative to participate.

1.11 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION

.1 Items listed in this Cx Plan include the following:
- .1 Pre-Start-Up inspections: by Departmental Representative and designer prior to permission to start up and rectification of deficiencies to Departmental Representative's satisfaction.
- .2 Conduct pre-start-up tests: contractor to conduct pressure, static, flushing, cleaning, and "bumping" test during construction.
- .3 Include completed documentation in Cx report.

.2 Pre-Cx activities - MECHANICAL:
- .1 HVAC equipment and systems:
  - .1 "Bump" each item of equipment in its "stand-alone" mode.
  - .2 At this time, complete pre-start-up checks and complete relevant documentation.
  - .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.
  - .4 Perform TAB on systems. TAB reports to be approved by Departmental Representative.
- .2 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 Departmental Representative.
  - .5 Perform final Cx and operational tests during demonstration period.
  - .6 Only additional testing after foregoing have been successfully completed to be

"Off-Season Tests".

1.12 START-UP

.1 Startup 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 Existing make-up air unit 50AHU01 with new DDC controls.
- .2 New rooftop unit for room 295, RTU2; 50PAC19.
- .3 New lab exhaust fans on roof, EXF1, EXF2, 50XAF134 and 50XAF135.
- .4 New inline exhaust fan EXF3, 50XAF136.
- .5 New 31kW duct electric Heater related to RTU2, 50UNH43.

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

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

.4 Performance Verification (PV):

- .1 Contractor to perform.
  - .1 Repeat when necessary until results are acceptable to [Departmental Representative] [DCC Representative] [Consultant].
- .2 Use procedures modified generic procedures to suit project requirements.
- .3 [Departmental Representative] to witness and certify reported results using approved PI and PV forms.
- .4 [Departmental Representative]to approve completed PV reports and provide to [Departmental Representative].
- .5 [Departmental Representative] [reserves right to] [will] verify up to [50]% of reported results at random.
- .6 Failure of randomly selected item shall result in rejection of PV report or report of system startup and testing.

1.13 CX ACTIVITIES AND RELATED DOCUMENTATION

.1 Perform Cx by specified Cx and approved by [Departmental Representative]

.2 [Departmental Representative] to monitor Cx activities.

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

.4 [Departmental Representative] to witness, certify reported results of, Cx activities and forward to [Departmental Representative].

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

1.14 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION

.1 Cx to be performed by specified Cx specialist.

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

.3 Upon satisfactory completion, Cx specialist to prepare Cx Report, and submitted to [Departmental Representative] for review.

.4 [Departmental Representative] [DCC Representative] [Consultant] reserves right to verify percentage of reported results.

1.15 INSTALLATION CHECK LISTS (ICL)

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

1.16 PRODUCT INFORMATION (PI) REPORT FORMS

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

1.17 PERFORMANCE VERIFICATION (PV) REPORT

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

1.18 CX SCHEDULES

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

- .1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:
  - .1 Pre-TAB review: [28]days after contract award, and before construction starts.
  - .2 Cx procedures: [1] month after award of contract.
  - .3 Cx Report format: [1]month after contract award.
  - .4 Submission of list of instrumentation with relevant certificates: [21] days before start of Cx.
  - .5 Notification of intention to start TAB: [7] days before start of TAB.
  - .6 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.
  - .7 Identification of deferred Cx.
  - .8 Implementation of training plans.

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

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

1.19 CX REPORTS

.1 Submit reports of tests, witnessed who will verify reported results.

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

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

1.20 PRELIMINARY AND FINAL CX

.1 [_____].

1.21 ACTIVITIES DURING WARRANTY PERIOD

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

.1 Fine tuning of HVAC systems.

1.22 TESTS TO BE PERFORMED BY OWNER/USER

.1 [None is anticipated on this project].

1.23 TRAINING PLANS

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

1.24 FINAL SETTINGS

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

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1- GENERAL

1.1 SUMMARY

.1 Section Includes:
.1 Commissioning forms to be completed for equipment, system and integrated system.

.2 Related Requirements
.1 Section [_____].

1.2 INSTALLATION/START-UP CHECK LISTS

.1 Include the following data:
- .1 Product manufacturer's installation instructions and recommended checks.
- .2 Special procedures as specified in relevant technical sections.
- .3 Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.

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

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

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

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

1.3 PRODUCT INFORMATION (PI) REPORT FORMS

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

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

1.4 PERFORMANCE VERIFICATION (PV) FORMS

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

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

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

1.5 SAMPLES OF COMMISSIONING FORMS

.1 [Departmental Representative] [DCC Representative] [Consultant] will develop and provide to Contractor required project-specific Commissioning forms in electronic format complete with specification data.
.1 [_____].
.2 [_____].

SPEC NOTE: Provide sample Commissioning forms to enable bidders to produce realistic bids.

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

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

1.6 CHANGES AND DEVELOPMENT OF NEW REPORT FORMS

.1 When additional forms are required, but are not available from [Departmental Representative] develop appropriate verification forms and submit to [Departmental Representative for approval prior to use.
.1 Additional commissioning forms to be in same format as provided by [Departmental Representative].

1.7 COMMISSIONING FORMS

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

.2 Strategy for Use:
.1 [Departmental Representative] provides Contractor project-specific Commissioning forms with Specification data included.
.2 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.
.3 Confirm operation as per design criteria and intent.
.4 Identify variances between design and operation and reasons for variances.
.5 Verify operation in specified normal and emergency modes and under specified load conditions.
.6 Record analytical and substantiating data.

.7 Verify reported results.
.8 Form to bear signatures of recording technician and reviewed and signed off by [Departmental Representative].
.9 Submit immediately after tests are performed.
.10 Reported results in true measured SI unit values.
.11 Provide [Departmental Representative] with originals of completed forms.
.12 Maintain copy on site during start-up, testing and commissioning period.

1.8 LANGUAGE

.1 Commissioning forms be prepared in English.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

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

.2 Related Requirements
.1 Section [_____].

1.2 TRAINEES

.1 Trainees: personnel selected for operating and maintaining this facility. Includes [Property] [Facility] Manager, building operators, maintenance staff, security staff, and technical specialists as required.

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

1.3 INSTRUCTORS

.1 [Departmental Representative] will provide:
- .1 Descriptions of systems.
- .2 Instruction on design philosophy, design criteria, and design intent.

.2 Contractor and certified factory-trained manufacturers' personnel: to provide instruction on the following:
- .1 Start-Up, operation, shut-down of equipment, components and systems.
- .2 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.
- .3 Instructions on servicing, maintenance and adjustment of systems, equipment and components.

.3 Contractor and equipment manufacturer to provide instruction on:
- .1 Start-up, operation, maintenance and shut-down of equipment they have certified installation, started up and carried out PV tests.

1.4 TRAINING OBJECTIVES

.1 Training to be detailed and duration to ensure:
- .1 Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.
- .2 Effective on-going inspection, measurements of system performance.
- .3 Proper preventive maintenance, diagnosis and trouble-shooting.
- .4 Ability to update documentation.
- .5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

1.5 TRAINING MATERIALS

.1 Instructors to be responsible for content and quality.

.2 Training materials to include:
- .1 "As-Built" Contract Documents.
- .2 Operating Manual.
- .3 Maintenance Manual.
- .4 Management Manual.
- .5 TAB and PV Reports.

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

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

.5 Supplement training materials:
- .1 Equipment models.

1.6 SCHEDULING

.1 Include in Commissioning Schedule time for training.

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

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

1.7 RESPONSIBILITIES

.1 Be responsible for:
- .1 Implementation of training activities,
- .2 Coordination among instructors,
- .3 Quality of training, training materials,

.2 [Departmental Representative] will evaluate training and materials.

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

1.8 TRAINING CONTENT

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

.2 Content includes:
- .1 Review of facility and occupancy profile.
- .2 Functional requirements.
- .3 System philosophy, limitations of systems and emergency procedures.
- .4 Review of system layout, equipment, components and controls.
- .5 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-

down procedures.

.6 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.

.7 Maintenance and servicing.

.8 Trouble-shooting diagnosis.

.9 Inter-Action among systems during integrated operation.

.10 Review of O&M documentation.

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

1.9 VIDEO-BASED TRAINING

.1 Not used.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 Protection

.1 Protect existing items designated to remain and materials designated for salvage. In event of damage, immediately replace such items or make repairs to approval of Departmental Representative and at no additional cost to Departmental Representative.

.2 Designated existing items and equipment to be identified and approved by NRC representative are located in Rooms 288A, 289, 289B, 289C, 290, 291A, 291B, 292, 293, 293B, 294, 295, 295B & CORRIDOR.

1.2 Measurement for Payment

.1 N/a

Part 2 PRODUCTS

2.1 N/A

Part 3 EXECUTION

3.1 Preparation

.1 Inspect site and verify with Departmental Representative items designated for removal and items to be preserved.

.2 Locate and protect utility lines. Preserve in operating condition active utilities traversing site.

3.2 Removal

.1 Remove items indicated.

.2 Do not disturb adjacent items designated to remain in place.

3.3 Salvage

.1 Carefully dismantle items containing materials directed or indicated for salvage. Store salvaged materials at locations directed or indicated.

3.4 Disposal of Material

.1 Dispose of materials not designated for salvage or re-use in work, off-site.

3.5 Restoration

.1 Upon completion of work, remove debris, trim surfaces and leave work site clean.

.2 Reinstate areas and existing works outside areas of demolition to match condition of adjacent, undisturbed areas.

END OF SECTION

Part 1 GENERAL

1.1 Scope of Work

.1 Provide interior protection prior to demolition work.

.2 Protection to be constructed in such a fashion so as to afford security, dust and weather resistance.

.3 Barriers to be constructed continuously on the interior perimeter within corridors to maintain access to stair for emergency evacuations.

.4 Within Rooms 288A, 289, 289B, 289C, 290, 291A, 291B, 292, 293, 293B, 294, 295, 295B & CORRIDOR , barriers to be provided to ensure protection of identified items and equipment.. Ensure walkthrough is maintain and well identified for exits. Coordinate with NRC representative.

Part 2 PRODUCTS

2.1 Materials

.1 1/2" x 4'-0" x 8'-0" wood sheathing.

.2 3-5/8" metal studding.

.3 3-1/2" spruce wood, construction grade studding.

.4 6 mil. polyethylene.

.5 Vinyl reinforced tarps c/w adequate sealed openings for access.

2.2 Erection

.1 Construct a solid barrier in all locations where window, A/C, or roof modifications are to occur.

.2 Construct barriers full height and line with polyethylene to ensure dust and water tightness.

.3 Have a mock-up assembly approved by the Departmental Representative prior to proceeding with the erection.

.4 Ensure that the barrier does not interfere with the building's overhead crane or the work operations of the building occupants.

Part 3 SECONDARY PROTECTION

3.1 Dust Walls

.1 As the work progresses and after all structural work and wall framing have been completed, remove the temporary interior protection walls and construct a 6 mill polyethylene dust wall in its place, to allow finish work to proceed.

.2 Install wood sheathing in the new window openings temporarily until the new glazing units have been received.

.3 Inspect walls on a regular basis to ensure integrity of the assembly and to avoid dust and water infiltration to the interior of the building.

.4 Remove interior protections only when approved by the Departmental Representative.

Part 4 REINSTATEMENTS

4.1 Finishes

.1 Reinstate the interior finishes affected by this work to the satisfaction of the Departmental Representative.

END OF SECTION

Part 1 GENERAL

1.1 Related Work Specified Elsewhere

.1 Section 07 52 00 - Modified Bitumen Membrane Roofing

.2 Section 07 62 00 – Sheet Metal Flashing and Trim.

.3 Section 07 90 00 – Joint Sealants.

1.2 General

.1 Provide wood blocking and sheathing for roofing and sheet metal work as indicated on the drawings or as required to complete the roof installation.

.2 Be responsible for the safe disposal of all debris caused by these operations, from the job site.

1.3 References

.1 CAN/CSA B111-1974(R2003) wire, Nails, Spikes and Staples.

.2 CAN/CSA O80 Series-97(R2002) Wood Preservation

.3 NLGA National Lumber Grades Authority, Standard Grading Rules for Canadian Lumber, 1987

.4 ULC underwriters' Laboratories of Canada.

1.4 Anchors and Fasteners

.1 Co-ordinate the location and installation of anchors and fasteners. Confirm types of fasteners to be utilized with Consultant.

.2 Do not use metals in combination that will set up electrolytic action.

.3 Use non-corrosive or galvanized steel fastenings, as approved by Consultant, or as otherwise specified.

.4 Space anchors within load bearing or shear capacity.

1.5 Quality Assurance

.1 Lumber shall bear the grading stamp of an agency certified by the Canadian Lumber Standards Administration Board.

1.6 Precautions

.1 Provide temporary protection, to the satisfaction of the Consultant, to render all wood blocking watertight, if for any reason permanent membrane protection cannot be provided within the same day.

.2 Ensure the base of any curbs are temporarily sealed to prevent water from entering below the curb assembly, or behind sheathing, should the roof assembly not be completed on the same day as the carpentry work.

Part 2 PRODUCTS

2.1 Dimension Lumber

.1 TO CAN/CSA 0141-91 and CAN3-086-M84 and to National Lumber Grades Authority Standard Grading Rules 1987-grade Category as follows:

.1 Light framing and blocking: species group spruce - "Construction" grade.

2.2 Fasteners

.1 Nails, spikes and staples: to CSA B111-1974; galvanized for exterior work. For sheathing, use #9 screws with Robertson or Philips head, complete with discs or specified adhesives. For blocking, use screws of sufficient length to penetrate second member a minimum of 38mm. Use expansion shields, friction fit pins or lag bolts in concrete.

2.3 Cement Board

.1 On verticals: 12mm Cement Board shall be a polymer modified concrete board, reinforced with alkali resistant mesh. Board to have a compressive strength of greater than 8Mpa and water absorption characteristics of less than 5% of its mass.

2.4 Pressure Treatment of Wood

.1 All wood blocking to be treated in accordance with CAN/CSA-080-1-M89

2.5 Wood Preservative

.1 Wood preservative: copper napthenate or penta-chlorophenol base, water repellent wood preservative to CSA 080-M89, coloured.

Part 3 APPLICATION

3.1 Securement of Blocking

.1 Secure to substrate with specified fasteners, galvanized, minimum 9mm diameter of a suitable length, placed in 2 rows, with each row spaced at 600mm on centres or as otherwise detailed. In concrete, fastener shall penetrate a minimum of 38mm and drill hole shall be 13mm deeper than fastener penetration.

.2 Double the amount of fasteners required for a distance of 2.4m from all outside corners.

3.2 Wood Preservative

.1 Cut all members to fit prior to installation and treat all faces and cuts with preservative prior to site fabrication of curbs.

3.3 Nailing

.1 All nails shall be long enough so that not less than half their length penetrates into the second member. Splitting of wood members shall be minimized by staggering the nails in the direction of the grain and by keeping nails well in from the edges.

END OF SECTION

Part 1 GENERAL N/A

Part 2 PRODUCTS

2.1 Insulation

.1 Bulk insulation: fabricated from friction fit batts or rolls [glass fibre][mineral fibre], RSI 0.6 (R3.33) for each 25 mm (1") thickness. Extruded polystyrene: below grade: to CAN/CGSB-51.20-M87, type 4 having RSI 0.87 for each 25 mm (1") thickness to thickness indicated and having a compressive strength of 210 Kpa, square edges. Only polystyrene insulations listed on CGSB Qualified Products List (GP-41) are acceptable for use on this project. For roofing application, use polystyrene board with pre-grooved channels on the underface to facilitate drainage.

.2 Extruded polystyrene: below grade: to CAN/CGSB-51.20-M87, type 4 having RSI 0.87 for each 25 mm (1") thickness to thickness indicated and having a compressive strength of 210 Kpa, square edges. Only polystyrene insulations listed on CGSB Qualified Products List (GP-41) are acceptable for use on this project. For roofing application, use polystyrene board with pre-grooved channels on the underface to facilitate drainage.

.3 Bulk insulation: fabricated from friction fit batts or rolls mineral fibre, RSI 0.6 (R3.33) for each 25 mm (1") thickness.

.4 Acoustical Fire Batt Insulation (ROCKWOOL AFB or Equivalent)(formerly ROXUL) for Commercial & Interior partition wall: Mineral Fiber Thermal Insulation is fabricated from natural stone and recycled formats, fire resistant (CAN4 S114, ASTM E 136, CAN/ULC S102 & S129), Corrosive Resistance (ASTM C 665 & 795), Air Erosion (UL 181), Compliance and Performance (CAN/ULC S702-07, ASTM C 665 & 553). Sizes 412.75mm x 1219mm, 615.95mm x 1219mm, Thickness 25mm to 88.9mm with 12.7mm increments (as well as 100mm, 125mm and 152mm). Density at 50mm thick (45kg/m³).

2.2 Accessories

.1 Insulation clips: impale type, perforated 50 x 50 mm (2" x 2") cold rolled carbon steel 0.8 mm (20 ga.) thick, adhesive back, spindle of 2.5 mm diameter annealed steel, length to suit insulation, 25 mm (1") diameter washers of self locking type.

.2 Sealant: to CAN/CGSB-19.21-M87.

.3 Tape for sealing as recommended by manufacturer.

Part 3 EXECUTION

3.1 Workmanship

.1 Install insulation after building substrate materials are dry.

.2 Install insulation to maintain continuity of thermal protection to building elements and spaces.

.3 Fit insulation closely around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.

.4 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.

.5 Offset both vertical and horizontal joints in multiple layer applications.

.6 Do not enclose insulation until it has been inspected and approved by Departmental Representative.

3.2 Semi-Rigid Insulation Installation

.1 Install glass fibre bulk insulation with insulation clips and disc, cut off fastener spindle 3 mm (1/8") beyond disc where installed to substrate. Install with adhesive to concrete substrate.

.2 Leave insulation board joints unbonded over line of expansion and control joints. Bond a continuous 150 mm (6") wide 0.15 mm (6 mil) polyethylene strip over joint using cmpatible adhesive before application of insulation.

3.3 Perimeter Foundation Insulation

.1 Interior application: extend boards vertically and horizontally below bottom of finish floor slab, installed on inside face of perimeter foundation walls as shown on drawings.

.2 Exterior application: extend boards below finish grade as shown on drawing. Install on exterior face of perimeter foundation wall with adhesive Type A. Protect entire face of insulation exposed to backfill with protection board.

.3 Under slab application: extend boards from perimeter foundation wall as shown on drawings. Lay boards on level compacted fill.

END OF SECTION

Part 1 General

1.1 RELATED Work Specified Elsewhere

.1 Instructions to Bidders.

.2 General Conditions of Contract

.3 Rough Carpentry For Roof- Section 06 10 00

.4 Insulation- Section 07 20 00

.5 Flashing and Sheet metal - Section 07 62 00

1.2 GENERAL

.1 Provide the necessary labour and materials to complete the removal of the existing roofing system, sheet metal flashings and membrane down to the existing structural deck/slab and install new roofing system as specified herein.

.2 Do roofing work in accordance with applicable standards in the Canadian Roofing Contractors Association (CRCA) roofing specifications manual.

.3 Remove and reinstate existing lightning protection to facilitate new roofing operations and submit certification that revisions comply with CAN/CSA-B72.

1.3 REFERENCES

.1 ASTM C79/C79M-01 CGSB 37-GP-9Ma Primer, Asphalt, Unfilled for Asphalt Roofing, Dampproofing and Waterproofing

.2 CGSB 37-GP-56M Membrane, Modified Bituminous, Prefabricated and Reinforced for Roofing

.3 CAN/CGSB 37.29-M89 Rubber-Asphalt Sealing compound.

.4 CSA B111-1974(R1998) Wire Nails, Spikes and Staples

.5 CAN/ULC-S704-2001 Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.(supersedes CN/CGSB 51.26)

.6 CRCA Canadian Roofing Contractors' Association Metric Specification Manual

1.4 PREPARATION

.1 All materials that may be reused on the new roof system, salvage and store for inspection by the Departmental Representative. Credits for such materials may be requested.

.2 The Contractor is solely responsible for the disconnection, relocation and re-installation of all existing mechanical and electrical services as required.

.3 Ensure that the Departmental Representative is aware of any such work that may effect the interior environment of the building, prior to disconnection or shut down.

.4 Disconnection and reconnection of all electrical services to meet latest regulations of Canadian Electrical Code and applicable Municipal and Provincial Codes and Regulations. In each and every instance of application, Code, Regulation, Statute, By-Law or Specification, the most stringent requirements shall apply.

.5 Provide the Departmental Representative with a schedule indicating time and dates, for any work creating a disruption to the interior environment and obtain the Owner's written approval.

Part 2 Products

2.1 PERFORMANCE CRITERIA

.1 Compatibility between components of roofing system is essential. Provide written declaration to Departmental Representative stating that materials and components, as assembled in system, meet this requirement.

.2 Roofing System: to CSA A123.21 for wind uplift resistance.

2.2 ROOF ASSEMBLY

.1 Supply all labour and materials necessary to complete the new Modified Bitumen Membrane Roofing, as specified in the areas indicated on the drawings.

The Typical Roof Assembly shall be:
Vapour Barrier
75mm (min) Rigid Insulation
Sloped rigid insulation to suit drainage pattern
6mm Asphalt Core Board
2 Ply Modified Bitumen Membrane
Existing Concrete Reinforced Slab

2.3 MEMBRANE FLASHING

.1 Supply all labour and materials necessary to complete the new two ply Modified Bitumen Membrane Flashings, as specified and detailed in the areas indicated on the drawings.

2.4 INSPECTION AND TESTING

.1 Inspection of membrane roofing and associated work will be done by the Departmental Representative. Notify the Departmental Representative at least 48 hours before commencement of any roofing work.

.2 The Departmental Representative reserves the right to have cut tests made in the presence of the Contractor. Costs of tests and subsequent repairs shall be borne by the Contractor.

.3 The Departmental Representative shall be notified in the event that the specifications conflict with the Manufacturer's recommendations or CRCA guidelines.

.4 The inspection and testing service does not relieve the Contractor of his responsibility for quality control of production and for errors made by him.

2.5 PRECAUTIONS

.1 Roofing shall not be carried out when materials are damp, or when ambient temperatures are less than minus ten (-10) degrees Celsius. (Postpone roofing work when inclement weather appears imminent.) Base sheet membranes shall be stored at above 10 degrees Celcius prior to use and shall be unrolled to relax prior to torching applications.

.2 Apply each part of roofing system only when surfaces are clean and dry.

.3 All adjacent parts of the building shall be protected from damage caused by roofing operations. Cover walls and other surfaces in the vicinity of hoisting apparatus with heavy canvas or other suitable protective material. Any damage caused by this contract shall be repaired to match the original materials and appearance.

.4 Locate equipment and materials in areas designated by the Departmental Representative.

.5 Conduct operations so as to leave deck exposed for minimum period of time. Protect, as required, to prevent water infiltration or environmental damage to building interior.

.6 Provide temporary membrane to render deck watertight, if for some unforseen reason work cannot be completed as specified. All temporary membranes shall be removed completely prior to any further roofing work.

.7 Where work must continue over finished roofing membrane, protect surface with minimum 12.5mm thick plywood sheets.

.8 Any sharp projections, that in the opinion of the Departmental Representative may penetrate the membrane, shall be ground smooth and flush.

.9 All aspects of the re-roofing operation shall follow in close sequence. No part of the operation shall be so far ahead of the succeeding part that the latter cannot be finished that working day.

.10 During roofing maintain a clean Site and keep 2 foam or dry type fire extinguishers on roof within easy access of torching application and in any open flame location while roofing is in progress. Verify no vent pipes venting flammable fumes (i.e. fuel storage tanks) are located in area of work. Do not have gasoline or other flammable solvents on roof while torching. Be vigilant against self-starting fires at end of roofing operations for day. Use a heat detector gun to spot any smouldering or concealed fire. Examine roof

for hot spots 2 hour after completion of roofing operations, especially at flashings and around roof penetrations. Alert watchman of such possibilities.

2.6 STORAGE

.1 Store membrane and other materials susceptible to damage from moisture, on dry base off ground and protected from damp, wet, freezing or contact with non-compatible materials. Membrane rolls shall be stored in an upright position.

.2 Deliver and store all materials in their original packaging; bearing the manufacturer's name, the grade, weight and standards pertaining thereto, as well as any other reference or markings considered standard.

.3 Any materials damaged and/or exposed to the elements and/or moisture, shall be removed from the work site at the discretion of the Departmental Representative.

.4 Stockpiling of materials on the roof will not be allowed. Distribute material as directed by the Departmental Representative.

2.7 COMPAIBILITY

.1 Compatibility between all components of roofing system is essential.

.2 The Contractor shall be responsible for ensuring that all items he elects to use are compatible with each other.

2.8 CUTTING, PATCHING AND MAKING GOOD

.1 Cut and modify existing surfaces, as required, to accommodate new work.

.2 Remove all items as shown or specified.

.3 Patch and make good all surfaces cut, damaged or disturbed, to Departmental Representative's satisfaction.

2.9 EXAMINATION

.1 Examine all surfaces to receive new roof assembly, and if corrective measures are necessary, report items to Departmental Representative in writing. Substrate shall be smooth, clean, dry and free from depressions or sharp edges. All required wood blocking and curbs shall be securely in place prior to start of roofing work.

.2 Inspect the substrates and all roof mounted mechanical equipment being affected by the work, to ensure they are in good repair and working order. Notify the Departmental Representative, in writing, prior to commencing contracted work, should corrective measures be required.

.3 Examine drawings and existing conditions, provide for all vents, curbs, stacks roof mounted equipment curbs, and other openings through membrane roofing.

2.10 CLEAN-UP

.1 Clean up as work progresses.

.2 Upon completion, remove scaffolding, temporary protections and surplus materials. Make good any defects noted at this stage.

.3 Clean areas affected under contract, to a condition at least equal to that previously existing and to satisfaction of the Departmental Representative.

.4 At the end of each work period, and more often if ordered by the Departmental Representative, remove debris from site and neatly stack material.

2.11 COORDINATION

.1 Study all documents which describe, or are related to any operation before commencement of that operation. Report discrepancies discovered between existing conditions and documentation. Obtain ruling on required interpretation before commencing work.

.2 Ensure that materials, equipment, services and operatives are brought to site in sufficient quantity and in accordance with requirements of the work schedule.

2.12 WARRANTY

.1 **The warranty shall be a period of two (2) years from the date of final completion. Repair of any actual leaks shall also include the removal and replacement of all related moisture damage materials.**

.2 Make all necessary repairs and replacements within 48 hours of receipt of written notification.

.3 Nothing contained in this Article shall be construed as in any way restricting or limiting the liability in common law and statutory liability of the Contractor.

.4 Provide a manufacturers warranty, which shall guarantee the membranes and membrane flashing performance, for a period of ten years against manufacturing defects and premature deterioration.

.5 Provide these written warranties, confirming above, issued on the corporate letterhead, signed and sealed by an authorized signing officer. The warranties will specifically reference the name of the Building, location and Owner.

Part 3 Products

3.1 SHEATHING

.1 See Section 06 10 00 for product and application requirements.

3.2 PRIMER

.1 Primer shall be dark brown or black bituminous emulsified primer (water based) shall be non-flammable, as recommended by the membrane manufacturer.

3.3 VAPOUR BARRIER

.1 Modified Bitumen Base Sheet Membrane: (Torch Application): to Class C, Grade 1 , material, reinforced with a minimum 180 gram/m sq non-woven polyester mat with minimum thickness 3mm to CGSB 37-GP-56M + Amdt. Dec. 85.

3.4 INSULATION

.1 Rigid closed cell polyisocyanurate insulation bonded on upper and lower surfaces to an organic \ inorganic facer. Material shall meet CAN/CGSB-51.26-M86 and CAN\UL-S126-M. The boards shall be distributed in **1200mm x 1200mm** panels, pre-wrapped to prevent moisture ingression. Standard of acceptance shall be Johns Manville E'NRG'Y 3,IKO Therm polyisocyanurate insulation or Atlas Roofing Corp AC FOAM II.

.2 Insulation slopes shall be as indicated on the detailed drawings and roof plans. The degree of slope shall be as noted on drawing.

.3 Fibrous glass batts, friction fit, unfaced to CSA A101 latest edition.

3.5 ADHESIVES

.1 Adhesive for securing insulation, tapered insulation and overlay board shall be

.1 an asphalt extended vulcanized adhesive.

.2 a single component urethane adhesive, dispensed from a portable pre-pressurized container requiring no external power source.

.3 a single component solvent free moisture curing adhesive.

.4 a two component, elastomeric, moisture cured; low rise urethane foam adhesive that contains no solvents.

.2 Standard of Acceptance shall be Fas-n-free by Tremco, Cold Gold by IKO or Duotack by Soprema.

3.6 JOINT TAPE

.1 Joint tape for all vertical joints in cement board at parapets and curbs and all joints and transitions in protection board, shall be a self adhering modified bitumen membrane, as distributed by the membrane manufacturer. Tape shall be 150mm wide and a minimum of 1.2mm thick.

3.7 OVERLAY BOARD

.1 Approved Overlay Board shall be a minimum of 6mm thick, asphalt based recovery board with non-woven glass facers, as distributed by the membrane manufacturer.

3.8 MODIFIED BITUMEN MEMBRANE

.1 Two (2) ply system made from prefabricated modified bitumen membranes containing minimum 15% of elastomer Styrene Butadiene Styrene (SBS) and reinforced with non-flammable, fireproof and stress resistant insert of glass fibre or polyester.

.1 Cap Sheet And Flashing (Torch Application): to be Class A, Grade 2 material, reinforced with 250 gram/m. sq. non-woven polyester mat with a minimum membrane thickness of 4mm to CGSB 37-GP-56M + Amdt. - Dec. 85. Granule colour to be selected by Owner and/or Consultant.

.2 Base Sheet and Flashing (Torch Application): to Class C, Grade 1 , material, reinforced with a minimum 180 gram/m sq non-woven polyester mat with minimum thickness 3mm to CGSB 37-GP-56M + Amdt. Dec. 85.

.2 Low Temperature Requirements: Grade 2 material to pass low temperature requirements at –30C to CGSB 37-GP-56M + Amdt. Dec. 85.

.3 Test Results: Test results from a certified independent laboratory showing conformance to above requirements shall be submitted with tender documents or within 48 hours of tender closing.

.4 Standard Of Acceptance: S.B.S. Modified Bitumen Membranes as manufactured by Soprema Waterproofing Inc., Monsey Bakor. or IKO.

3.9 ACCESSORIES

.1 Install insulation to meet thickness as required in scope of work and indicated on the drawings. Ensure polyethylene film on base sheet vapour barrier is completely removed prior to applying adhesives.

.2 Stagger all joints in the boards, for all layers, and adhere with continuous 12mm wide beads of adhesive spaced at 300mm O.C. Alternatively, adhesive may be applied by trowel 3mm thick and 40mm wide bands, 150mm apart. Follow Manufacturers printed instructions for the use of Tremco and IKO adhesives.

.3 In the sump area around the drain, reduce base insulation by 25mm and install sloped insulation as detailed.

.4 Cap all insulation, as detailed, with the overlay board, secured with the specified adhesives.

.5 Unless specifically stated otherwise, strictly follow the adhesives Manufacturers printed instructions for the application of the adhesives, including spread patterns and requirements for walking over the boards.

.6 Stagger all joints in the insulation boards, for all layers, and adhere with continuous 12mm wide beads of adhesive spaced at 300mm O.C. Alternatively, adhesive may be applied by trowel 3mm thick and 40mm wide bands, 150mm apart. Follow Manufacturers printed instructions for the use of Tremco and IKO adhesives.

Part 4 Application

4.1 ASPHALT PRIMER

.1 Apply by brush, roller or spray, at a rate of 10m sq. per 4 litres over existing vapour barrier and new sheathing and allow to dry. Consult sheathing manufacturer for specific written instructions for primer applications.

4.2 VAPOUR BARRIER

.1 Install under new wood blocking as detailed on the drawings and lap over parapets.

.2 Commencing at the lowest point of the roof, apply vapour barrier by torching application. Apply membrane with 75mm side laps and 150mm end laps. Supplement adhesion where necessary with additional membrane strips to ensure waterproof protection until application of roof assembly.

.3 Ensure membrane is unrolled to enable membrane to relax prior to installation. Time required for relaxation will vary with weather conditions.

.4 Torch weld all lap joints by heat softening the membrane and pressing the edge of the membrane firmly with a roofing trowel. Ensure consistent adhesion has been achieved between the substrate and base sheet membrane.

4.3 INSULATION

.1 Install insulation to meet thickness as required in scope of work and indicated on the drawings. Ensure polyethylene film on base sheet vapour barrier is completely removed prior to applying adhesives.

.2 Stagger all joints in the boards, for all layers, and adhere with continuous 12mm wide beads of adhesive spaced at 300mm O.C. Alternatively, adhesive may be applied by trowel 3mm thick and 40mm wide bands, 150mm apart. Follow Manufacturers printed instructions for the use of Tremco and IKO adhesives.

.3 In the sump area around the drain, reduce base insulation by 25mm and install sloped insulation as detailed.

.4 Cap all insulation, as detailed, with the overlay board, secured with the specified adhesives.

.5 Unless specifically stated otherwise, strictly follow the adhesives Manufacturers printed instructions for the application of the adhesives, including spread patterns and requirements for walking over the boards.

.6 Stagger all joints in the insulation boards, for all layers, and adhere with continuous 12mm wide beads of adhesive spaced at 300mm O.C. Alternatively, adhesive may be applied by trowel 3mm thick and 40mm wide bands, 150mm apart. Follow Manufacturers printed instructions for the use of Tremco and IKO adhesives.

4.4 BASE SHEET

.1 Commencing at the lowest point of the roof, apply the base sheet by torching application, ensuring full adhesion to the substrate. Apply base sheet with 75mm side laps and 150mm end laps. Apply consistent pressure to ensure full adhesion and pressure roll all laps.

.2 Apply additional strips of membrane at deficient seams, where required to ensure protection, until cap sheet can be torch applied.

.3 Ensure base sheet is unrolled to enable membrane to fully relax prior to installation. Relaxation time will vary with weather conditions.

.4 All wrinkles and application deficiencies shall be cut out and repaired prior to cap sheet application.

4.5 CAP SHEET

.1 Plan the membrane application so that the laps are not superimposed over the laps of the base sheet. Mark a chalk line where the first course is to start. Unroll 2 - 3m of the membrane and line it up to the chalk line or to the selvage edge. Re-roll and commence application. If the roll goes out of line by more than 12mm, cut and re-align.

.2 With a torch, adhere one ply of the membrane, granule side up. Carefully heat the underside of the membrane and slowly unroll. Constantly check the adhesion to be certain that proper bonding is achieved.

.3 Side laps must cover the selvage edge and be a minimum of 75mm, end laps must be 150mm.

.4 Using a torch and round nosed roofing trowel, embed the surface granules into heated and soft bitumen, from the chalk line to the edge of the cap sheet at the top of the horizontal surface. A minimum distance of 150mm from the edge of the cap sheet.

4.6 MEMBRANE FLASHING

.1 Check sheathing manufacturers requirements for torching requirements. Ensure burning of scrim sheet does not interfere with adhesion of membranes. Cut testing of all curb detailing shall be requested during the flashing installation.

.2 Plan 2 ply membrane flashing application so that laps are not superimposed over the laps on the underlying membrane.

.3 Install membrane flashing with full roll widths perpendicular to the deck, 1.0m wide maximum.

.4 Install reinforcing gussets at all inside and outside corners as per manufacturer's recommendations.

.5 Install base sheet flashing prior to horizontal cap sheet application. Extend membrane 100mm onto horizontal surface and 400mm up any verticals, or as indicated on the detail drawings. Set base sheet and cap sheet membrane flashing by torch application.

.6 Using a chalk line, lay out a straight line on the cap sheet surface. Set line parallel to the roof edge and 150mm from the base of the vertical. Install cap sheet flashing after application of horizontal cap sheet. Extend membrane 150mm onto horizontal surface and 400mm up verticals or as indicated on the Drawings.

.7 Granules shall be embedded for the preparation of the selvage where the membrane will overlap on the mineral surface.

.8 Using the propane torch, heat the back of the flashing strip until the coating flows and bonds to the roof and up to the vertical. Press in firmly for proper adhesion. Continue by bonding the upper portion to the wall, taking precautions not to stretch the membrane. Secure all membrane flashings to verticals with continuous securement strips installed along the top edge of membrane flashings and fastened at 300mm O.C. or as detailed. Lap all flashing strips to the selvage or a minimum of 75mm and seal the laps securely.

.9 Use a wet sponge to tamp the membranes in place at the junction of the horizontal and vertical surfaces.

.10 Torch application of membrane flashings shall be performed by skilled tradesmen in accordance with the manufacturer's recommendations.

4.7 Pavers

.1 25mm type 4 polystyrene, as shown on drawing.

4.8 Grounding Wire Flashing

.1 Construct new composite curbs around base lightning wire penetration after installation of cap sheet membrane. Curb alignment shall be performed to ensure curbs are of consistent size and centered on the post or service line.

.2 Adhere curb to membrane and seal all joints, prior to installing rubberized filler. Mix rubberised filler immediately before filling and cove to exterior for drainage

4.9 Spun Aluminium Flashings

.1 Install new sleeves over existing vents and centre on existing vent.

.2 Prime aluminum flange and set into a coat of compatible mastic. Flash with one (1) ply of base sheet membrane for reinforcement, to extend a minimum of 200mm beyond flange. Complete installation with the application of the cap sheet membrane.

.3 Install batt insulation between vent and aluminum flashing.

.4 Caulk as detailed.

4.10 Lighting Cable Reinstatement

.1 On completion of all roofing operations, reinstate lightning protection system in accordance with CAN/CSA-B72. Wherever feasible, secure cable to parapets and curbs to elevate cable above membrane surfaces.

.2 Bond discharge conductors to service mast or other non current-carrying or electrical parts.

.3 Submit certification to consultant

4.11 COMPLETION OF DAY'S WORK

.1 Install water cut-offs at the end of each day's work; remove completely prior to continuing further roofing applications.

.2 Inspect all laps of the membrane application to ensure they are properly bonded. Repair any deficiencies prior to leaving the site for the day.

.3 Base sheet applications should not be left exposed overnight unless all seams are torch welded prior to leaving the work site.

.4 Provide a two (2) hour fire watch at the end of each day when torching membrane. Walk the day's entire production area to check for smoke and hot spots. The fire watch shall include use of a hand held digital infrared thermometer, which shall be scanned over the day's production area every 20 minutes.

4.12 GENERAL

.1 Patching of the cap sheet membrane shall be carried out utilizing patches with a minimum size of 450mm by 1000mm. Minimum length of cap sheet on flat run of roof shall not be less than 1000mm.

.2 Wrinkled or deformed ends of cap sheet rolls will not be tolerated and therefore must be discarded prior to application.

.3 Following completion of new roofing, torch soften and apply a liberal application of approved bulk type mineral granules to cap sheet membrane edges where asphalt has extruded or flowed beyond clean lines and to all surface damage.

.4 Splices in delivered rolls of membrane are to be removed. Cut back the roll 450mm on both sides of the splices and remove prior to installation.

END OF SECTION

Part 1 GENERAL

1.1 Related Work specified Elsewhere

.1 Modified Bitumen Membrane Roofing - Section 07 52 00

1.2 General

.1 Supply and install all sheet metal caps, counter flashings, fascia and all other roof related metal flashings required to complete roof installation.

.2 Form to profiles as detailed upon the drawings, or as required to suit specific site conditions

.3 All work to be performed by experienced mechanics skilled in the trade to the satisfaction of the Departmental Representative.

1.3 References

.1 Standard practices, unless otherwise noted herein, shall be deemed to constitute recommended procedures published in S.M.A.C.N.A. Architectural Manual and the CRCA – Canadian Roofing Contractors Association Guidelines.

.2 ASTM Specifications A563/A563M-03

1.4 Workmanship

.1 Sheet metal flashings work shall be carried out in accordance with the best standard practices of the industry ; with joints locked, cleated, caulked as required, and exposed edges hemmed. Ample allowance shall be made in all work for expansion and contraction without compromising the waterproofing integrity of the structure.

.2 Mitred corners shall be straight and profiles level as indicated on the drawings or as required to suit the specific site conditions, with flat surfaces free of distortion and free of face nailing

1.5 Warranty

.1 For work of this section, the 12 months warranty period prescribed in subsection GC 32.2 of General Conditions "C" is extended to 24 months.

Part 2 **PRODUCTS**

2.1 Metal Flashing

.1 Metal flashing shall be 0.55mm (26 ga) or as specifically noted otherwise. Material to be commercial galvanized to ASTM Specifications A563/A563M-03. Coating designation G90, PPD 8000 Series from standard colour chart. Finished colour to be selected by Departmental Representative.

2.2 Starter Strip

.1 Starter strips to be manufactured from the same type of material used for cap and counter flashings, and shall be a minimum thickness of .65mm

2.3 Fasteners

.1 Non-corrosive colour to match exposed flashings.

.2 Unexposed galvanized flat head nails CSA B111-1974.

.3 Exposed: screws with neoprene washers under the heads

.4 Cadmium plated screws, coloured head.

2.4 Sealant

.1 Caulking compound to CGSB 19-GP-5M colour to suit application.

2.5 Sheet Metal:

.1 Use one or more of the following for the particular application indicated on the drawings.

.1 Galvanized - 0.71 mm (0.028").]
.2 Copper - 0.68mm (0.027").] [
.3 Aluminum 0.80mm (0.031") 35 type H.[
.4 Prefinished - as indicated on drawings.

.2 Fasteners: non-corrosive colour to match exposed flashings.

.3 Unexposed: galvanized nails.

.4 Exposed: screws with neoprene washers under the heads.

.5 Caulking compound to CGSB 19-GP-5M colour to suit application.

.6 Solder to ASTM B32-93 45% tin, 55% lead.

Part 3 APPLICATION

3.1 General

.1 All free edges of metal flashing shall be strengthened by a fold at least 13mm wide, set out slightly and presenting a straight line and neat finish. Form flashings in 2.4 metre lengths, and make allowance for expansion and contraction.

.2 Metal shall be formed on a bending brake, shaping trimmed and hard seaming shall be done on bench, as far as practicable, with proper sheet metal working tools. Angles of bends and folds for interlocking metal shall be made with full regard to expansion and contraction to avoid buckling and to avoid damaging metal surfaces.

.3 Dry joints are to be tight but not dented so as to permit slight adjustments of sheets and yet remain watertight.

.4 Lock seams at all corners.

3.2 Anchors and Fasteners

.1 Space exposed fasteners evenly and in an organized pattern, keep number to a minimum. Where exposed to view, use metal fasteners of same material, colour, texture and finish as the metal on which they occur. Obtain written approval from the consultant before installing any exposed fasteners.

3.3 Counter Flashings

.1 Install metal counter flashings as soon as possible after membrane flashings are in place and accepted by Consultant.

.2 Counter flashing shall have crimped bottom edge, stiffening break and shall extend up verticals as detailed.

.3 Secure sections of metal in S-lock joints and allow for sufficient expansion and contraction between each piece.

.4 Secure metal counter flashing a minimum of 300mm above roof membrane. Use fasteners of sufficient length to penetrate at least 25mm into substrate.

3.4 Cap Flashing

.1 Supply and install continuous metal starter strips, secure at 600mm O.C. maximum of 50mm above drip edge, with fastener of sufficient length to penetrate a minimum of 25mm into substrate.

.2 Use concealed fastenings except where approved by Consultant.

.3 Secure sections of metal in S-lock joints, and allow for sufficient expansion and contraction between each piece.

.4 Form cap flashings to profiles as shown on the detail drawings. Ensure positive drainage to the interior (roof surface) areas.

3.5 Clean Up

.1 Finished sheet metal flashing work shall be clean and left in neat, workmanlike condition. Adjoining materials shall be properly cleaned of soil caused by this trade.

.2 Remove and discard all sheet metal scraps and fasteners not required to complete the work. Remove and replace all sheet metal sections that received surface damage or scratches during fabrication, delivery or installation

Part 4 **EXECUTION**

4.1 Execution

.1 Form sheet metal on a bending brake.

.2 Provide flush type expansion joints at the maximum of 2400 mm (8'-0").

.3 Back paint metal that comes in contact with other materials.

.4 Fasten all exposed metal with non-corrosive screws c/w neoprene washers under the heads.

.5 Caulk all joints indicated and all that are necessary to render installation watertight. Caulk around services at walls.

.6 Extend ducts indicated on drawings with metal and gauge to match existing.

.7 All metal flashings, reglets and parapets to be level and parallel with building lines.

END OF SECTION

Part 1 GENERAL

1.1 General

.1 One manufacturer's product only to be used throughout.

.2 Sealant must be approved by Departmental Representative as acceptable product.

.3 Exclude the following other sections of specifications;

.1 07 62 00 – Flashing and Sheet Metal,

.4 Colours of all sealants to be selected by the Departmental Representative prior to proceeding.

Part 2 PRODUCTS

2.1 Materials

.1 Multi-purpose sealant: Silicone,"Dow Corning #732" or equivalent approved by Departmental Representative.

.2 Exterior Insulated Finish System (EIFS) sealant: Silicone, "Dow Corning #795" or equivalent approved by Departmental Representative.

.3 Filler of backing material: white non-absorbent, closed cell foam polyethylene. Material 30-50% wider than joint width to receive same.

.4 Primers: sealant manufacturer's type.

.5 Cleaners: as recommended by sealant manufacturers.

Part 3 EXECUTION

3.1 Preparation

.1 Ensure all materials which will bear sealant on their surfaces are clean and free from foreign material which would affect bonding.

.2 Permit concrete and mortar to cure fully before sealing.

.3 Use bond breaking backing: to prevent sealant bonding to joint bottom.

.4 Prime joint sides in accordance with manufacturer's directions.

.5 Mask adjacent surfaces to prevent contamination by sealant. Remove mask immediately after joints completed.

3.2 Application

.1 Employ a professional applicator to run continuous non varying width and depth beads of sealant on joints.

.2 Apply sealant as per manufacturer's recommendations.

.3 Do not apply sealant when surrounding air temperature air is below 5°C.

.4 Immediately clean surplus compound from adjacent surfaces.

END OF SECTION

Part 1 GENERAL

1.1 Reference Standards

.1 Installation: to ASTM C636-92 except where specified otherwise.

.2 The work of this section, and related work specified in other sections shall comply with all requirements of Division 1.

1.2 Design Criteria

.1 Maximum deflection: 1/360th of span to ASTM C635-83 deflection test.

.2 Ceiling system to show basic construction and assembly, treatment at walls, recessed fixtures, splicing, interlocking, finishes, acoustical unit installation.

1.3 Section Includes

.1 Provision of all labour, materials, equipment and incidental services necessary to provide acoustic tile ceiling systems including:

.1 Acoustic ceiling tiles
.2 Suspension grid systems
.3 Hangers and inserts
.4 Accessories for system

1.4 Samples

.1 Submit one representative sample of ceiling tile in accordance with Section 00 10 00.

1.5 Closeout Submittals

.1 Provide twelve (12) ceiling tiles for each pattern and type on project. Extra materials shall be from same production run as installed materials, in unopened packages.

Part 2 PRODUCTS

2.1 Materials

.1 Intermediate duty suspension system to ASTM C635-91.

.2 Basic materials for suspension system: commercial quality cold rolled steel, conforming to ASTM A525-91b and ASTM A526/A526M-90, zinc coated to Z275.

.3

.4 Suspension system: non fire rated, made up as follows:

.1 Two directional exposed tee bar grid.

.5 Exposed tee bar grid components: shop painted satin sheen white. Components die cut. Main tee with double web, rectangular bulb and 25 mm (1") rolled cap on exposed face. Cross tee with rectangular bulb; web extended to form positive interlock with main tee webs: lower flange extended and offset to provide flush intersection.

.6 Hanger wire: galvanized soft annealed steel 3.0 mm (1/8") dia. (12 gauge).

.7 Hangers: self-drilling type anchors similar to Phillips "Red Head" T-32.

.8 Carrying channels: 38 x 25 mm (1-1/2" x 1") channel, of 1.2 mm thick galvanized steel.

.9 Ceiling tiles: to CAN/CGSB-92.1; 5/8” thick, 2’-0” x 2’-0” non-combustible mineral fibre lay-in panels, square edge, colour white, Armstrong KITCHEN ZONE (NO.672 FLAT WHITE).

.10 Accessories: splices, clips, wire ties, retainers and wall moulding, flush, to complement suspension system components, as recommended by system manufacturer.

Part 3 EXECUTION

3.1 Installation

.1 Install suspension system to manufacturer's instruction.

.2 Secure hangers to overhead structure using attachment methods acceptable to engineer. Install hangers spaced at maximum 1200 mm (4'-0") centres and within 150 mm (6") from ends of main tees.

.3 Do not erect ceiling suspension system until work above ceiling has been inspected by Designated Representative.

.4 Lay out system according to reflected ceiling plan.

.5 Suspension system and ceiling components to be installed continuous over walls of demountable office partitions. Coordinate installation to allow for installation of acoustic insulation over demountable wall locations.

.6 Ensure suspension system is co-ordinated with location of related components.

.7 Install wall mould to provide correct ceiling height. Finished ceiling system to be level within 1:1000.

.8 Completed suspension system to support superimposed loads, such as lighting fixtures, diffusers and grilles, etc.

.9 Support light fixtures, diffusers, with additional ceiling suspension hangers within 150 mm (6") of each corner and at 600 mm (2'-0") around perimeter of fixture, also install at splices.

.10 Interlock cross member to main runner to provide rigid assembly.

.11 Frame at openings for light fixtures, air diffusers, speakers and at changes in ceiling heights.

.12 Install ceiling tiles in correct seated position within suspended grid system.

3.2 Coordination

.1 Coordinate ceiling work to accommodate components of other sections, including light fixtures, diffusers, speakers, sprinkler heads, exposed mechanical and electrical installations, to be built into or above acoustical ceiling components.

3.3 Cleaning

.1 Touch up scratches, abrasions, voids and other defects in painted surfaces to the satisfaction of the Departmental Representative.

END OF SECTION

Part 1 GENERAL

1.1 Samples

.1 Deliver on the NRC Departmental Representative's request for approval, samples of materials proposed for use in the work. Make up samples 100mm wide by 300mm long (4" x 1'-0"). Finished work shall be equal to approved samples.

1.2 Qualifications

.1 Work shall be carried out by skilled labour under the supervision of a responsible and experienced foreman.

.2 Equipment shall be clean and in optimum working condition.

1.3 Protection

.1 Provide protective barriers and signs to protect the work and the public from contact with paint not yet dry.

.2 Protect surfaces likely to attract dust and insects thus liable to mar the finished surface.

.3 Have hardware, electrical and mechanical fittings removed and replaced by appropriate trades, else protect the above and other adjacent work.

1.4 Reference Standards

.1 Do painting and finishing to CGSB 85-GP series standards and to material manufacturer's instructions, except where specified otherwise.

.2 Stucco and Brick: Comply with CGSB 85-GP-31M.

.3 Concrete Floors: Comply with CGSB 85-GP-32M.

.4 Ferrous Metal: Comply with CGSB 81-GP-10M, 11a, 12, 13 or 15 as applicable.

.5 Galvanized Steel: 85-GP-16M.

.6 Copper & Copper Alloys: 85-GP-20M.

.7 Interior Plaster and Wallboard: 85-GP-33M.

.8 Exterior Unpainted Wood: 85-GP-1M.

.9 Exterior Wood Previously Painted: 85-GP-2M.

1.5 WARNING

.1 DO NOT USE SPRAY EQUIPMENT: Only paint brush and roller will be accepted on this project.

Part 2 PRODUCTS

2.1 Materials

.1 Paint Materials: to CGSB Standards listed in Finishing Formula.

.2 Paint materials for each coating formula to be product of a single manufacturer.

2.2 Finishing Formula

.1 Apply number of coats of specified materials to designated surfaces as follows:

.2 Interior Finishes:

.1 Plaster and Gypsum Board Ceiling Apply:
- .1 one coat primer-sealer CAN/CGSB-1.119-M89.
- .2 two coats flat latex paint CAN/CGSB-100M.

.2 Plaster and Gypsum Board Walls Apply:
- .1 one coat primer-sealer CAN/CGSB-1.119-M89.
- .2 two coats semi-gloss enamel CAN/CGSB-1.57-M90.

.3 Wood Apply:
- .1 one coat enamel undercoat CAN/CGSB-1.38-M91.
- .2 two coats semi-gloss enamel CAN/CGSB-1.57-M90.

.4 Natural or Stained Woodwork apply:
- .1 one coat paste-filler
- .2 one coat pigmented stain CAN/CGSB-1.145-M90, Type II.
- .3 one coat varnish gloss CAN/CGSB-1.36-M90, Type II.
- .4 one coat varnish satin CAN/CGSB-1.36-M90, Type II.

.5 Cupboard and Drawer Interiors apply:
- .1 two coats varnish gloss CAN/CGSB-1.36-M90, Type II; cut 1st coat 25% with thinner CAN/CGSB-1.4-92.

2.3 Exterior Finishes:

.1 Primed Ferrous Metal Surfaces apply:

.1 one coat spot priming CAN/CGSB-1.40-M89.
.2 one coat lead primer CAN/CGSB-1.40-M89.
.3 two coats exterior enamel CAN/CGSB-1.59-M89.

.2 Galvanized and Zinc Coated Metal apply:

.1 one coat vinyl wash primer CAN/CGSB-1.121-93.
.2 one coat steel primer CAN/CGSB-1.40-M89.
.3 two coats exterior enamel CAN/CGSB-1.59-M89.

.3 Masonry, Concrete and Cement Plaster Surfaces apply:

.1 two coats exterior masonry coating.

.4 Stained Wood Door apply:

.1 one coat clear sealer CAN/CGSB-1.102-M89.
.2 two coats pigmented stain CAN/CGSB-1.145-M90, Type 1.

.5 Polyurethane Finish on Wood Surfaces apply:

.1 two coats polyurethane, resistant to yellowing CAN/CGSB-1.177-M91.
two coats polyurethane two package 1-GP-180MA Type [].

.6 Mechanical and Electrical Equipment:

.1 Un-insulated: Brush on one prime coat CAN/CGSB-1.40-M89 and as required to match adjacent wall or ceiling surfaces.
.2 Insulated: Apply one coat glue size and paint using CAN/CGSB-1.38-M91 as a primer. Finish to match adjacent surfaces.
.3 High Temperature: Apply two coats CAN/CGSB-1.143-M90.

Part 3 EXECUTION

3.1 Examination of Surfaces

.1 Examine the work to be finished to determine whether the surfaces are in proper condition to receive paint work.

3.2 Preparation of Surfaces

.1 General:

.1 Patch defective shop prime coats. Ensure that surfaces to be painted are smooth, level, dry, free from dust and any matter liable to interfere with adhesion of paint, cause bleeding or staining.
.2 Set all nails and screws below surface and putty flush.

.2 Substrates: Whenever substrates required repairs not covered by this specification, suspend work on the affected portion and advise the Departmental Representative. Paint repairs at completion as part of the original work.

.3 Glazing: Remove perished putty and defective stops and reset the glass, prime rabbets, replace broken glass, and reputty.

.4 Wood (Paint finish):

.1 Seal all knots and pitch streaks with CAN/CGSB-1.126-M91 if not previously painted. Comply with CAN/CGSB-85-GP-1M for exterior work, CAN/CGSB-85-GP-2M for repair work. Resecure loose items. Restore surfaces to their original shape by filling, before and after priming.

.2 .2 Sand all woodwork lightly between all coats, clean and dust.

.5 .5 Wood (varnish, lacquer, natural finishes):

.1 New Surfaces: Bleach out dark staining and restain to the general tint with non-grain-raising stains.

.2 Previously Coated Surfaces: Remove waxes, oils and other previous coatings with steel wool steeped in appropriate solvent then proceed as for new surfaces.

.6 Concrete (for other than latex paint):

.1 Bare. If smooth etch with 10% muriatic acid and after not more than 10 minutes rinse with clear water, mop and dry. If powdery, sweep and seal with CAN/CGSB-1.142-M89.

.2 Painted. If the specified new coating is incompatible with the existing or if old paint is loose, remove all paint.

.7 Plaster: To be bone-dry, all patching and replacing complete before first coat of paint or sizing is applied. Sand smooth all roughness before any application of paint.

.8 Ferrous Metal: Remove dirt and grease with Benzene. Remove rust and defective paint down to bare metal and touch up with red lead. Paint ferrous metals immediately upon delivery on site.

.9 Sheet Metal: Treat galvanized sheet metal with a wash of phosphate conditioner prior to priming or a special coat of primer for that purpose. CGSB 31-GP-107MA.

.10 Metal:

.1 Unpainted: Clean down to good metal. Use appropriate metal filler to restore the original surface. Coat with CAN/CGSB-1.121-93.

.2 Painted: Clean paint by washing. Treat bare spots as above.

3.3 Application

.1 Varnish: Apply by brush only.

.2 Remove all paint liable to show or bleed through new finish. Prime uncoated surfaces only.

.3 Apply two finish coats to all previously finished or primed work.

.4 Give the Departmental Representative due notice and ample opportunity to inspect each coat and do not proceed with any coat until the last preceding coat is approved. Each coat shall be a different tint, under white a light blue.

.5 Apply no finish nor paint to wet, frozen or rusty surfaces.

.6 Clean castings with wire brushes.

.7 Do not paint at temperatures under 10°C (50°F) or over 35°C (95°F) (lacquer not lower than 15°C (59°F)) nor on surfaces where condensation is likely to form.

.8 Give additional coats to work which is unsatisfactory to the Departmental Representative after the application of the specified number of coats without extra compensation. Touch up dead or dull spots.

.9 Brush paint wood and metal surfaces. Other surfaces may be roller painted. Do not use rollers on uneven surfaces.

.10 Mix materials thoroughly, apply evenly, in full coats and free from sags, runs, crawls and other defects. Cut in neatly where required.

.11 Let each coat dry perfectly and hard before a following coat is applied.

.12 Finish ledges and surfaces above sight lines; tops, bottoms and edges of doors to match faces.

.13 Even up stained woodwork in colour as required by the nature of the wood.

.14 Apply all ready-mixed paint, lacquer, varnish or other finishes without cutting or admixture of any kind.

.15 Colour filler, if required. Work well into grain of wood, and before it sets, wipe clean.

.16 Do not apply exterior painting during rainy, foggy or humid weather.

.17 Apply material in accordance with the directions and instruction of their manufacturers.

.18 Doors, windows: and other shop made items, shop prime. Seal and paint the bottoms and edges of all doors before hanging.

.19 Allow a minimum of 24 hours between coats for oil based paints and 8 hours between coats of water based paints.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

.1 For purposes of mechanical sections, the following definitions shall apply:

.1 "Concealed" – mechanical services and equipment is suspended ceilings and in chases and furred spaces.

.2 "Exposed" – will mean not concealed as defined above.

1.2 EXAMIMATION OF THE SITE

.1 Carefully examine conditions at the site which will or may affect your work, and become familiar with both the new and existing construction, finishes, and other work associated with your work in order that your tender price includes for everything necessary for completion of your work within the proposed project schedule.

1.3 COORDINATION & COOPERATION WITH OTHER TRADES

.1 Co-ordinate your work with the work of all trades to ensure a proper and complete installation. Notify all trades concerned of the requirement for openings, sleeves, inserts and other hardware necessary in their work for the installation of your work.

.2 The exact locations and routing of mechanical and electrical services must be properly planned, coordinated and established with all affected trades prior to installation such that they will clear each other as well as any obstructions. Generally, piping requiring uniform pitch shall be given the right of way, with other services located and arranged to suit.

1.4 PERMITS, CERTIFICATIES & FEES

.1 Display all required permits on worksite.

.2 Obtain "Hot Work Permit" from Departmental Representative prior to commencement of soldering, welding or other high temperature work.

1.5 FEDERAL HALOCARBON REGULATION

.1 Generate halocarbon records for work on equipment (cooling equipment with CFC's, HCFC's and HRC refrigerants; fire suppression systems; solvent cleaning systems) that may result in the release of a halocarbon.

.2 Tag equipment with duplicate of halocarbon record.

.3 Provide additional copy of halocarbon record to the Departmental Representative for inclusion in Zone Halocarbon Service File.

1.6 SUBMITTALS

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

.2 Shop drawings; submit stamped and signed shop drawings.

.3 Shop drawings to show:

.1 Mounting arrangements.

.2 Operating and maintenance clearances.

.4 Shop drawings and product data accompanied by:

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

.2 Acoustical sound power data, where applicable.

.3 Points of operation on performance curves.

.4 Manufacturer to certify current model production.

.5 Certification of compliance to applicable codes.

.5 Closeout Submittals:

.1 Provide operation and maintenance data for incorporation into manual specified in Section 00 10 00 - General Instructions.

.2 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.

.3 Operation data to include:

.1 Control schematics for systems including environmental controls.

.2 Description of systems and their controls.

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

.4 Operation instruction for systems and component.

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

.6 Valves schedule and flow diagram.

.7 Colour coding chart.

.4 Maintenance data to include:

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

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

.5 Performance data to include:

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

.2 Equipment performance verification test results.

.3 Special performance data as specified.

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

.6 Approvals:

.1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.

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

.7 Additional data:

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

.8 Site records:

.1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

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

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection.

.9 As-built drawings:

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

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

1.7 MAINTENANCE

.1 Furnish spare parts in accordance with Section 00 10 00 - General Instructions as follows:

.1 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.

.2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 00 10 00 - General Instructions.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Wherever possible, coordinate equipment deliveries with the manufacturers and/or suppliers such that equipment is delivered to the site when it is required, or so that it can be suitably stored within the building and protected from the elements.

.2 Arrange for sufficient storage facilities off the premises for the storage of equipment and materials which will not be allowed to stand in the open, nor to interfere with normal operations in the building.

.3 Bring prefabricated materials on the job site as and when required to be installed.

1.9 EQUIPMENT LIST

.1 Submit list of manufacturer's name and details of materials to be used on this project within 10 days after award of contract. Do not order equipment until list has been reviewed or approved.

1.10 METRIC & IMPERIAL MEASUREMENTS

.1 Generally, both metric and imperial units of measurement are given in Sections of the Specification governed by this Section. Metric conversions are "soft" and have been rounded off.

.2 Metric and Imperial Dimensions appearing on the drawings and in the specification shall conform to the following schedule:

METRIC	IMPERIAL
6 mm	¼"
12 mm	½"
20 mm	¾"
25 mm	1"
32 mm	1-¼"
40 mm	1-½"
50 mm	2"
65 mm	2-½"
75 mm	3"
100 mm	4"
150 mm	6"
200 mm	8"
250 mm	10"

Part 2 Products

2.1 HOISTING & SCAFFOLDING

.1 Provide all necessary hoists and scaffolding required for your work.

.2 Design and construction of scaffolding to be in accordance with CSA S269.2.

Part 3 Execution

3.1 CLEANING

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

3.2 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests and submit report as described in PART 1 - SUBMITTALS.

.1 Start-up and commissioning of the new roof top unit 50PAC08.

.2 Start-up and commissioning of the new roof top unit 50PAC19.

.3 Start-up and commissioning of the new exhaust fans 50XAF134 and 50XAF135.

.4 Start-up and commissioning of the new inline exhaust fan 50XAF136.

.5 Commissioning of new BAS control for existing makeup air unit 50AHU01.

.2 Manufacturer's Field Services:

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

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

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

3.3 DEMONSTRATION

.1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

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

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

.4 Instruction duration time requirements as specified in appropriate sections.

3.4 PROTECTION

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation of Corrosive Fume Exhaust Ducts, joints and accessories.

1.2 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.2 American Society for Testing and Materials International, (ASTM).

.1 ASTM A480/A480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

.1 SMACNA HVAC Duct Construction Standards - Metal and Flexible.

.2 SMACNA HVAC Air Duct Leakage Test Manual.

1.3 SUBMITTALS

.1 Submittals: in accordance with Section 00 10 00 – General Instructions and Section 230502.

.2 Shop drawings to show:

.1 Gaskets.

.2 Dampers.

.3 All Joints.

1.4 QUALITY ASSURANCE

.1 Certification of Ratings:

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: in accordance with Section 00 10 00 – General Instructions and Section 00 15 45 – General Safety Section and Fire Instructions.

Part 2 Products

2.1 Reference

.1 Refer to the section entitled "Basic Materials and Methods" in this Division of the Specification for products which apply to Air Distribution work.

2.2 STAINLESS STEEL

.1 To ASTM A480/A480M, Prime quality Type 316.

.2 Finish: No. 4.

.3 Thickness, fabrication and reinforcement: in accordance with SMACNA standards to suit the duct configuration and classification or as indicated.

.4 Joints: to SMACNA and be continuous inert gas welded.

2.3 PVC

.1 Schedule 40 PVC duct, where shown on the drawings.

.2 Fabrication: ducts and fittings to SMACNA.

.3 Reinforcement: to SMACNA.

.4 Joints: continuous weld.

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 Round: smooth radius. Centreline radius: 1.5 times diameter.

.3 Branches:

.1 Round main and branch: enter main duct at 45 degrees with conical connection.

.2 Provide volume control damper in branch duct near connection to main duct.

.4 Transitions:

.1 Diverging: 20 degrees maximum included angle.

.2 Converging: 30 degrees maximum included angle.

.5 Offsets:

.1 Short radiused elbows.

2.6 BALANCING & SHUT-OFF DAMPERS

.1 Unless noted otherwise dampers for round st. stl. duct shall be butterfly type to suit the duct pressure class, minimum thickness 0.083" type 316 st. stl. full diameter blade, and Duro Dyne code AL-1255 regulator set with st. stl. Locking regulator, st. stl. Bearings, shaft & and shaft seals. Provide a visual indication of damper position from the duct exterior.

.2 Dampers for Isolation/Shut-Off shall provide tight seal shut-off.

2.7 IRIS BALANCING DAMPER

.1 Ruskin IRIS Balancing Damper model VFBD35

.1 Frame: 22 gauge (.759) stainless steel.

.2 Blade segments: 22 gauge (.759) stainless steel.

.3 Seal full circumference neoprene.

.4 Casing leakage 6 cfm (170 l/s) max.

.5 Air pressure taps plastic with integral plastic caps.

.6 Accuracy ±5%.

.7 Temperature range: 32°f (0°c) – 180°f (82°c) continuous 250°f (121°c) intermittent (stainless option)

.8 Stainless steel frame & blades

.9 Positive seal.

2.8 INSTRUMENT TEST

.1 [1.6] mm thick steel zinc plated after manufacture.

.2 Cam lock handles with neoprene expansion plug and handle chain.

.3 8 mm minimum inside diameter. Length to suit insulation thickness.

.4 Neoprene mounting gasket.

2.9 SUPPORTS

.1 Provide roof ducting supports equivalent to Miro Industries Inc. rooftop support products models 6-ds, 8-ds, 10-ds, and installed according to the manufacturer's recommendations. Provide 1-1/2" thick ridged Styrofoam below all base pads.

.2 Ductwork on roof must be seismically supported, designed by a structural engineer.

Part 3 Execution

3.1 GENERAL

.1 Do work in accordance with SMACNA.

.2 Support risers in accordance with SMACNA.

.3 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

3.2 FABRICATION AND INSTALLATION OF DUCTWORK

.1 Provide all required stainless steel ductwork and suitable fittings and adapters for a complete installation from the tie in points to new equipment.

.2 Unless specifically noted otherwise, all stainless steel duct, bends, elbows, transformations, branch fittings, etc. shall be fabricated, sealed and installed in accordance with the -3" water gauge (-0.75 kPa) pressure class (nonabrasive) of the latest edition of SMACNA Round Industrial Duct Construction Standards.

3.3 INSTALLATION OF BALANCING DAMPERS

.1 Provide volume type dampers in all open end ductwork and wherever else shown.

.2 Install the dampers such that the operating mechanism is positioned for easy operation, and such that the dampers cannot move or rattle:

3.4 INSTRUMENT TEST PORTS

.1 General:

.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.3 Locate to permit easy manipulation of instruments.

.4 Install insulation port extensions as required.

.5 Locations:

.1 For traverse readings:

.1 Ducted inlets to roof and wall exhausters.

.2 Inlets and outlets of other fan systems.

.3 Main and sub main ducts.

.4 And as indicated.

.2 For temperature readings:

.1 At outside air intakes.

.2 In mixed air applications in locations as approved by Departmental Representative.

.3 At inlet and outlet of coils.

.4 Downstream of junctions of two converging air streams of different temperatures.

.5 And as indicated

3.5 AIR QUANTITY BALANCING & TESTING

.1 Perform air quantity balancing and testing for the fume exhaust system.

.2 Air quantity balancing and testing of any system must not begin until the system is complete and fully operational.

.3 Testing shall be performed by a qualified independent testing and balancing company satisfactory to the Engineer, as a Sub-Contractor to you.

.4 Generally, balance and test exhaust systems as follows:

.1 Adjust new main and branch exhaust air ducts to within 8% of design.

.2 Provide Pitot tube openings with approved caps where necessary to obtain accurate flow readings.

.5 Prepare and submit to the Engineer for review, the records of the results of air quantity balancing and testing in an approved manner and format.

3.6 LEAKAGE TESTS

.1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air Systems.

.2 In accordance with SMACNA HVAC Duct Leakage Test Manual.

.3 Do leakage tests in sections.

.4 Make trial leakage tests as instructed to demonstrate workmanship.

.5 Do not install additional ductwork until trial test has been passed.

.6 Test section minimum of 30m long with not less than three branch takeoffs and two 90 degrees elbows.

.7 Complete test before performance insulation or concealment Work.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Vibration isolation materials and components, seismic control measures and their installation.

.2 Related Sections:

.1 [___].

1.2 REFERENCES

.1 National Building Code of Canada (NBC) - [1995]

1.3 SUBMITTALS

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

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

.2 Submit shop drawings in accordance with Section [00 10 00 – General Instructions] [___].

.1 Shop drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of [Ontario], Canada.

.2 Provide [separate shop drawings for each isolated system] complete with performance and product data.

.3 [Provide detailed drawings of seismic control measures for equipment and piping] [___].

.3 Quality assurance submittals: submit following in accordance with Section [00 10 00 – General Instructions].

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

.2 Instructions: submit manufacturer's installation instructions.

.3 Manufacturer's Field Reports: manufacturer's field reports specified.

1.4 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section [00 10 00 – General Instructions] [___].

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for [reuse] [and] [recycling] [___].

Part 2 Products

2.1 GENERAL

.1 Size and shape of bases type and performance of vibration isolation as indicated.

2.2 ELASTOMERIC PADS

.1 Type EP1 - neoprene waffle or ribbed; [9] [___] mm minimum thick; [50] [___] durometer; maximum loading [350] [___] kPa.

.2 Type EP2 - rubber waffle or ribbed; [9] [___] mm minimum thick; [30] [___]durometer natural rubber; maximum loading [415] [___] kPa.

.3 Type EP3 - neoprene-steel-neoprene; [9] [___] mm minimum thick neoprene bonded to [1.71] [___] mm steel plate; [50] [___] durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading [350] [___] kPa.

.4 Type EP4 - rubber-steel-rubber; [9] [___] mm minimum thick rubber bonded to [1.71] [___] mm steel plate; [30] durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading [415] [___] kPa.

2.3 ELASTOMERIC MOUNTS

.1 Type M1 - colour coded; neoprene in shear; maximum durometer of [60] [___]; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

2.4 SPRINGS

.1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.

.2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.

.3 Cadmium plate for [outdoor] [100% relative humidity] installations.

.4 Colour code springs.

2.5 SPRING MOUNT

.1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.

.2 Type M2 - stable open spring: support on bonded [6] mm minimum thick ribbed neoprene or rubber friction and acoustic pad.

.3 Type M3 - stable open spring: [6] mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.

.4 Type M4 - restrained stable open spring: supported on bonded [6] mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.

.5 Type M5 - enclosed spring mounts with snubbers for isolation up to [950] [___] kg maximum.

.6 Performance: [___] [as indicated].

2.6 HANGERS

.1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.

.2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.

.3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.

.4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.

.5 Type H4 - stable spring, elastomeric element with precompression washer and nut [with deflection indicator] [___].

.6 Performance: [___] [as indicated].

2.7 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES

.1 Acoustic barriers: between pipe and support, consisting of 25 mm minimum thick heavy duty duck and neoprene isolation material.

2.8 HORIZONTAL THRUST RESTRAINT

.1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to [9] [___] mm.

.2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

2.9 STRUCTURAL BASES

.1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2400 mm on smallest dimension, split for field welding on sizes over 2400 mm on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize

height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.

.2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.

.3 Bases to clear housekeeping pads by 25 mm minimum.

2.10 INERTIA BASE

.1 Type B3 - Full depth perimeter structural or formed channels, frames: welded in place reinforcing rods running in both directions; spring mounted, carried by gusseted height-saving brackets welded to frame; and clear housekeeping pads by 50 mm minimum.

.2 Pump bases: "T" shaped, where applicable, to provide support for elbows.

.3 Concrete: to Section [03 30 00 - Cast-in-Place Concrete] [___].

2.11 ROOF CURB ISOLATION RAILS

.1 General: complete factory assembled [without need for sub-base] [___].

.2 Lower member: continuous [rectangular steel tube] [or] [extruded aluminum channel].

.3 Upper member: continuous [rectangular steel tube] [or] [extruded aluminum channel] to provide continuous support for equipment, complete with all-directional neoprene snubber bushings [6] [___] mm thick to resist wind [and seismic] [___] forces.

.4 Springs: steel, adjustable, removable, selected for [25] [___] mm maximum static deflection plus 50% additional travel to solid, cadmium plated, sized and positioned to ensure uniform deflection.

.5 High frequency isolation: 6 mm minimum thick [continuous gasket on top and bottom of complete assembly] [or] [pads on top and bottom of each spring]. Material: closed cell neoprene.

.6 Weatherproofing: continuous flexible counterflashing to curb and providing access to springs. Material: [aluminum] [neoprene].

.7 Hardware: cadmium plated or galvanized.

2.12 SEISMIC CONTROL MEASURES

.1 General:

.1 Following systems and/or equipment to remain operational during and after earthquakes:

.1 [Roof Top Units].

.2 [Laboratory Exhaust Fans]

.3 Laboratory exhaust ductwork.

.2 Seismic control systems to work in every direction.

.3 Fasteners and attachment points to resist same maximum load as seismic restraint.

.4 Drilled or power driven anchors and fasteners not permitted.

.5 No equipment, equipment supports or mounts to fail before failure of structure.

.6 Supports of cast iron or threaded pipe not permitted.

.7 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] [and] [or] [as indicated]:

.1 Install tight to structure.

.2 Cross brace in every direction.

.3 Brace back to structure.

.4 Cable restraint system.

.3 Seismic restraints:

.1 Cushioning action gentle and steady.

.2 Never reach metal-like stiffness.

.3 Vibration isolated equipment:

.1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.

.2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.

.3 As indicated.

.4 Piping systems:

.1 Fire protection systems: to NFPA 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 [Departmental Representative] [Engineer] [Consultant] [___].

.2 Structural angles or channels.

.3 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

.6 Service and utilities entrance into building: [___].

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 [Seismic control measures to meet requirements of NBC] [___].

.2 Install vibration isolation equipment in accordance with manufacturer’s instructions and adjust mountings to level equipment.

.3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

.4 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:

.1 Up to NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and Over: first 6 points of support.

.2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.

.5 Where isolation is bolted to floor use vibration isolation rubber washers.

.6 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.

.2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:

.1 After delivery and storage of Products.

.2 After preparatory work is complete but before installation commences.

.3 Twice during the installation, at [25] % and [60] % completion stages.

.4 Upon completion of installation.

.3 Submit manufacturer's reports to [Departmental Representative] within [3] days of manufacturer representative's review.

.4 Make adjustments and corrections in accordance with written report.

.2 Inspection and Certification:

.1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC system[s] after start up and TAB of systems to Section [23 05 93 - Testing, Adjusting and Balancing for HVAC] [___].

.2 Take vibration measurements for equipment [as indicated] [listed below].

.1 [___].

.3 Provide [Departmental Representative] [Engineer] with notice [24h in advance of commencement of tests.

.4 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).

.5 Submit complete report of test results including sound curves.

.3 Verification requirements in accordance with Section [01 47 17 - Sustainable Requirements: Contractor's Verification] [___], include:

.1 Materials and resources.

.2 Storage and collection of recyclables.

.3 Construction waste management.

.4 Resource reuse.

.5 Recycled content.

.6 Local/regional materials.

.7 Certified wood.

.8 Low-emitting materials.

3.4 CLEANING

.1 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 General

.1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do all other work as specified in this section.

1.2 Qualifications of TAB Personnel

.1 Names of all personnel proposed to perform TAB to be submitted to and approved by the Departmental representative within 30 days of award of contract.

.2 Provide documentation confirming qualifications, successful experience.

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 so as to meet specified performance requirements and to achieve specified interaction with all other related systems under all 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 be 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 so as 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 Engineer adequacy of provisions for TAB and all other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to Engineer in writing all proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of all 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 Engineer for verification of TAB reports.

1.9 Start of TAB

.1 Notify the Departmental Representative 7 days prior to start of TAB.

.2 Verify the proper, normal and safe operation of all 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 All 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 Laboratory HVAC systems: plus 5%, minus 0 %.
.2 All other HVAC systems: plus 5%, minus 5 %.
.3 Hydronic systems: plus or minus 10%.

1.11 Accuracy Tolerances

.1 Measured values to be accurate to within plus or minus 2% of actual values.

1.12 Instruments

.1 Prior to TAB, submit to Engineer list of instruments to be 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 Engineer.

1.13 Submittals

.1 Submit, prior to commencement of TAB:
.1 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.14 Preliminary TAB Report

.1 Submit for checking and approval of Engineer, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
.1 Details of instruments used.
.2 Details of TAB procedures employed.
.3 Calculations procedures.
.4 Summaries.

1.15 TAB Report

.1 Format to be in accordance with referenced standard.

.2 TAB report to show all results in SI units and to include:
.1 Project record drawings.
.2 System schematics.

.3 Submit 1 electronic copy of TAB Report to Engineer for verification and approval.

1.16 Verification

.1 All reported results subject to verification by Engineer.

.2 Provide manpower and instrumentation to verify up to 30 % of all reported results.

.3 Number and location of verified results to be at discretion of Engineer.

.4 Bear costs to repeat TAB as required to satisfaction of Engineer.

1.17 Settings

.1 After TAB is completed to satisfaction of Engineer, replace drive guards, close all access doors, lock all devices in set positions, ensure sensors are at required settings.

.2 Permanently mark all settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

1.18 Completion of TAB

.1 TAB to be considered complete only when final TAB Report received and approved by Engineer.

1.19 Air Systems

.1 Standard: TAB to be to most stringent of this section or TAB standards of AABC, NEBB, SMACNA and ASHRAE.

.2 Do TAB of all systems, equipment, components, controls specified Division 23.

.3 **Qualifications: personnel performing TAB to be current member in good standing of AABC or NEBB.**

.4 Quality assurance: Perform TAB under direction of supervisor qualified by AABC or NEBB.

.5 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

.6 Locations of equipment measurements: To include, but not be limited to, following as appropriate:
.1 Inlet and outlet of each damper, filter, coil, humidifier, fan, other equipment causing changes in

conditions.
.2 At each controller, controlled device.

.7 Locations of systems measurements to include, but not be limited to, following as appropriate: Each main duct, main branch, sub-branch, run-out (or grille, register or diffuser).

PART 2 - PRODUCTS

PART 3 - EXECUTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and methods for pressure testing ducts over [5] [___] m in length, forming part of a supply, return or exhaust ductwork system directly or indirectly connected to air handling equipment.

1.2 REFERENCES

.1 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)

.1 SMACNA HVAC Air Duct Leakage Test Manual, [1985].

1.3 SUBMITTALS

.1 Make submittals in accordance with Section [00 10 00 – General Instructions].

.2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties. Include pressure test information and results as follows:

.1 Submit proposed report form and test report format to [Departmental Representative] for approval at least [one] months before proposed date of first series of tests. Do not start tests until approval received in writing from [Departmental Representative].

.2 Prepare report of results and submit to [Departmental Representative] within [24] hours of completion of tests. Include:

.1 Schematic of entire system.

.2 Schematic of section under test showing test site.

.3 Required and achieved static pressures.

.4 Orifice differential pressure at test sites.

.5 Permissible and actual leakage flow rate (L/s) for test sites.

.6 Witnessed certification of results.

.3 Include test reports in final TAB report.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

.6 Manufacturer's field reports specified.

1.4 QUALITY ASSURANCE

.1 Pre-Installation Meetings:

.1 Convene pre-installation meeting [one] week prior to beginning [work of this Section] [and] [on-site installations].

.1 Verify project requirements.

.2 Review installation [and substrate] conditions.

.3 Co-ordination with other building subtrades.

.4 Review [manufacturer's] installation instructions and warranty requirements.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section [00 10 00 – General Instructions].

Part 2 Products

2.1 TEST INSTRUMENTS

.1 Test apparatus to include:

.1 Fan capable of producing required static pressure.

.2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.

.3 Flow measuring instrument compatible with the orifice plate.

.4 Calibration curves for orifice plates used.

.5 Flexible duct for connecting to ductwork under test.

.6 Smoke bombs for visual inspections.

.2 Test apparatus: accurate to within +/- [3] % of flow rate and pressure.

.3 Submit details of test instruments to be used to [Departmental Representative] at least [one] months before anticipated start date.

.4 Test instruments: calibrated and certificate of calibration deposited with [Departmental Representative] no more than [28] days before start of tests.

.5 Re-calibrated every [six] months thereafter.

2.2 EQUIPMENT LEAKAGE TOLERANCES

.1 Equipment and system components such as VAV boxes, duct heating leakage: [___] %.

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 TEST PROCEDURES

.1 Maximum lengths of ducts to be tested consistent with capacity of test equipment.

.2 Section of duct to be tested to include:

.1 Fittings, branch ducts, tap-ins.

.3 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.

.4 Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual.

.5 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

3.3 SITE TOLERANCES

.1 System leakage tolerances specified are stated as percentage of total flow rate handled by system. Pro-rate specified system leakage tolerances. Leakage for sections of duct systems: not to exceed total allowable leakage.

.2 Leakage tests on following systems not to exceed specified leakage rates.

.1 Small duct systems up to 250 Pa: leakage [2] %.

.2 [VAV] [___] box and duct on downstream side of VAV box: leakage [2] %.

.3 Large low pressure duct systems up to 500 Pa: leakage [2] %.

.4 HP duct systems up to 1000 Pa pressure classification, including upstream side of VAV boxes: leakage [1] %.

.5 Supply and return ducts serving room 295, between room 295 and the RTU2 0%.

.6 Exhaust ductwork system on roof 1%.

.7 Exhaust branches serving room 295 including new exhaust duct inside the room 0%.

.8 Test the exhaust duct as if the duct is exposed at positive pressure equal to its negative pressure rating.

.3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

3.4 TESTING

.1 Test ducts before installation of insulation or other forms of concealment.

.2 Test after seals have cured.

.3 Test when ambient temperature will not affect effectiveness of seals, and gaskets.

.4 Flexible connections to VAV boxes.

3.5 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[s] 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 Schedule site visits, to review Work, at stages listed:

.1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.

.2 [Twice] [___] during progress of Work at [25%] [___] and [60%] [___] complete.

.3 Upon completion of the Work, after cleaning is carried out.

.4 Obtain reports, within [3] days of review, and submit, immediately, to [Departmental Representative].

.2 Performance Verification:

.1 Departmental Representative to witness tests and to verify reported results.

.2 To be certified by same TAB agency approved by [Departmental Representative] to undertake TAB on this project.

3.6 CLEANING

.1 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 REFERENCES

.1 Definitions:
- .1 For purposes of this section:
- .2 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
- .3 "EXPOSED" - means "not concealed" as previouslydefined.
- .4 Insulation systems - insulation material, fasteners, jackets, and other accessories.

.2 TIAC Codes:
- .1 CRD: Code Round Ductwork,
- .2 CRF: Code Rectangular Finish.

.2 Reference Standards:
- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- .2 ANSI/ASHRAE/IESNA 90.1-[04], SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .3 ASTM International Inc.
- .4 ASTM B 209M-[07], Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
- .5 ASTM C 449/C 449M-[00], Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
- .6 ASTM C 553-[02e1], Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- .7 ASTM C 612-[04e1], Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- .8 ASTM C 795-[03], Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- .9 ASTM C 921-[03a], Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.2 Canadian General Standards Board (CGSB)
- .1 CGSB 51-GP-52Ma-[89], Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.3 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).

.4 Underwriters Laboratories of Canada (ULC)
- .1 CAN/ULC-S102-[03], Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .2 CAN/ULC-S701-[05], Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section [00 10 00 – General Instructions].

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Samples:
.1 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed.
.2 Mount sample on 12 mm plywood board.
.3 Affix typewritten label beneath sample indicating service.

.4 Manufacturers' Instructions:
.1 Provide manufacture's written duct insulation jointing recommendations. and special handling criteria, installation sequence, cleaning procedures [and] [_____].

1.3 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, [qualified to standards] [member of TIAC].

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address [and ULC markings].

.2 Packaging Waste Management: remove for reuse [and return] [by manufacturer] of [pallets] [crates] [padding] [and] [packaging materials.

PART 2 - PRODUCTS

2.1 FIRE AND SMOKE RATING

.1 To CAN/ULC-S102:
.1 Maximum flame spread rating: [25].
.2 Maximum smoke developed rating: [50].

2.2 INSULATION

.1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C 335.

.3 TIAC Code C-1: Rigid mineral fibre board to ASTM C 612, [with] [without] factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

.4 TIAC Code C-2: Mineral fibre blanket to ASTM C 553 faced [with] [without] factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).

.1 Mineral fibre: to ASTM C 553.
.2 Jacket: to CGSB 51-GP-52Ma.
.3 Maximum "k" factor: to ASTM C 553.

2.3 JACKETS

.1 Canvas:
  .1 [220] gm/mý cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.

.2 Lagging adhesive: compatible with insulation.

.3 Aluminum:
  .1 To ASTM B 209 [with] [and][without] moisture barrier as scheduled in PART 3 of this section.
  .2 Thickness: [0.50] mm sheet.
  .3 Finish: [Smooth] [Stucco embossed] [Corrugated].
  .4 Jacket banding and mechanical seals: [12] [19] mm wide, 0.5 mm thick stainless steel.

.4 Stainless steel:
  .1 Type: [304] [316].
  .2 Thickness: [0.25] [0.50] mm sheet.
  .3 Finish: [Smooth] [Corrugated] [Stucco embossed].
  .4 Jacket banding and mechanical seals: [12] [19] mm wide, 0.5 mm thick stainless steel.

.5 VentureClad 1577CW:
.1 For insulation cladding and jacketing applications. 5-ply, self-adhesive material.
  .1 High performance jacketing product performs well over a wide temperature range; -30°F to +300°F (-34°C to +149°C) service temperature
  .2 Venture CW cold weather acrylic adhesive applies easily at temperatures as cold as -10°F (-23°C).
  .3 Zero permeability, absolute vapor barrier
  .4 High puncture and tear resistance
  .5 Tested and approved mold inhibiting agents
  .6 Self-adhesive material installs easily with no off-site fabrication required
  .7 Exceeds standard building design requirements (UL 723 10/20 Flame Spread/Smoke Rating)
  .8 Finish: Natural Aluminum Stucco Embossed (1577CW - E).

2.4 ACCESSORIES

.1 Vapour retarder lap adhesive:
  .1 Water based, fire retardant type, compatible with insulation.

.2 Indoor Vapour Retarder Finish:
  .1 Vinyl emulsion type acrylic, compatible with insulation.

.3 Insulating Cement: [hydraulic] setting on mineral wool, to ASTM C 449.

.4 ULC Listed Canvas Jacket:

.1 [220] gm/mý cotton, plain weave, [treated with dilute fire retardant lagging adhesive to ASTM C 921] [untreated].

.5 Outdoor Vapour Retarder Mastic:
.1 Vinyl emulsion type acrylic, compatible with insulation.
.2 Reinforcing fabric: Fibrous glass, untreated 305 g/mý.

.6 Tape: self-adhesive, aluminum, [plain] [reinforced], [50] [75] mm wide minimum.

.7 Contact adhesive: quick-setting

.8 Canvas adhesive: washable.

.9 Tie wire: [1.5] mm stainless steel.

.10 Banding: [12] [19] mm wide, [0.5] mm thick stainless steel.

.11 Facing: [25] mm [stainless] [galvanized] steel hexagonal wire mesh stitched on [[one face] [both faces] of insulation] [one face of insulation with expanded metal lath on other face].

.12 Fasteners: [2] [4] mm diameter pins with[35] mm [diameter] [square] clips, length to suit thickness of insulation.

PART 3 - EXECUTION

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PRE-INSTALLATION REQUIREMENTS

.1 Pressure test ductwork systems complete, witness and certify.

.2 Ensure surfaces are clean, dry, free from foreign material.

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturers instructions and as indicated.

.3 Use [2] layers with staggered joints when required nominal thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
.1 Ensure hangers, and supports are outside vapour retarder jacket.
.2 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.5 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum [2] rows each side.

3.4 DUCTWORK INSULATION SCHEDULE

.1 Insulation types and thicknesses: conform to following table:

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular cold and dual temperature supply air ducts	[C-1]	[yes]	[50]
Round cold supply air ducts	[C-2]	[yes]	[50]
Rectangular warm air ducts	[C-1]	[no]	[25]
Mixing plenums	[C-1]	[yes]	[25]
Exhaust duct between dampers and louvres	[C-1]	[no]	[25]
Rectangular ducts outside	[C-1]	[special]	[50]
Round ducts outside	[C-1]	[special]	[50]

.2 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:

.1 Use TIAC code C-1 insulation, scored to suit diameter of duct.

.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
Outdoor,	CRF/3	CRD/4

exposed to precipitation		
Outdoor, elsewhere	CRF/4	CRD/5

3.5 CLEANING

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

.2 Waste Management: separate waste materials for [reuse] [and] [recycling].

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation of low-pressure metallic ductwork, joints and accessories.

1.2 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.2 American Society for Testing and Materials International, (ASTM).

.1 ASTM A480/A480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.

.2 ASTM A635/A635M, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.

.3 ASTM A653/A653M], 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, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.2 NFPA 90B, 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.

.2 SMACNA HVAC Air Duct Leakage Test Manual.

.3 IAQ Guideline for Occupied Buildings Under Construction.

1.3 SUBMITTALS

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

.2 Shop drawings to show:

.1 Sealants.

.2 Tape.

.3 All Joints.

1.4 QUALITY ASSURANCE

.1 Certification of Ratings:

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: in accordance with Section 00 10 00 – General Instructions and Section 00 15 45 – General Safety Section and Fire Instructions.

Part 2 Products

2.1 SEAL CLASSIFICATION

.1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	C
250	C
125	C

.2 Seal classification:

.1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

.2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant tape or combination thereof.

.3 Class C: transverse joints and connections made air tight with gaskets, sealant tape or combination thereof. Longitudinal seams unsealed.

.4 Unsealed seams and joints.

2.2 SEALANT

.1 Sealant: oil resistant, 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.

.1 Apply on all longitudinal seams.

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: Centerline 1.5 times width of ductwork

.2 Round: smooth radius. Centreline radius: 1.5 times diameter.

.3 Mitred elbows, rectangular:

.1 To 400mm: with single thickness turning vanes.

.2 Over 400mm: with double thickness turning vanes.

.4 Branches:

.1 Rectangular main and branch: with [radius on branch 1.5 times width of duct or 45 degrees entry on branch.

.2 Round main and branch: enter main duct at 45 degrees with conical connection.

.3 Provide volume control damper in branch duct near connection to main duct.

.4 Main duct branches: with splitter damper.

.5 Transitions:

.1 Diverging: 20 degrees maximum included angle.

.2 Converging: 30 degrees maximum included angle.

.6 Offsets:

.1 Short radiused elbows.

.7 Obstruction deflectors: maintain full cross-sectional area.

.1 Maximum included angles as indicated.

2.6 FIRE STOPPING

.1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 – Firestopping.

.2 Fire stopping material and installation must not distort duct.

2.7 GALVANIZED STEEL

.1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.

.2 Thickness, fabrication and reinforcement: to SMACNA.

.3 Joints: to SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

2.8 STAINLESS STEEL

.1 To ASTM A480/A480M, Type 304.

.2 Finish: No. 4.

.3 Thickness, fabrication and reinforcement: to SMACNA or as indicated.

.4 Joints: to SMACNA and be continuous inert gas welded.

2.9 ALUMINUM

.1 To SMACNA. Aluminum type: 3003-H-14.

.2 Thickness, fabrication and reinforcement: to SMACNA or as indicated.

.3 Joints: to SMACNA and be continuous weld.

2.10 BLACK STEEL

.1 To ASTM A635/A635M.

.2 Thickness: 1.2 mm or as indicated.

.3 Fabrication: ducts and fittings to SMACNA.

.4 Reinforcement: to SMACNA.

.5 Joints: continuous weld.

2.11 HANGERS AND SUPPORTS

.1 Hangers and Supports: Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 500mm.

.2 Hanger configuration: SMACNA.

.3 Hangers: galvanized steel angle with galvanized steel rods to SMACNA per 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

.4 Upper hanger attachments:

.1 For concrete: manufactured concrete inserts.

.2 For steel joist: manufactured joist clamp steel plate washer.

.3 For steel beams: manufactured beam clamps:

Part 3 Execution

3.1 GENERAL

.1 Do work in accordance with NFPA 90A, NFPA 90B, SMACNA.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.

.1 Insulate strap hangers 100 mm beyond insulated duct and insulate strap hangers 100MM beyond insulated ductwork.

.3 Support risers in accordance with SMACNA..

.4 Install breakaway joints in ductwork on sides of fire separation.

.5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

.6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

3.2 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, as follows:

Duct Size (mm)	Spacing (mm)
to 1500	3000
1501 and over	2500

3.3 WATERTIGHT DUCT

.1 Provide watertight duct for:

.1 Fresh air intake.

.2 Minimum 3000 mm from duct mounted humidifier in all directions.

.3 As indicated.

.2 Form bottom of horizontal duct without longitudinal seams.

.1 Weld joints of bottom and side sheets.

.2 Seal other joints with duct sealer.

.3 Slope horizontal branch ductwork down towards fume hoods served.

.1 Slope header ducts down toward risers.

.4 Fit base of riser with 150mm deep drain sump and 32 mm drain connected, with deep seal trap and valve and discharging to open funnel drain or as indicated else were

3.4 SEALING AND TAPING

.1 Apply sealant to outside of joint to manufacturer's recommendations.

.2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturers recommendations.

3.5 LEAKAGE TESTS

.1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air Systems.

.2 In accordance with SMACNA HVAC Duct Leakage Test Manual.

.3 Do leakage tests in sections.

.4 Make trial leakage tests as instructed to demonstrate workmanship.

.5 Do not install additional ductwork until trial test has been passed.

.6 Test section minimum of 30m long with not less than three branch takeoffs and two 90 degrees elbows.

.7 Complete test before performance insulation or concealment Work.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for duct accessories including flexible connections, access doors, vanes and collars.

1.2 REFERENCES

.1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

.1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, [95].

1.3 SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:

.1 Flexible connections.

.2 Flexible ductwork.

.3 Balancing dampers.

.4 Duct access doors.

.5 Instrument test ports.

.3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

.6 Manufacturer's Field Reports: manufacturer's field reports specified.

.7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section [00 10 00 – General Instructions].

1.4 QUALITY ASSURANCE

.1 Pre-Installation Meetings:

.1 Convene pre-installation meeting [one] week prior to beginning [work of this Section] [and] [on-site installations].

.1 Verify project requirements.

.2 Review installation [and substrate] conditions.

.3 Co-ordination with other building sub-trades.

.4 Review manufacturer's installation instructions and warranty requirements.

.2 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section [00 10 00. - General Instructions].

1.5 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

.1 The contractor is responsibility to coordinate and dispose of all waste material to local provincial and municipality requirements. Refer to section [00 10 00 – General Instructions].

.2 It is the full responsibility of the contractor to insure that all construction material, equipment, tools, etc. are stored and used in a safe and reasonable manor as per good industry standards.

.3 The contractor is responsible for all damaged and stolen material, tools or equipment on site.

.4 The contractor is responsible for all delivery of material, tools or equipment

Part 2 Products

2.1 GENERAL

.1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 STEEL DUCTWORK

.1 Prime quality galvanized sheet steel with metal gauges in accordance with SMACNA standards to suit the duct configuration and classification.

2.3 FLEXIBLE DUCTWORK - UNINSULATED

.1 Flexmaster Triple Lock, U.L.C. listed, fire and smoke-proof, spiral wound aluminum ductwork mechanically corrugated and meeting NFPA 90A requirements.

.2 Acceptable manufacturers are Flexmaster Ltd., Trans Continental Equipment Ltd., "Al-U-Flex", and Alpha Sheet Metal Co.

2.4 FLEXIBLE DUCTWORK – INSULATED

.1 Flexmaster Triple Lock Type V U.L.C. listed flexible ductwork c/w a core of standard triple lock metal flexible ducting, factory supplied glass or mineral wool insulating blanket and an outer jacket of flexible PVC sheet.

.2 Acceptable manufacturers are Flexmaster Ltd., Trans Continental Equipment Ltd., "Al-U-Flex", and Alpha Sheet Metal Co.

2.5 FLEXIBLE CONNECTIONS

.1 Frame: galvanized sheet metal frame [___] mm thick with fabric clenched by means of double locked seams.

.2 Material:

.1 Fire resistant, self extinguishing, neoprene coated glass fabric, airtight and moisture proof material, temperature rated at minus [40] degrees C to plus [90] degrees C, density of [1.3] kg/m^2.

.3 Acceptable manufacturers are Duro-Dyne Ltd., "Durolon" as above, Ventfabrics "Ventglas" and Elgen Engineering Ltd. "Neoprene".

2.6 FIRE DAMPERS

.1 Not used.

2.7 ROUND TO RECTANGULAR DUCT CONNECTIONS

.1 Nailor-Hart Industries Inc. "Spin-In" galvanized steel round to rectangular duct take-off connection collars, Model #1801 where dampers are not required, Model #1802 with integral damper where dampers are required.

.2 Acceptable manufacturers are Nailor-Hart Industries Inc., Controlled Air Manufacturing and Flexmaster Canada Ltd.

2.8 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.

2.9 SPLITTER DAMPERS

.1 Not used.

2.10 BALANCING DAMPERS

.1 Nailor-Hart Industries Inc. opposed blade galvanized steel control damper, Model No. 1020 for rectangular ductwork, Model No. 1021 for round ductwork, each complete with No. 16 U.S.S. gauge frame, No. 18 U.S.S. gauge blades, nylon blade shaft bearings, linkage shaft extension, and a suitable and secure damper operator with locking device and visual indication of damper position from the duct exterior.

.2 Acceptable manufacturers are Nailor-Hart Industries Inc., Controlled Air Manufacturing Ltd., Ruskin Ltd., and Air Specialties Manufacturing Ltd.

2.11 BACK DRAFT DAMPERS

.1 Not used.

2.12 TURNING VANES

.1 Factory or shop fabricated [double thickness] [[with] trailing edge], to recommendations of SMACNA and as indicated.

2.13 DUCT ACCESS DOORS

.1 **General:**

.1 Non-insulated sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.7 mm thick (No. 24 gauge) complete with sheet metal angle frame.

.2 Insulated sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.7 mm thick No. 24 gauge) complete with sheet metal angle frame and 25mm (1") thick rigid glass fibre insulation.

.2 Gaskets: neoprene or foam rubber.

.3 **Hardware:**

.1 Up to 300 x 300 mm (12" x 12"): 2 sash locks.

.2 301 to 450 mm (12" x 18"): 4 sash locks [complete with safety chain].

.3 451 to 1000 mm (18" x 40"): piano hinge and minimum 2 sash locks [complete with safety chain].

.4 Doors over 1000 mm (40"): piano hinge and 2 handles operable from both sides.

.5 [[300 x 300] mm glass viewing panels].

2.14 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.

2.15 SECURITY SCREEN

.1 Heavy gauge galvanized steel or aluminum mesh, 12mm x 12mm (1/2" x 1/2"), sized as indicated on the drawings.

2.16 BIRD SCREEN

.1 Heavy gauge galvanized steel or aluminum mesh 12 mm x 12 mm (1/2" x 1/2") sized as indicated on the drawings.

2.17 ACOUSTIC DUCT LINER

.1 **General:**

.1 Fibrous glass duct liner 25 mm (1") thick: air side coated with black neoprene.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50.

.3 Fibrous glass rigid board for rectangular surfaces, fibrous glass blanket for round surfaces.

.2 **Fasteners:**

.1 Duro-Dyne clip pins for installation through the insulation, length to suit the insulation thickness.

.3 Acceptable manufacturers of acoustic duct liner are Fiberglass Canada Ltd., Manville Canada Inc. and Atlas Asbestos Co. Ltd.

2.18 GRILLES, REGISTERS & DIFFUSERS

.1 Grilles, registers and diffusers of the type, size and arrangement as specified on the drawings.

.2 Grilles, registers and diffusers shall be product of one manufacturer.

.3 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

.4 Acceptable manufacturers are E.H. Price Ltd., Titus Ltd., Air Vector Ltd., Nailor Industries Inc., Krueger Manufacturing Co. and Carnes.

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 data sheet.

3.2 INSTALLATION

.1 DUCT, DAMPER & SIMILAR FORMED OPENINGS

.1 Duct openings, air inlet and outlet openings, fire damper openings, etc. will be provided in poured concrete work, masonry, drywall surfaces, etc., by the trade responsible for the particular construction in which the opening is required.

.2 Ensure that openings for fire dampers to 350 mm (14") high are sized to suit the damper arrangement with folding blade out of the air stream.

.2 FABRICATION & INSTALLATION OF STEEL DUCTWORK

.1 Provide all required steel ductwork. Unless otherwise noted, all ductwork shall be constructed of galvanized steel.

.2 Unless specifically noted otherwise, all duct, bends, elbows, transformations, branch fittings, etc. shall be fabricated, sealed and installed in accordance with the 1" water gauge (0.25 kPa) pressure class of the latest edition of SMACNA Hvac Duct Construction Standards, except for duct upstream of VAV boxes, which shall comply with the requirements of the 2" water gauge (0.50 kPa) pressure class.

.3 Install automatic control dampers and similar duct mounted control components supplied as part of the work specified in Section ( ).

.3 FLEXIBLE DUCTWORK

.1 Install flexible ductwork where indicated.

.2 At connections between sheet metal ducts and flexible ducts, provide galvanized steel round to rectangular duct connections as specified hereinbefore.

.3 Install flexible ducts as straight as possible, secure at each end with steel gear type clamps, and seal joints. Where bends are required, they shall be long radius.

.4 Maximum length of flexible duct to be 1.5m (5').

.4 FLEXIBLE CONNECTIONS

.1 Provide flexible connection 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: [150] mm (6”).

.3 Install in accordance with recommendations of SMACNA.

.4 Minimum distance between metal parts when system in operation: [75] mm (3”).

.5 When fan is running:

.1 Ducting on sides of flexible connection to be in alignment.

.2 Ensure slack material in flexible connection.

.5 FIRE DAMPERS

.1 Not used.

.6 SPLITTER DAMPERS

Not used.

.7 BALANCING DAMPERS

.1 Provide volume type dampers in all open end ductwork and wherever else shown.

.2 Install the dampers such that the operating mechanism is positioned for easy operation, and such that the dampers cannot move or rattle.

.8 BACK-DRAFT DAMPERS

.1 Not used.

.9 TURNING VANES

.1 Install in accordance with recommendations of SMACNA and as indicated.

.10 DUCT ACCESS DOORS

.1 Provide access doors in ductwork for access to all duct system components which will or may need maintenance and/or repair.

.2 Size:

.1 [___] x [___] mm for person size entry.

.2 [___] x [___] mm for servicing entry.

.3 [___] x [___] mm for viewing.

.4 As indicated.

.3 Locations:

.1 Fire and smoke dampers.

.2 Control dampers.

.3 Devices requiring maintenance.

.4 Required by code.

.5 Reheat coils.

.6 Elsewhere as indicated.

.4 Identify access doors provided for fusible link fire damper maintenance as such.

.5 Access doors in insulated ductwork shall be sandwich construction type with insulation between the inner and outer panels.

.11 SECURITY SCREEN

.1 Provide security screens where indicated on the drawings.

.12 BIRD SCREEN

.1 Provide galvanized steel or aluminum bird screen over air intake and exhaust air openings in walls where indicated.

.13 ACOUSTIC DUCT LINER

.1 Provide acoustic lining for interior surfaces of ducts where indicated.

.2 Fasten lining to interior sheet metal surfaces with 100% coverage of adhesive.

.3 Install weld pins at 400 mm (16") centres on top and side surfaces and seal all joints, exposed edges, weld pin and clip penetrations and all damaged areas of liners. Cover lining joints with tape secured with 2 coats of sealer.

.4 During installation, take particular care to ensure that the lining coating is not damaged and that exposed lining edges are protected properly such that the lining does not erode when subjected to the velocity in the particular system. Badly damaged areas of lining to be replaced at discretion of the Engineer.

.5 Increase the size of all lined ducts such that interior duct dimensions with lining in place are the dimensions shown and/or specified on the drawings.

.6 Where turning vanes, dampers, etc., occur in lined duct, they must be installed in a manner such that the liner surface is not damaged, the damper operation is not restricted, and friction loss within the duct is not increased.

.14 GRILLES, REGISTERS & DIFFUSERS

.1 Provide grilles and diffusers of the type, size and arrangement specified and shown on the drawings.

.2 Exactly locate grilles and diffusers to conform to the final architectural reflected ceiling plans and detailed wall elevations, and to conform to the final lighting, ceiling layout, ornamental and other wall treatment.

.3 Equip supply diffusers having a basic four-way or all round air pattern for operation in one (1), two (2) or three (3) way pattern where so directed on the drawings.

.4 Confirm finish of grilles, registers and diffusers prior to ordering.

.15 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 Ducted inlets to roof and wall exhausters.

.2 Inlets and outlets of other fan systems.

.3 Main and sub main ducts.

.4 And as indicated.

.2 For temperature readings:

.1 At outside air intakes.

.2 In mixed air applications in locations as approved by [Departmental Representative].

.3 At inlet and outlet of coils.

.4 Downstream of junctions of two converging air streams of different temperatures.

.5 And as indicated.

3.3 CLEANING

.1 Perform cleaning operations as specified in Section [00 10 00] and in accordance with manufacturer's recommendations.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Operating dampers for mechanical forced air ventilation and air conditioning systems.

1.2 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section [00 10 00 – General instructions] . Include product characteristics, performance criteria, and limitations.

.2 Indicate the following:

.1 Performance data.

.2 [___].

.2 Closeout Submittals

.1 Provide maintenance data for incorporation into manual.

Part 2 Products

2.1 MULTI-LEAF DAMPERS (TAMCO)

.1 TAMCO SERIES 1500 ENHANCED AIR-FOIL CONTROL DAMPER

.2 Extruded aluminum (6063-T5) damper frame shall not be less than 0.080” (2.03 mm) in thickness. Damper frame shall be 4” (101.6 mm) deep x 1" (25.4 mm), with duct mounting flanges on both sides of frame. Damper frame shall have a 2" (50.8 mm) mounting flange on the rear of the damper, when installed as Extended Rear Flange install type. Frame to be assembled using zinc-plated steel mounting fasteners. Welded frames shall not be acceptable.

.3 Blades shall be maximum 6" (152.4 mm) deep extruded aluminum (6063-T5) air-foil profiles with a minimum wall thickness of 0.06” (1.52mm). Aluminum end caps shall be press fitted to blade ends, in order to seal hollow interior and reduce air leakage rates. All blades shall be symmetrically pivoted.

.4 Blade seals shall be extruded silicone, secured in an integral slot within the aluminum blade extrusions and shall be mechanically fastened to prevent shrinkage and movement over the life of the damper. Adhesive or clip-on type blade seals will not be approved.

.5 Frame seals shall be extruded silicone, secured in an integral slot within the aluminum frame extrusions and shall be mechanically fastened to prevent shrinkage and movement over the life of the damper. Metallic compression type jamb seals will not be approved.

.6 Bearings shall be a dual bearing system composed of a Celcon inner bearing (fixed around a $^{7}/_{16}$" (11.11 mm) aluminum hexagon blade pivot pin), rotating within a polycarbonate outer

bearing inserted in the frame. Single axle bearing, rotating in an extruded or punched hole shall not be acceptable. Bearings are to be maintenance-free, requiring no lubrication.

.7 Hexagonal control shaft shall be $^{7}/_{16}$" (11.11 mm). It shall have an adjustable length and shall be an integral part of the blade axle. A field-applied control shaft shall not be acceptable. All parts shall be zinc-plated steel.

.8 Linkage hardware shall be aluminum and corrosion-resistant zinc-plated steel, installed in the frame side, out of the airstream, and accessible after installation. Linkage hardware shall be complete with cup-point trunnion screws to prevent linkage slippage and a Celcon bearing between moving parts to reduce wear and increase longevity. Linkage that consists of metal rubbing metal will not be approved.

.9 Dampers shall be:

.1 Designed for operation in temperatures ranging from -40°F (-40°C) to 212°F (100°C).

.2 AMCA rated for Leakage Class 1A at 1 in. w.g. (0.25 kPa) static pressure differential. Standard air leakage data to be certified under the AMCA Certified Ratings Program.

.3 Custom made to required size, with blade stops not exceeding 1¼” (31.7 mm) in height. The blade stop shall be a continuous and integral part of the head/sill. Welded and caulked blade stops shall not be acceptable.

.4 Opposed blade action, as indicated on the plans.

.5 Installed in the following manner: Square to Round Transition.

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 where indicated.

.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.

.3 Seal multiple damper modules with silicon sealant.

.4 Ensure dampers are observable and accessible.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Fans, motors, accessories and hardware for commercial use.

.2 Related Sections:

.1 [___].

1.2 REFERENCES

.1 Air Conditioning and Mechanical Contractors (AMCA)

.1 AMCA Publication 99-[2003], Standards Handbook.

.2 AMCA 300-[1996], Reverberant Room Method for Sound Testing of Fans.

.3 AMCA 301-[1990], Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

.1 ANSI/AMCA 210-[1999], Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB 1.181-[99], Ready-Mixed Organic Zinc-Rich Coating.

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

.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section [00 10 00 - General Instructions]. Include product characteristics, performance criteria, and limitations.

.2 Shop Drawings:

.1 Submit shop drawings and product data in accordance with Section [00 10 00 - General Instructions].

.1 Indicate the following:

.1 motors;

.2 wheels;

.3 bearings;

.4 shafts;

.5 corrosion resistant coating;

.6 Inlet Piezometric Ring;

.7 Shaft Grounding Ring.

.8 Seismic Vibration isolation base.

.3 Provide :

.1 Fan performance curves showing point of operation, [BHP] [kW] and efficiency.

.2 Sound rating data at point of operation.

.4 Indicate:

.1 Motors, sheaves, bearings, shaft details.

.2 Minimum performance achievable with [variable speed controllers].

.5 Quality assurance submittals: submit following in accordance with Section [00 10 00 - General Instructions].

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

.2 Instructions: submit manufacturer's installation instructions.

.6 Closeout Submittals:

.1 Provide operation and maintenance data for incorporation into manual specified in Section [00 10 00 - General Instructions].

1.4 QUALITY ASSURANCE

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section [001545 -General and Fire Safety Requirements].

1.5 MAINTENANCE

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section [00 10 00 - General Instructions].

.1 Spare parts to include:

.1 Matched sets of belts.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:

.1 Bearings and seals.

.2 Addresses of suppliers.

.3 List of specialized tools necessary for adjusting, repairing or replacing.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section [00 10 00 - General Instructions].

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 Refer to the drawings for the model and type of fan to be provided for this project.

.2 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, [total] [static] pressure, [bhp] [W], 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. [Supply unit with ANSI/AMCA certified sound rating seal].

.5 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210. [Supply unit with ANSI/AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter].

.6 Substitution of any product other than that specified, must ensure no deviation below the stated capacities, or air flow rate. Power requirements must not be exceeded, and where specifically defined, sound power levels must not be exceeded. Applications for "equal" or "alternate" must address these factors.

2.2 FANS GENERAL

.1 Motors:

.1 Suitable for use with variable speed controllers.

.2 Sizes as [indicated].

.2 Accessories and hardware: matched sets of V-belt drives, adjustable [slide rail] [___] motor bases, belt guards, as indicated.

.3 Factory primed before assembly in colour standard to manufacturer.

.4 Scroll casing drains: as indicated.

.5 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

.6 Vibration isolation: spring isolators with seismic control designed to suit the combined loads of the fan, motor, structural base and exhaust stack.

.7 Flexible connections: chemical resistant Teflon type.

.8 Factory-supplied steel base-frames.

.9 Alternate products must show savings and clearly indicate all areas where they do not meet specified product.

2.3 CENTRIFUGAL FANS

.1 Fan wheels:

.1 Blades shall be die-formed to achieve accurate cross-section. Hubs shall be cast iron or fabricated steel, welded and/or bolted to the backplate. The complete fan wheel shall be of continuously welded construction, and shall be dynamically balanced to ANSI Standard S2.l9, Quality Grade 2.5..

.2 [Air foil] blades, as indicated.

.2 Bearings: [heavy duty] [split pillow-block] [flange mounted] grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of [200,000] hours.

.3 Shaft: Fan shafts to be AISI-Cl045 hot-rolled steel, turned to tight tolerance or turned, ground, polished and ring gauged for accuracy. Fan shafts shall be designed so as to operate at no more than 80% of the first critical speed when the fan operates at the top of the fan class speed range.

.4 Housings:

.1 Fan housing shall be constructed of heavy gauge steel suitable for the Class of duty, reinforced with structural angle for rigidity. All seams and joints are to be continuously welded to eliminate leakage.

.2 Flanged inlet and outlet.

.3 Housing drain plug.

.4 Provide [latched] airtight access doors with handles.

.5 Standard features: All grease lubricated bearings that are not directly accessible shall be fitted with extended grease leads terminating at an accessible location on the fan housing.

.6 Coatings:

.1 Prepare fans with commercial blast cleaning and ensure they are thoroughly cleaned and degreased. Interior and exterior of fan to be coated with 1 prime coat Intergard 345 HB Epoxy and 1 finish coat Intergard 740 Epoxy with a total of 6 mils. All guards covering rotating components shall have a finish coat of Safety Yellow – these do not require any commercial sand blast.

.7 Factory Run-Test:

.1 Fans to be completely assembled and run-tested prior to shipment. Filtered vibration levels taken at the bearing caps are not to exceed .15 in/sec. Fan Run-Test reports to be retained at the factory for record for a minimum of 2 years.

.8 Motor:

.1 Motors are to be rated 575 volts, 60 cycle, 3 phase, TEFC, premium efficiency, with a minimum service factor of 1.10. Acceptable manufacturers are: Leeson, Baldor/Reliance, Toshiba and TECO. Type of enclosure and duty of motor to be suitable for any applicable hazardous site conditions.

.2 Motor to be equipped with a Shaft Grounding Ring.

.9 Piezometer Ring:

.1 Fan to be equipped with a piezo metric Ring for flow measurement.

.2 Manufacturer to provide the airflow factor and the differential pressure of the ring at the design air flow.

.10 Variable volume control devices:

.1 Variable Speed Drives: refer to Section 26 29 23.

.11 Warranty:

.1 Fan manufacturer to provide warranty on materials and workmanship for a period of 12 months from date of shipment.

.2 Acceptable product:

.1 Twin City: model BAF-SW, size as shown on drawings, or approved equal.

2.4 IN-LINE CENTRIFUGAL FANS

.1 Characteristics and construction: [as for centrifugal fan wheels, with axial flow construction and [direct] or [belt] drive].

.2 Provide AMCA arrangements 1 or 9 as indicated with stiffened flanges, smooth rounded inlets, and stationary guide vanes.

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 FAN INSTALLATION

.1 Install fans as indicated, complete with resilient mountings specified in Section [23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment], flexible electrical leads and flexible connections.

.2 Provide sheaves and belts required for final air balance.

.3 Bearings and extension tubes to be easily accessible.

.4 Access doors and access panels to be easily accessible.

.5 Provide electrical grounding to prevent static electrical charge.

.6 Fans will be equipped with Piezometric Rings for air flow reading. Insure the ports for the rings are not blocked.

.7 Insure shaft groundings rings are installed for all fan operated with variable frequency drives.

3.3 ANCHOR BOLTS AND TEMPLATES

.1 Size anchor bolts to withstand seismic acceleration and velocity forces as specified [___].

3.4 CLEANING

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Supply, return and exhaust grilles and registers, diffusers and linear grilles, for commercial and residential use.

.2 Related Sections:

.1 Section 00 10 00 – General Instructions.

.2 Section 00 15 45 – General Safety Section and Fire Instructions

.3 Section 21 05 01 – Common Work Results- Mechanical

.4 Section 21 05 02 – Mechanical Identification

.5 Section 23 05 13 – Common Motor Requirements for HVAC

.6 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC

1.2 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.

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 00 10 00 – General Instructions. Include product characteristics, performance criteria, and limitations.

.2 Indicate following:

.1 Capacity.

.2 Throw and terminal velocity.

.3 Noise criteria.

.4 Pressure drop.

.5 Neck velocity.

.6 [___].

.2 Quality assurance submittals: submit following in accordance with Section 00 10 00 – General Instructions.

1.4 QUALITY ASSURANCE

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 00 15 45 – General Safety Section and Fire Instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 00 10 00 – General Instructions.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: in accordance with Section 00 10 00 – General Instructions.

Part 2 Products

2.1 GENERAL

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity.

.2 Frames:

.1 Full perimeter gaskets.

.2 Plaster frames [where set into plaster or gypsum board] [and as specified].

.3 Concealed fasteners.

.3 Concealed manual volume control damper operators.

.4 Colour: as directed by Departmental Representative.

.5 All new and existing diffusers, grilles and registers as well as any associated ductwork is to be cleaned and vacuumed (within vacuum hose length)

2.2 MANUFACTURED UNITS

.1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

2.3 SUPPLY GRILLES AND REGISTERS

.1 General: with [opposed blade dampers] .

.2 Type SG1: [aluminum], [21] [25] [32] mm border, double deflection with airfoil shape, horizontal face and vertical rear bars. Finish: [___]. *Acceptable Material: EH Price Model 610, or approved equal.*

2.4 RETURN AND EXHAUST GRILLES AND REGISTERS *(delete or modify to suit)*

.1 General: with [opposed blade dampers] [___].

.2 Type EG1: [aluminum,] [19] [___] mm border, single [0] [45] degrees deflection, horizontal face bars. Finish: [___].*Acceptable Material: EH Price Model 610Z, or approved equal.*

2.5 DIFFUSERS *(delete or modify to suit)*

.1 General: volume control dampers with flow straightening devices [and blank-off quadrants] [___] and gaskets.

.2 Type SD1: [aluminum,] square type, having [adjustable] [fixed] pattern, [lay-in] [and] [or] [surface] mounted. Finish: [___].*Acceptable Material: EH Price Model SPD, or approved equal.*

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 manufacturers instructions.

.2 Install with [flat head] [oval head] [stainless steel] [cadmium plated] screws in countersunk holes where fastenings are visible.

.3 Bolt grilles, registers and diffusers, in place, in gymnasium and similar game rooms.

.4 Provide concealed safety chain on each grille, register and diffuser in gymnasium and similar game rooms [and elsewhere as indicated] [___].

3.3 CLEANING

.1 Proceed in accordance with Section 00 10 00 – General Instructions

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and application of electric duct heaters.

.2 Related Sections:

.1 Section [00 10 00 – General Instructions].
.2 Section [01 91 13 - General Commissioning (Cx) Requirements].
.3 Section [26 05 00 - Common Work Results - for Electrical].

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA C22.2 No.46-[M1998(R2001)], Electric Air-Heaters.

1.3 SUBMITTALS

.1 Make submittals in accordance with Section [00 10 00 – General Instructions] [___].

.2 Submit product data and include:

.1 Element support details.
.2 Heater: total kW rating, voltage, phase.
.3 Number of stages.
.4 Rating of stage: rating, voltage, phase.
.5 Heater element watt/density and maximum sheath temperature.
.6 Maximum discharge temperature.
.7 Physical size.
.8 Unit support.
.9 Performance limitations.
.10 Clearance from combustible materials.
.11 Internal components wiring diagrams.
.12 Minimum operating airflow.
.13 Pressure drop [operating] [minimum] airflow.

1.4 QUALITY ASSURANCE

.1 Health and Safety.

.1 Do construction occupational health and safety in accordance with Section [00 10 00 – General Instructions].

Part 2 Products

2.1 DUCT HEATERS

.1 Duct heaters: [insert type].

.2 Elements:

.1 Helical coils of nickel chrome alloy resistance wire.

.2 Finned tubular.

.3 Incoloy sheathed.

.3 Staging:

.1 Staged heaters: balanced line current at each stage.

.2 Each stage: uniform face distribution.

.4 Maximum temperature at discharge: [___] degrees Celcius.

.5 Controls:

.1 Factory mounted and wired in control box. Use terminal blocks for power and control wiring to thermostat and sail switch.

.2 Remote mounted as indicated with terminal strips in heater terminal box for power and control wiring.

.3 Controls mounted in a CSA Type [___] enclosure and to include:

.1 Control transformers.

.2 [SCR] controller.

.4 Where controls are mounted in heater, exercise care in mounting contactors to minimize switching noise transmission through ductwork.

.5 High temperature cut-out and air proving switch.

.6 Electrical: (see schedule in mechanical drawings)

.1 Duct heater rating:

.1 [___] kW.

.2 [___] voltage.

.3 [___] phase.

.2 Stages:

.1 [___] number.

.2 [___] rating.

.3 [___] kW.

.4 [___] voltage.

.5 [___] phase.

.7 Heater element watt/density: [___] W/ mm^2.

.8 Main isolation disconnect switch.

Part 3 Execution

3.1 INSTALLATION

.1 Make power and control connections to CSA C22.2 No.46.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section [01 91 13 - General Commissioning (Cx) Requirements] and Section [26 05 00 - Common Work Results - for Electrical].

.2 Perform tests in presence of [Departmental Representative] .

.1 Provide test report and include copy with Operations and Maintenance Manuals.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for self-contained single zone, electric heating, and refrigeration cooling packaged rooftop HVAC units.

.2 Related Sections:

.1 Section 00 10 00 – General instructions.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/Air Conditioning and Refrigeration Institute (ARI)

.1 ANSI/ARI 210/240, Unitary Air-Conditioning and Air-Source Heat Pump Equipment.

.2 ARI 270, Sound Rating of Outdoor Unitary Equipment.

.2 ANSI/UL 1995 B, Standard for Heating and Cooling Equipment.

.3 Canadian Standards Association (CSA International)

.1 CSA B52, Mechanical Refrigeration Code.

.2 CSA C22.1 HB, Canadian Electrical Code Handbook.

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

.1 Material Safety Data Sheets (MSDS).

.5 National Fire Protection Association

.1 NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 00 10 00 – General instructions.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet for packaged rooftop HVAC units.

.3 Shop Drawings:

.1 Submit shop drawings to indicate project layout and dimensions; indicate:

.1 Equipment, piping, and connections, together with valves, strainers, control assemblies, thermostatic controls, auxiliaries and hardware, and recommended ancillaries which are mounted, wired and piped ready for final connection to building system, its size and recommended bypass connections.

.2 Control equipment shipped loose, showing final location in assembly.

.3 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, mounting curb details, sizes and location of mounting bolt holes; include mass distribution drawings showing point loads.

.4 Detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices of ancillaries, accessories, controllers.

.5 Fan performance curves.

.6 Details of vibration isolation.

.7 Estimate of sound levels to be expected across individual octave bands in dB referred to A rating.

.8 Type of refrigerant used.

.4 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.6 Instructions: submit manufacturer's installation instructions.

.7 Manufacturer's Field Reports: manufacturer's field reports specified.

.8 Closeout submittals: submit commissioning report, maintenance and engineering data for incorporation into manual specified in Section 00 10 00 – General instructions include data as follows:

.1 Indicate: brief description of unit, indexed, with details of function, operation, control, and service for components.

.2 Provide for units, manufacturer's name, type, year, number of units, and capacity.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

.1 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.2 Handle and dispose of hazardous materials in accordance with Regional and Municipal regulations.

Part 2 Products

2.1 GENERAL

.1 Roof mounted, self-contained single zone unit with electric heating elements and DX refrigeration and bear label of CSA or ULC.

.2 Units to consist of cabinet and frame, supply fan, electric heater, control, air filter, refrigerant cooling coil, compressor, condenser coil and fans, motorized economizer damper, barometric exhaust damper.

.3 Prefabricated roof curb to conform to requirements of National Roofing Contractors Association (NRCA), minimum height 600 mm.

.4 Conform to ANSI/ARI 210/240 rating for unit larger than 40 kW nominal.

2.2 CABINET

.1 Cabinets: weatherproofing tested and certified to AGA and soundproofing tested to ARI 270.

.2 Framing and supports: 2 mm thick welded steel, galvanized after manufacture, with lifting points.

.3 Outer casing: weathertight galvanized steel with baked enamel finish.

.4 Access: gasketted hinged access doors with locking door handle type fasteners.

.5 Insulation: neoprene coated glass fiber on surfaces, 50 mm thick.

2.3 FANS

.1 Indoor Fan: Belt drive, forward curved centrifugal fan, statically and dynamically balanced. Motor shall have an adjustable idler-arm assembly for quick-adjustment of fan belts and motor sheaves. Motor shall be thermally protected. Fan shall be equipped with VFD.

.2 Outdoor Fans: Outdoor fans shall be direct-drive, statically and dynamically balanced, draw-through in the vertical discharge position. The fan motors shall be permanently lubricated and shall have built-in thermal overload protection.

2.4 AIR FILTERS

.1 50 mm thick, MERV 13, metal framed, throwaway type.

2.5 ELECTRIC HEATERS

.1 Heavy-duty nickel chromium elements internally wye connected for 480 and 600 volt. Staging shall be achieved through ReliaTel. Each heater package shall have automatically reset high limit control operating through heating element contactors. All heaters shall be individually fused from the factory, where required, and shall meet all NEC and CEC requirements when properly installed. Power assemblies shall provide single-point connection. Electric heat modules shall be UL listed or CSA certified. The heater must be factory installed.

.2 .2 Control/regulation

.1 Switchboard with modulating silicon rectifier controller.

.2 Indicator light station.

.3 Fuse plates (one per stage, unless otherwise specified).

.4 Built-in control transformer.

.5 Thermal circuit breakers: one automatic reset device.

.6 Built-in switch, [without fuse].

.7 Easily accessible control/regulatory devices, including self-monitoring protection devices for zero air flow, short circuits or ground leakage.

.8 High temperature limiter to protect unit from overheating by shutting off heating elements as required.

.9 Complies with the requirements of the Canadian Electrical Code, CSA C22.1.

2.6 REFRIGERATION

.1 Conform to CSA B52 and ANSI/UL 1995 requirements.

.2 Compressor/Condenser Section:

.1 Hermetic scroll compressors, vibration isolated with flexible suction and discharge connections, oil sight glass, oil pressure switch, and crankcase heater.

.2 Electrical system: complete with operating controls, oil and refrigerant pressure protection, motor overload protection, weatherproof electrical wiring with weatherproof disconnect.

.3 Include refrigerant piping with sight glass, filter and valves.

.4 Condenser: Microchannel condenser coils leak tested to 225 PSIG and pressure tested to 450 PSIG.

.5 Refrigerant: R410A.

.3 Evaporator:

.1 Rated to ANSI/ARI 210/240.

.2 Thermostatic expansion valve, with adjustable super heat.

.3 Coil: Microchannel evaporator coil, internally finned, 8 mm copper tubes mechanically bonded to a configured aluminum plate fin. Evaporator coil shall be leak tested to 225 PSIG and pressure tested to 450 PSIG.

.4 Cooling coil condensate drain pans: designed to avoid standing water, easily cleaned or removable for cleaning. Drain connection: deep seal trap.

2.7 CONTROLS

.1 Single Zone Cooling Control:

.1 Discharge air temperature sensor to activate cooling relay in control circuit cycling compressor. Provide safeties and pressure controls. Condenser fans to operate in sequence.

.2 As back pressure is reduced, hot gas bypass opens to maintain set back pressure.

.3 When call for cooling is satisfied, relay is de-energized closing liquid line solenoid valve and pumps down. On two compressor units provide separate circuits to evaporator and condenser.

.2 Single Zone Heat-Cool Unit:

.1 Discharge air temperature sensor controls heater stages in sequence with delay between stages, compressors and supply fan to maintain discharge air temperature set point.

2.8 REMOTE PANEL

2.9 CAPACITY

.1 As indicated on drawing.

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 Contractor to provide seismic design approved by Professional Engineer.

.2 Install roof curb provided by manufacturer as per seismic design.

.3 Install roof top unit as per manufacturers' instructions and seismic design on roof curb provided by manufacturer.

.4 Manufacturer to certify installation, supervise start-up and commission unit.

.5 Run drain line from cooling coil condensate drain pan to discharge over roof.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its product, and submit written reports, in acceptable format, to verify compliance of work with Contract.

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

.3 Schedule site visits to review work at stages listed:

.1 Upon completion of work, after cleaning is carried out.

.2 Obtain reports within 3 days of review and submit immediately to Departmental Representative.

.3 Verify accessibility, serviceability of components including motorized dampers, filters coils, fans, motors, operators, humidifiers, sensors, electrical disconnects.

.4 Verify accessibility, cleanability, drainage of drain pans for coils, humidifiers.

.5 Performance Verification:

.1 Rooftop Air Handling Units:

.1 Set outside air and return air dampers for minimum outside air set point.

.2 Check for smooth, vibration less correct rotation of supply fan impeller.

.3 Measure supply fan capacity.

.4 Adjust impeller speed as necessary and repeat measurement of fan capacity.

.5 Measure pressure drop at each component of air handling unit.

.6 OAD: verify for proper stroking, interlock with RAD.

.7 Measure DBT, WBT of SA, RA, EA.

.8 Measure air cooled condenser discharge DBT.

.9 Measure flow rates (minimum and maximum) of SA, RA, EA, relief air.

.10 Use smoke test to verify no short-circuiting of EA, relief air to outside air intake or to condenser intake.

.11 Simulate maximum heating load and:

.1 Verify temperature rise across heat exchanger.

.2 Simulate minimum heating load and repeat measurements.

.12 Measure radiated and discharge sound power levels under maximum heating demand and under maximum cooling demand with compressors running.

.13 Verify operating control strategies, including:

.1 Freeze protection.

.2 Economizer cycle operation, temperature of change-over.

.3 Alarms.

.2 Verify accessibility, serviceability of components including motorized dampers, filters coils, fans, motors, operators, humidifiers, sensors, electrical disconnects.

.3 Verify accessibility, clean ability, drainage of drain pans for coils, humidifiers.

3.4 CLEANING

.1 Perform cleaning operations as specified in Section 21 05 01 – Common Work Results - Mechanical and in accordance with manufacturer's recommendations.

.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 SUMMARY

.1 Section Includes.

.1 Methods and procedures for start-up, verification and commissioning, for building Energy Monitoring and Control System (EMCS) and includes:

.1 Start-up testing and verification of systems.

.2 Check out demonstration or proper operation of components.

.3 On-site operational tests.

.2 Related Sections.

.1 Section [01 33 00 - Submittal Procedures].

.2 Section [01 78 00 - Closeout Submittals].

.3 Section [01 91 13 - General Commissioning (Cx) Requirements].

.4 Section [01 79 00 - Demonstration and Training].

.5 Section [25 05 01 - EMCS: General Requirements].

1.2 DEFINITIONS

.1 For additional acronyms and definitions refer to Section [25 05 01 - EMCS: General Requirements] [___].

.2 AEL: ratio between total test period less any system downtime accumulated within that period and test period.

.3 Downtime: results whenever EMCS is unable to 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 re-start of components was as specified.

.2 Failure of communications link, provided that:

.1 Controller automatically and correctly operated in stand-alone mode.

.2 Failure was not due to failure of any specified EMCS equipment.

.3 Functional failure resulting from individual sensor inputs or output devices, provided that:

.1 System recorded said fault.

.2 Equipment defaulted to fail-safe mode.

.3 AEL of total of all input sensors and output devices is at least [99] [___] % during test period.

1.3 DESIGN REQUIREMENTS

.1 Confirm with Departmental Representative that Design Criteria and Design Intents are still applicable.

.2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intents.

1.4 SUBMITTALS

.1 Submittals in accordance with Section [00 10 00 – General Conditions].

.2 Final Report: submit report to Departmental Representative.

.1 Bear signature of commissioning technician and supervisor

.2 Report format to be approved by Departmental Representative before commissioning is started.

.3 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to Departmental Representative in accordance with Section [00 10 00 – General Conditions] [___].

.4 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.5 CLOSEOUT SUBMITTALS

.1 Provide documentation, O&M Manuals, and training of O&M personnel for review of Departmental Representative before interim acceptance in accordance with Section [01 78 00 - Closeout Submittals] [___].

1.6 COMMISSIONING

.1 Do commissioning in accordance with Section [01 91 13 - General Commissioning (Cx) Requirements] [___].

.2 Carry out commissioning under direction of Departmental Representative and in presence of Departmental Representative.

.3 Inform, and obtain approval from, Departmental Representative in writing at least [14] [___] days prior to commissioning or each test. Indicate:

.1 Location and part of system to be tested or commissioned.

.2 Testing/commissioning procedures, anticipated results.

.3 Names of testing/commissioning personnel.

.4 Correct deficiencies, re-test in presence of Departmental Representative until satisfactory performance is obtained.

.5 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.

.6 Perform tests as required.

1.7 COMPLETION OF COMMISSIONING

.1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by Departmental Representative.

1.8 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

.1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

Part 2 Products

2.1 EQUIPMENT

.1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.

.2 Instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.

.3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than [3] months prior to tests.

.4 Locations to be approved, readily accessible and readable.

.5 Application: to conform to normal industry standards.

Part 3 Execution

3.1 PROCEDURES

.1 Test each system independently and then in unison with other related systems.

.2 Commission each system using procedures prescribed by the Departmental Representative.

.3 Commission integrated systems using procedures prescribed by Departmental Representative.

.4 Debug system software.

.5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.

.6 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

3.2 FIELD QUALITY CONTROL

.1 Completion Testing.

.1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.

.2 Include following activities:

.1 Test and calibrate field hardware including stand-alone capability of each controller.

.2 Verify each A-to-D convertor.

.3 Test and calibrate each AI using calibrated digital instruments.

.4 Test each DI to ensure proper settings and switching contacts.

.5 Test each DO to ensure proper operation and lag time.

.6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.

.7 Test operating software.

.8 Test application software and provide samples of logs and commands.

.9 Verify each CDL including energy optimization programs.

.10 Debug software.

.11 Blow out flow measuring and static pressure stations with high pressure air at [700] [___] kPa.

.12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space for the commissioning technician and Departmental Representative. This document will be used in final startup testing.

.3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Departmental Representative and provide:

.1 Technical personnel capable of re-calibrating field hardware and modifying software.

.2 Detailed daily schedule showing items to be tested and personnel available.

.3 Departmental Representative's acceptance signature to be on executive and applications programs.

.4 Commissioning to commence during final startup testing.

.5 Commissioning to be supervised by qualified supervisory personnel and Departmental Representative.

.6 Commission systems considered as life safety systems before affected parts of the facility are occupied.

.7 Operate systems as long as necessary to commission entire project.

.8 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 hour days.

.3 Tests to include:

.1 Demonstration of correct operation of monitored and controlled points.

.2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.

.4 System will be accepted when:

.1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.

.2 Requirements of Contract have been met.

.5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.

.6 Correct defects when they occur and before resuming tests.

.5 Commissioning Manager to verify reported results.

3.3 ADJUSTING

.1 Final adjusting: upon completion of commissioning as reviewed by Departmental Representative, set and lock devices in final position and permanently mark settings.

3.4 DEMONSTRATION

.1 Demonstrate to Departmental Representative operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 General requirements for building Energy Monitoring and Control System (EMCS) that are common to NMS EMCS Sections.

.2 Related Sections:

.1 Section [00 10 00 – General Requirements].

.2 Section [25 05 02 - EMCS: Shop Drawings, Product Data and Review Process].

.3 Section [25 05 54 - EMCS: Identification].

.4 Section [25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation].

.5 Section [260521 - Wires and Cables (0-1000 V)]

.6 Section [260534 - Conduits, Conduit Fastenings and Conduit Fittings]

1.2 REFERENCES

.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 Canadian Standards Association (CSA International).

.1 CAN/CSA-Z234.1-[89(R1995)], Canadian Metric Practice Guide.

.5 Consumer Electronics Association (CEA).

.1 CEA-709.1-[B-2002], Control Network Protocol Specification.

.6 Department of Justice Canada (Jus).

.1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.

.2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

.7 Electrical and Electronic Manufacturers Association (EEMAC).

.1 EEMAC 2Y-1-[1958], Light Gray Colour for Indoor Switch Gear.

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

.1 Material Safety Data Sheets (MSDS).

1.3 ACRONYMS AND ABBREVIATIONS

.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 Center.
.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.

1.4 DEFINITIONS

.1 Point: may be logical or physical.

.1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.

.2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.

.2 Point Name: The Andover™ system utilizes an **[Area/System/Point]** naming convention. To maximize the potential of the Continuum software it is essential to maintain a standard point naming convention.

.1 Master Control Unit Names **[Area]**: Naming the **Area** is the first name to consider. This name should be simple and reflective of the area in which this MCU shall be controlling.

Example:	M50MAST/xxx/xxx	(Montreal Road Campus Building M50 Master)
	M36BCX1/xxx/xxx	(Montreal Road Campus Building M36 BACnet Master/Router)

.2 <u>LCU's, ECU's,TCU's, IOU Modules Names **[System]**:</u> Naming the **System** controller is the second name to consider. This name should reflect the building in which it is located and the primary equipment this controller is controlling. As much as is possible, the NRC Equipment name is to be embedded into the code via the point naming convention.

Example:	XXX/AHU02/xxx	(Air Handling Unit 02)
	XXX/BLR01/xxx	(Boiler 01)
	XXX/MISC3/xxx	(Miscellaneous 3)
	XXX/Rm103/xxx	(Room 103)
	XXX/IOU1/xxx	(Input Output Module 1)

In the event that there are multiple pieces of equipment being controlled i.e.: 2 air handling units, the controller name shall follow the following standard.

Example:	XXX/AHU01_02/xxx	(Air Handling Units 01 and 02)

.3 <u>Point Inputs/Outputs Names **[Point]**:</u> The **Point** name is an abbreviation of the input/output function. Each type of equipment (chilled water system controllers, terminal unit controllers, etc.) has a standard list of input and output abbreviations (see attached list). Again, as much as is possible, the NRC Equipment name is to be embedded into the code via the point naming convention.

E*xample:*	XXX/xxx/SFA	(Supply Fan Amperage)
	XXX/xxx/CCV	(Cooling Coil Valve)

XXX/xxx/RMT	(Room Temperature)
XXX/xxx/WTM01	(Water Meter)
XXX/xxx/CHWST	(Chilled Water Supply Temperature)

In the event that there are multiple end devices on the same controller with the same function these would be first identified by the type of input/output followed by an underscore and an abbreviation of the location/description of the multiple type input.

Example:	XXX/xxx/RMT_102	(Room 102 Room Temperature)
	XXX/xxx/DCP01	(Domestic Circulating Pump 01)
	XXX/xxx/HCV2	(Heating Coil Valve Secondary)
	XXX/xxx/RM02_FLOOD	(Room 02 Flood Alarm)

.4 Numeric (virtual points) Names: The numeric should take on a similar naming standard as the point names. The numeric is a virtual point whose value is calculated by programs within the operator work station. The name for these virtual points should refer first to the point it is directly effecting followed by its function.

Example:	XXX/xxx/DATSp	(Discharge Air Temperature Setpoint)
	XXX/xxx/ RFS	(Return Fan Status)
	XXX/xxx/SFm	(Supply Fan Mode)

Other numeric's that do not involve points directly but programs shall be named for the function they server.

Example:	XXX/xxx/WINTER	(Winter Flag)
	XXX/xxx/SiteOAT	(Site Outside Air Temperature)
	XXX/xxx/CTL	(Pseudo System Control Value)

.5 Control Program Names:

Program names should be names in the same convention as Point and Numeric Names. The program name should first start with a description of its function followed by the point that the program controls.

Example:	XXX/xxx/CtlCCV	(Cooling Coil Valve Control)
	XXX/xxx/CtlMode	(Mode Control)
	XXX/xxx/VARCALC	(Variable Calculations)

.3 Point expansion : comprised of three fields, one for each descriptor. Expanded form of shortform or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide [32] [___] character field for each point expansion.

.4 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 BI (binary input).

.6 BO (binary output).

.5 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.

.1 Printouts: to ANSI/IEEE 260.1.

.2 Refer also to Section [25 05 54- EMCS: Identification] [___].

1.5 CONTRACTOR'S QUALIFICATIONS

.1 The EMCS controls systems contractor shall:

.1 Be an authorized distributor of the product lines listed in these specifications and on the drawings.

.2 Have a proven record of similar at least five (5) years of experience in the installation and maintenance of DDC/BAS control systems.

.3 Have in-house qualified technicians and tradesmen for the installation, maintenance and repair of systems.

.4 Have an office within 20 km of the project site and shall be able to offer emergency service 24 hrs/day, 365 days/year.

.5 BAS contractor shall also have experience in remote communication of BAS data transfer applications through the use of a standard telephone modem and personal computer. It shall be possible to modify all software and analyze all system data from the Contractor's or the Departmental representative's office.

.6 **Ainsworth Inc.** shall be considered as Base Bid for this project. Any alternate Controls Contractor wishing to submit a quotation to execute the work shall submit a pre-qualification proposal to the Engineer for evaluation, 7 working days prior to tender closing. Tenders submitted without prequalification will not be accepted. Approved alternatives will be added by a pre-tender addendum.

1.6 SYSTEM DESCRIPTION

.1 Refer to [control schematics] [and] [___] 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 listed in I/O point summary tables.

.3 OWS(s).

.4 Data communications equipment necessary to effect EMCS data transmission system.

.5 Field control devices.

.6 Software/Hardware complete with full documentation.

.7 Complete operating and maintenance manuals.

.8 Training of personnel.

.9 Acceptance tests, technical support during commissioning, full documentation.

.10 Electrical 120 volt power distribution and low voltage power wiring as required for controllers and devices.

.11 Wiring interface co-ordination of equipment supplied by others.

.12 Control air piping and tubing as required for controllers and devices.

.13 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 Departmental Representative prior to installation.

.3 Location of controllers as reviewed by Departmental Representative prior to installation.

.4 Provide utility power to EMCS [and emergency power to EMCS] [___] as indicated.

.5 Imperial 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 Input and output commands and messages from operator-initiated functions and field related changes and alarms 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 SUBMITTALS

.1 Make submittals in accordance with Section [00 10 00 – General Conditions] [and] [25 05 02 - EMCS: Shop Drawings, Product Data and Review Process] [___].

.2 Co-ordinate submittal requirements and provide submittals required by Section [01 47 15 - Sustainable Requirements: Construction] [___].

.3 Submit for review:

.1 [Equipment list] [and] [systems manufacturers] within [10] [___] days after award of contract.

.4 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 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: Shop Drawings, Product Data 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 Departmental 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 Departmental Representative

1.8 QUALITY ASSURANCE

.1 Have local office within 20km of project, staffed by trained personnel capable of providing instruction, routine maintenance and emergency service on systems,

.2 Provide record of successful previous installations submitting tender showing experience with similar installations utilizing computer-based systems.

.3 Have access to local supplies of essential parts and provide [7] [___] year guarantee of availability of spare parts after obsolescence.

.4 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.

.5 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section [00 10 00 – General Conditions] [___].

1.9 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Departmental Representative with schedule within [2] [___]weeks after award of Contract.

.2 Waste Management and Disposal:

.1 Separate waste materials for [reuse] [and] [recycling] [___].

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal [paper] [plastic] [polystyrene] [corrugated cardboard] [___] packaging material [in appropriate on-site bins] [___] for recycling in accordance with Waste Management Plan.

.4 Separate for [reuse] [and] [recycling] [___] and place in designated containers [Steel] [Metal] [Plastic] [___] waste in accordance with Waste Management Plan.

.5 Place materials defined as hazardous or toxic in designated containers.

.6 Handle and dispose of hazardous materials in accordance with [CEPA,] [TDGA,] [Regional and Municipal,] [___] regulations.

.7 Label location of salvaged material's storage areas and provide barriers and security devices.

.8 Ensure emptied containers are sealed and stored safely.

.9 Divert unused [metal] [___]materials from landfill to [metal] [___] recycling facility as approved by Departmental Representative.

.10 Fold up [metal] [and] [plastic] banding, flatten and place in designated area for recycling.

1.10 EXISTING CONDITIONS - 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 Departmental 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 Departmental 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 Departmental 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 Departmental Representative.

.1 Be responsible for items repaired or replaced by Departmental Representative.

.2 Be responsible for repair costs due to negligence or abuse of equipment.

.3 Responsibility for existing devices terminates [upon final acceptance of [EMCS] [___]] [applicable portions of EMCS as approved by Departmental Representative.

.7 Remove existing controls, conduit, wiring and pneumatic tubing (poly or copper) not re-used or not required. Place in approved storage for disposition as directed.

Part 2 Products

2.1 EQUIPMENT

.1 [Control Network Protocol] [and] [Data Communication Protocol]: to [CEA 709.1] [ASHRAE STD 135] [___].

.2 Complete list of equipment and materials to be used on project and forming part of [bid] [tender] documents by adding manufacturer's name, model number and details of materials, and submit for approval.

Part 3 Execution

3.1 MANUFACTURER'S RECOMMENDATIONS

.1 Installation: to manufacturer's recommendations.

3.2 ELECTRICAL POWER AND CONTROL WIRING

.1 Provide 120 volt electrical power and low voltage control wiring to controllers and devices in accordance with specification sections 260521 and 260534, and coordinate work with the main electrical contractor.

3.3 CONTROL AIR PIPING AND TUBING

.1 Use type “L” air copper pipe with silver brazed joints in the following locations:

- .1 In mechanical rooms.
- .2 -Areas of ambient temperature above 80C.
- .3 In fire rated walls and ceilings.
- .4 Areas where piping may be subject to damage.
- .5 In other locations polyethylene plastic tubing with barbed type fittings is acceptable.

3.4 PAINTING

.1 Painting: as follows:

- .1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.
- .2 Restore to new condition, finished surfaces too extensively damaged to be primed and touched up to make good.
- .3 Clean and prime exposed hangers, racks, fastenings, and other support components to match existing building standards.
- .4 Paint unfinished equipment installed indoors to [EEMAC 2Y-1] [___].

3.5 FIELD QUALITY CONTROL

.1 Verification requirements include:

- .1 Materials and resources.
- .2 Storage and collection of recyclables.
- .3 Construction waste management.
- .4 Resource reuse.

.5 Recycled content.

.6 Local/regional materials.

.7 Certified Wood.

.8 Low-emitting materials.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Methods and procedures for shop drawings submittals, preliminary and detailed review process including review meetings, for building Energy Monitoring and Control System (EMCS).

.2 Related Sections.

.1 Section [00 10 00 – General Conditions].

.2 Section [25 05 01 - EMCS: General Requirements].

.3 Section [25 01 11 - EMCS: Start-up, Verification and Commissioning].

1.2 DEFINITIONS

.1 Acronyms and definitions: refer to Section [25 05 01 - EMCS: General Requirements] [___].

1.3 SUBMITTALS

.1 Submittals in accordance with Section [00 10 00 – General Conditions] [___] and coordinate with requirements in this Section.

.2 Submit shop drawing documents within [15] [___] working days after contract award, for review by Departmental Representative.

.3 Shop Drawings to consist of [1] soft copy of design documents, shop drawings, product data and software.

.4 Soft copy to be in PDF format, structured using menu format for easy loading and retrieval on OWS.

1.4 SHOP DRAWING REVIEW

.1 Shop drawings to include the following.

.1 Location of [local] [___] office.

.2 Names of project manager and project engineer.

.3 Item-by-item statement of compliance.

.4 Proof of demonstrated ability of system to communicate utilizing [Proprietary Communications Protocol (Andover Infinet)] [BACnet] [Lontalk].

.5 Detailed system architecture showing all points associated with each controller identifying the following:

.1 Controller locations.

.2 Auxiliary control cabinet locations.

.6 Points list to include the following item:

.1 Input output termination location

.2 Input output type

.3 Point name [see Section 250501 for NRC point naming convention]

.4 Point description

.5 Point revision

.6 Product part number

.7 Product wiring details

.7 System Schematic Diagrams and Sequence of Events detailing the following but not limited to:

.1 Display of [air] [and] [water] systems with point identifiers, textual description of system, [electrical ladder diagrams], [areas served] [location of equipment] as specified.

.2 Narrative descriptions of each automatic and manual procedure required to achieve proper operation of the mechanical equipment associated with this project, including the proceedures used during the complete failure of EMCS.

.1 List of time of day schedules.

.8 Equipment Schedule

.1 Valves: complete schedule listing including following information: designation, service, manufacturer, model, design flow rate, design pressure drop, Valve size, actual Cv, spring range, pilot range and close off pressure (actual).

.2 Dampers: interconnecting hardware, operator locations, operator spring range, pilot range, actual torque.

.3 Flow measuring stations: complete schedule listing designation, service, manufacturer, model, size, velocity at design flow rate, manufacturer.

.9 Specification sheets to include:

.1 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.

.10 [Compressor schematic and sizing data.]

.11 Interface wiring diagrams showing termination connections and signal levels [for equipment to be supplied by others] [___].

.12 Outline of proposed start-up and verification procedures. Refer to Section [25 01 11 - EMCS: Start-up, Verification and Commissioning].

1.5 QUALITY ASSURANCE

.1 Shop Drawing Review Meeting: Participate in meeting within [5] [___]working days of receipt of reviewed shop drawings. Meeting to be convened by NRC:

.1 Undertake functional review of shop drawing documents, resolve inconsistencies.

.2 Resolve conflicts between contract document requirements and actual items (e.g.: points list inconsistencies).

.3 Review interface requirements of materials supplied by others.

.4 Review "Sequence of Operations".

.2 Departmental Representative retains right to revise sequence or subsequent CDL prior to software finalization without cost to Departmental 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 Section Includes.

.1 Requirements and procedures for identification of devices, sensors, wiring tubing, conduit and equipment, for building Energy Monitoring and Control System (EMCS) Work and nameplates materials, colours and lettering sizes.

.2 Related Sections.

.1 Section [00 10 00 – General Requirements].

.2 Section [25 05 01 - EMCS: General Requirements].

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA C22.1-[09], The Canadian Electrical Code, Part I (21th 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 SUBMITTALS

.1 Submittals in accordance with Section [00 10 00 – General Requirements] supplemented and modified by requirements of this Section.

.2 Submit to Departmental Representative for approval samples of nameplates, identification tags and list of proposed wording.

Part 2 Products

2.1 NAMEPLATES FOR PANELS/CABINETS

.1 Identify by 1/10 inch thick Melamine, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.

.2 Sizes: 1 inch x 2-3/4 inches minimum.

.3 Lettering: minimum ¼ inch high, black.

.4 Inscriptions: machine engraved to identify function.

2.2 NAMEPLATES FOR CONTROLLERS

.1 Identify by stick-on label the controller identifier.

.2 Location: outside cover of controller.

.3 Letter size: to suit, clearly legible.

2.3 NAMEPLATES FOR FIELD DEVICES

.1 Identify by plastic encased cards attached by plastic tie.

.2 Sizes: 2 x 4 inches minimum.

.3 Lettering: minimum 1/5 inch 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.

2.4 NAMEPLATES FOR ROOM SENSORS

.1 Identify by stick-on labels using point identifier.

.2 Location: as directed by Departmental Representative.

.3 Letter size: to suit, clearly legible.

2.5 WARNING SIGNS

.1 Equipment including motors, starters under remote automatic control: supply and install 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 Departmental Representative.

2.6 WIRING

.1 Tape markings on wiring inside panels to clearly identify EMCS point name.

.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.

2.7 PNEUMATIC TUBING

2.8 Tape markings on pneumatic tubing inside panels to clearly identify EMCS point name.

2.9 CONDUIT

.1 Pre-paint box covers and conduit fittings.

.2 Coding: use fluorescent orange paint and confirm colour with Departmental 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 SUMMARY

.1 Section Includes.

.1 Requirements and procedures for warranty and activities during warranty period and service contracts, for building Energy Monitoring and Control System (EMCS).

.2 Related Sections.

.1 Section [00 10 00 – General Conditions].

.2 Section [25 05 01 - EMCS: General Requirements].

.3 References.

.1 Canada Labour Code (R.S. 1985, c. L-2)/Part I - Industrial Relations.

.2 Canadian Standards Association (CSA International).

.1 CSA Z204-[94(R1999)], Guidelines for Managing Indoor Air Quality in Office Buildings.

1.2 DEFINITIONS

.1 For acronyms and definitions refer to Section [25 05 01 - EMCS: General Requirements] [___].

1.3 SUBMITTALS

.1 Not Used.

.1 Not Used.

1.4 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 Departmental 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 2 hours] [___] after receiving request for service.

.5 Perform Work continuously until EMCS restored to reliable operating condition.

.3 Work requests: record each service call request, when received separately on approved form and include:

.1 Serial number identifying component 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.

1.5 SERVICE CONTRACTS

.1 Provide in-depth technical expertise and assistance to Departmental Representative in preparation and implementation of service contracts and in-house preventive maintenance procedures.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Control devices integral to the Building Energy Monitoring and Control System (EMCS): [transmitters,] [sensors,][controls,] [meters,] [switches,] [transducers,] [dampers,] [damper operators,] [valves,] [valve actuators,] [and] [low voltage current transformers] [___].

.2 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: Shop Drawings, Product Data 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 - Electrical].

.7 Section [26 27 26 - Wiring Devices].

1.2 REFERENCES

.1 American National Standards Institute (ANSI).

.1 ANSI C12.7-[1993(R1999)], Requirements for Watthour Meter Sockets.

.2 ANSI/IEEE C57.13-[1993], Standard Requirements for Instrument Transformers.

.2 American Society for Testing and Materials International, (ASTM).

.1 ASTM B148-[97(03)], Standard Specification for Aluminum-Bronze Sand Castings.

.3 National Electrical Manufacturer's Association (NEMA).

.1 NEMA 250-[03], Enclosures for Electrical Equipment (1000 Volts Maximum).

.4 Air Movement and Control Association, Inc. (AMCA).

.1 AMCA Standard 500-D-[98], Laboratory Method of Testing Dampers For Rating.

.5 Canadian Standards Association (CSA International).

.1 CSA-C22.1-[02], Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations.

1.3 DEFINITIONS

.1 Acronyms and Definitions: refer to Section [25 05 01 - EMCS: General Requirements] [___].

1.4 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 Departmental 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.

1.5 EXISTING CONDITIONS

.1 Repair surfaces damaged during execution of Work.

.2 Turn over to Departmental 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], [shockproof], [vibration-proof], [heat resistant], [___] 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, twist on connections or connector blocks unless otherwise specified..

.5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.

.6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

.7 Outdoor installations: use weatherproof construction in NEMA [4] [___]enclosures.

.8 Devices installed in user occupied space not exceed Noise Criteria (NC) of [35] [___]. Noise generated by any device must not be detectable above space ambient conditions.

2.2 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] [150] mm as indicated.

.2 Room temperature sensors and display wall modules.

.1 Temperature sensing and display wall module.

.1 LCD display to show space temperatureand temperature setpoint.

.2 Buttons for occupant selection of temperature setpoint [and occupied/unoccupied mode] [___].

.3 Jack connection for plugging in laptop personal computer [contractor supplied zone terminal unit] [contractor supplied palm compatible handheld device] for access to zone bus.

.4 Integral thermistor sensing element [10,000] [___] ohm at [24] [___] degrees.

.5 Accuracy 0.2 degrees C over range of 0 to 70 degrees C.

.6 Stability 0.02 degrees C drift per year.

.7 Separate mounting base for ease of installation.

.2 Room temperature sensors.

.1 Wall mounting, in slotted type covers having [brushed aluminum] [brushed stainless steel]finish or with plastic cover and guardas indicated][___].

.2 Element [10-50] [___]mm long RTD with ceramic tube or equivalent protection or thermistor, [10,000] [___] ohm, accuracy of plus or minus [0.2] [___] degrees C.

.3 Duct temperature sensors:

.1 General purpose duct type: suitable for insertion into ducts at various orientations, insertion length [460] [___] mm [or] [as indicated].

.2 Averaging duct type: incorporates numerous sensors inside assembly which are averaged to provide one reading. Minimum insertion length [6000] [___] mm. Bend probe at field installation time to [100] [___] mm radius at point along probe without degradation of performance.

.4 Outdoor air temperature sensors:

.1 Outside air type: non-corroding shield to minimize solar and wind effects, threaded fitting for mating to [13] [___] mm conduit, weatherproof construction in NEMA 4 enclosure.

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/ [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 HUMIDITY SENSORS

.1 Room and Duct Requirements:

.1 Range: [2] - [90] [___] % RH minimum.

.2 Operating temperature range: [0] - [60] [___] degrees C.

.3 Absolute accuracy:

.1 Duct sensors: [plus or minus [3] [___] %] [___].

.2 Room sensors: [plus or minus [2] [___] %] [___].

.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 Room sensors: [locate in air stream near RA grille] [wall mounted] as indicated.

.7 Duct mounted sensors: locate so that sensing element is in air flow in duct.

.2 Outdoor Humidity Requirements:

.1 Range: [0] - [100] [___] % RH minimum.

.2 Operating temperature range: [-40] - [50] degrees C.

.3 Absolute accuracy: plus or minus [2] [___]%.

.4 Temperature coefficient: plus or minus 0.03%RH/ degrees C over 0 to 50 degrees C.

.5 Must be unaffected by condensation or 100% saturation.

.6 No routine maintenance or calibration is required.

2.5 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/ [6] [___] months.

2.6 PRESSURE TRANSDUCERS

.1 Requirements:

.1 Combined sensor and transmitter measuring pressure.

.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 Temperature effects: not to exceed plus or minus [1.5] [___] % full scale/ [50] [___] degrees C.

.6 Over-pressure input protection to at least twice rated input pressure.

.7 Output short circuit and open circuit protection.

.8 Accuracy: plus or minus [1] [___]% of Full Scale.

2.7 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.

2.8 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.

2.9 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

2.10 VELOCITY PRESSURE SENSORS

.1 Requirements:

.1 Multipoint static and total pressure sensing element with self-averaging manifold with integral air equalizer and straightener section.

.2 Maximum pressure loss: [37] [___]Pa at [1000] [___] m/s.

.3 Accuracy: plus or minus [1] [___] % of actual duct velocity.

2.11 VELOCITY PRESSURE TRANSMITTERS

.1 Requirements:

.1 Output signal: [4] - [20] [___] mA linear into [500] [___] ohm maximum load.

.2 Calibrated span: not to exceed [125] [___] % of duct velocity pressure at maximum flow.

.3 Accuracy: [0.4] [___] % of span.

.4 Repeatability: within [0.1] [___] % of output.

.5 Linearity: within [0.5] [___] % 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.

2.12 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES

.1 Requirements:

.1 Internal materials: suitable for continuous contact with compressed air, water, steam, etc., as applicable.

.2 Adjustable setpoint and differential.

.3 Switch: snap action type, rated at [120V, 15 amps AC] [or] [24 V DC].

.4 Switch assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure.

.5 Accuracy: within [2] [___]% repetitive switching.

.6 Provide switches with isolation valve and snubber, where code allows, between sensor and pressure source.

.7 Switches on steam and high temperature hot water service: provide pigtail syphon.

2.13 CURRENT / PNEUMATIC (I/P) TRANSDUCERS

.1 Requirements:

.1 Input range: [4] [___] to [20] [___] mA.

.2 Output range: proportional [20-104] kPa [or] [20-186] [___] kPa as applicable.

.3 Housing: dustproof or panel mounted.

.4 Internal materials: suitable for continuous contact with industrial standard instrument air.

.5 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus [2] [___] % of full scale over entire range.

.6 Integral zero and span adjustment.

.7 Temperature effect: plus or minus [2.0] [___] % of full scale/ [50] [___]degrees C or less.

.8 Regulated supply pressure: [206] [___] kPa maximum.

.9 Air consumption: [16.5] [___] ml/s maximum.

.10 Integral gauge manifold c/w gauge (0-206 kPa).

2.14 SOLENOID CONTROL AIR VALVES

.1 Coil: [120V AC] [or] [24V DC], as indicated.

.2 Capacity: to pass a minimum of 0.15 l/s air at 140 kPa differential.

2.15 AIR PRESSURE GAUGES

.1 Diameter: [38] [___] mm minimum.

.2 Range: zero to two times operating pressure of measured pressure media or nearest standard range.

2.16 ELECTROMECHANICAL RELAYS

.1 Requirements:

- .1 Double voltage, DPDT, plug-in type with termination base.
- .2 Coils: rated for [120V AC] [or] [24V DC]. Other voltage: provide transformer.
- .3 Contacts: rated at [5] [___] amps at [120] [___] V AC.
- .4 Relay to have visual status indication

2.17 SOLID STATE RELAYS

.1 General:

- .1 Relays to be socket or rail mounted.
- .2 Relays to have LED Indicator
- .3 Input and output Barrier Strips to accept 14 to 28 AWG wire.
- .4 Operating temperature range to be -20 degrees C to 70 degrees C.
- .5 Relays to be CSA Certified.
- .6 Input/output Isolation Voltage to be 4000 VAC at 25 degrees C for 1 second maximum duration.
- .7 Operational frequency range, 45 to 65 HZ.

.2 Input:

- .1 Control voltage, 3 to 32 VDC.
- .2 Drop out voltage, 1.2 VDC.
- .3 Maximum input current to match AO (Analog Output) board.

.3 Output.

- .1 AC or DC Output Model to suit application.

2.18 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.

2.19 CONTROL DAMPERS

.1 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.

.2 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.

.1 Frame seals: synthetic type, mechanically locked into frame sides.

.3 Performance: minimum damper leakage meet or exceed [AMCA Standard 500-D] [___] ratings.

.1 Size/Capacity: refer to damper schedule

.2 [25] [___] L/s/m^2 maximum allowable leakage against [1000] [___] Pa static pressure for outdoor air and exhaust air applications.

.3 Temperature range: [minus 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 shaft and operate dampers throughout their range.

.2 Include corrosion resistant connecting hardware to accommodate connection to damper actuating device.

.3 Install using manufacturers installation guidelines.

.4 Use same manufacturer as damper sections.

2.20 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: [5] [___] VA maximum at 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 actuator to drive damper from full open to full closed in less than [120] [___] seconds.

2.21 CONTROL VALVES

.1 Body: [globe style], [characterized ball] [___].

.1 Flow characteristic as indicated on control valve schedule: [linear,] [equal percentage,] [quick opening] [___].

.2 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.

.3 [Normally open] [Normally closed], as indicated.

.4 [Two] [Three] port, 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], [brass], [bronze] [___].

.9

.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.

.11 NPS 2-1/2 and larger:

.1 Flanged connections.

.2 Valves to ANSI Class [150] [___] or [250] [___] as indicated, valves to bear ANSI mark.

.3 Rangeability [100:1] [___]minimum.

2.22 ELECTRONIC / ELECTRIC VALVE ACTUATORS

.1 Requirements:

.1 Construction: steel, cast iron, aluminum.

.2 Control signal: [0-10V DC] [or] [4-20 mA 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 actuator to meet requirements and performance of control valve specifications.

.7 For interior and perimeter terminal heating and cooling applications floating control actuators are acceptable.

.8 Minimum shut-off pressure: refer to control valve schedule.

2.23 WATTHOUR METERS AND CURRENT TRANSFORMERS

.1 Requirements:

.1 Include three phases, test and terminal blocks for watthour meter connections and connections for monitoring of current. [Provide twotransformers for 600 V 3 wire systems for watthour meter use] [___]. Accuracy: plus or minus [0.25] [___] % of

full scale. [For chiller applications: to have instantaneous indicator with analog or digital display] [___].

.2 Watthour meter sockets: to ANSI C12.7.

.3 Potential and current transformers: to ANSI/IEEE C57.13.

.4 Potential transformers: provide two primary fuses.

.5 Demand meters: configure to measure demand at [15] [___] minute intervals.

2.24 PANELS

.1 [Free-standing] [wall mounted] enamelled steel cabinets with hinged and key-locked front door.

.2 Multiple panels as [required] [indicated] to handle requirements with additional space to accommodate 25% additional capacity as required by [Departmental Representative] [Engineer] [Consultant] [___] without adding additional cabinets.

.3 Panels to be lockable with same key.

2.25 WIRING

.1 In accordance with Section [26 27 10 - Modular Wiring System] [26 27 26 - Wiring Devices].

.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] [20AWG stranded twisted pair].

.2 Analog input and output: shielded [#18 minimum solid copper] [#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 Fire stopping: provide space for fire stopping in accordance with Section [07 84 00 - Firestopping] [___]. Maintain fire rating integrity.

.6 Electrical:

.1 Complete installation in accordance with Section CSA C22.1-09, Canadian Electrical Code, Part 1 (21st Edition), Safety Standard for Electrical Installations.

.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 [in Section [25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation] [___]] [on drawings]. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by [Departmental Representative] [___]before beginning Work.

.4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

.5 All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

.6 All wiring and cabling, including that within factory-fabricated panels shall be labelled at each end within 5 cm (2in.) of termination with the EMCS point name.

.7 Install Low Voltage Control Wiring in EMT in the following circumstances:

.1 Mechanical rooms, electrical rooms, service rooms and exposed wiring – All wiring in mechanical, electrical, service rooms and exposed wiring – or where subject to mechanical damage – shall be in EMT.

.2 Communication wiring – Communication wiring to be installed in EMT where exposed. Communication wiring to mean all wiring linking building controllers, field panels and Operator Work Station(s).

.3 Power Wiring – Wiring supplying power to all levels of controllers to be in EMT where exposed.

.4 Building controllers, field panels and OWS(s) – All wiring between building controllers, field panels and OWS(s) to be installed in EMT where exposed. Field panels to mean all panels not considered building controllers. Ex: panels with I/P transducers.

.8 EMT Installation:

.1 EMT sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.

.2 Maximum EMT fill not to exceed [40]%.

.3 Minimum EMT size is 1.905 cm (¾ in.) unless its to final device where 1.27 cm (½ in.) would be acceptable.

.4 Include one pull string in each EMT 1.905 cm (¾ in.) or larger.

.5 Wherever possible, all wiring in EMT shall be installed as continuous lengths, with no splices permitted between termination points or junction boxes.

.6 Conceal all EMT, except within mechanical, electrical, or service rooms. Install EMT to maintain a minimum clearance of 15 cm (6 in.) from high-temperature equipment (e.g. steam pipes or flues)

.7 Flexible metal conduits and liquid-tight, flexible metal conduits shall not exceed 0.3048 m (1 ft) in length and shall be supported at each end. Flexible metal conduit less than 1.27 cm (½ in.) electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal conduits shall be used.

.8 EMT must be adequately supported, properly reamed at both ends, and left clean and free of obstructions. EMT sections shall be joined with steel set-screw connectors and couplings for EMT. Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

.9 Design drawings do not show conduit layout.

.10 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Departmental Representative to review before starting Work.

.9 Communication Wiring:

.1 The contractor shall adhere to the items in the “Electrical” article in Part 3 Of the specification Section 25 30 02 “EMCS: Field Control Devices”.

.2 Do not install communication wiring in raceway and enclosures containing Class 1 wiring.

.3 Maximum pulling, tension, and bend radius for cable installation, as specified by the cable manufacturer, shall not be exceeded during the installation.

.4 Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.

.5 When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lightning arrestor shall be installed according to the manufacturer’s instructions.

.6 All runs of communication wiring shall be unspliced length when that length is commercially available.

.7 All communication wiring shall be labelled to indicate origination and destination data.

.8 Power source to be labelled on each controller. A table of circuits used for the controllers installed to be submitted to NRC representative.

.9 All controllers to be wired to emergency power.

.7 Pneumatic: provide Pneumatic tubing, valves and fittings for field control devices in accordance with Section [23 09 43 - Pneumatic Control System for HVAC] [___].

.8 Mechanical: supply and install in accordance with Section [23 09 43 - Pneumatic Control System for HVAC] [___].

.1 Pipe Taps.

.2 Wells and Control Valves.

.3 Air flow stations, dampers, and other devices.

.9 VAV Terminal Units: supply, install and adjust as required.

.1 [Air probe, actuator and associated vav controls]

.2 Tubing from air probe to dp sensor as well as installation and adjustment of air flow sensors and actuators.

.3 Co-ordinate air flow adjustments with balancing trade.

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 Outdoor installation:

.1 Protect from solar radiation and wind effects by non-corroding shields.

.2 Install in NEMA 4 enclosures.

.4 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.

.5 Averaging duct type temperature sensors.

.1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.

.2 Wire multiple sensors in series for low temperature protection applications.

.3 Wire multiple sensors separately for temperature measurement.

.4 Use software averaging algorithm to derive overall average for control purposes.

.6 Thermowells: install for piping installations.

.1 Locate well in elbow where pipe diameter is less than well insertion length.

.2 Thermowell to restrict flow by less than 30%.

.3 Use thermal conducting paste inside wells.

3.3 PANELS

.1 Arrange for conduit and tubing entry from top, bottom or either side.

.2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.

.3 Identify wiring and conduit clearly.

3.4 MAGNEHELIC PRESSURE INDICATORS

.1 Install adjacent to fan system static pressure sensor and duct system velocity pressure sensor as reviewed by Departmental Representative.

.2 Locations: [as indicated] [as specified].

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 I/P TRANSDUCERS

.1 Install air pressure gauge on outlet.

3.7 AIR PRESSURE GAUGES

.1 Install pressure gauges on pneumatic devices, I/P, pilot positioners, motor operators, switches, relays, valves, damper operators, valve actuators.

.2 Install pressure gauge on output of auxiliary cabinet pneumatic devices.

3.8 IDENTIFICATION

.1 Identify field devices in accordance with Section [25 05 54 - EMCS: Identification] [___].

3.9 AIR FLOW MEASURING STATIONS

.1 Protect air flow measuring assembly until cleaning of ducts is completed.

3.10 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 SUMMARY

.1 Section Includes:

.1 At minimum detailed narrative description of Sequence of Operation of each system including ramping periods and reset schedules.

.1 System Diagrams consisting of the following; EMCS System architectural diagram, Control Design Schematic for each system (as viewed on OWS), System flow diagram for each system with electrical ladder diagram for MCC starter interface.

.2 Sequence of Operations

1.2 SCOPE OF WORK

.1 The intended sequences of operation for the mechanical and electrical systems are outlined in this section.

.2 Provide all labour and materials required to design, install and commission the specified sequences. If portions of the intended sequence are specified to be installed by others such as by the mechanical contractor, coordinate this work as outlined in the mechanical specification sequences by providing engineering data and control equipment as may be required, otherwise complete the work as outlined.

.3 Use the system schematics and point definition sheets along with the written sequence to develop the program structure.

.4 Allow a reasonable amount of time for program changes, which NRC may require due to unforeseen conditions with equipment performance, installation conditions or design intent.

1.3 STANDARD ROUTINES

.1 Turn off the equipment controlled by a local controller on a power interruption at the controller, as if a signal to stop the equipment had been given, unless the equipment is wired through normally closed contacts. On a return from power failure, restart or stop the equipment in an orderly fashion with time delays between each major system.

.2 If the power interruption has been to more than one local controller, the equipment start up shall be delayed between controllers.

.3 When equipment is in the off state, whether through program function, operator command or equipment failure, the following events must occur unless specified otherwise in the sequence.

.1 Close outside air, relief and exhaust dampers.

.2 Set control valves on water heating coils to allow some flow if the outside temperature is below freezing.

.3 Turn off humidification systems.

.4 Turn off interlocked equipment such as refrigeration equipment serving that unit only.

.5 Position variable speed or inlet dampers to minimum value.

.6 Close steam converter or heating coil valves.

.7 Issue alarms to indicate the status of the equipment that does not match the commanded state.

.4 Execute Control sequences if the associated equipment is operating. For example, if the operator puts a supply fan in the hand position, and the fan is capable of operating as there are no external interlocks or safeties that would prevent it from operating such as an end switch, the sequence shall execute as if the BAS system had initiated the start up.

.5 Structure programs and loop control such that integral windup does not occur.

1.4 ALARMS & EVENT MESSAGES

.1 Equipment failure shall be deemed to have occurred when the status point does not correspond with the commanded status. An alarm shall be generated.

.2 Whenever an input point or an output point has failed, is over ranged or not connected, the EMCS shall disable the input point and place all outputs dependent on the disabled input to a safe state. An alarm shall be generated for each occurrence.

.3 Allow programming labour for the generation of 2 alarm messages per major system.

.4 Provide room high and low temperature alarms set for 15 and 25 degrees.

.5 Designate alarms level 3 type unless specified otherwise.

1.5 SET POINTS

.1 All set points, time delay values and hours of operation as indicated in the sequence of operation or points list are for initial set up of the system. During the commissioning process and building operation, the set points are to be adjusted as deemed necessary to optimize HVAC system operation.

.2 Virtual set points shall be operator adjustable by commanding the point to the desired value.

1.6 SEQUENCE OF OPERATIONS

.1 Laboratory MUA and Fume Exhaust Systems Coordination:

.1 Provide overall RUN/STOP control for the MUA and Fume Exhaust Systems as selected by the BAS operator.

.2 Activate the BAS controls, start the Fume Exhaust system, then the MUA system and the HVAC control system in sequence on initial start-up, and in reverse order on shut down.

.2 Laboratory make-up air (MUA) System Existing 50AHU1:

.1 The existing 50AHU1 will be operating in sequence with the new fume exhaust fans in addition to the existing control for this unit.

.3 Laboratory Fume Exhaust System (EXF1-2) 50XAF134 and 50XAF135:

.1 General:

.1 Exhaust fans 50XAF134 and 50XAF135 serve the epitaxy labs.

.2 Exhaust fans 50XAF134 and 50XAF135 are lead and standby, variable speed, and should run 24/7 and alternate on a weekly basis.

.3 Exhaust fans 50XAF134 and 50XAF135 Are equipped with Piezometric rings for air flow reading.

.2 Stopped Mode:

.1 When the exhaust fans are both stopped, the fans isolation dampers shall be fully closed. By-pass air damper shall be fully closed.

.2 Motorized exhaust damper for room 295 shall remain at its set-point position.

.3 Inline exhaust fan 50EXF136 serving the scrubber in rm 289B shall be stopped.

.3 Start-Up Mode:

.1 50XAF134 and 50XAF135 will be started first by an OWS manual command or by an automatic start/stop program.

.2 As the system starts, the isolation damper for the lead fan shall fully open and the damper for the standby fan shall be fully closed. Bypass damper shall be fully closed. **Alarm if the damper is not fully opened.**

.3 The lead fan will alternate between the two (2) fans 50XAF134 and 50XAF135. Selection of lead and standby fan shall be evaluated on a weekly basis. The fan with the least run time shall be considered the lead fan and the other the standby. The EMCS system will start the standby fan after a 60 second delay should the start of the lead fan fail. Issue a level 2 alarm in the event the lead fan fails, and a level 1 alarm should all the (2)fans for the same system fail.

.4 A current sensor is installed on the load side of each of the fans. The EMCS system uses the sensor to confirm the fan is in the desired state (i.e. on or off) and generates an alarm if status deviates from EMCS start/stop control.

.4 Normal operation:

.1 Provide virtual HAND/OFF/AUTO control for each fume exhaust fan, as selected by the BAS operator.

.2 Modulate the speed of the fan to maintain the exhaust plenum static pressure set point (**175Pa**) (adjustable) as sensed by the average pressure of 3 differential pressure sensors.

.3 If the pressure in the plenum falls below set-point for more than 50Pa (adjustable) and the fan is at full speed, start the standby fan and stop the lead fan. If the loss of static pressure remain, a "priority 1" alarm should be sent to M06.

.4 Outdoor by-pass air damper operating procedure:

.1 When the fan is operated at a reduced speed to maintain the system static pressure and the airflow drops below the minimum, as read by the fan's Piezometric ring, (2360l/s, 5000 cfm, adjustable) and the static pressure in the main duct is at set-point, start opening the outdoor bypass damper gradually until the minimum air flow is reached.

.5 Interface with Fire Alarm: (requires editing)

.1 Monitor the EPITAXY Wing zone status of the existing fire alarm system. Upon receiving a signal indicating a fire within the zone; shut down the make-up air system.

.2 Upon receiving a signal from the fire alarm system indicating the fire emergency is over; start the make-up air system and reset the fume exhaust duct static pressure set point to its original value.

.4 Sequence of operation, room 295:

.1 General:

.1 Air balancing for the exhaust system in room 295 must be completed to the satisfaction of the departmental representative. In general, the air balancing shall be done with a diversity factor of 150% with the modulating damper fully open. When air balancing is completed, locate the position of the modulating damper for the 100% diversity factor of the required air flow for the room.

.2 Differential pressure between room 295 and (293, 294 and 289B), must be always negative. Set-point -4Pa (adjustable).

.2 Normal operation:

.1 The modulating damper for the branch serving room 295 shall be set at pre-set % position as determined by the air balancing for the required exhaust air flow for the room.

.2 When a loss in differential pressure is detected between room 295 and any of the adjacent rooms 293, 294 and 289B lower than (-1Pa) for more than 10 minutes (adjustable), modulate the damper open to maintain a minimum of (-4Pa) to any of the adjacent rooms.

.3 When the modulating damper position is 100% and the differential pressure to any of the adjacent rooms is (0Pa) for more than 5 minutes (adjustable), a "priority 1" alarm should be sent to M06.

.3 Operation under emergency conditions:

.1 RTU2 room pressure control operation mode:

.1 Use the new RTU2 to control the room 295 pressure. (Only in case of an emergency).

.2 When a loss in differential pressure is detected between room 295 and rooms 293, 294 and 289B lower than (-1Pa) and the exhaust air modulating damper is fully open, modulate closed the flow station to decrease the supply air flow to a minimum set-point (adjustable) to maintain the room differential pressure of (-4Pa). If the room temperature start increasing above the maximum set-point (adjustable) and **there is no toxic gas alarm**, start opening the RTU2 and room 295 return air dampers and increase the supply air to maintain the room temperature set-point. (It is preferred not to re-circulate the air to the RTU2 unless there is a need for it and safe to re-circulate and there is no toxic gas alarm).

.4 Toxic gas alarm situation:

.1 If a toxic gas alarm signal is received from the toxic gas monitoring system, open the exhaust control damper to 100% to increase the differential pressure of the room above set point. Shutdown the RTU2 if needed, if the differential pressure in the room is not satisfactory. (We need to discuss when the RTU to be turned off).

.5 Sequence of operation, RTU2 (50PAC19):

.1 General:

.1 The RTU2, DAIKIN **(50PAC19)** unit is dedicated for room 295 only.

.2 The unit is designed for 1800cfm and will be operated at around 1000cfm, 100% outdoor air.

.3 Supplemental electric heater is installed in the supply ductwork.

.4 Room 295 also has perimeter hot water heater.

.2 Stopped Mode:

.1 When the system is stopped, the supply fan 50PAC19 is stopped, the outdoor air damper, the exhaust air damper and the bypass damper are all fully closed. The return air damper is fully closed.

.2 The airflow station damper is closed

.3 The room 295 return air damper is fully closed.

.4 The electric duct heater PAC13_HTG is off.

.5 The perimeter hot water heater RAD is also off but shall be turned on should the temperature drop too low during winter operation as sensed by the space temperature sensor RMT.

.3 Start-Up Mode:

.1 RTU2 (50PAC19) will be started first by an OWS manual command or by an automatic start/stop program.

.2 When the airflow station senses status from the rooftop unit that is supplying the air 50PAC19 the damper shall open

.4 Normal operation:

.1 New (50PAC19) will operate to maintain the discharge air temperature set-point and duct static pressure.

.2 The airflow station shall modulate to provide a constant air volume to the lab space SAVSp 472L/S (1000cfm) (adjustable).

.3 The new (50PAC19) serving room 295 will supply constant 100% outside airflow around 1000cfm as determined by the airflow station set point (adjustable). Return air damper will be always closed.

.4 The room 295 return air damper will be always closed.

.5 The new (50PAC19) fan speed will increase or decrease to maintain a supply air duct pressure as sensed by the duct pressure sensor. Duct pressure set point will be determined on site; initial set-point around 70Pa.

.6 Supplemental duct electric heating:

.1 When in heating mode and when the internal electric heating is not sufficient. The supplemental external electric heater will modulate to maintain the discharge air temperature set point.

.5 Emergency power mode (when applicable)

.1 On emergency power, the supplemental electric heat will not be available.

.2 When on emergency power, reduce the supply air flow to the minimum set-point (adjustable) to maintain the room air temperature if needed.

.3 When on an emergency power and when the supply air flow is at minimum set-point and the room temperature is still below set-point, re-circulation of the air from room 295 will be allowed, as long as no toxic gas signal is present, to accommodate the room 295 temperature from dropping below a minimum set point.

.6 Interface with Gas Monitoring TGMS system: (requires editing)

.1 Monitor [ ].

.2 Upon receiving a signal from the TGMS or from the Scrubber pressure transducer, [ ].

.3 Send signal to the TGMS system to shut down the lab in an event that both exhaust fans 50EXF134 and 50EXF135 are off.

.6 **Sequence of operation, RTU1 (50PAC08):** (From EcoStruxure)

.1 General

.1 The rooftop unit System 50PAC08 consists of an outdoor air damper, return air damper, exhaust air damper, bypass damper electric heater, humidifier valve and a supply fan.

.2 The new 50PAC08 unit will serve the EPITAXY lab area VAV boxes, except room 295 and room 289B.

.2 Stopped Mode

.1 When the system is stopped, the supply fan 50PAC08 is stopped, the outdoor air damper, the exhaust air damper and the bypass damper are all fully closed. The return air damper is fully open.

.2 The humidifier valve PAC08_HUMVLV is closed.

~~.3 The electric heater PAC08_HTG is off.~~

.3 Start - Up Mode

.1 50PAC08 will be started first by an OWS manual command or by an automatic start/stop program.

.4 Normal Operation

.1 Supply air temperature, the outside air damper, return air damper and exhaust air damper PAC08_MAD will modulate to maintain supply air setpoint PAC08_DATSp 59°F (15°C) (adjustable).

.2 The mixed air temperature sensor PAC08_MAT will act as a low temperature reset and will not allow the temperature to drop below the setpoint PAC08_MATSp 50°F (10°C) (adjustable). Should enthalpy mode be detected the dampers will go to minimum position PAC08_MADMin 20% (adjustable).

.3 Supply air temperature, during winter operation the PAC08 internal SCR controlled electric heater will modulate ~~PAC08_HTG~~ to maintain supply air setpoint PAC08_DATSp 59°F (15°C) (adjustable) in conjunction with the mixed air dampers.

.4 Supply air temperature, during summer operation the DX cooling PAC08_CLG will be used when the mixed air dampers are at minimum position to maintain supply air setpoint PAC08_DATSp 59°F (15°C) (adjustable).

.5 Supply air pressure, the supply air fan speed will modulate to maintain a duct static pressure set-point as sensed by the duct pressure sensor PAC08_SSPSp 120Pa (adjustable).

.6 Return Air Humidity, during winter operation the humidifier valve PAC08_HUMVLV will modulate to maintain the return air humidity setpoint PAC08_RAHSp 35%Rh (adjustable).

.7 On a return to normal power following a power failure, the system will be restarted automatically, if so scheduled. The restart sequence to follow the heavy motor restart provisions.

.8 The DDC will monitor the supply fan status (PAC08_SFS – Dry Contact) and generate an alarm if status deviates from DDC start/stop control state.

.9 The DDC system will monitor the mixed air temperature PAC08_MAT and initiate a low temperature alarm below setpoint (PAC08_MATSp - 5°C).

.10 The DDC system will monitor the discharge air temperature PAC08_DAT and initiate a high space temperature alarm above setpoint (PAC08_DATSp + 10°C) and a low temperature alarm below setpoint (PAC08_DATSp - 5°C).

.11 The DDC system will monitor the return air humidity PAC08_RAH and initiate a high space humidity alarm above setpoint (PAC08_RAHSp + 10%Rh) and a low humidity alarm below setpoint (PAC08_RAHSp – 10%Rh).

1.7 Lab VAV – Sequence of Operation

.1 General

.1 The lab VAV system consist of a VAV, and a perimeter hot water heater (if applicable).

.2 Stopped Mode

.1 When the system is stopped, the VAV is closed.

.2 The perimeter hot water heater RAD (if applicable) is also off but shall be turned on should the temperature drop too low during winter operation as sensed by the space temperature sensor RMT.

.3 Start - Up Mode

.1 When the VAV senses status from the rooftop unit that is supplying the air 50PAC08 the box shall open.

.4 Normal Operation

.1 The VAV shall modulate to maintain the lab space temperature set point (adjustable).

.2 Lab space temperature, the perimeter hot water heater RAD (if applicable) shall be used to maintain the space temperature at set point RMTSp 69.8°F (21°C) (adjustable) if the VAV is fully open and the lab space temperature continue to drop.

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 35 30.

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 Light fixtures are the only exceptions for electrical equipment identification (except as noted in 7.13 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 condulets of existing conduits as follows:

- .1 Fire alarm – red
- .2 Emergency power circuits – yellow
- .3 Voice/data – blue
- .4 Gas detection system – purple
- .5 Building Automation system – orange
- .6 Other base building low voltage control system - white
- .7 Security system – green
- .8 Research center control system - black

.3 For system running with cable, half-lap wrap with dedicated coloured PVC tape to 100 mm width, tape every 5 m and both sides where cable penetrates a wall.

.4 All other systems to follow site instruction from NRC departmental representative.

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 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 stranded wire no smaller than No. 12 AWG for lighting and power and no smaller than No. 16 AWG for control wiring.
- .7 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 volt 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 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 WIRE AND BOX CONNECTORS

.1 Pressure type wire connectors sized to fit conductors.

2.2 WIRING TERMINATIONS

.1 Provide first grade wire and cable connectors suitable for the service on which they are used and install them in accordance with the latest trade practice.

.2 Provide high quality extruded copper-free aluminium (0.4% or less) connectors for single and multi conductor cable. Steel and then zinc plated connectors for multi conductor cables.

.3 When used in hazardous area, connectors should be certified for such location in Class, Division and Group.

.4 For large conductor sizes, use bolted or compression solderless type connectors.

.5 Use high temperature connectors and insulation on all connections of high temperature conductors.

.6 Where connector types are called for on the drawings or in the specification, do not use other types.

.7 Lugs, terminals, screws used for termination of wiring to be suitable for copper conductors.

.8 For fire alarm wiring refer to Section 28 31 00.

Part 3 Execution

3.1 INSTALLATION

.1 Install stress cones, terminations, and splices in accordance with manufacturer's instructions.

.2 Bond and ground as required [to CSA C22.2No.41].

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1-09, Canadian Electrical Code, Part 1, 21st Edition

PART 2 - PRODUCTS

2.1 SPLITTERS

.1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Terminations: main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

.3 Spare Terminals: minimum three spare terminals or lugs on each connection or lug block sized less than 400 A.

2.2 JUNCTION AND PULL BOXES

.1 Construction: welded steel enclosure.

.2 Covers Surface Mounted: screw-on flat, turned edge covers

PART 3 - EXECUTION

3.1 SPLITTER INSTALLATION

.1 Mount plumb, true and square to building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Install terminal block as indicated in Type T cabinets.

.3 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1

3.3 IDENTIFICATION

.1 Equipment Identification: to Section 26 05 00.

.2 Identification Labels: size 2 indicating system name, voltage and phase or as indicated

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 FITTINGS

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

.2 Steel coupling for EMT.

.3 Fittings for liquid-tight flexible conduits shall be liquid-tight connectors.

.4 Provide expansion couplings for all conduits running in slabs through expansion joints. These shall be the type approved for use in concrete with a bonding conductor.

.5 Factory bends are not permitted to be modified. Ensure conduit bends other than factory bends are made with an approved bender. Making offsets and other bends by cutting and rejoining factory bends are not permitted.

2.2 OUTLET BOXES

.1 Size boxes in accordance with CSA-C22.

.2 Unless otherwise specified, provide galvanized steel outlet boxes at least 40mm (1-1/2") deep, single or ganged style, of proper size to accommodate devices used and shall be equipped with covers as necessary of the type designed for the specified fittings. Pull boxes shall be steel and shall be galvanized or painted to prevent rusting. For lighting fixture outlets, use 100mm (4") octagon boxes.

.3 Equip with plaster rings for flush mounting devices in finished walls.

.4 Blank cover plates for boxes without wiring devices.

.5 Equip with centre fixture studs for light fixtures.

.6 Use cast boxes where indicated and for surface mounted wiring. In areas above hung ceilings where appearance is not significant, pressed steel surface boxes may be used.

.7 Supply all outlet boxes and pull boxes sized according to code requirements unless specified otherwise on the drawings.

2.3 SUPPORT HARDWARE

.1 Use 10mm (3/8") threaded rod for suspended unistrut and conduit.

.2 Unless otherwise specified, use 41mm x 41mm (1-5/8" x 1-5/8") galvanized steel unistrut for conduit support systems.

Part 3 Execution

3.1 INSTALLATION

.1 Install outlet boxes as follows:

.1 Support boxes independently of connecting conduits.

.2 Make necessary mounting adjustments to the outlet to match interior finish.

.3 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of construction material.

.4 Where more than one conduit enters a switch or receptacle box on the same side, provide a 100mm (4") minimum square box with a suitable plaster ring.

.5 Location and appearance to be to the NRC Departmental Representative's approval.

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 RACEWAYS

.1 General:

.1 Unless otherwise noted, all wires to run inside raceways, either in ceiling space, open space or surface mounted.

.2 Conduit:

.1 Each length of conduit to be new and bear the CSA Stamp of Approval.

.2 Conduit, unless otherwise noted, to be EMT, no smaller than 16mm (1/2").

.3 Conduit to be coloured as required for systems described in section 260500.9.

.3 Bushings and Connectors:

.1 Insulated type, with the insulation an integral part of the fitting.

.4 Conduit Fastening:

.1 One hole malleable iron straps to secure surface conduits. Two hole straps for conduits larger than 50mm (2").

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits.

.5 Pull Cord:

.1 Polypropylene cord in empty conduit.

.6 Unless specifically called for on the drawings, do not use flexible conduits but it is recognized that there may be applications where this material will be useful, such as equipment connections, etc. In such cases, obtain permission for its use from the NRC Departmental Representative. For tender purposes, assume that flexible conduits will not be permitted unless specifically called for on the drawings or equipment specifications. All flexible conduits for vapour-tight applications shall be liquid-tight flexible conduits (seal-tight).

.7 Provide expansion couplings for all conduits running in slabs through expansion joints. These shall be the type approved for use in concrete with a bonding conductor.

.8 Use AC90 (BX) cable **only** under the following conditions:

.1 Wiring from a junction box to a recessed device, such as lighting fixture, sensor, speaker, BAS control device, etc. in suspended ceilings. Cable length not to exceed straight run from junction box to device plus 1.5 m (5'), or

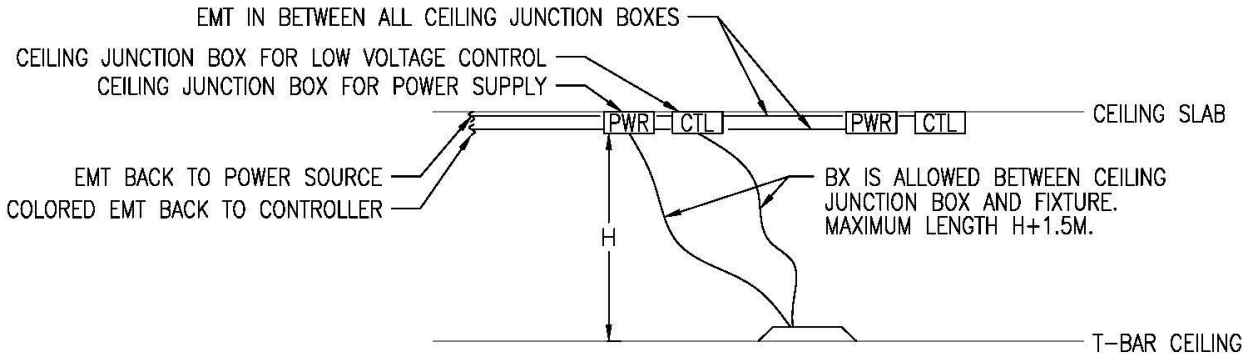
.2 Wiring switches or receptacles in existing or new hollow gypsum partitions, vertical runs only with cable length not to exceed 3.5m (12’), or

.3 When specifically called for on drawings or approved in writing by departmental representative.

.4 AC90 shall not be used in insulated walls or masonry walls.

.5 Only AC90 cable of No. 12 AWG will be accepted for 120V AC circuits.

.6 Sample diagram shown as below:



2.2 SUPPORT HARDWARE

.1 Use 10mm (3/8") threaded rod for suspended unistrut and conduit.

.2 Unless otherwise specified, use 41mm x 41mm (1-5/8" x 1-5/8") galvanized steel unistrut for conduit support systems.

Part 3 Execution

3.1 RACEWAYS

.1 Install raceways as follows:

.1 Rigidly supported.

.2 Workmanlike manner.

.3 Maintain maximum headroom.

.4 Concealed in finished area.

.5 Surface-mounted in open area.

.6 Do not pass conduits through structural members except as indicated.

.7 Parallel to or at right angles to the building lines.

.8 Thoroughly ream all conduits at ends and terminate with appropriate locknuts and bushings.

.9 Cause minimum interference in spaces through which they pass.

.10 Plug or cap conduit during construction to protect from dust, dirt or water.

.11 Unless specifically indicated on drawings or with the permission of the NRC Departmental Representative, do not cast conduits in concrete.

.12 Dry conduits out before installing wire.

.13 Mechanically bend conduit of any size. Bend conduit cold.

.14 Do not cut or modify prefabricated bends.

.15 PVC conduit as indicated.

.16 Function and appearance to be to the NRC Departmental Representative's approval.

.17 Seal conduit and cable openings in fire- rated walls and floors with an approved fire stop material.

.18 Seal conduit and cable openings in exterior walls with a weatherproof silicone sealant.

.19 Paint exposed conduits and boxes to match existing wall / ceiling except the colored EMT specified in 260500.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 10 00.

.2 Submit stamped engineered drawings for structures supporting transformers on walls or other structures other than the floor.

.3 Prior to any installation of circuit breakers in either a new or existing installation, Contractor must submit three (3) copies of a certificate of origin, from the manufacturer, duly signed by the factory and the local manufacturer's representative, certifying that all circuit breakers come from this manufacturer, they are new and they meet standards and regulations. These certificates must be submitted to the Departmental Representative for approval.

.1 The above applies to all breakers rated above 240V.

.2 The above applies to all breakers rated up to 240V and 100A or more.

.4 A delay in the production of the certificate of origin won't justify any extension of the contract and additional compensation.

.5 Any work of manufacturing, assembly or installation should begin only after acceptance of the certificate of origin by Departmental Representative. Unless complying with this requirement, Departmental Representative reserves the right to mandate the manufacturer listed on circuit breakers to authenticate all new circuit breakers under the contract at the Contractor's expense.

.6 In general, the certificate of origin must contain:

.1 The name and address of the manufacturer and the person responsible for authentication. The responsible person must sign and date the certificate;

.2 The name and address of the licensed dealer and the person of the distributor responsible for the Contractor's account.

.3 The name and address of the Contractor and the person responsible for the project.

.4 The name and address of the local manufacturer's representative. The local representative must sign and date the certificate.

.5 The name and address of the building where circuit breakers will be installed:

.1 Project title.

.2 End user's reference number.

.3 The list of circuit breakers.

1.2 IDENTIFICATION

.1 Identification as per Section 26 05 00.

Part 2 Products

2.1 DISCONNECT SWITCHES, FUSED AND NON-FUSED

.1 Fusible and non-fusible disconnect switches in EEMAC Enclosure as indicated.

.2 Provision for padlocking in "OFF" switch position.

.3 Mechanical voidable door interlock in "ON" position.

.4 Fuses: size and type as indicated.

.5 Fuseholders in each switch to be suitable without adaptors, for type and size of fuse indicated.

.6 Quick-make, quick-break action.

.7 "ON-OFF" switch position indication on switch enclosure cover.

.8 Standard of acceptance: Square D.

2.2 GROUNDING

.1 Insulated grounding conductors in accordance with Section 26 05 00.

.2 Compression connectors for grounding to equipment provided with lugs.

2.3 DRY TYPE TRANSFORMER

.1 Type ANN, C802.2.

.2 Single or three phase, KVA rating, input and output voltage as indicated.

.3 Class 200, 130°C temperature rise insulation rating for 15kva and 30kva transformer. Class 220, 150°C temperature rise insulation system for other sizes.

.4 Copper windings.

.5 Four 2.5% taps, 2-FCAN and 2-FCBN.

.6 EEMAC 1 enclosure with lifting lugs, removable metal front and side panels.

.7 Drip shield.

.8 Meet latest efficiency regulation: DOE 2016/ NRCAN 2018/ONTARIO GREEN ENERGY ACT 2018.

.9 Standard of acceptance: Hammond.

2.4 PANELBOARDS

.1 600 volt rated power panelboards: bus and breakers rated for 25,000 amp r.m.s. symmetrical interrupting capacity at 600V or as indicated.

.2 250 volt lighting panelboards to have minimum interrupting capacity of 10,000 amp r.m.s. symmetrical.

.3 Panelboards that have a main breaker indicated in plan shall be service entranced approved (i.e. barrier to separate main breaker from remainder of panels).

.4 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.

.5 Panelboards: mains, number of circuits, number and size of branch circuit breakers as indicated.

.6 Two keys for each panelboard and all panelboards to be keyed alike.

.7 Copper bus, neutral and ground bar with neutral of same ampere rating as mains.

.8 Suitable for: plug-in breaker for molded case circuit breaker, bolt-on breakers for miniature circuit breaker

.9 Hinged door, trim finish: baked grey enamel.

.10 Drip shield.

.11 Surface mount with hinge door, unless otherwise indicated on drawing.

.12 Complete circuit directory with typewritten legend showing description of each circuit.

.13 3 Phase panel shall be equipped with 100% neutral unless otherwise indicated on the drawing.

.14 Manufacturer: Square D.

2.5 MOLDED CASE CIRCUIT BREAKER

.1 Thermal-magnetic moulded case circuit breakers, quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.

.2 Common-trip breakers with single handle for multiple applications.

.3 All new 120V to 600V circuit breakers installed on this project are to include the handle accessory, "Handle Padlock Attachment", which locks breakers on or off.

.4 Magnetic instantaneous trip elements in circuit breakers, to operate only when the value of current reaches 10 times their setting.

.5 Circuit breaker and panel to be of same manufacturer.

Circuit breakers minimum interrupt rating: 25KA for 600/347V or greater if indicated.

.6 Self-powered Electronic trip unit as indicated by drawing.

LI: long time and instantaneous

LSI: long time, short time and instantaneous

LSIG: long time, short time , instantaneous and grounding

A: with Ammeter

E: with energy meter

.7 On board control power for trip unit unless otherwise indicated on drawing

.8 Standard of acceptance: Square D or match existing panel.

2.6 FUSES

.1 250V and 600V time delay, Class J unless otherwise indicated.

Part 3 Execution

3.1 DISCONNECT SWITCHES

.1 Install disconnect switches complete with fuses as indicated.

3.2 GROUNDING

.1 Install complete permanent, continuous, system and circuit, equipment, grounding systems including, conductors, compression connectors, accessories, as indicated, to conform to requirements of Engineer, and local authority having jurisdiction over installation. 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 Soldered joints not permitted.

3.3 DRY TYPE TRANSFORMER

.1 Transformers above 75 kVA mount on floor.

.2 Provide adequate clearance around transformer for ventilation.

.3 Install transformers in level upright position.

.4 Remove shipping supports only after transformer is installed and just before putting into service.

.5 Loosen isolation pad bolts until no compression is visible.

.6 Make primary and secondary connections shown on wiring diagram.

.7 Energize transformers immediately after installation is completed, where practicable.

.8 Provide equipment identification in accordance with Section 26 05 00.

.9 Connect transformer through side of housing.

3.4 PANELBOARDS

.1 Locate panelboards as indicated and mount securely, plumb, and square, to adjoining surfaces.

.2 Mount panels to height specified in section 26 27 26 or as indicated.

.3 Connect loads to circuits as indicated.

.4 Connect neutral conductors to common neutral bus.

3.5 MOLDED CASE CIRCUIT BREAKERS

.1 Install circuit breakers as indicated.

3.6 FUSES

.1 Install fuses in mounting devices immediately before energizing circuit.

.2 Install fuses correctly sized to assigned electrical circuits.

.3 Provide 3 spare fuses for each rating supplied.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 Motors and controls to Sections 26 22 19, 26 29 03 & 26 29 10.

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.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 10 00.

1.4 IDENTIFICATION

.1 Identification as per Section 26 05 00.

Part 2 Products

2.1 WIRING DEVICES

.1 Switches:

- .1 Specification grade, shallow body, designed to withstand high inductive fluorescent loads CSA C22.2 No. 55.
- .2 Number of poles as indicated.
- .3 Captive mounting screws, quiet safe mechanical action with rust-proofed mounting strap and silver alloy contact points.
- .4 Toggle actuated, colour white unless otherwise indicated.
- .5 Brass screw terminals rated 20 AMP at 125 volt.
- .6 Standard of acceptance: Hubbell, Leviton.

.2 LED Dimming Switches:

- .1 0-10VDC, electronic, suitable for use with installed light fixture.
- .2 Rated for 1200W.
- .3 Suitable for use in “3-way” configuration where indicated.
- .4 Standard of acceptance:
  - .1 Philips SR1200ZTUNV or equivalent approved by NRC Departmental Representative.
  - .2 3-way style to be Philips SR3W or equivalent approved by NRC Departmental Representative.

.3 LED occupancy sensor (wall mounted):

.1 120V, suitable for use with installed light fixture.

.2 Rated for 600W LED.

.3 Can be set to Manual-ON/Automatic-OFF or Auto-ON/Auto-OFF.

.4 Adjustable delayed-OFF time.

.5 Suitable for use in “3-way” configuration where indicated.

.6 Fire year warranty.

.7 Standard of acceptance: Hubbell, Leviton, Philips or equivalent approved by NRC Departmental Representative.

.4 LED occupancy sensor (ceiling mounted):

.1 120V, suitable for use with installed light fixture.

.2 360° coverage pattern.

.3 No minimum load requirements.

.4 Adjustable delayed-OFF time.

.5 No field calibration or sensitivity adjustments required.

.6 Fire year warranty.

.7 Standard of acceptance: Philips LRM2377 or equivalent approved by NRC Departmental Representative.

.5 LED dimmable motion switches:

.1 Dimmer with dual technology utilizes PIR/Microphonics detection to control LED fixtures.

.2 180° sensor field-of-view.

.3 Up to 20’ motion detection.

.4 Integrated photocell with adaptive daylight harvesting.

.5 Adjustable timeout and high/low sensitivity adjustment.

.6 Adjustable settings for auto-on light level: 100%, 50%, last light level, or locked pre-set light level.

.7 120V.

.8 5 year warranty.

.9 Standard of acceptance: Sensorswitch WSX-PDT-D-VLP-WH.

.6 Receptacles:

.1 Duplex type, CSA type 5-15R, 125 volt, 15A, U ground, specification grade with the following features:

.1 Flush type with parallel blade slots.

.2 Double-wiping contacts.

.3 Double-grounding terminals.

.4 Break-off feature for separate feeds.

.5 One piece body, colour white unless otherwise indicated.

.2 Special receptacles with ampacity and voltage as indicated.

.3 Receptacles of one manufacturer throughout the project.

.7 Rooftop maintenance receptacles:

.1 Class A type ground fault protection.

.2 CSA 5-20R configuration.

.3 Supplied by a dedicated circuit.

.8 Outdoor GFCI Receptacles cover:

.1 Non-metallic In-Use cover.

.2 Single gang. Deep cover. Clear color.

.3 Horizontal or vertical mount.

.4 Includes attached gasket and mounting hardware.

.5 Standard of acceptance: Hubbell MM510C.

.9 Cover Plates:

.1 Cover plates for wiring devices.

.2 Smooth white plastic for wiring devices mounted in flush-mounted outlet box.

.3 Sheet metal cover plates for wiring devices mounted in surface-mounted outlet box.

.4 Multi-outlet covers as indicated.

.10 Splitters, Junction Boxes & Cabinets:

.1 Sheet metal enclosure, welded corners and formed cover, provided as required.

.2 Splitter to be 3 phase, 4 wires, minimum 225A, voltage as indicated. Refer to drawing for quantity of the lugs. Allow minimum two extra lugs for future use, size to match the maximum rating of the existing wire.

Part 3 Execution

3.1 LOCATION OF OUTLETS

.1 The number and general location of outlets for lighting, power, telephones, etc., are to be as shown on the drawings. Install all outlets accurately and uniformly with respect to building details. When centering outlets, make allowance for overhead pipes, ducts, etc. and for variations in wall or ceiling finish, window trim, etc. Reinstall incorrectly installed outlets at no cost to the Owner. Make field power and control connections as indicated.

.2 The location of all outlets as shown on the plans are approximate and are subject to change, up to 3m (10') without extra cost or credit provided the information is given prior to the installation of the outlet.

.3 Unless otherwise specified, locate light switches on latch side of doors. Determine the direction of all door swings from the architectural drawings or on site, not from the electrical drawings.

.4 Locate roof top maintenance receptacle within 7.5m of the rooftop electrical equipment.

3.2 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not indicated verify before proceeding with installation.

.3 Generally, locate outlets as follows: (except those otherwise shown on the drawings):

- .1 Local switches 1.2m (3'-11") to centreline.
- .2 Wall receptacles 400mm (1'-4") to centreline.
- .3 Clock receptacles 2.4m (8'-0") to centreline.
- .4 Lighting panels 1.8m (6'-0") to top.
- .5 Telephone and data communications outlet 400mm (1'-4") to centreline.
- .6 Fan coil speed control switch 1.2m (3'-11") to centreline.
- .7 Roof top maintenance receptacle: 750mm above the finished roof.

3.3 WIRING DEVICES

.1 Install wiring devices as follows:

- .1 Where more than one local device is shown at one location, they are to be set under one cover plate.
- .2 Install single throw switches with handle in "up" position when switch closed.
- .3 Devices in gang type outlet box when more than one device is required in one location.
- .4 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .5 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
- .6 Install metal barriers where required.
- .7 Remove insulation carefully from ends of conductors and connect wiring as required.
- .8 Bond and ground as required.

3.4 SPLITTERS AND DEVICES

.1 Installation of splitters, junction boxes, pull boxes & cabinets as follows:

- .1 Mount plumb, true and square to the building lines.
- .2 Install in inconspicuous but accessible locations.
- .3 Install pull boxes so as not to exceed 30 m (100') of conduit run between boxes or as indicated.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Common Work Results - Electrical Section 26 05 00

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 10 00.

.2 Include schematic, wiring, interconnection diagrams.

.3 Indicate:

- .1 Mounting method and dimensions.
- .2 Starter size and type.
- .3 Layout of identified internal and front panel components.
- .4 Enclosure types.
- .5 Wiring diagram for each type of starter.
- .6 Interconnection diagrams.

.4 Motors specified and supplied with mechanical equipment. Refer to Division 23.

1.3 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 00 10 00.

.2 Include operation and maintenance data for each type and style of starter.

Part 2 Products

2.1 MATERIALS

.1 Starters:

- .1 IEC rated starters not acceptable.

2.2 MANUAL MOTOR STARTERS

.1 Single and three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:

- .1 Switching mechanism, quick make and break.
- .2 One and three overload heaters as indicated, manual reset, trip indicating handle.

.2 Accessories:

- .1 Toggle switch, key switch or pushbutton as specified.
- .2 Indicating light: type and colour as indicated.

.3 Locking tab to permit padlocking in "ON" or "OFF" position.

.3 Standard of acceptance: Square D, Class 2510 or approved equal.

2.3 FULL VOLTAGE MAGNETIC STARTERS

.1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:

.1 Contactor solenoid operated, rapid action type.

.2 Solid state overload protective device in each phase, class 10/20 selectable, manually reset from outside enclosure. Provide protective functions: thermal overload, phase loss/imbalance, selectable trip class, voltage/current unbalance, long start/jam, phase reversal, ground fault.

.3 Power and control terminals.

.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 Combination type starters to include motor circuit interrupter or circuit breaker with adjustable protective setting, operating lever on outside of enclosure to control motor circuit interrupter or circuit breaker and provision for:

.1 Locking in "OFF" position with up to 3 padlocks.

.2 Locking in "ON" position.

.3 Independent locking of enclosure door.

.4 Provision for preventing switching to "ON" position while enclosure door open.

.3 Accessories:

.1 Pushbuttons and selector switches: type and labelled as indicated.

.2 Indicating lights: PUSH TO TEST type and color as indicated.

.3 2-N/O and 2-N/C spare auxiliary contacts unless otherwise indicated.

.4 Standard of acceptance: Square D, Class 8539 or approved equal.

2.4 MULTI-SPEED STARTERS

.1 2-Speed starters of size, type, rating, and enclosure type as indicated. Starter suitable for constant torque and variable torque type motor with components as follows:

.1 One-3 pole contactor for each winding for separate winding motors.

.2 Three overload relays with 3 heater elements and manual reset for each speed.

.2 Accessories:

.1 Selector switches: standard labelled as indicated.

.2 Indicating lights: PUSH TO TEST type and color as indicated.

.3 Auxiliary control devices as indicated.

2.5 FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 00.

2.6 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 260500.

Part 3 Execution

3.1 INSTALLATION

.1 Install starters, connect power and control as indicated.

.2 Install control devices and relay panels and interconnect as indicated.

.3 Install correct fuses and overload device elements.

.4 Megger all motors. Dry out motor if dampness is present in accordance with manufacturer's recommendations.

.5 For installation of motor with mechanical equipment refer to Division 23.

.6 Make connection to motor as indicated. Use liquid-tight PVC jacketted flexible conduit between rigid conduit and motor.

.7 Make flexible conduit long enough to permit movement of motor.

3.2 TESTS

.1 Perform tests in accordance with Section 26 05 00 and Manufacturer's instructions.

.2 Operate switches, 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.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Common Work Results - Electrical Section 26 05 00

1.2 DESCRIPTION

.1 This specification is to cover a complete Variable Frequency motor Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor.

.2 The drive manufacturer shall supply the drive and all necessary controls as herein specified. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of twenty years. All VFDs installed on this project shall be from the same manufacturer.

1.3 QUALITY ASSURANCE

.1 Referenced Standards:

1. Institute of Electrical and Electronic Engineers (IEEE)
   - .1 Standard 519-1992, IEEE Guide for Harmonic Content and Control.

.2 Underwriters laboratories
   - .1 UL508C

.3 National Electrical Manufacturer's Association (NEMA)
   - .1 ICS 7.0, AC Adjustable Speed Drives

.4 IEC 16800 Parts 1 and 2

.5 CSA 22.2

.2 Qualifications:

.1 VFDs and options shall be UL listed and CSA approved as a complete assembly. VFDs that require the customer to supply external fuses for the VFD to be UL listed are not acceptable. VFDs requiring additional branch circuit protection are not acceptable. The base VFD shall be UL listed for 100 KAIC without the need for input fusing.

1.4 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 10 00.

.2 Include schematic, wiring, interconnection diagrams.

.3 Indicate:

.1 Outline dimensions, conduit entry locations and weight.

.2 Customer connection and power wiring diagrams.

.3 Complete technical product description include a complete list of options provided. **Any portions of the specifications not complied with must be clearly indicated**

or the supplier and contractor shall be liable to provide all components required to meet the specification.

.4 Compliance to IEEE 519 – harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD).

.1 The VFD manufacturer shall provide calculations, where required on the drawing; specific to the installation, showing total harmonic voltage distortion is less than 5%.

.2 Input filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with the IEEE electrical system standard 519. All VFDs shall include a minimum of 5% equivalent impedance reactors, **no exceptions**.

.4 Motors specified and supplied with mechanical equipment. Refer to Division 23.

1.5 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 00 10 00.

.2 Include operation and maintenance data for each type and style of starter.

.3 On completion of the installation, the supplier shall provide the following:

.1 Full commissioning report documenting all programmable settings, AC input voltage, DC Bus voltage, current draw at maximum speed, and a description of ambient conditions.

.2 One operator's manual for each VFD installed.

.3 One 8.5" x 11" wiring diagram for each VFD installed.

1.6 GENERAL DESIGN CHARACTERISTICS

.1 The VFD shall be of the Pulse Width Modulated (PWM) type.

.2 The VFD shall be rated for variable torque applications, with an overload rating of 110% for 60 seconds.

.3 All VFD's shall be factory UL/cUL Listed.

.4 All packaged drive systems shall be CSA Listed.

.5 The VFD shall have the capability of operating multiple motors. The minimum VFD continuous current rating shall be the sum of the full load current ratings of the connected motors.

.6 The VFD shall have a minimum displacement power factor of 0.96 or higher at all output frequencies.

.7 The VFD manufacturer shall have a minimum of ten years experience in the Canadian Market.

Part 2 Products

2.1 VARIABLE FREQUENCY DRIVES

.1 The VFD package as specified herein shall be enclosed in a NEMA rated enclosure, completely assembled and tested by the manufacturer in an ISO9001 facility. The VFD tolerated voltage window shall allow the VFD to operate from a line of +30% nominal, and -35% nominal voltage as a minimum.

.1 Environmental operating conditions: 0 – 40^0 C continuous. Altitude 0 to 3300 feet above sea level, up to 95% humidity, non-condensing. All circuit boards shall have conformal coating.

.2 The VFD shall operate within the following rated values.

.1 Output Frequency Range: 0.1 to 400 Hz.

.2 Overload Rating: VT – 110% for 60 seconds

.3 Input Voltage: 3 phase + ground , 600V +10% / -20%

.4 Input Frequency: 48-62 Hz

.3 The VFD shall be designed to include the following protective functions and display for maintainability:

.1 *Instantaneous Over Current Protection*: The VFD output shall be turned off if the operating current exceeds the specified level.

.2 *Motor Overload Protection*: cUL/CSA approved electronic thermal overload protection.

.3 *External Trip Input*: Programmable for either N/O or N/C operation.

.4 *Over Voltage Protection*: The VFD output shall turned off if the DC Bus voltage exceeds the specified level.

.5 *Ground Fault Protection*: The VFD output shall turned off in the event of a ground fault.

.6 *Line or Load Phase Loss Protection*: Programmable for enable - disable

.7 *Software Lock*: The VFD shall include a software function that prevents changes to the user-defined settings.

.8 *CPU or EEPROM Error*: The VFD output shall turned off in the event of an error in the CPU or EEPROM.

.4

.2 All VFDs shall have the following features:

.1 All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.

.2 The keypad shall include Hand-Off-Auto selections and manual speed control. There shall be fault reset and “Help” buttons on the keypad. The Help button shall include “on-line” assistance for programming and troubleshooting.

.3 There shall be a built-in time clock in the VFD keypad. The clock shall have a battery back up with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. If the battery fails, the VFD shall automatically revert to hours of operation since initial power up. The clock shall also be programmable to control start/stop functions,

constant speeds, PID parameter sets and output relays. The VFD shall have a digital input that allows an override to the time clock (when in the off mode) for a programmable time frame. There shall be four (4) separate, independent timer functions that have both weekday and weekend settings. Capacitor backup is not acceptable.

.4 The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to setpoint without safety tripping or component damage (flying start).

.5 The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430-150 for 4-pole motors.

.6 The VFD shall have 5% equivalent impedance internal reactors to reduce the harmonics to the power line and to add protection from AC line transients. The 5% equivalent impedance may be from dual (positive and negative DC bus) reactors, or 5% AC line reactors. VFDs with only one DC reactor shall add an AC line reactor.

.7 The VFD shall include a coordinated AC transient protection system consisting of 4-120 joule rated MOV's (phase to phase and phase to ground), a capacitor clamp, and 5% equivalent impedance internal reactors.

.8 The VFD shall provide a programmable proof of flow Form-C relay output (broken belt / broken coupling). The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay outputs shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false underload condition.

.3 All VFDs to have the following adjustments:

.1 Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.

.2 Two (2) PID Setpoint controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed loop control. The VFD shall have 250 ma of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. There shall be two parameter sets for the first PID that allow the sets to be switched via a digital input, serial communications or from the keypad for night setback, summer/winter setpoints, etc. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain setpoint of an independent process (ie. valves, dampers, etc.). All setpoints, process variables, etc. to be accessible from the serial communication network.

.3 Two (2) programmable analog inputs shall accept current or voltage signals.

.4 Two (2) programmable analog outputs (0-20ma or 4-20 ma). The outputs may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, and other data.

.5 Six (6) programmable digital inputs.

.6 Three (3) programmable digital Form-C relay outputs. The relays shall include programmable on and off delay times and adjustable hysteresis. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating 2 amps RMS.

Outputs shall be true Form-C type contacts; open collector outputs are not acceptable.

.7 Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close.

.8 Two independently adjustable accel and decel ramps with 1 – 1800 seconds adjustable time ramps.

.9 The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and audible motor noise.

.10 The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows higher carrier frequency without derating the VFD or operating at high carrier frequency only at low speeds.

.11 The VFD shall include password protection against parameter changes.

.4 The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (LED and alpha-numeric codes are not acceptable). All VFD faults shall be displayed in English words.

.5 All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):

.1 Output Frequency

.2 Motor Speed (RPM, %, or Engineering units)

.3 Motor Current

.4 Drive Temperature

.5 DC Bus Voltage

.6 Output Voltage

.6 The VFD shall include a fireman's override input. Upon receipt of a contact closure from the fireman's control station, the VFD shall operate in one of two modes: 1) Operate at a programmed predetermined fixed speed or operate in a specific fireman's override PID algorithm that automatically adjusts motor speed based on override set point and feedback. The mode shall override all other inputs (analog/digital, serial communication, and all keypad commands), except customer defined safety run interlock, and force the motor to run in one of the two modes above. "Override Mode" shall be displayed on the keypad. Upon removal of the override signal, the VFD shall resume normal operation.

.7 Serial Communications

.1 The VFD shall have an RS-485 port as standard. The standard protocols shall be Modbus, BACnet, Johnson Controls N2 bus, and Siemens Building Technologies FLN. Each individual drive shall have the protocol in the base VFD. The use of third party gateways and multiplexers is not acceptable. All protocols shall be "certified" by the governing authority (i.e. BTL Listing for BACnet). Use of non-certified protocols is not allowed.

.2 The BACnet connection shall be an RS485, MS/TP interface operating at 9.6, 19.2, 38.4, or 76.8 Kbps. The connection shall be tested by the BACnet Testing Labs

(BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:

.1 Data Sharing – Read Property – B.

.2 Data Sharing – Write Property – B.

.3 Device Management – Dynamic Device Binding (Who-Is; I-AM).

.4 Device Management – Dynamic Object Binding (Who-Has; I-Have).

.5 Device Management – Communication Control – B.

.3 Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The DDC shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible.

.8 EMI / RFI filters. All VFDs shall include EMI/RFI filters. The VFD shall comply with standard EN 61800-3 for the First Environment, restricted level with up to 100’ of motor cables. No Exceptions. Certified test lab test reports shall be provided with the submittals.

.9 All VFDs through 60HP shall be protected from input and output power mis-wiring. The VFD shall sense this condition and display an alarm on the keypad. The VFD shall not be damaged by this condition.

.10 OPTIONAL FEATURES – Optional features to be furnished and mounted by the drive manufacturer. All optional features shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label. The bypass enclosure door and VFD enclosure must be interlocked such that input power is turned off before either enclosure can be opened. The VFD and Bypass as a package shall have a UL listed short circuit rating of 100,000 amps and shall be indicated on the data label.

.1 A complete factory wired and tested bypass system consisting of an output contactor and bypass contactor, service (isolation) switch and VFD input fuses are required. Bypass designs, which have no VFD only fuses, or that incorporate fuses common to both the VFD and the bypass will not be accepted

.2 Door interlocked padlockable disconnect switch that will disconnect all input power from the drive and all internally mounted options.

.3 If Drive is located outdoors, a cabinet with thermostatically controlled heater, suitable for operation at -40^0 C continuous.

.11 The following operators shall be provided:

Bypass Hand-Off-Auto
Drive mode selector and light
Bypass mode selector and light
Bypass fault reset

Bypass LDC display, 2 lines, for programming and status / fault / warning indications

.1 Motor protection from single phase power conditions - The Bypass system must be able to detect a single phase input power condition while running in bypass, disengage the motor in a controlled fashion, and give a single phase input power indication. Bypass systems not incorporating single phase protection in Bypass mode are not acceptable.

.2 The systems (VFD and Bypass) tolerated voltage window shall allow the system to operate from a line of +30%, -35% nominal voltage as a minimum. The system shall incorporate circuitry that will allow the drive or bypass contactor to remain "sealed in" over this voltage tolerance at a minimum.

.3 The Bypass system shall NOT depend on the VFD for bypass operation. The bypass shall be completely functional in both Hand and Automatic modes even if the VFD has been removed from the enclosure for repair / replacement.

.4 Serial communications – the bypass and VFD shall be capable of being monitored and or controlled via serial communications. Provide communications protocols for ModBus; Johnson Controls N2; Siemens Building Technologies FLN (P1) and BACnet in the bypass controller.

.5 BACnet Serial communication bypass capabilities shall include, but not be limited to; bypass run-stop control; the ability to force the unit to bypass; and the ability to lock and unlock the keypad. The bypass shall have the capability of allowing the DDC to monitor feedback such as, bypass current (in amps), bypass kilowatt hours (resettable), bypass operating hours (resettable), and bypass logic board temperature. The DDC shall also be capable of monitoring the bypass relays output status, and all digital input status. All bypass diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible. The following additional bypass status indications and settings shall be transmitted over the serial communications bus – keypad "Hand" or "Auto" selected, and bypass selected. The DDC system shall also be able to monitor if the motor is running under load in both VFD and bypass (proof of flow) in the VFD mode over serial communications or Form-C relay output. A minimum of 40 field parameters shall be capable of being monitored in the bypass mode.

.6 Run permissive circuit - there shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, time-clock control, or serial communications) the VFD and bypass shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a VFD system input and allows motor operation. Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close.

.7 The bypass control shall monitor the status of the VFD and bypass contactors and indicate when there is a welded contactor contact or open contactor coil. This failed contactor operation shall be indicated on the Bypass LCD display as well as over the serial communications protocol.

.8 The bypass control shall include a programmable time delay for bypass start and keypad indication that this time delay is in process. This will allow VAV boxes to be driven open before the motor operates at full speed in the bypass mode. The time delay shall be field programmable from 0 – 120 seconds.

.9 The bypass control shall be programmable for manual or automatic transfer to bypass. The user shall be able to select via keypad programming which drive faults will generate an automatic transfer to bypass and which faults require a manual transfer to bypass.

.10 There shall be an adjustable motor current sensing circuit for the bypass and VFD mode to provide proof of flow indication. The condition shall be indicated on the keypad display, transmitted over the building automation protocol and on a relay output contact closure.

.11 The bypass controller shall have six programmable digital inputs, and five programmable Form-C relay outputs.

.12 The relay outputs from the bypass shall be programmable for any of the following indications.

.1 System started

.2 System running

.3 Bypass override enabled

.4 Drive fault

.5 Bypass fault

.6 Bypass H-O-A position

.7 Motor proof of flow (broken belt)

.8 Overload

.9 Bypass selected

.10 Bypass run

.11 System started (damper opening)

.12 Bypass alarm

.13 Over temperature

.13 The digital inputs for the system shall accept 24VAC or 24VDC. The bypass shall incorporate internally sourced power supply and not require an external control power source. The bypass power board shall supply 250 ma of 24 VDC for use by others to power external devices.

.14 Customer Interlock Terminal Strip – provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in VFD or Bypass mode. The remote start/stop contact shall operate in VFD and bypass modes. The terminal strip shall allow for independent connection of up to four (4) unique safety inputs.

.15 The user shall be able to select the text to be displayed on the keypad when the safety opens. Example text display indications include “Firestat”, “Freezestat”, “Over pressure” and “Low pressure”. The user shall also be able to determine which of the four (4) safety contacts is open over the serial communications connection.

.16 Class 10, 20, or 30 (selectable) electronic motor overload protection shall be included.

.17 Standard of acceptance:

.1 ABB ACH Series and E-Clipse Bypass or equivalent approved by NRC departmental representative. **Approval does not relieve supplier of specification requirements.**

Part 3 Execution

3.1 INSTALLATION

.1 Installation shall be the responsibility of the electrical contractor. The contractor shall install the drive in accordance with the requirements of the VFD manufacturer's installation manual.

.2 The contractor is to verify that the jobsite conditions for installation meet the factory recommendations and code required conditions for the VFD installation prior to installation. These shall include as a minimum:

.1 Clearance spacing.

.2 Compliance with environmental ratings of the VFD system.

.3 Separate conduit installation of the input wiring, the motor wiring, and control wiring. At no time does any of this wiring run in parallel with each other.

.4 All power and control wiring is complete.

.3 The VFD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The VFD system shall not be operated while the unit is covered.

3.2 ON-SITE STARTUP

.1 The manufacturer shall provide start-up and commissioning of the variable frequency drive and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. The commissioning personnel shall be the same personnel that will provide the factory service and warranty repairs at the customer site. Sales personnel and other agents who are not factory certified technicians for drive repair shall not be acceptable as commissioning agents.

.2 Start-up services shall include checking for verification of proper operation and installation of the VFD, its options and its interface wiring to the building automation system. Included in this service shall be as a minimum:

.1 Verification of contractor wire terminations and conduit runs to and from the VFD.

.2 Up to four hours of customer operator training on the operation and service diagnostics at the time of commissioning. On-site training is to be provided by the same factory trained application engineering and service personnel to demonstrate full programming and operating features and procedures. Date and time for this training is to be coordinated with the NRC Departmental Representative.

.3 Measurement for verification of proper operation of the following:

.1 Motor voltage and frequency. Verification of proper motor operation.

.2 Control input for proper building automation system interface and control calibration.

.3 Calibration check for the following set-points:

.1 minimum speed

.2 maximum speed

.3 acceleration and deceleration rates.

.3 Commissioning agent to verify the programming of the VFD and to provide a written copy of the settings to the engineer.

.4 Commissioning agent to lock out critical frequencies throughout the operating curve of the equipment as identified and required by the engineer. The agent shall record amperages at six (minimum) different frequencies from minimum to maximum speed.

3.3 PRODUCT SUPPORT

.1 Factory trained application engineering and service personnel that are thoroughly familiar with the VFD products offered shall be locally available at both the specifying and installation locations. A toll free 24/365 technical support line shall be available.

.2 A computer based training CD or 8-hour professionally generated video (VCR format) shall be provided to the owner at the time of project closeout. The training shall include installation, programming and operation of the VFD, bypass and serial communication.

3.4 WARRANTY

.1 Warranty shall be 24 months from the date of certified start-up. The warranty shall include all parts, labor, travel time and expenses

END OF SECTION

TP1 Amount Payable – General

1.1 Subject to any other provisions of the contract, Her Majesty shall pay the Contractor, at the times and in the manner hereinafter set out, the amount by which

1.1.1 the aggregate of the amounts described in TP2 exceeds

1.1.2 the aggregate of the amounts described in TP3

and the Contractor shall accept that amount as payment in full satisfaction for everything furnished and done by him in respect of the work to which the payment relates.

TP2 Amounts Payable to the Contractor

2.1 The amounts referred to in TP1.1.1 are the aggregate of

2.1.1 the amounts referred to in the Articles of Agreement, and

2.1.2 the amounts, if any, that are payable to the Contractor pursuant to the General Conditions.

TP3 Amounts Payable to Her Majesty

3.1 The amounts referred to in TP1.1.2 are the aggregate of the amounts, in any, that the Contractor is liable to pay Her Majesty pursuant to the contract.

3.2 When making any payments to the Contractor, the failure of Her Majesty to deduct an amount referred to in TP3.1 from an amount referred to in TP2 shall not be constitute a waiver of the right to do so, or an admission of lack of entitlement to do so in any subsequent payment to the Contractor.

TP4 Time of Payment

4.1 In these Terms of Payment

4.1.1 The "payment period" means a period of 30 consecutive days or such other longer period as is agreed between the Contractor and the Departmental Representative.

4.1.2 An amount is "due and payable" when it is due and payable by Her Majesty to the Contractor according to TP4.4, TP4.7 or TP4.10.

4.1.3 An amount is overdue when it is unpaid on the first day following the day upon which it is due and payable.

4.1.4 The "date of payment" means the date of the negotiable instrument of an amount due and payable by the Receiver General for Canada and given for payment.

4.1.5 The "Bank Rate" means the discount rate of interest set by the Bank of Canada in effect at the opening of business on the date of payment.

4.2 The Contractor shall, on the expiration of a payment period, deliver to the Departmental Representative in respect of that payment period a written progress claim that fully describes any part of the work that has been completed, and any material that was delivered to the work site but not incorporated into the work during that payment period.

4.3 The Departmental Representative shall, not later than ten days after receipt by him of a progress claim referred to in TP4.2,

4.3.1 inspect the part of the work and the material described in the progress claim; and

4.3.2 issue a progress report, a copy of which the Departmental Representative will give to the Contractor, that indicates the value of the part of the work and the material described in the progress claim that, in the opinion of the Departmental Representative,

4.3.2.1 is in accordance with the contract, and

4.3.2.2 was not included in any other progress report relating to the contract.

4.4 Subject to TP1 and TP4.5 Her Majesty shall, not later than 30 days after receipt by the Departmental Representative of a progress claim referred to in TP4.2, pay the Contractor

4.4.1 an amount that is equal to 95% of the value that is indicated in the progress report referred to in TP4.3.2 if a labour and material payment bond has been furnished by the Contractor, or

4.4.2 an amount that is equal to 90% of the value that is indicated in the progress report referred to in TP4.3.2 if a labour and material payment bond has not been furnished by the Contractor.

4.5 It is a condition precedent to Her Majesty's obligation under TP4.4 that the Contractor has made and delivered to the Departmental Representative,

4.5.1 a statutory declaration described in TP4.6 in respect of a progress claim referred to in TP4.2,

4.5.2 in the case of the Contractor's first progress claim, a construction schedule in accordance with the relevant sections of the Specifications, and

4.5.3 if the requirement for a schedule is specified, an update of the said schedule at the times identified in the relevant sections of the Specifications.

4.6 A statutory declaration referred to in TP4.5 shall contain a deposition by the Contractor that

4.6.1 up to the date of the Contractor's progress claim, the Contractor has complied with all his lawful obligations with respect to the Labour Conditions; and

4.6.2 up to the date of the Contractor's immediately preceding progress claim, all lawful obligations of the Contractor to subcontractors and suppliers of material in respect of the

work under the contract have been fully discharged.

4.7 Subject to TP1 and TP4.8, Her Majesty shall, not later than 30 days after the date of issue of an Interim Certificate of Completion referred to in GC44.2, pay the Contractor the amount referred to in TP1 less the aggregate of

4.7.1 the sum of all payments that were made pursuant to TP4.4;

4.7.2 an amount that is equal to the Departmental Representative's estimate of the cost to Her Majesty or rectifying defects described in the Interim Certificate of Completion; and

4.7.3 an amount that is equal to the Departmental Representative's estimate of the cost to Her Majesty of completing the parts of the work described in the Interim Certificate of Completion other than the defects referred to in TP4.7.2.

4.8 It is a condition precedent to Her Majesty's obligation under TP4.7 that the Contractor has made and delivered to the Departmental Representative,

4.8.1 a statutory declaration described in TP4.9 in respect of an Interim Certificate of Completion referred to in GC44.2, and

4.8.2 if so specified in the relevant sections of the Specifications, and update of the construction schedule referred to in TP4.5.2 and the updated schedule shall, in addition to the specified requirements, clearly show a detailed timetable that is acceptable to the Departmental Representative for the completion of any unfinished work and the correction of all defects.

4.9 A statutory declaration referred to in TP4.8 shall contain a deposition by the contractor that up to the date of the Interim Certificate of Completion the Contractor has

4.9.1 complied with all of the Contractor's lawful obligations with respect to the Labour Conditions;

4.9.2 discharged all of the Contractor's lawful obligations to the subcontractors and suppliers of material in respect of the work under the contract; and

4.9.3 discharged the Contractor's lawful obligations referred to in GC14.6.

4.10 Subject to TP1 and TP4.11, Her Majesty shall, not later than 60 days after the date of issue of a Final Certificate of Completion referred to in GC44.1, pay the Contractor the amount referred to in TP1 less the aggregate of

4.10.1 the sum of all payments that were made pursuant to TP4.4; and

4.10.2 the sum of all payments that were made pursuant to TP4.7.

4.11 It is a condition precedent to Her Majesty's obligation under TP4.10 that the Contractor has made and delivered a statutory declaration described in TP4.12 to the Departmental Representative.

4.12 A statutory declaration referred to in TP4.11 shall, in addition to the depositions described in TP4.9, contain a deposition by the Contractor that all of the Contractor's lawful obligations and any lawful claims against the Contractor that arose out of the performance of the contract have been discharged and satisfied.

TP5 Progress Report and Payment Thereunder Not Binding on Her Majesty

5.1 Neither a progress report referred to in TP4.3 nor any payment made by Her Majesty pursuant to these Terms of Payment shall be construed as an admission by Her Majesty that the work, material or any part thereof is complete, is satisfactory or is in accordance with the contract.

TP6 Delay in Making Payment

6.1 Nothwithstanding GC7 any delay by Her Majesty in making any payment when it is due pursuant to these Terms of Payment shall not be a breach of the contract by Her Majesty.

6.2 Her Majesty shall pay, without demand from the Contractor, simple interest at the Bank Rate plus 1 -1/4 per centum on any amount which is overdue pursuant to TP4.1.3, and the interest shall apply from and include the day such amount became overdue until the day prior to the date of payment except that

6.2.1 interest shall not be payable or paid unless the amount referred to in TP6.2 has been overdue for more that 15 days following

6.2.1.1 the date the said amount became due and payable, or

6.2.1.2 the receipt by the Departmental Representative of the Statutory Declaration referred to in TP4.5, TP4.8 or TP4.11,

whichever is the later, and

6.6.2 interest shall not be payable or paid on overdue advance payments if any.

TP7 Right of Set-off

7.1 Without limiting any right of set-off or deduction given or implied by law or elsewhere in the contract, Her Majesty may set off any amount payable to Her Majesty by the Contractor under this contract or under any current contract against any amount payable to the Contractor under this contract.

7.2 For the purposes of TP7.1, "current contract" means a contract between Her Majesty and the Contractor

7.2.1 under which the Contractor has an undischarged obligation to perform or supply work, labour or material, or

7.2.2 in respect of which Her Majesty has, since the date of which the Articles of Agreement were made, exercised any right to take the work that is the subject of the contract out of the Contractor's hands.

TP8 Payment in Event of Termination

8.1 If the contract is terminated pursuant to GC41, Her Majesty shall pay the Contractor any amount that is lawfully due and payable to the Contractor as soon as is practicable under the circumstances.

TP9 Interest on Settled Claims

9.1 Her Majesty shall pay to the Contractor simple interest on the amount of a settled claim at an average Bank Rate plus 1 ¼ per centum from the date the settled claim was outstanding until the day prior to the date of payment.

9.2 For the purposes of TP9.1,

9.2.1 a claim is deemed to have been settled when an agreement in writing is signed by the Departmental Representative and the Contractor setting out the amount of the claim to be paid by Her Majesty and the items or work for which the said amount is to be paid.

9.2.2 an "average Bank Rate" means the discount rate of interest set by the Bank of Canada in effect at the end of each calendar month averaged over the period the settled claim was outstanding.

9.2.3 a settled claim is deemed to be outstanding from the day immediately following the date the said claim would have been due and payable under the contract had it not been disputed.

9.3 For the purposes of TP9 a claim means a disputed amount subject to negotiation between Her Majesty and the Contractor under the contract.

GC1 Interpretation

1.1 In the contract

1.1.1 where reference is made to a part of the contract by means of numbers preceded by letters, the reference shall be construed to be a reference to the particular part of the contract that is identified by that combination of letters and numbers and to any other part of the contract referred to therein;

1.1.2 "contract" means the contract document referred to in the Articles of Agreement;

1.1.3 "contract security" means any security given by the Contractor to Her Majesty in accordance with the contract;

1.1.4 "Departmental Representative" means the officer or employee or Her Majesty who is designated pursuant to the Articles of Agreement and includes a person specially authorized by him to perform, on his behalf, any of his functions under the contract and is so designated in writing to the Contractor;

1.1.5 "material" includes all commodities, articles and things required to be furnished by or for the Contractor under the contract for incorporation into the work;

1.1.6 "Minister" includes a person acting for, or if the office is vacant, in place of the Minister and his successors in the office, and his or their lawful deputy and any of his or their representatives appointed for the purposes of the contract;

1.1.7 "person" includes, unless the context otherwise requires, a partnership, proprietorship, firm, joint venture, consortium and a corporation;

1.1.8 "plant" includes all animals, tools, implements, machinery, vehicles, buildings, structures, equipment and commodities, articles and things other than material, that are necessary for the due performance of the contract;

1.1.9 "subcontractor' means a person to whom the Contractor has, subject to GC4, subcontracted the whole or any part of the work;

1.1.10 "superintendant" means the employee of the Contractor who is designated by the Contractor to act pursuant to GC19;

1.1.11 "work includes, subject only to any express stipulation in the contract to the contrary, everything that is necessary to be done, furnished or delivered by the Contractor to perform the contract.

1.2 The headings in the contract documents, other than in the Plans and Specifications, form no part of the contract but are inserted for convenience of reference only.

1.3 In interpreting the contract, in the event of discrepancies or conflicts between anything in the Plans and Specifications and the General Conditions, the General Conditions govern.

1.4 In interpreting the Plans and Specifications, in the event of discrepancies or conflicts between

1.4.1 the Plans and Specifications, the Specifications govern;

1.4.2 the Plans, the Plans drawn with the largest scale govern; and

1.4.3 figured dimensions and scaled dimensions, the figured dimensions govern.

GC2 Successors and Assigns

2.1 The contract shall inure to the benefit of and be binding upon the parties hereto and their lawful heirs, executors, administrators, successors and assigns.

GC3 Assignment of Contract

3.1 The contract may not be assigned by the Contractor, either in whole or in part, without the written consent of the Minister.

GC4 Subcontracting by Contractor

4.1 Subject to this General Condition, the Contractor may subcontract any part of the work.

4.2 The Contractor shall notify the Departmental Representative in writing of his intention to subcontract.

4.3 A notification referred to in GC4.2 shall identify the part of the work, and the subcontractor with whom it is intended to subcontract.

4.4 The Departmental Representative may object to the intended subcontracting by notifying the Contractor in writing within six days of receipt by the Departmental Representative of a notification referred to in GC4.2.

4.5 If the Departmental Representative objects to a subcontracting pursuant to GC4.4, the Contractor shall not enter into the intended subcontract.

4.6 The contractor shall not, without the written consent of the Departmental Representative, change a subcontractor who has been engaged by him in accordance with this General Condition.

4.7 Every subcontract entered into by the Contractor shall adopt all of the terms and conditions of ths contract that are of general application.

4.8 Neither a subcontracting nor the Departmental Representative's consent to a subcontracting by the Contractor shall be construed to relieve the Contractor from any obligation under the contract or to impose any liability upon Her Majesty.

GC5 Amendments

5.1 No amendment or change in any of the provisions of the contract shall have any force or effect until it is reduced to writing.

GC6 No Implied Obligations

6.1 No implied terms or obligations of any kind by or on behalf of Her Majesty shall arise from anything in the contract and the express covenants and agreements therein contained and made by Her Majesty are the only covenants and agreements upon which any rights against Her Majesty are to be founded.

6.2 The contract supersedes all communications, negotiations and agreements, either written or oral, relating to the work that were made prior to the date of the contract.

GC7 Time of Essence

7.1 Time is of the essence of the contract.

GC8 Indemnification by Contractor

8.1 The Contractor shall indemnify and save Her Majesty harmless from and against all claims, demand, losses, costs, damages, actions, suits, or proceedings by whomever made, brought or prosecuted and in any manner based upon, arising out of, related to, occasioned by or attributable to the activities of the Contractor, his servants, agents, subcontractors and sub-subcontractors in performing the work including an infringement or an alleged infringement of a patent of invention or any other kind of intellectual property.

8.2 For the purpose of GC8.1, "activities" includes any act improperly carried out, any omission to carry out an act and any delay in carrying out an act.

GC9 Indemnification by Her Majesty

9.1 Her Majesty shall, subject to the Crown Liability Act, the Patent Act, and any other law that affects Her Majesty's rights, powers, privileges or obligations, indemnify and save the Contractor harmless from and against all claims, demands, losses, costs, damage, actions, suits or proceedings arising out of his activities under the contract that are directly attributable to

9.1.1 lack of or a defect in Her Majesty's title to the work site whether real or alleged; or

9.1.2 an infringement or an alleged infringement by the Contractor of any patent of invention or any other kind of intellectual property occurring while the Contractor was performing any act for the purposes of the contract employing a model, plan or design or any other thing related to the work that was supplied by Her Majesty to the Contractor.

GC10 Members of House of Commons Not to Benefit

10.1 As required by the Parliament of Canada Act, it is an express condition of the contract that no member of the House of Commons shall be admitted to any share of part of the contract or to any benefit arising therefrom.

GC11 Notices

11.1 Any notice, consent, order, decision, direction or other communication, other than a notice referred to in GC11.4, that may be given to the Contractor pursuant to the contract may be given in any manner.

11.2 Any notice, consent, order, decision, direction or other communication required to be given in writing, to any party pursuant to the contract shall, subject to GC11.4, be deemed to have been effectively given

11.2.1 to the Contractor, if delivered personally to the Contractor or the Contractor's superintendent, or forwarded by mail, telex or facsimile to the Contractor at the address set out in A4.1, or

11.2.2 to Her Majesty, if delivered personally to the Departmental Representative, or forwarded by mail, telex or facsimile to the Departmental Representative at the address set out in A1.2.1.

11.3 Any such notice, consent, order, decision, direction or other communication given in accordance with GC11.2 shall be deemed to have been received by either party

11.3.1 if delivered personally, on the day that it was delivered,

11.3.2 if forwarded by mail, on the earlier of the day it was received and the sixth day after it was mailed, and

11.3.3 if forwarded by telex or facsimile, 24 hours after it was transmitted.

11.4 A notice given under GC38.1.1, GC40 and GC41, if delivered personally, shall be delivered to the Contractor if the Contractor is doing business as sole proprietor or, if the Contractor is a partnership or corporation, to an officer thereof.

GC12 Material, Plant and Real Property Supplied by Her Majesty

12.1 Subject to GC12.2, the Contractor is liable to Her Majesty for any loss of or damage to material, plant or real property that is supplied or placed in the care, custody and control of the Contractor by Her Majesty for use in connection with the contract, whether or not that loss or damage is attributable to causes beyond the Contractor's control.

12.2 The Contractor is not liable to Her Majesty for any loss or damage to material, plant or real property referred to in GC12.1 if that loss or damage results from and is directly attributable to reasonable wear and tear.

12.3 The Contractor shall not use any material, plant or real property referred to in GC12.1 except for

the purpose of performing this contract.

12.4 When the Contractor fails to make good any loss or damage for which he is liable under GC12.1 within a reasonable time after being required to do so by the Departmental Representative, the Departmental Representative may cause the loss or damage to be made good at the Contractor's expense, and the Contractor shall thereupon be liable to Her Majesty for the cost thereof and shall, on demand, pay to Her Majesty an amount equal to that cost.

12.5 The Contractor shall keep such records of all material, plant and real property referred to in GC12.1 as the Departmental Representative from time to time requires and shall satisfy the Departmental Representative, when requested, that such material, plant and real property are at the place and in the condition which they ought to be.

GC13 Material, Plant and Real Property Become Property of Her Majesty

13.1 Subject to GC14.7 all material and plant and the interest of the Contractor in all real property, licenses, powers and privileges purchased, used or consumed by the Contractor for the contract shall, after the time of their purchase, use or consumption be the property of Her Majesty for the purposes of the work and they shall continue to be the property of Her Majesty.

13.1.1 in the case of material, until the Departmental Representative indicates that he is satisfied that it will not be required for the work, and

13.1.2 in the case of plant, real property, licenses, powers and privileges, until the Departmental Representative indicates that he is satisfied that the interest vested in Her Majesty therein is no longer required for the purposes of the work.

13.2 Material or plant that is the property of Her Majesty by virtue of GC13.1 shall not be taken away from the work site or used or disposed of except for the purposes of the work without the written consent of the Departmental Representative.

13.3 Her Majesty is not liable for loss of or damage from any cause to the material or plant referred to in GC13.1 and the Contractor is liable for such loss or damage notwithstanding that the material or plant is the property of Her Majesty.

GC14 Permits and Taxes Payable

14.1 The Contractor shall, within 30 days after the date of the contract, tender to a municipal authority an amount equal to all fees and charges that would be lawfully payable to that municipal authority in respect of building permits as if the work were being performed for a person other than Her Majesty.

14.2 Within 10 days of making a tender pursuant to GC14.1, the Contractor shall notify the Departmental Representative of his action and of the amount tendered and whether or not the municipal authority has accepted that amount.

14.3 If the municipal authority does not accept the amount tendered pursuant to GC14.1 the Contractor shall pay that amount to Her Majesty within 6 days after the time stipulated in GC14.2.

14.4 For the purposes of GC14.1 to GC14.3 "municipal authority" means any authority that would have jurisdiction respecting permission to perform the work if the owner were not Her Majesty.

14.5 Notwithstanding the residency of the Contractor, the Contractor shall pay any applicable tax arising from or related to the performance of the work under the contract.

14.6 In accordance with the Statutory Declaration referred to in TP4.9, a Contractor who has neither residence nor place of business in the province in which work under the contract is being performed shall provide Her Majesty with proof of registration with the provincial sales tax authorities in the said province.

14.7 For the purpose of the payment of any applicable tax or the furnishing of security for the payment of any applicable tax arising from or related to the performance of the work under the contract, the Contractor shall, notwithstanding the fact that all material, plant and interest of the Contractor in all real property, licenses, powers and privileges, have become the property of Her Majesty after the time of purchase, be liable, as a user or consumer, for the payment or for the furnishing of security for the payment of any applicable tax payable, at the time of the use or consumption of that material, plant or interest of the Contractor in accordance with the relevant legislation.

GC15 Performance of Work under Direction of Departmental Representative

15.1 The Contractor shall

15.1.1 permit the Departmental Representative to have access to the work and its site at all times during the performance of the contract;

15.1.2 furnish the Departmental Representative with such information respecting the performance of the contract as he may require; and

15.1.3 give the Departmental Representative every possible assistance to enable the Departmental Representative to carry out his duty to see that the work is performed in accordance with the contract and to carry out any other duties and exercise any powers specially imposed or conferred on the Departmental Representative under the contract.

CG16 Cooperation with Other Contractors

16.1 Where, in the opinion of the Departmental Representative, it is necessary that other contractors or workers with or without plant and material, be sent onto the work or its site, the Contractor shall, to the satisfaction of the Departmental Representative, allow them access and cooperate with them in the carrying out of their duties and obligation.

16.2 If

16.2.1 the sending onto the work or its site of other contractors or workers pursuant to GC16.1 could not have been reasonably foreseen or anticipated by the Contractor when entering into the contract, and

16.2.2 the Contractor incurs, in the opinion of the Departmental Representative, extra expense in complying with GC16.1, and

16.2.3 The Contractor has given the Departmental Representative written notice of his claim for the extra expense referred to in GC16.2.2 within 30 days of the date that the other contractors or workers were sent onto the work or its site,

Her Majesty shall pay the Contractor the cost, calculated in accordance with GC48 to GC50, of the extra labour, plant and material that was necessarily incurred.

GC17 Examination of Work

17.1 If, at any time after the commencement of the work but prior to the expiry of the warranty or guarantee period, the Departmental Representative has reason to believe that the work or any part thereof has not been performed in accordance with the contract, the Departmental Representative may have that work examined by an expert of his choice.

17.2 If, as a result of an examination of the work referred to in GC17.1, it is established that the work was not performed in accordance with the contract, then, in addition to and without limiting or otherwise affecting any of Her Majesty's rights and remedies under the contract either at law or in equity, the Contractor shall pay Her Majesty, on demand, all reasonable costs and expenses that were incurred by Her Majesty in having that examination performed.

GC18 Clearing of Site

18.1 The Contractor shall maintain the work and its site in a tidy condition and free from the accumulation of waste material and debris, in accordance with any directions of the Departmental Representative.

18.2 Before the issue of an interim certificate referred to in GC44.2, the Contractor shall remove all the plant and material not required for the performance of the remaining work, and all waste material and other debris, and shall cause the work and its site to be clean and suitable for occupancy by Her Majesty's servants, unless otherwise stipulated in the contract.

18.3 Before the issue of a final certificate referred to in GC44.1, the Contractor, shall remove from the work and its site all of the surplus plant and material and any waste material and other debris.

18.4 The Contractor's obligations described in GC18.1 to GC18.3 do not extend to waste material and other debris caused by Her Majesty's servants or contractors and workers referred to in GC16.1.

GC19 Contractor's Superintendent

19.1 The Contractor shall, forthwith upon the award of the contract, designate a superintendent.

19.2 The Contractor shall forthwith notify the Departmental Representative of the name, address and telephone number of a superintendent designate pursuant to GC19.1.

19.3 A superintendent designated pursuant to GC19.1 shall be in full charge of the operations of the Contractor in the performance of the work and is authorized to accept any notice, consent, order, direction, decision or other communication on behalf of the Contractor that may be given to the superintendent under the contract.

19.4 The Contractor shall, until the work has been completed, keep a competent superintendent at the work site during working hours.

19.5 The Contractor shall, upon the request of the Departmental Representative, remove any superintendent who, in the opinion of the Departmental Representative, is incompetent or has been conducting himself improperly and shall forthwith designate another superintendent who is acceptable to the Departmental Representative.

19.6 Subject to GC19.5, the Contractor shall not substitute a superintendent without the written consent of the Departmental Representative.

19.7 A breach by the Contractor of GC19.6 entitles the Departmental Representative to refuse to issue any certificate referred to in GC44 until the superintendent has returned to the work site or another superintendent who is acceptable to the Departmental Representative has been substituted.

GC20 National Security

20.1 If the Minister is of the opinion that the work is of a class or kind that involves the national security, he may order the Contractor

20.1.1 to provide him with any information concerning persons employed or to be employed by him for purposes of the contract; and

20.1.2 to remove any person from the work and its site if, in the opinion of the Minister, that person may be a risk to the national security.

20.2 The Contractor shall, in all contracts with persons who are to be employed in the performance of the contract, make provision for his performance of any obligation that may be imposed upon him under GC19 to GC21.

20.3 The Contractor shall comply with an order of the Minister under GC20.1

GC21 Unsuitable Workers

21.1 The Contractor shall, upon the request of the Departmental Representative, remove any person employed by him for purposes of the contract who, in the opinion of the Departmental Representative, is incompetent or has conducted himself improperly, and the Contractor shall not permit a person who has been removed to return to the work site.

GC22 Increased or Decreased Costs

22.1 The amount set out in the Articles of Agreement shall not be increased or decreased by reason of any increase or decrease in the cost of the work that is brought about by an increase or decrease in the cost of labour, plant or material or any wage adjustment arising pursuant to the Labour Conditions.

22.2 Notwithstanding GC22.1 and GC35, an amount set out in the Articles of Agreement shall be adjusted in the manner provided in GC22.3, if any change in a tax imposed under the Excise Act, the Excise Tax Act, the Old Age Security Act, the Customs Act, the Customs Tariff or any provincial sales tax legislation imposing a retail sales tax on the purchase of tangible personal property incorporated into Real Property

22.2.1 occurs after the date of the submission by the Contractor of his tender for the contract,

22.2.2 applies to material, and

22.2.3 affects the cost to the Contractor of that material.

22.3 If a change referred to in GC22.2 occurs, the appropriate amount set out in the Articles of Agreement shall be increased or decreased by an amount equal to the amount that is established by an examination of the relevant records of the Contractor referred to in GC51 to be the increase or decrease in the cost incurred that is directly attributable to that change.

22.4 For the purpose of GC22.2, where a tax is changed after the date of submission of the tender but public notice of the change has been given by the Minister of Finance before that date, the change shall be deemed to have occurred before the date of submission of the tender.

GC23 Canadian Labour and Material

23.1 The Contractor shall use Canadian labour and material in the performance of the work to the full extent to which they are procurable, consistent with proper economy and expeditious carrying out of the work.

23.2 Subject to GC23.1, the Contractor shall, in the performance of the work, employ labour from the locality where the work is being performed to the extent to which it is available, and shall use the offices of the Canada Employment Centres for the recruitment of workers wherever practicable.

23.3 Subject to GC23.1 and GC23.2, the Contractor shall, in the performance of the work, employ a reasonable proportion of persons who have been on active service with the armed forces of Canada and have been honourably discharged therefrom.

GC24 Protection of Work and Documents

24.1 The Contractor shall guard or otherwise protect the work and its site, and protect the contract, specifications, plans, drawings, information, material, plant and real property, whether or not they are supplied by Her Majesty to the Contractor, against loss or damage from any cause, and he shall not use, issue, disclose or dispose of them without the written consent of the Minister, except as may be essential for the performance of the work.

24.2 If any document or information given or disclosed to the Contractor is assigned a security rating by the person who gave or disclosed it, the Contractor shall take all measures directed by the Departmental Representative to be taken to ensure the maintenance of the degree of security that is ascribed to that rating.

24.3 The Contractor shall provide all facilities necessary for the purpose of maintaining security, and shall assist any person authorized by the Minister to inspect or to take security measures in respect of the work and its site.

24.4 The Departmental Representative may direct the Contractor to do such things and to perform such additional work as the Departmental Representative considers reasonable and necessary to ensure compliance with or to remedy a breach of GC24.1 to GC24.3.

GC25 Public Ceremonies and Signs

25.1 The Contractor shall not permit any public ceremony in connection with the work without the prior consent of the Minister.

25.2 The Contractor shall not erect or permit the erection of any sign or advertising on the work or its site without the prior consent of the Departmental Representative.

GC26 Precautions against Damage, Infringement of Rights, Fire, and Other Hazards

26.1 The Contractor shall, at his own expense, do whatever is necessary to ensure that

26.1.1 no person, property, right, easement or privilege is injured, damaged or infringed by reasons of the Contractor's activities in performing the contract;

26.1.2 pedestrian and other traffic on any public or private road or waterway is not unduly impeded, interrupted or endangered by the performance or existence of the work or plant;

26.1.3 fire hazards in or about the work or its site are eliminated and, subject to any direction that may be given by the Departmental Representative, any fire is promptly extinguished;

26.1.4 the health and safety of all persons employed in the performance of the work is not endangered by the method or means of its performance;

26.1.5 adequate medical services are available to all persons employed on the work or its site at all times during the performance of the work;

26.1.6 adequate sanitation measures are taken in respect of the work and its site; and

26.1.7 all stakes, buoys and marks placed on the work or its site by or under the authority of the Departmental Representative are protected and are not removed, defaced, altered or destroyed.

26.2 The Departmental Representative may direct the Contractor to do such things and to perform such additional work as the Departmental Representative considers reasonable and necessary to ensure

compliance with or to remedy a breach of GC26.1.

26.3 The Contractor shall, at his own expense, comply with a direction of the Departmental Representative made under GC26.2.

GC27 Insurance

27.1 The Contractor shall, at his own expense, obtain and maintain insurance contracts in respect of the work and shall provide evidence thereof to the Departmental Representative in accordance with the requirements of the Insurance Conditions "E".

27.2 The insurance contracts referred to in GC27.1 shall

27.2.1 be in a form, of the nature, in the amounts, for the periods and containing the terms and conditions specified in Insurance Conditions "E", and

27.2.2 provide for the payment of claims under such insurance contracts in accordance with GC28.

GC28 Insurance Proceeds

28.1 In the case of a claim payable under a Builders Risk/Installation (All Risks) insurance contract maintained by the Contractor pursuant to GC27, the proceeds of the claim shall be paid directly to Her Majesty, and

28.1.1 the monies so paid shall be held by Her Majesty for the purposes of the contract, or

28.1.2 if Her Majesty elects, shall be retained by Her Majesty, in which event they vest in Her Majesty absolutely.

28.2 In the case of a claim payable under a General Liability insurance contract maintained by the Contractor pursuant to GC27, the proceeds of the claim shall be paid by the insurer directly to the claimant.

28.3 If an election is made pursuant to GC28.1, the Minister may cause an audit to be made of the accounts of the Contractor and of Her Majesty in respect of the part of the work that was lost, damaged or destroyed for the purpose of establishing the difference, if any, between

28.3.1 the aggregate of the amount of the loss or damage suffered or sustained by Her Majesty, including any cost incurred in respect of the clearing and cleaning of the work and its site and any other amount that is payable by the Contractor to Her Majesty under the contract, minus any monies retained pursuant to GC28.12, and

28.3.2 the aggregate of the amounts payable by Her Majesty to the Contractor pursuant to the contract up to the date of the loss or damage.

28.4 A difference that is established pursuant to GC28.3 shall be paid forthwith by the party who is determined by the audit to be the debtor to the party who is determined by the audit to be the

creditor.

28.5 When payment of a deficiency has been made pursuant to GC28.4, all rights and obligations of Her Majesty and the Contractor under the contract shall, with respect only to the part of the work that was the subject of the audit referred to in GC28.3, be deemed to have been expended and discharged.

28.6 If an election is not made pursuant to GC28.1.2 the Contractor shall, subject to GC28.7, clear and clean the work and its site and restore and replace the part of the work that was lost, damaged or destroyed at his own expense as if that part of the work had not yet been performed.

28.7 When the Contractor clears and cleans the work and its site and restores and replaces the work referred to in GC 28.6, Her Majesty shall pay him out of the monies referred to in GC28.1 so far as they will thereunto extend.

28.8 Subject to GC28.7, payment by Her Majesty pursuant to GC28.7 shall be made in accordance with the contract but the amount of each payment shall be 100% of the amount claimed notwithstanding TP4.4.1 and TP4.4.2.

GC29 Contract Security

29.1 The Contractor shall obtain and deliver contract security to the Departmental Representative in accordance with the provisions of the Contract Security Conditions.

29.2 If the whole or a part of the contract security referred to in GC29.1 is in the form of a security deposit, it shall be held and disposed of in accordance with GC43 and GC45.

29.3 If a part of the contract security referred to in GC29.1 is in the form of a labour and material payment bond, the Contractor shall post a copy of that bond on the work site.

GC30 Changes in the Work

30.1 Subject o GC5, the Departmental Representative may, at any time before he issues his Final Certificate of Completion,

30.1.1 order work or material in addition to that provided for in the Plans and Specifications; and

30.1.2 delete or change the dimensions, character, quantity, quality, description, location or position of the whole or any part of the work or material proved for in the Plans and Specifications or in any order made pursuant to GC30.1.1,

if that additional work or material, deletion, or change is, in his opinion, consistent with the general intent of the original contract.

30.2 The Contractor shall perform the work in accordance with such orders, deletions and changes that are made by the Departmental Representative pursuant to GC30.1 from time to time as if they had appeared in and been part of the Plans and Specifications.

30.3 The Departmental Representative shall determine whether or not anything done or omitted by the Contractor pursuant to an order, deletion or change referred to in GC30.1 increased or decreased the cost of the work to the Contractor.

30.4 If the Departmental Representative determines pursuant to GC30.3 that the cost of the work to the Contractor has been increased, Her Majesty shall pay the Contractor the increased cost that the Contractor necessarily incurred for the additional work calculated in accordance with GC49 or GC50.

30.5 If the Departmental Representative determines pursuant to GC303.3 that the cost of the work to the Contractor has been decreased, Her Majesty shall reduce the amount payable to the Contractor under the contract by an amount equal to the decrease in the cost caused by the deletion or change referred to in GC30.1.2 and calculated in accordance with GC49.

30.6 GC30.3 to GC30.5 are applicable only to a contract or a portion of a contract for which a Fixed Price Arrangement is stipulated in the contract.

30.7 An order, deletion or change referred to in GC30.1 shall be in writing, signed by the Departmental Representative and given to the Contractor in accordance with GC11.

GC31 Interpretation of Contract by Departmental Representative

31.1 If, ar any time before the Departmental Representative has issued a Final Certificate of Completion referred to in GC44.1, any question arises between the parties about whether anything has been done as required by the contract or about what the Contractor is required by the contract to do, and, in particular but without limiting the generality of the foregoing, about

31.1.1 the meaning of anything in the Plans and Specification,

31.1.2 the meaning to be given to the Plans and Specifications in case of any error therein, omission therefrom, or obscurity or discrepancy in their working or intention,

31.1.3 whether or not the quality or quantity of any material or workmanship supplied or proposed to be supplied by the Contractor meets the requirements of the contract,

31.1.4 whether or not the labour, plant or material provided by the Contractor for performing the work and carrying out the contract are adequate to ensure that the work will be performed in accordance with the contract and that the contract will be carried out in accordance with its terms,

31.1.5 what quantity of any kind of work has been completed by the Contractor, or

31.1.6 the timing and scheduling of the various phases of the performance of the work,

the question shall be decided by the Departmental Representative whose decision shall be final and conclusive in respect of the work.

31.2 The Contractor shall perform the work in accordance with any decisions of the Departmental

Representative that are made under GC31.1 and in accordance with any consequential directions given by the Departmental Representative.

GC32 Warranty and Rectification of Defects in Work

32.1 Without restricting any warranty or guarantee implied or imposed by law or contained in the contract documents, the Contractor shall, at his own expense,

32.1.1 rectify and make good any defect or fault that appears in the work or comes to the attention of the Minister with respect to those parts of the work accepted in connection with the Interim Certificate of Completion referred to GC44.2 within 12 months from the date of the Interim Certificate of Completion;

32.1.2 rectify and make good any defect or fault that appears in or comes to the attention of the Minister in connection with those parts of the work described in the Interim Certificate of Completion referred to in GC44.2 within 12 months from the date of the Final Certificate of Completion referred to in GC44.1.

32.2 The Departmental Representative may direct the Contractor to rectify and make good any defect or fault referred to in GC32.1 or covered by any other expressed or implied warranty or guarantee.

32.3 A direction referred to in GC32.2 shall be in writing, may include a stipulation in respect of the time within which a defect or fault is required to be rectified and made good by the Contractor, and shall be given to the Contractor in accordance with GC11.

32.4 The Contractor shall rectify and make good any defect or fault described in a direction given pursuant to GC32.2 within the time stipulated therein.

GC33 Non-Compliance by Contractor

33.1 If the Contractor fails to comply with any decision or direction given by the Departmental Representative pursuant to GC18, GC24, GC26, GC31 or GC32, the Departmental Representative may employ such methods as he deems advisable to do that which the Contractor failed to do.

33.2 The Contractor shall, on demand, pay Her Majesty an amount that is equal to the aggregate of all cost, expenses and damage incurred or sustained by Her Majesty by reason of the Contractor's failure to comply with any decision or direction referred to in GC33.1, including the cost of any methods employed by the Departmental Representative pursuant to GC33.1.

GC34 Protesting Departmental Representative's Decisions

34.1 The Contractor may, within ten days after the communication to him of any decision or direction referred to in GC30.3 or GC33.1, protest that decision or direction.

34.2 A protest referred to in GC34.1 shall be in writing, contain full reasons for the protest, be signed

by the Contractor and be given to Her Majesty by delivery to the Departmental Representative.

34.3 If the Contractor gives a protest pursuant to GC34.2, any compliance by the Contractor with the decision or direction that was protested shall not be construed as an admission by the Contractor of the correctness of that decision or direction, or prevent the Contractor from taking whatever action he considers appropriate in the circumstances.

34.4 The giving of a protest by the Contractor pursuant to GC34.2 shall not relieve him from complying with the decision or direction that is the subject of the protest.

34.5 Subject to GC34.6, the Contractor shall take any action referred to in GC34.3 within three months after the date that a Final Certificate of Completion is issued under GC44.1 and not afterwards.

34.6 The Contractor shall take any action referred to in GC34.3 resulting from a direction under GC32 within three months after the expiry of a warranty or guarantee period and not afterwards.

34.7 Subject to GC34.8, if Her Majesty determines that the Contractor's protest is justified, Her Majesty shall pay the Contractor the cost of the additional labour, plant and material necessarily incurred by the Contractor in carrying out the protested decision or direction.

34.8 Costs referred to in GC34.7 shall be calculated in accordance with GC48 to GC50.

GC35 Changes in Soil Conditions and Neglect or Delay by Her Majesty

35.1 Subject to GC35.2 no payment, other than a payment that is expressly stipulated in the contract, shall be made by Her Majesty to the Contractor for any extra expense or any loss or damage incurred or sustained by the Contractor.

35.2 If the Contractor incurs or sustains any extra expense or any loss or damage that is directly attributable to

35.2.1 a substantial difference between the information relating to soil conditions at the work site that is contained in the Plans and Specifications or other documents supplied to the Contractor for his use in preparing his tender or a reasonable assumption of fact based thereon made by the Contractor, and the actual soil conditions encountered by the Contractor at the work site during the performance of the contract, or

35.2.2 any neglect or delay that occurs after the date of the contract on the part of Her Majesty in providing any information or in doing any act that the contract either expressly requires Her Majesty to do or that would ordinarily be done by an owner in accordance with the usage of the trade,

he shall, within ten days of the date the actual soil conditions described in GC35.2.1 were encountered or the neglect or delay described in GC35.2.2 occurred, give the Departmental Representative written notice of his intention to claim for that extra expense or that loss or damage.

35.3 When the Contractor has given a notice referred to in GC35.2, he shall give the Departmental Representative a written claim for extra expense or loss or damage within 30 days of the date that

a Final Certificate of Completion referred to in GC44.1 is issued and not afterwards.

35.4 A written claim referred to in GC35.3 shall contain a sufficient description of the facts and circumstances of the occurrence that is the subject of the claim to enable the Departmental Representative to determine whether or not the claim is justified and the Contractor shall supply such further and other information for that purpose as the Departmental Representative requires from time to time.

35.5 If the Departmental Representative determines that a claim referred to in GC35.3 is justified, Her Majesty shall make an extra payment to the Contractor in an amount that is calculated in accordance with GC47 to GC50.

35.6 If, in the opinion of the Departmental Representative, an occurrence described in GC35.2.1 results in a savings of expenditure by the Contractor in performing the contract, the amount set out in the Articles of Agreement shall, subject to GC35.7, be reduced by an amount that is equal to the saving.

35.7 The amount of the saving referred to in GC35.6 shall be determined in accordance with GC47 to GC49.

35.8 If the Contractor fails to give a notice referred to in GC35.2 and a claim referred to in GC35.3 within the times stipulated, an extra payment shall not be made to him in respect of the occurrence.

GC36 Extension of Time

36.1 Subject to GC36.2, the Departmental Representative may, on the application of the Contractor made before the day fixed by the Articles of Agreement for completion of the work or before any other date previously fixed under this General Condition, extend the time for its completion by fixing a new date if, in the opinion of the Departmental Representative, causes beyond the control of the Contractor have delayed its completion.

36.2 An application referred to in GC36.1 shall be accompanied by the written consent of the bonding company whose bond forms part of the contract security.

GC37 Assessments and Damages for Late Completion

37.1 For the purposes of this General Condition

37.1.1 the work shall be deemed to be completed on the date that an Interim Certificate of Completion referred to in GC44.2 is issued, and

37.1.2 "period of delay" means the number of days commencing on the day fixed by the Articles of Agreement for completion of the work and ending on the day immediately preceding the day on which the work is completed but does not include any day within a period of extension granted pursuant to GC36.1, and any other day on which, in the opinion of the Departmental Representative, completion of the work was delayed for reasons beyond the control of the Contractor.

37.2 If the Contractor does not complete the work by the day fixed for its completion by the Articles of Agreement but completes it thereafter, the Contractor shall pay Her Majesty an amount equal to the aggregate of

37.2.1 all salaries, wages and travelling expenses incurred by Her Majesty in respect of persons overseeing the performance of the work during the period of delay;

37.2.2 the cost incurred by Her Majesty as a result of the inability to use the completed work for the period of delay; and

37.2.3 all other expenses and damages incurred or sustained by Her Majesty during the period of delay as a result of the work not being completed by the day fixed for its completion.

37.3 The Minister may waive the right of Her Majesty to the whole or any part of the amount payable by the Contractor pursuant to GC37.2 I , in the opinion of the Minister, it is in the public interest to do so.

GC38 Taking the Work Out of the Contractor's Hands

38.1 The Minister may, at his sole discretion, by giving a notice in writing to the Contractor in accordance with GC11, take all or any part of the work out of the Contractor's hands, and may employ such means as he sees fit to have the work completed if the Contractor

38.1.1 Has not, within six days of the Minister or the Departmental Representative giving notice to the Contractor in writing in accordance with GC11, remedied any delay in the commencement or any default in the diligent performance of the work to the satisfaction of the Departmental Representative;

38.1.2 has defaulted in the completion of any part of the work within the time fixed for its completion by the contract;

38.1.3 has become insolvent;

38.1.4 has committed an act of bankruptcy;

38.1.5 has abandoned the work;

38.1.6 has made an assignment of the contract without the consent required by GC3.1; or

38.1.7 has otherwise failed to observe or perform any of the provisions of the contract.

38.2 If the whole or any part of the work is taken out of the Contractor's hands pursuant to GC38.1,

38.2.1 the Contractor's right to any further payment that is due or accruing due under the contract is, subject only to GC38.4, extinguished, and

38.2.2 the Contractor is liable to pay Her Majesty, upon demand, an amount that is equal to the amount of all loss and damage incurred or sustained by Her Majesty in respect of the

Contractor's failure to complete the work.

38.3 If the whole or any part of the work that is taken out of the Contractor's hands pursuant to GC38.1 is completed by Her Majesty, the Departmental Representative shall determine the amount, if any, of the holdback or a progress claim that had accrued and was due prior to the date on which the work was taken out of the Contractor's hands and that is not required for the purposes of having the work performed or of compensating Her Majesty for any other loss or damage incurred or sustained by reason of the Contractor's default.

38.4 Her Majesty may pay the Contractor the amount determined not to be required pursuant to GC38.3.

GC39 Effect of Taking the Work Out of the Contractor's Hands

39.1 The taking of the work or any part thereof out of the Contractor's hands pursuant to GC38 does not operate so as to relieve or discharge him from any obligation under the contract or imposed upon him by law except the obligation to complete the performance of that part of the work that was taken out of his hands.

39.2 If the work or any part thereof is taken out of the Contractor's hands pursuant to GC38, all plant and material and the interest of the Contractor is all real property, licenses, powers and privileges acquired, used or provided by the Contractor under the contract shall continue to be the property of Her Majesty without compensation to the Contractor.

39.3 When the Departmental Representative certifies that any plant, material, or any interest of the Contractor referred to in GC39.2 is no longer required for the purposes of the work, or that it is not in the interest of Her Majesty to retain that plant, material or interest, it shall revert to the Contractor.

G40 Suspension of Work by Minister

40.1 The Minister may, when in his opinion it is in the public interest to do so, require the Contractor to suspend performance of the work either for a specified or an unspecified period by giving a notice of suspension in wiring to the Contractor in accordance with GC11.

40.2 When a notice referred to in GC40.1 is received by the Contractor in accordance with GC11, he shall suspend all operations in respect of the work except those that, in the opinion of the Departmental Representative, are necessary for the care and preservation of the work, plant and material.

40.3 The Contractor shall not, during a period of suspension, remove any part of the work, plant or material from its site without the consent of the Departmental Representative.

40.4 If a period of suspension is 30 days or less, the Contractor shall, upon the expiration of that period, resume the performance of the work and he is entitled to be paid the extra cost, calculated in accordance with GC48 to GC50, of any labour, plant and material necessarily incurred by him as a result of the suspension.

40.5 If, upon the expiration of a period of suspension of more than 30 days, the Minister and the Contractor agree that the performance of the work will be continued by the Contractor, the Contractor shall resume performance of the work subject to any terms and conditions agreed upon by the Minister and the Contractor.

40.6 If, upon the expiration of a period of suspension of more than 30 days, the Minister and the Contractor do not agree that performance of the work will be continued by the Contractor or upon the terms and conditions under which the Contractor will continue the work, the notice of suspension shall be deemed to be a notice of termination pursuant to GC41.

GC41 Termination of Contract

41.1 The Minister may terminate the contract at any time by giving a notice of termination in writing to the Contractor in accordance with GC11.

41.2 When a notice referred to in GC41.1 is received by the Contractor in accordance with GC11, he shall, subject to any conditions stipulated in the notice, forthwith cease all operations in performance of the contract.

41.3 If the contract is terminated pursuant to GC41.1, Her Majesty shall pay the Contractor, subject to GC41.4, an amount equal to

41.3.1 the cost to the contractor of all labour, plant and material supplied by him under the contract up to the date of termination in respect of a contract or part thereof for which a Unit Price Arrangement is stipulated in the contract, or

41.3.2 the lesser of

41.3.2.1 an amount, calculated in accordance with the Terms and Payment, that would have been payable to the Contractor had he completed the work, and

41.3.2.2 an amount that is determined to be due to the Contractor pursuant to GC49 in respect of a contract or part thereof for which a Fixed Price Arrangement is stipulated in the contract

less the aggregate of all amounts that were paid to the Contractor by Her Majesty and all amounts that are due to Her Majesty from the Contractor pursuant to the contract.

41.4 If Her Majesty and the Contractor are unable to agree about an amount referred to in GC41.3 that amount shall be determined by the method referred to in GC50.

GC42 Claims Against and Obligations of the Contractor or Subcontractor

42.1 Her Majesty may, in order to discharge lawful obligations of and satisfy claims against the Contractor or a subcontractor arising out of the performance of the contract, pay any amount that is due and payable to the Contractor pursuant to the contract directly to the obligees of and the claimants against the Contractor or the subcontractor but such amount if any, as is paid by Her Majesty, shall not exceed that amount which the Contractor would have been obliged to pay to

such claimant had the provisions of the Provincial or Territorial lien legislation, or, in the Province of Quebec, the law relating to privileges, been applicable to the work. Any such claimant need not comply with the provisions of such legislation setting out the steps by way of notice, registration or otherwise as might have been necessary to preserve or perfect any claim for lien or privilege which claimant might have had;

42.2 Her Majesty will not make any payment as described in GC42.1 unless and until that claimant shall have delivered to Her Majesty:

42.2.1 a binding and enforceable Judgment or Order of a court of competent jurisdiction setting forth such amount as would have been payable by the Contractor to the claimant pursuant to the provisions of the applicable Provincial or Territorial lien legislation, or, in the Province of Quebec, the law relating to privileges, had such legislation been applicable to the work; or

42.2.2 a final and enforceable award of an arbitrator setting forth such amount as would have been payable by the Contractor to the claimant pursuant to the provisions of the applicable Provincial or Territorial lien legislation, or, in the Province of Quebec, the law relating to privileges, had such legislation been applicable to the work; or

42.2.3 the consent of the Contractor authorizing a payment.

For the purposes of determining the entitlement of a claimant pursuant to GC42.2.1 and GC42.2.2, the notice required by GC42.8 shall be deemed to replace the registration or provision of notice after the performance of work as required by any applicable legislation and no claim shall be deemed to have expired, become void or unenforceable by reason of the claimant not commencing any action within the time prescribed by any applicable legislation.

42.3 The Contractor shall, by the execution of his contract, be deemed to have consented to submit to binding arbitration at the request of any claimant those questions that need be answered to establish the entitlement of the claimant to payment pursuant to the provisions of GC42.1 and such arbitration shall have as parties to it any subcontractor to whom the claimant supplied material, performed work or rented equipment should such subcontractor wish to be adjoined and the Crown shall not be a party to such arbitration and, subject to any agreement between the Contractor and the claimant to the contrary, the arbitration shall be conducted in accordance with the Provincial or Territorial legislation governing arbitration applicable in the Province or Territory in which the work is located.

42.4 A payment made pursuant to GC42.1 is, to the extent of the payment, a discharge of Her Majesty's liability to the Contractor under the contract and may be deducted from any amount payable to the Contractor under the contract.

42.5 To the extent that the circumstances of the work being performed for Her Majesty permit, the Contractor shall comply with all laws in force in the Province or Territory where the work is being performed relating to payment period, mandatory holdbacks, and creation and enforcement of mechanics' liens, builders' liens or similar legislation or in the Province of Quebec, the law relating to privileges.

42.6 The Contractor shall discharge all his lawful obligations and shall satisfy all lawful claims against him arising out of the performance of the work at least as often as the contract requires Her

Majesty to pay the Contractor.

42.7 The Contractor shall, whenever requested to do so by the Departmental Representative, make a statutory declaration deposing to the existence and condition of any obligations and claims referred to in GC42.6.

42.8 GC42.1 shall only apply to claims and obligations

42.8.1 the notification of which has been received by the Departmental Representative in writing before payment is made to the Contractor pursuant to TP4.10 and within 120 days of the date on which the claimant

42.8.1.1 should have been paid in full under the claimant's contract with the Contractor or subcontractor where the claim is for money that was lawfully required to be held back from the claimant; or

42.8.1.2 performed the last of the services, work or labour, or furnished the last of the material pursuant to the claimant's contract with the Contractor or subcontractor where the claim is not for money referred to in GC42.8.1.1, and

42.8.2 the proceedings to determine the right to payment of which, pursuant to GC42.2. shall have commenced within one year from the date that the notice referred to in GC42.8.1 was received by the Departmental Representative, and

the notification required by GC42.8.1 shall set forth the amount claimed to be owing and the person who by contract is primarily liable.

42.9 Her Majesty may, upon receipt of a notice of claim under GC42.8.1, withhold from any amount that is due and payable to the Contractor pursuant to the contract the full amount of the claim or any portion thereof.

42.10 The Departmental Representative shall notify the Contractor in writing of receipt of any claim referred to in GC42.8.1 and of the intention of Her Majesty to withhold funds pursuant to GC42.9 and the Contractor may, at any time thereafter and until payment is made to the claimant, be entitled to post, with Her Majesty, security in a form acceptable to Her Majesty in an amount equal to the value of the claim, the notice of which is received by the Departmental Representative and upon receipt of such security Her Majesty shall release to the Contractor any funds which would be otherwise payable to the Contractor, that were withheld pursuant to the provisions of GC42.9 in respect of the claim of any claimant for whom the security stands.

GC43 Security Deposit – Forfeiture or Return

43.1 If

43.1.1 the work is taken out of the Contractor's hands pursuant to GC38,

43.1.2 the contract is terminated pursuant to GC41, or

43.1.3 the Contractor is in breach of or in default under the contract,

Her Majesty may convert the security deposit, if any, to Her own use.

43.2 If Her Majesty converts the contract security pursuant to GC43.1, the amount realized shall be deemed to be an amount due from Her Majesty to the Contractor under the contract.

43.3 Any balance of an amount referred to in GC43.2 that remains after payment of all losses, damage and claims of Her Majesty and others shall be paid by Her Majesty to the Contractor if, in the opinion of the Departmental Representative, it is not required for the purposes of the contract.

GC44 Departmental Representative's Certificates

44.1 On the date that

44.1.1 the work has been completed, and

44.1.2 the Contractor has complied with the contract and all orders and directions made pursuant thereto,

both to the satisfaction of the Departmental Representative, the Departmental Representative shall issue a Final Certificate of Completion to the Contractor.

44.2 If the Departmental Representative is satisfied that the work is substantially complete he shall, at any time before he issues a certificate referred to in GC44.1, issue an Interim Certificate of Completion to the Contractor, and

44.2.1 for the purposes of GC44.2 the work will be considered to be substantially complete,

44.2.1.1 when the work under the contract or a substantial part thereof is, in the opinion of the Departmental Representative, ready for use by Her Majesty or is being used for the purpose intended; and

44.2.1.2 when the work remaining to be done under the contract is, in the opinion of the Departmental Representative, capable of completion or correction at accost of not more that

44.2.1.2.1 -3% of the first $500,000, and

44.2.1.2.2 -2% of the next $500,000, and

44.2.1.2.3 -1% of the balance

of the value of the contract at the time this cost is calculated.

44.3 For the sole purpose of GC44.2.1.2, where the work or a substantial part thereof is ready for use or is being used for the purposes intended and the remainder of the work or a part thereof cannot be completed by the time specified in A2.1, or as amended pursuant to GC36, for reasons beyond the control of the Contractor or where the Departmental Representative and the Contractor agree not to complete a part of the work within the specified time, the cost of that part of the work

which was either beyond the control of the Contractor to complete or the Departmental Representative and the Contractor have agreed not to complete by the time specified shall be deducted from the value of the contract referred to GC44.2.1.2 and the said cost shall not form part of the cost of the work remaining to be done in determining substantial completion.

44.4 An Interim Certificate of Completion referred to in GC44.2 shall describe the parts of the work not completed to the satisfaction of the Departmental Representative and all things that must be done by the Contractor

44.4.1 before a Final Certificate of Completion referred to in GC44.1 will be issued, and

44.4.2 before the 12-month period referred to in GC32.1.2 shall commence for the said parts and all the said things.

44.5 The Departmental Representative may, in addition to the parts of the work described in an Interim Certificate of Completion referred to in GC44.2, require the Contractor to rectify any other parts of the work not completed to his satisfaction and to do any other things that are necessary for the satisfactory completion of the work.

44.6 If the contract or a part thereof is subject to a Unit Price Arrangement, the Departmental Representative shall measure and record the quantities of labour, plant and material, performed, used and supplied by the Contractor in performing the work and shall, at the request of the Contractor, inform him of those measurements.

44.7 The Contractor shall assist and co-operate with the Departmental Representative in the performance of his duties referred to in GC44.6 and shall be entitled to inspect any record made by the Departmental Representative pursuant to GC44.6.

44.8 After the Departmental Representative has issued a Final Certificate of Completion referred to in GC44.1, he shall, if GC44.6 applies, issue a Final Certificate of Measurement.

44.9 A Final Certificate of Measurement referred to in GC44.8 shall

44.9.1 contain the aggregate of all measurements of quantities referred to in GC44.6, and

44.9.2 be binding upon and conclusive between Her Majesty and the Contractor as to the quantities referred to therein.

GC45 Return of Security Deposit

45.1 After an Interim Certificate of Completion referred to in GC44.2 has been issued, Her Majesty shall, if the Contractor is not in breach of or in default under the contract, return to the Contractor all or any part of the security deposit that, in the opinion of the Departmental Representative, is not required for the purposes of the contract.

45.2 After a Final Certificate of Completion referred to in GC44.1 has been issued, Her Majesty shall return to the Contractor the remainder of any security deposit unless the contract stipulates otherwise.

45.3 If the security deposit was paid into the Consolidated Revenue Fund of Canada, Her Majesty shall pay interest thereon to the Contractor at a rate established from time to time pursuant to section 21(2) of the Financial Administration Act.

GC46 Clarification of Terms in GC47 to GC50

46.1 For the purposes of GC47 to GC50,

46.1.1 "Unit Price Table" means the table set out in the Articles of Agreement, and

46.1.2 "plant" does not include tools customarily provided by a tradesman in practicing his trade.

GC47 Additions or Amendments to Unit Price Table

47.1 Where a Unit Price Arrangement applies to the contract or a part thereof the Departmental Representative and the Contractor may, by an agreement in writing,

47.1.1 add classes of labour or material, and units of measurement, prices per unit and estimated quantities to the Unit Price Table if any labour, plant or material that is to be included in the Final Certificate of Measurement referred to in GC44.8 is not included in any class of labour, plant or material set out in the Unit Price Table; or

47.1.2 subject to GC47.2 and GC47.3, amend a price set out in the Unit Price Table for any class of labour, plant or material included therein if the Final Certificate of Measurement referred to in GC44.8 shows or is expected to show that the total quantity of that class of labour, plant or material actually performed, used or supplied by the Contractor in performing the work is

47.1.2.1 less than 85% of that estimated total quantity, or

47.1.2.2 in excess of 115% of that estimated total quantity.

47.2 In no event shall the total cost of an item set out in the Unit Price Table that has been amended pursuant to GC47.1.2.1 exceed the amount that would have been payable to the Contractor had the estimated total quantity actually been performed, used or supplied.

47.3 An amendment that is made necessary by GC47.1.2.2 shall apply only to the quantities that are in excess of 115%.

47.4 If the Departmental Representative and the Contractor do not agree as contemplated in GC47.1, the Departmental Representative shall determine the class and the unit of measurement of the labour, plant or material and, subject to GC47.2 and GC47.3, the price per unit therefore shall be determined in accordance with GC50.

GC48 Determination of Cost – Unit Price Table

48.1 Whenever, for the purposes of the contract, it is necessary to determine the cost of labour, plant or material, it shall be determined by multiplying the quantity of that labour, plant or material expressed in the unit set out in column 3 of the Unit Price Table by the price of that unit set out in column 5 of the Unit Price Table.

GC49 Determination of Cost – Negotiation

49.1 If the method described in GC48 cannot be used because the labour, plant or material is of a kind or class that is not set out in the Unit Price Table, the cost of that labour, plant or material for the purposes of the contract shall be the amount agreed upon from time to time by the Contractor and the Departmental Representative.

49.2 For the purposes of GC49.1, the Contractor shall submit to the Departmental Representative any necessary cost information requested by the Departmental Representative in respect of the labour, plant and material referred to in GC49.1

GC50 Determination of Cost – Failing Negotiation

50.1 If the methods described in GC47, GC48 or GC49 fail for any reason to achieve a determination of the cost of labour, plant and material for the purposes referred to therein, that cost shall be equal to the aggregate of

50.1.1 all reasonable and proper amounts actually expended or legally payable by the Contractor in respect of the labour, plant and material that falls within one of the classes of expenditure described in GC50.2 that are directly attributable to the performance of the contract,

50.1.2 an allowance for profit and all other expenditures or costs, including overhead, general administration cost, financing and interest charges, and every other cost, charge and expenses, but not including those referred to in GC50.1.1 or GC50.1.3 or a class referred to in GC50.2, in an amount that is equal to 10% of the sum of the expenses referred to in GC50.1.1, and

50.1.3 interest on the cost determined under GC50.1.1 and GC50.1.2, which interest shall be calculated in accordance with TP9,

provide that the total cost of an item set out n the Unit Price Table that is subject to the provisions of GC47.1.2.1 does not exceed the amount that would have been payable to the Contractor had the estimated total quantity of the said item actually be performed, used or supplied.

50.2 For purposes of GC50.1.1 the classes of expenditure that may be taken into account in determining the cost of labour, plant and material are,

50.2.1 payments to subcontractors;

50.2.2 wages, salaries and travelling expenses of employees of the Contractor while they are actually and properly engaged on the work, other than wages, salaries, bonuses, living

and travelling expenses of personnel of the Contractor generally employed at the head office or at a general office of the Contractor unless they are engaged at the work site with the approval of the Departmental Representative,

50.2.3 assessments payable under any statutory authority relating to workmen's compensation, unemployment insurance, pension plan or holidays with pay;

50.2.4 rent that is paid for plant or an amount equivalent of the said rent if the plant is owned by the Contractor that is necessary for and used in the performance of the work, if the rent of the equivalent amount is reasonable and use of that plant has been approved by the Departmental Representative;

50.2.5 payments for maintaining and operating plant necessary for and used in the performance of the work, and payments for effecting such repairs thereto as, in the opinion of the Departmental Representative, are necessary to the proper performance of the contract other than payments for any repairs to the plant arising out of defects existing before its allocation to the work;

50.2.6 payments for material that is necessary for and incorporated in the work, or that is necessary for and consumed in the performance of the contract;

50.2.7 payments for preparation, delivery, handling, erection, installation, inspection protection and removal of the plant and material necessary for and used in the performance of the contract; and

50.2.8 any other payments made by the Contractor with the approval of the Departmental Representative that are necessary for the performance of the contract.

GC51 Records to be kept by Contractor

51.1 The Contractor shall

51.1.1 maintain full records of his estimated and actual cost of the work together with all tender calls, quotations, contracts, correspondence, invoices, receipts and vouchers relating thereto.

51.1.2 make all records and material referred to in GC5.1.1 available to audit and inspection by the Minister and the Deputy Receiver General for Canada or by persons acting on behalf of either of both of them, when requested;

51.1.3 allow any of the person referred to in GC51.1.2 to make copies of and to take extracts from any of the records and material referred to in GC51.1.1; and

51.1.4 furnish any person referred to in GC51.1.2 with any information he may require from time to time in connection with such records and material.

51.2 The records maintained by the Contractor pursuant to GC51.1.1 shall be kept intact by the Contractor until the expiration of two years after the date that a Final Certificate of Completion referred to in GC44.1 was issued or until the expiration of such other period of time as the

Minister may direct.

51.3 The Contractor shall cause all subcontractors and all other persons directly or indirectly controlled by or affiliated with the Contractor and all persons directly or indirectly having control of the Contractor to comply with GC51.1 and GC51.2 as if they were the Contractor.

GC52 Conflict of Interest

52.1 It is a term of this contract that no former public office holder who is not in compliance with the Conflict of Interest and Post-Employment Code for Public Office Holders shall derive a direct benefit from this contract.

GC53 Contractor Status

53.1 The Contractor shall be engaged under the contract as an independent contractor.

53.2 The Contractor and any employee of the said Contractor is not engaged by the contract as an employee, servant or agent of Her Majesty.

53.3 For the purposes of GC53.1 and GC53.2 the Contractor shall be solely responsible for any and all payments and deductions required to be made by law including those required for Canada or Quebec Pension Plans, Unemployment Insurance, Worker's Compensation or Income Tax.

GENERAL CONDITONS

IC 1 Proof of Insurance
IC 2 Risk Management
IC 3 Payment of Deductible
IC 4 Insurance Coverage

GENERAL INSUANCE COVERAGES

GCI 1 Insured
GIC 2 Period of Insurance
GIC 3 Proof of Insurance
GIC 4 Notification

COMMERCIAL GENERAL LIABILITY

CGL 1 Scope of Policy
CGL 2 Coverages/Provisions
CGL 3 Additional Exposures
CGL 4 Insurance Proceeds
CGL 5 Deductible

BUILDER'S RISK – INSTALLATION FLOATER – ALL RISKS

BR 1 Scope of Policy
BR 2 Property Insured
BR 3 Insurance Proceeds
BR 4 Amount of Insurance
BR 5 Deductible
BR 6 Subrogation
BR 7 Exclusion Qualifications

INSURER'S CERTIFICATE OF INSURANCE

General Conditions

IC 1 Proof of Insurance
(02/12/03)

Within thirty (30) days after acceptance of the Contractor's tender, the Contractor shall, unless otherwise directed in writing by the Contracting Officer, deposit with the Contracting Officer an Insurer's Certificate of Insurance in the form displayed in this document and, if requested by the Contracting Officer, the originals or certified true copies of all contracts of insurance maintained by the Contractor pursuant to the Insurance Coverage Requirements shown hereunder.

IC 2 Risk Management
(01/10/94)

The provisions of the Insurance Coverage Requirements contained hereunder are not intended to cover all of the Contractor's obligations under GC8 of the General Conditions "C" of the contract. Any additional risk management measures or additional insurance coverages the Contractor may deem necessary to fulfill its obligations under GC8 shall be at its own discretion and expense.

IC 3 Payment of Deductible
(01/10/94)

The payment of monies up to the deductible amount made in satisfaction of a claim shall be borne by the Contactor.

IC 4 Insurance Coverage
(02/12/03)

The Contractor has represented that it has in place and effect the appropriate and usual liability insurance coverage as required by these Insurance Conditions and the Contractor has warranted that it shall obtain, in a timely manner and prior to commencement of the Work, the appropriate and usual property insurance coverage as required by these Insurance Conditions and, further, that it shall maintain all required insurance policies in place and effect as required by these Insurance Conditions.

INSURANCE COVERAGE REQUIREMENTS

PART I
GENERAL INSUANCE COVERAGES (GIC)

GCI 1 Insured
(02/12/03)

Each insurance policy shall insure the Contractor, and shall include, as an Additional Named Insured, Her Majesty the Queen in right of Canada, represented by the National Research Council Canada.

GIC 2 Period of Insurance
(02/12/03)

Unless otherwise directed in writing by the Contracting Officer or otherwise stipulated elsewhere in these Insurance Conditions, the policies required hereunder shall be in force and be maintained from the date of the contract award until the day of issue of the Departmental Representative's Final Certificate of Completion.

GIC 3 Proof of Insurance
(01/10/94)

Within twenty five (25) days after acceptance of the Contractor's tender, the Insurer shall, unless otherwise directed by the Contractor, deposit with the Contractor an Insurer's Certificate of Insurance in the form displayed in the document and, if requested, the originals or certified true copies of all contracts of insurance maintained by the Contractor pursuant to the requirements of these Insurance Coverages.

GIC 4 Notification
(01/10/94)

Each Insurance policy shall contain a provision that (30) days prior written notice shall be given by the Insurer to Her Majesty in the event of any material change in or cancellation of coverage. Any such notice received by the Contractor shall be transmitted forthwith to Her Majesty.

PART II
COMMERCIAL GENERAL LIABILITY

CGL 1 Scope of Policy
(01/10/94)

The policy shall be written on a form similar to that known and referred to in the insurance industry as IBC 2100 – Commercial General Liability policy (Occurrence form) and shall provide for limit of liability of not less than $2,000,000 inclusive for Bodily Injury and Property Damage for any one occurrence or series of occurrences arising out of one cause. Legal or defence cost incurred in respect of a claim or claims shall not operate to decrease the limit of liability.

CGL 2 Coverages/Provisions
(01/10/94)

The policy shall include but not necessarily be limited to the following coverages/provisions.

2.1 Liability arising out of or resulting from the ownership, existence, maintenance or use of premises by the Contractor and operations necessary or incidental to the performance of this contract.

2.2 "Broad Form" Property Damage including the loss of use of property.

2.3 Removal or weakening of support of any building or land whether such support be natural or otherwise.

2.4 Elevator liability (including escalators, hoists and similar devices).

2.5 Contractor's Protective Liability

2.6 Contractual and Assumed Liabilities un this contact.

2.7 Completed Operations Liability – The insurance, including all aspects of this Part II of these Insurance Conditions shall continue for a period of at least one (1) year beyond the date of the Departmental Representative's Final Certificate of Completion for the Completed Operations.

2.8 Cross Liability – The Clause shall be written as follows:

Cross Liability – The insurance as is afforded by this policy shall apply in respect to any claim or action brought against any one Insured by any other Insured. The coverage shall apply in the same manner and to the same extent as though a separate policy had been issued to each Insured. The inclusion herein of more than one Insured shall not increase the limit of the Insurer's liability.

2.9 Severability of Interests – The Clause shall be written as follows:

Severability of Interests – This policy, subject to the limits of liability stated herein, shall apply separately to each Insured in the same manner and to the same extent as if a separate policy had been issued to each. The inclusion herein of more than one insured shall not increase the limit of the Insurer's liability.

CGL 3 Additional Exposures
(02/12/03)

The policy shall either include or be endorsed to include the following exposures of hazards if the Work is subject thereto:

3.1 Blasting

3.2 Pile driving and calsson work

3.3 Underpinning

3.4 Risks associated with the activities of the Contractor on an active airport

3.5 Radioactive contamination resulting from the use of commercial isotopes

3.6 Damage to the portion of an existing building beyond that directly associated with an addition, renovation or installation contract.

3.7 Marine risks associated with the contraction of piers, wharves and docks.

CGL 4 Insurance Proceeds
(01/10/94)

Insurance Proceeds from this policy are usually payable directly to a Claimant/Third Party.

CGL 5 Deductible
(02/12/03)

This policy shall be issued with a deductible amount of not more than $10,000 per occurrence applying to Property Damage claims only.

PART III
BUILDER'S RISK – INSTALLATION FLOATER – ALL RISKS

BR 1 Scope of Policy
(01/10/94)

The policy shall be written on an "All Risks" basis granting coverages similar to those provided by the forms known and referred to in the insurance industry as "Builder's Risk Comprehensive Form" or "Installation Floater – All Risks".

BR 2 Property Insured
(01/10/94)

The property insured shall include:

2.1 The Work and all property, equipment and materials intended to become part of the finished Work at the site of the project while awaiting, during and after installation, erection or construction including testing.

2.2 Expenses incurred in the removal from the construction site of debris of the property insured, including demolition of damaged property, de-icing and dewatering, occasioned by loss, destruction or damage to such property and in respect of which insurance is provided by this policy.

BR 3 Insurance Proceeds
(01/10/94)

3.1 Insurance proceeds from this policy are payable in accordance with GC28 of the General Conditions "C" of the contract.

3.2 This policy shall provide that the proceeds thereof are payable to Her Majesty or as the Minister may direct.

3.3 The Contractor shall do such things and execute such documents as are necessary to effect payment of the proceeds.

BR 4 Amount of Insurance
(01/10/94)

The amount of insurance shall not be less than the sum of the contract value plus the declared value (if any) set forth in the contract documents of all material and equipment supplied by Her Majesty at the site of the project to be incorporated into and form part of the finished Work.

BR 5 Deductible
(02/12/03)

The Policy shall be issued with a deductible amount of not more than $10,000.

BR 6 Subrogation
(01/10/94)

The following Clause shall be included in the policy:

"All rights of subrogation or transfer of rights are hereby waived against any corporation, firm, individual or other interest, with respect to which, insurance is provided by this policy".

BR 7 Exclusion Qualifications
(01/10/94)

The policy may be subject to the standard exclusions but the following qualifications shall apply:

7.1 Faulty materials, workmanship or design may be excluded only to the extent of the cost of making good thereof and shall not apply to loss or damage resulting therefrom.

7.2 Loss or damage caused by contamination by radioactive material may be excluded except for loss or damage resulting from commercial isotopes used for industrial measurements, inspection, quality control radiographic or photographic use.

7.3 Use and occupancy of the project or any part of section thereof shall be permitted where such use and occupancy is for the purpose for which the project is intended upon completion.

INSURER'S CERTIFICATE OF INSURANCE

(TO BE COMPLETED BY INSURER (NOT BOKER) AND DELIVERD TO NATIONAL RESEARCH COUNCIL CANADA WITH 30 DAYS FOLLOWING ACCEPTANCE OF TENDER)

CONTRACT

DESCRIPTION OF WORK	CONTRACT NUMBER	AWARD DATE
LOCATION		

INSURER

NAME
ADDRESS

BROKER

NAME
ADDRESS

INSURED

NAME OF CONTRACTOR
ADDRESS

ADDITIONAL INSURED

HER MAJESTY THE QUEEN IN RIGHT OF CANADA AS REPRESENTED BY THE NATIONAL RESEARCH COUNCIL CANADA

THIS DOCUENT CERTIFIES THAT THE FOLLOWING POLICES OF INSURANCE ARE AT PRESENT IN FORCE COVERING ALL OPERATIONS OF THE INSURE IN CONNECTION WITH THE CONTRACT MADE BETWEEN THE NAMED INSURED AND THE NATIONAL RESEARCH COUNCIL CANADA AND IN ACCORDANCE WITH THE INSURANCE CONDITIONS "E"

POLICY					
TYPE	NUMBER	INCEPTION DATE	EXPIRY DATE	LIMITS OF LIABILITY	DEDUCTIBLE
COMMERCIAL GENERAL LIABILITY					
BUILDERS RISK "AL RISKS"					
INSTALLATION FLOATER "ALL RISKS"					

THE INSURER AGREES TO NOTIFY THE NATIONAL RESEARCH COUNCIL CANADA IN WRITING 30 DAYS PRIOR TO ANY MATERIAL CHANGE IN OR CANCELLATION OF ANY POLICY OR COVERAGE SPECIFICALLY RELATED TO THE CONTRACT

NAME OF INSURER'S OFFICER OR AUTHORIZED EMPLOYEE	SIGNATURE	DATE:
		TELEPHONE NUMBER:

ISSUANCE OF THIS CERTIFIATE SHALL NOT LIMIT OR RESTRICT THE RIGHT OF THE NATIONAL RESEARCH COUNCIL CANADA TO REQUEST AT ANY TIME DUPLICATE COPIES OF SAID INSURANCE POLICIES

CS1 Obligation to provide Contract Security

1.1 The Contractor shall, at the Contractor's own expense, provide one or more of the forms of contract security prescribed in CS2.

1.2 The Contractor shall deliver to the Departmental Representative the contract security referred to in CS1.1 within 14 days after the date that the Contractor receives notice that the Contractor's tender or offer was accepted by Her Majesty.

CS2 Prescribed Types and Amounts of Contract Security

2.1 The Contractor shall deliver to the Departmental Representative pursuant to CS1

2.1.1 a performance bond and a labour and material payment bond each in an amount that is equal to not less than 50% of the contract amount referred to in the Articles of Agreement, or

2.1.2 a labour and material payment bond in an amount that is equal to not less than 50% of the contract amount referred to in the Articles of Agreement, and a security deposit in an amount that is equal to

2.1.2.1 not less than 10% of the contract amount referred to in the Articles of Agreement where that amount does not exceed $250,000, or

2.1.2.2 $25,000 plus 5% of the part of the contract amount referred to in the Articles of Agreement that exceeds $250,000, or

2.1.3 a security deposit in an amount prescribed by CS2.12 plus an additional amount that is equal to 10% of the contract amount referred to in the Articles of Agreement.

2.2 A performance bond and a labour and material payment bond referred to in CS2.1 shall be in a form and be issued by a bonding or surety company that is approved by Her Majesty.

2.3 The amount of a security deposit referred to in CS2.1.2 shall not exceed $250,000 regardless of the contract amount referred to in the Articles of Agreement.

2.4 A security deposit referred to in CS2.1.2 and CS2.1.3 shall be in the form of

2.4.1 a bill of exchange made payable to the Receiver General of Canada and certified by an approved financial institution or drawn by an approved financial institution on itself, or

2.4.2 bonds of or unconditionally guaranteed as to principal and interest by the Government of Canada.

2.5 For the purposes of CS2.4

2.5.1 a bill of exchange is an unconditional order in writing signed by the Contractor and addressed to an approved financial institution, requiring the said institution to pay, on demand, at a fixed or determinable future time a sum certain of money to, or to the order

of, the Receiver General for Canada, and

2.5.2 If a bill of exchange is certified by a financial institution other than a chartered bank then it must be accompanied by a letter or stamped certification confirming that the financial institution is in a t least one of the categories referred to in CS2.5.3

2.5.3 an approved financial institution is

2.5.3.1 any corporation or institution that is a member of the Canadian Payments Association,

2.5.3.2 a corporation that accepts deposits that are insured by the Canada Deposit Insurance Corporation or the Régie de l'assurance-dépôts du Québec to the maximum permitted by law,

2.5.3.3 a credit union as defined in paragraph 137(6)(b) of the *Income Tax Act*,

2.5.3.4 a corporation that accepts deposits from the public, if repayment of the deposit is guaranteed by Her Majesty in right of a province, or

2.5.3.5 The Canada Post Corporation.

2.5.4 the bonds referred to in CS2.4.2 shall be

2.5.4.1 made payable to bearer, or

2.5.4.2 accompanied by a duly executed instrument of transfer of the bonds to the Receiver General for Canada in the form prescribed by the Domestic Bonds of Canada Regulations, or

2.5.4.3 registered, as to principal or as to principal and interest in the name of the Receiver General for Canada pursuant to the Domestic Bonds of Canada Regulations, and

2.5.4.4 provided on the basis of their market value current at the date of the contract.

Government of Canada / Gouvernement du Canada

Contract Number / Numéro du contrat
835980
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 ASPM
3. a) Subcontract Number / Numéro du contrat de sous-traitance	3. b) Name and Address of Subcontractor / Nom et adresse du sous-traitant Tender

4. Brief Description of Work / Brève description du travail

M50 50PAC08 Replacement

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?

Government of Canada / Gouvernement du Canada

Contract Number / Numéro du contrat
835980
Security Classification / Classification de sécurité
UNCLASSIFIED

PART C - *(continued)* / PARTIE C - *(suite)*

For users completing the form **manually** use the summary chart below to indicate the category(ies) and level(s) of safeguarding required at the supplier's site(s) or premises.
Les utilisateurs qui remplissent le formulaire **manuellement** doivent utiliser le tableau récapitulatif ci-dessous pour indiquer, pour chaque catégorie, les niveaux de sauvegarde requis aux installations du fournisseur.

For users completing the form **online** (via the Internet), the summary chart is automatically populated by your responses to previous questions.
Dans le cas des utilisateurs qui remplissent le formulaire **en ligne** (par Internet), les réponses aux questions précédentes sont automatiquement saisies dans le tableau récapitulatif.

SUMMARY CHART / TABLEAU RÉCAPITULATIF

Category Catégorie	PROTECTED PROTÉGÉ			CLASSIFIED CLASSIFIÉ			NATO				COMSEC					
	A	B	C	CONFIDENTIAL CONFIDENTIEL	SECRET	TOP SECRET TRÈS SECRET	NATO RESTRICTED NATO DIFFUSION RESTREINTE	NATO CONFIDENTIAL NATO CONFIDENTIEL	NATO SECRET	COSMIC TOP SECRET COSMIC TRÈS SECRET	PROTECTED PROTÉGÉ A	PROTECTED PROTÉGÉ B	PROTECTED PROTÉGÉ C	CONFIDENTIAL CONFIDENTIEL	SECRET	TOP SECRET TRES SECRET
Information / Assets Renseignements / Biens																
Production																
IT Media / Support TI																
IT Link / Lien électronique																

12. a) Is the description of the work contained within this SRCL PROTECTED and/or CLASSIFIED?
La description du travail visé par la présente LVERS est-elle de nature PROTÉGÉE et/ou CLASSIFIÉE?

☑ No / Non ☐ Yes / Oui

If Yes, classify this form by annotating the top and bottom in the area entitled "Security Classification".
Dans l'affirmative, classifier le présent formulaire en indiquant le niveau de sécurité dans la case intitulée « Classification de sécurité » au haut et au bas du formulaire.

12. b) Will the documentation attached to this SRCL be PROTECTED and/or CLASSIFIED?
La documentation associée à la présente LVERS sera-t-elle PROTÉGÉE et/ou CLASSIFIÉE?

☑ No / Non ☐ Yes / Oui

If Yes, classify this form by annotating the top and bottom in the area entitled "Security Classification" and indicate with attachments (e.g. SECRET with Attachments).
Dans l'affirmative, classifier le présent formulaire en indiquant le niveau de sécurité dans la case intitulée « Classification de sécurité » au haut et au bas du formulaire et indiquer qu'il y a des pièces jointes (p. ex. SECRET avec des pièces jointes).

Government of Canada | Gouvernement du Canada

Contract Number / Numéro du contrat
835980
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
Mark O'Connor	Project Manager	

Telephone No. - N° de téléphone	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel	Date
991-9873		mark.o'connor@nrc.ca	19 Sept 2019

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
613-998-7352		Tori.Pelletier@nrc-cnrc.gc.ca	09/19/2019

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
		Digitally signed by Leroux, Alain DN: cn=Leroux, Alain, c=CA, o=GC, ou=NRC-CNRC, email=alain.leroux2@canada.ca Date: 2021.03.11 10:18:59 -05'00'

Telephone No. - N° de téléphone	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel	Date

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