



# SPECIFICATIONS

**SOLICITATION #:** 22-58032

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

**PROJECT:** M50-ROOM 186E VENTILATION  
MODIFICATIONS

**PROJECT #:** 6136

**Date:** July 2022

# **SPECIFICATION**

## **TABLE OF CONTENTS**

**Construction Tender Form**

**Buy and Sell Notice**

**Instructions to Bidders**

**Ontario Sales Tax**

**Acceptable Bonding Companies**

**Articles of Agreement**

**Plans and Specifications** **A**

**Terms of Payment** **B**

**General Conditions** **C**

**Labour Conditions and Fair Wage Schedule** **D**

**N/A**

**Insurance Conditions** **E**

**Contract Security Conditions** **F**

**Security Requirement Check List** **G**

## Construction Tender Form

**Project Identification**      **M50-ROOM 186E VENTILATION MODIFICATIONS**

**Tender No.:**      22-58032

**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.

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National Research Council Canada	Conseil national de recherches Canada
Finance and Procurement Services Branch	Direction des services financiers et d'approvisionnement

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### **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 services 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 form as described in Article 5 of the General Instructions to Tenderers, my/our tender is subject to disqualification.

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National Research Council      Conseil national de recherches  
Canada                              Canada

Finance and Procurement      Direction des services financiers  
Services Branch                    et d'approvisionnement

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**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)**

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National Research Council Canada	Conseil national de recherches Canada
Finance and Procurement Services Branch	Direction des services financiers et d'approvisionnement

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**1.10 Execution of Tender**

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

**SIGNED, ATTESTED TO AND DELIVERED on the \_\_\_\_\_ day of  
\_\_\_\_\_ on behalf of**

\_\_\_\_\_  
(Type or print the business name of the Tenderer)

**AUTHORIZED SIGNATORY (IES)**

\_\_\_\_\_  
(Signature of Signatory)

\_\_\_\_\_  
(Print name & Title of Signatory)

\_\_\_\_\_  
(Signature of Signatory)

\_\_\_\_\_  
(Print name & Title of Signatory)

**SEAL**

## BUY AND SELL NOTICE

### M50-ROOM 186E VENTILATION MODIFICATIONS

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

Work under this contract covers the installation of new Energy Recovery Ventilator (ERV), electric duct heater and associated ducting in the Council's Building M50 of the National Research Council.

#### 1. GENERAL

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

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

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

#### 2. MANDATORY SITE VISIT

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

The site visits will be held on August 2<sup>nd</sup> and August 3<sup>rd</sup> 2022 at **9:00**. Meet Salim Fettaka at Building M-50, Main Entrance, 1200 Montreal Road, Ottawa, ON. Bidders who, for any reason, cannot attend at the specified date and time will not be given an alternative appointment to view the site and their tenders, therefore, will be considered as non-responsive. **NO EXCEPTIONS WILL BE MADE.**

As proof of attendance, at the site visit, the Contracting Authority will have an Attendance Form which **MUST** be signed by the bidder's representative. It is the responsibility of all bidders to ensure they have signed the Mandatory Site Visit Attendance form prior to leaving the site. Proposals submitted by bidders who have not attended the site visit or failed to sign the Attendance Form will be deemed non-responsive.

#### 3. CLOSING DATE

Closing date is August 16<sup>th</sup>, 2022, 14:00

#### 4. TENDER RESULTS

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

#### 5. SECURITY REQUIREMENT FOR CANADIAN CONTRACTORS

## 5.1 MANDATORY SECURITY REQUIREMENT:

This procurement contains a mandatory security requirement as follows:

1. The Contractor must, at all times during the performance of the Contract, hold a valid Designated Organization Screening (DOS), issued by the Canadian Industrial Security Director (CISD), Public Works Government Services Canada.
2. The Contractor personnel requiring access to sensitive work site(s) must EACH hold a valid RELIABILITY STATUS, granted or approved by CISD/PWGSC.
3. The Contractor must comply with the provisions of the:
  - a. Security Requirements Checklist attached at Appendix "D"
  - b. Industrial Security Manual (Latest Edition) available at: <https://www.tpsgc-pwgsc.gc.ca/esc-src/msi-ism/index-eng.html>

## 5.2 VERIFICATION OF SECURITY CLEARANCE AT BID CLOSING

1. The Bidder must hold a valid Designated Organization Screening (DOS) issued by the Canadian Industrial Security Directorate (CISD), Public Works and Government Services Canada (PWGSC), **TO BE INCLUDED WITH THEIR TENDER OR PROVIDED WITHIN 48 HOURS FROM THE DATE AND TIME OF TENDER CLOSING.** Verifications will be made through CISD to confirm the security clearance status of the Bidder. Failure to comply with this requirement will render the bid non-compliant and no further consideration will be given to the bid.
2. Within 72 hours of tender closing, the General Contractor must name all of his sub-contractors, each of whom must hold a valid **RELIABILITY STATUS**, granted or approved by CISD/PWGSC, or any other Federal Department or Agency along with the names and birthdates or security clearance certificate numbers of all personnel who will be assigned to the project.
3. It is to be noted that any subcontractor required to perform any part of the work during the performance of the subsequent contract must also adhere to the mandatory security requirement of the contract. As well, no personnel without the required level of security will be allowed on site. It will be the responsibility of the successful bidder to ensure that the security requirement is met throughout the performance of the contract. The Crown will not be held liable or accountable for any delays or additional costs associated with the contractor's non-compliance to the mandatory security requirement. Failure to comply with the mandatory security requirement will be grounds for being declared in default of contract.
4. For any enquiries concerning the project security requirement during the bidding period, the Bidder/Tenderer must contact the Security Officer @ 613-993-8956.

## 6. WSIB (WORKPLACE SAFETY AND INSURANCE BOARD)

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

## 7. OFFICE OF THE PROCUREMENT OMBUDSMAN

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

The Office of the Procurement Ombudsman (OPO) was established by the Government of Canada to provide an independent venue for Canadian bidders to raise complaints regarding



the award of federal contracts under \$25,300 for goods and under \$101,100 for services. Should you have any issues or concerns regarding the award of a federal contract below these dollar amounts, contact OPO by e-mail at [boa.opo@boa-opo.gc.ca](mailto:boa.opo@boa-opo.gc.ca), by telephone at 1-866-734-5169, or by web at [www.opo-boa.gc.ca](http://www.opo-boa.gc.ca). For more information about OPO, including the available services, please visit the OPO website.

## 2. Contract Administration

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

To file a complaint, the Office of the Procurement Ombudsman may be contacted by e-mail at [boa.opo@boa-opo.gc.ca](mailto:boa.opo@boa-opo.gc.ca), by telephone at 1-866-734-5169, or by web at [www.opo-boa.gc.ca](http://www.opo-boa.gc.ca).

## 3. Dispute Resolution

The Parties agree to make every reasonable effort, 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 and bear the cost of mediation led by the Procurement Ombudsman pursuant 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](mailto:boa.opo@boa-opo.gc.ca), or by web at [www.opo-boa.gc.ca](http://www.opo-boa.gc.ca).

The Departmental Representative or his designate for this project is: Salim Fettaka  
[Salim.Fettaka@nrc-cnrc.gc.ca](mailto:Salim.Fettaka@nrc-cnrc.gc.ca)  
Telephone: (343) 575-3097

Contracting Authority for this project is: Collin Long  
[Collin.Long@nrc-cnrc.gc.ca](mailto:Collin.Long@nrc-cnrc.gc.ca)

## INSTRUCTIONS TO BIDDERS

### Article 1 – Receipt of Tender

- 1a) Tender must be received **by email only** not later than the specified tender closing time. Electronic bids received after the indicated closing time - NRC servers received time - will be irrevocably rejected. Bidders are urged to send their proposal sufficient time in advance of the closing time to prevent any technical issues. NRC will not be held responsible for bids sent before closing time but received by the NRC servers after the closing time. Tenders received after this time are invalid and shall not be considered, regardless of any reason for their late arrival.
- 1b) A letter of printed telecommunication from a bidder quoting a price shall not be considered as a valid tender unless a formal tender has been received on the prescribed Tender Form.
- 1c) Bidders may amend their tenders by **email only** provided that such amendments are received not later than the specified tender closing time.
- 1d) Any amendments to the tender which are transmitted by **email only** must be signed and must clearly identify the tenderer.

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

[Collin.Long@nrc-cnrc.gc.ca](mailto:Collin.Long@nrc-cnrc.gc.ca)

### Article 2 – Tender Form & Qualifications

- 1) All tenders must be submitted on the Construction Tender Form and the tender must be signed in compliance with the following requirements:
  - a) Limited Company: The full names of the Company and the name(s) and status of the authorized signing officer(s) must be printed in the space provided for that purpose. The signature(s) of the authorized officer(s) and the corporate seal must be affixed.
  - b) Partnership: The firm name and the name(s) of the person(s) signing must be printed in the space provided. One or more of the partners must sign in the presence of a witness who must also sign. An adhesive colored seal must be affixed beside each signature.
  - c) Sole Proprietorship: The business name and the name of the sole proprietor must be printed in the space provided. The sole proprietor must sign in the presence of a witness who must also sign. An adhesive coloured seal must be affixed beside each signature.
- 2) Any alterations in the printed part of the Construction Tender Form or failure to provide the information requested therein, may render the tender invalid.
- 3) All space in the Construction Tender Form must be completed and any handwritten or typewritten corrections to the parts so completed must be initialed immediately to the side of the corrections by the person or persons executing the tender on behalf of the tenderer.
- 4) Tenders must be based on the plans, specifications and tender documents provided.

- 5) A proposal submitted by a bidder whose 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 take precedence.

#### Article 3 - Contract

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

#### Article 4 – Tender Destination

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

[Collin.Long@nrc-cnrc.gc.ca](mailto:Collin.Long@nrc-cnrc.gc.ca)

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

- 1b) Unless otherwise specified, the only documents required to be submitted with the tender are the Tender form 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 amount 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 is 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:

$$1/36 \times \text{net book value at date of import} \times \text{number of months in Ontario} \times \text{tax rate}$$

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 x 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)

## M a n u f a c t u r i n g   f o r   O w n   U s e

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)

## C o n t r a c t s   w i t h   t h e   F e d e r a l   G o v e r n m e n t

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.

## E x e m p t i o n s

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](http://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

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## 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

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## Articles of Agreement

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.

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## Articles of Agreement

### 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:

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## Articles of Agreement

### 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.

<b>Column 1</b> Item	<b>Column 2</b> Class of Labour Plant  Or Material	<b>Column 3</b> Unit of Measurement	<b>Column 4</b> Estimated Total Quantity	<b>Column 5</b> Price per Unit	<b>Column 6</b> 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.



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**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 \_\_\_\_\_ and  
Position

of

on the \_\_\_\_\_

day of \_\_\_\_\_

**Seal**

	Pages
Division 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS	
Section 00 01 10 - Table of Contents .....	2
Section 00 10 00 – General Instructions.....	11
Section 00 15 45 – General and Fire Safety Requirements.....	6
Division 01 - GENERAL REQUIREMENTS	
Section 01 21 00 – Allowances.....	2
Section 01 33 00 – Submittal Procedures.....	4
Section 01 91 13 – General Commissioning (CX) Requirements.....	11
Section 01 91 31 – Commissioning (CX) Plan.....	9
Section 01 91 33 – Commissioning Forms.....	3
Section 01 91 33 – Commissioning Forms – Appendix.....	6
Section 01 91 41 – Commissioning: Training.....	3
Division 2 – EXISTING CONDITIONS	
Section 02 07 00 – Site Work and Demolition.....	2
Section 02 07 50 – Interior Protection.....	2
Division 7 – THERMAL & MOISTURE PROTECTION	
Section 07 10 00 – Air and Vapour Barrier.....	2
Division 9 – FINISHES	
Section 09 51 00 – Acoustical Ceiling Assemblies.....	8
Division 21 - MECHANICAL	
Section 21 05 01 - Common Work Results for Mechanical .....	5
Section 21 05 02 – Mechanical Identification .....	3
Division 23 - HEATING, VENTILATING AND AIR CONDITIONING (HVAC)	
Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.....	8
Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.....	5
Section 23 05 93 – Testing, Adjusting and Balancing for HVAC.....	4
Section 23 07 13 – Duct Insulation.....	5
Section 23 33 00 – Air Duct Accessories.....	3
Section 23 33 14 – Dampers Balancing.....	3
Section 23 37 13 – Diffusers, Registers and Grilles.....	2
Section 23 37 20 – Louvres, Intakes and Vents.....	3
Section 23 55 01 – Duct Heaters.....	3
Section 23 72 00 – Air-to-Air Energy Recovery Ventilator.....	5
Section 23 31 13.01 – Metal Ducts – Low Pressure to 500 Pa .....	5

Division 25 - INTEGRATED AUTOMATION

Section 25 01 11 – EMCS: Start-Up, Verification and Commissioning.....	6
Section 25 01 12 – EMCS: Training.....	3
Section 25 05 01 – EMCS: General Requirements.....	7
Section 25 05 02 – EMCS: Submittals and Review Process.....	3
Section 25 05 03 – EMCS: Project Record Documents.....	3
Section 25 05 54 – EMCS: Identification.....	3
Section 25 08 20 – EMCS: Warranty and Maintenance.....	4
Section 25 10 01 – EMCS: Local Area Network (LAN).....	3
Section 25 30 01 – EMCS: Building Controllers.....	8
Section 25 30 02 – EMCS: Field Control Devices.....	6
Section 25 90 01 – EMCS: Site Requirements, Applications and Systems Sequence of Operation.....	3

Division 26 – ELECTRICAL

Section 26 05 00 – Common Work Results - Electrical.....	6
Section 26 05 21 – Wires and Cables (0-1000V).....	2
Section 26 05 22 – Connectors and Terminations.....	2
Section 26 05 33 – Raceways for Electrical Systems.....	3

END OF TABLE

**1. SCOPE OF WORK**

- .1 Work under this contract covers the installation of new Energy Recovery Ventilator (ERV), electric duct heater and associated ducting 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:

6136 – G00

6136 – G01

6136 – M01

**3. GENERAL**

- .1 The word "provide" in this Specification means to supply and install.
- .2 Provide items mentioned in either the drawings or the specification.

**4. SPECIFIED ACCEPTABLE & ALTERNATIVE EQUIPMENT & MATERIALS**

- .1 Materials and equipment scheduled and/or specified on the drawings or in the specifications have been selected to establish a performance and quality standard. In most cases, acceptable manufacturers are stated for any material or equipment specified by manufacturer's name and model number. Contractors may base their tender price on materials and equipment supplied by any of the manufacturers' names as acceptable for the particular material or equipment.
- .2 In addition to the manufacturers specified or named as acceptable, you may propose alternative manufacturers of materials or equipment to the Departmental Representative for acceptance. For a product to be considered as an alternative product substitute, make a written application to the Departmental Representative during the tender period, not later than seven (7) working days before tender closing.
- .3 Certify in writing that the alternative meets all requirements of the specified material or equipment. In addition, it shall be understood that all costs required by or as a result of acceptance or proposed alternatives, will be borne by the Contractor.
- .4 Approval of alternatives will be signified by issue of an Addendum to the Tender Documents.
- .5 Any alternative manufacturers or materials submitted which are incomplete and cannot be evaluated, or are later than seven (7) working days before tender closing date or after the tender period, will not be considered.

**5. 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.

**6. 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

**7. 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.

**8. COST BREAKDOWN**

- .1 Submit, for approval by the Departmental Representative, a cost breakdown of tender 72 hours after the contract is awarded.
- .2 Use the approved cost breakdown as the basis for submitting all claims.

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

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

**9. SUB-TRADES**

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

**10. PERSONNEL SECURITY AND IDENTIFICATION**

- .1 All persons employed by the Contractor, or by any sub-contractor and present on the site must be security cleared in accordance with the requirements of the Section entitled Special Instructions to Tenderers.
- .2 All such persons must wear and keep visible identification badges as issued by the Security Office of NRC.

**11. WORKING HOURS AND SECURITY**

- .1 Normal working hours on the NRC property are from 8:00 a.m. until 4:30 p.m., Monday to Friday inclusive, except statutory holidays.
- .2 At all other times, special written passes are required for access to the building site.
- .3 Before scheduling any work outside normal working hours, obtain permission from the Departmental Representative to perform the specific tasks.
- .4 An escort may be required whenever working outside normal hours. Contractor to bear the associated costs.

**12. SCHEDULE**

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

- .3 14 day(s) before the scheduled completion date, arrange to do an interim inspection with the Departmental Representative.

**13. 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.

**14. SHOP DRAWINGS**

- .1 Submit to Departmental Representative for review, shop drawings, product data and samples specified within three (3) 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 weekly basis and any changes to the list shall be immediately notified in writing to the Departmental Representative.
- .3 Review shop drawings, data sheets and samples prior to submission.
- .4 Submit one (1) electronic copy of all shop drawings and product data and samples for review, unless otherwise specified.
- .5 Review of shop drawings and product data by the Departmental Representative does not relieve the Contractor of the responsibility for errors and omissions and for the conformity with contract documents.

**15. SAMPLES AND MOCK-UPS**

- .1 Submit samples in sizes and quantities as specified.
- .2 Where colour, pattern or texture is criterion, submit full range of samples.
- .3 Construct field samples and mock-ups at locations acceptable to Departmental Representative.
- .4 Reviewed samples or mock-ups will become standards of workmanship and material against which installed work will be checked on the project.

**16. MATERIALS AND WORKMANSHIP**

- .1 Install only new materials on this project unless specifically noted otherwise.
- .2 Only first class workmanship will be accepted, not only with regard to safety, efficiency, durability, but also with regard to neatness of detail and performance.

**17. WORK & MATERIALS SUPPLIED BY OWNER**

- .1 Work and materials not included in this contract are described on drawings and in this specification.
- .2 Deliver to a storage place, as directed by the Departmental Representative, all materials returned to the Owner.
- .3 Unless otherwise specified, accept owner-supplied materials at their storage location and provide all transportation as required.
- .4 General Contractor's duties:
  - .1 Unload at site.
  - .2 Promptly inspect products and report damaged or defective items.
  - .3 Give written notification to the Departmental Representative for items accepted in good order.
  - .4 Handle at site, including uncrating and storage.
  - .5 Repair or replace items damaged on site.
  - .6 Install, connect finished products as specified.

**18. SITE ACCESS**

- .1 Make prior arrangements with the Departmental Representative before starting work or moving materials and equipment on site.
- .2 Obtain approval of Departmental Representative for regular means of access during the construction period.
- .3 Obtain approval of Departmental Representative before temporarily suspending operations on site; before returning to the site and before leaving the site at the end of the job.
- .4 Provide and maintain access to site.
- .5 Make good any damage and clean up dirt, debris, etc., resulting from Contractor's use of existing roads.

**19. USE OF SITE**

- .1 Restrict operations on the site to the areas approved by the Departmental Representative
- .2 Locate all temporary structures, equipment, storage, etc., to the designated areas.
- .3 Restrict parking to the designated areas.

**20. ACCEPTANCE OF SITE**

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



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

**21. SITE OFFICE & TELEPHONE**

- .1 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.

**22. SANITARY FACILITIES**

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

**23. TEMPORARY SERVICES**

- .1 A source of temporary power will be made available in the area. Bear all costs to make connections to the power source and perform distribution on site.
- .2 Provide all load centres, breakers, conduit, wiring, disconnects, extension cords, transformers, as required from the source of power.
- .3 Power is to be used only for power tools, lighting, controls, motors, and not for space heating.
- .4 A source of temporary water will be made available if required.
- .5 Bear all costs associated with distributing the water to the required locations.
- .6 Comply with NRC requirements when connecting to existing systems in accordance with the articles entitled "Co-operation" and "Service Interruptions" of this section.

**24. DOCUMENTS REQUIRED AT WORK SITE**

- .1 The Contractor shall keep on the site, one (1) up-to-date copy of all contract documents, including specifications, drawings, addenda, shop drawings, change notices, schedule and any reports or bulletins pertaining to the work, in good order, available to the Departmental Representative and to his / her representatives at all times.
- .2 At least one (1) copy of specifications and drawings shall be marked by the Contractor to show all work "As Built" and shall be provided to the Departmental Representative with the Application for Payment and for the Final Certificate of Completion.

**25. CO-OPERATION**

- .1 Co-operate with NRC staff in order to keep disruption of normal research work to an absolute minimum.
- .2 Work out in advance, a schedule for all work which might disrupt normal work in the building.

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

**26. PROTECTION AND WARNING NOTICES**

- .1 Provide all materials required to protect existing equipment.
- .2 Erect dust barriers to prevent dust and debris from spreading through the building.
- .3 Place dust protection in the form of cover sheets over equipment and furniture and tape these sheets to floors, to ensure no dust infiltration.
- .4 Repair or replace any and all damage to Owner's property caused during construction, at no cost to the Owner and to the satisfaction of the Departmental Representative.
- .5 Protect the buildings, roads, lawns, services, etc. from damage which might occur as a result of this work.
- .6 Plan and co-ordinate the work to protect the buildings from the leakage of water, dust, etc.
- .7 Ensure that all doors, windows, etc., that could allow transfer of dust, noise, fumes, etc., to other areas of the building are kept closed.
- .8 Be responsible for security of all areas affected by the work under the Contract until acceptance by NRC. Take all necessary precautions to prevent entry to the work area by unauthorized persons and guard against theft, fire and damage by any cause. Secure working area at the end of each day's work and be responsible for same.
- .9 Provide and maintain adequate safety barricades around the work sites to protect NRC personnel and the public from injury during the construction.
- .10 Post warnings, in all instances where possible injury could occur such as Work Overhead, Hard Hat Areas, etc. or as required by the Departmental Representative.
- .11 Provide temporary protective enclosures over building entrances and exits to protect pedestrians. All enclosures to be structurally sound against weather and falling debris.

**27. BILINGUALISM**

- .1 Ensure that all signs, notices, etc. are posted in both official languages.
- .2 Ensure that all identification of services called for by under this contract are bilingual.

**28. LAYOUT OF WORK**

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

- .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with the manufacturer's recommendations for safety, access and maintenance.
- .3 Employ competent person to lay out work in accordance with the contract documents.

**29. DISCREPANCIES & INTERFERENCES**

- .1 Prior to the start of the work, examine drawings and specifications. Report at once to the Departmental Representative, any defects, discrepancies, omissions or interferences affecting the work.
- .2 Contractor to immediately inform the Departmental Representative in writing, of any discrepancies between the plans and the physical conditions so the Departmental Representative may promptly verify same.
- .3 Any work done after such a discovery, until authorized, is at the Contractor's risk.
- .4 Where minor interferences as determined by the Departmental Representative are encountered on the job and they have not been pointed out on the original tender or on the plans and specifications, provide offsets, bends or reroute the services to suit job conditions at no extra cost.
- .5 Arrange all work so as not to interfere in any way with other work being carried out.

**30. MANUFACTURER'S INSTRUCTIONS**

- .1 Unless otherwise specified, comply with manufacturer's latest printed instructions for materials and installation methods.
- .2 Notify the Departmental Representative in writing of any conflict between these specifications and manufacturer's instruction. Departmental Representative will designate which document is to be followed.

**31. 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. 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.

**32. 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.

**33. 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.

**34. 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.

**35. 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.

**36. DRAINAGE**

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

**37. 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.

**38. 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.

**39. 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.

**40. 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.

**41. 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.

**42. 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.

**43. 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.

**44. 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.

**45. 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.

**46. 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.

**47. 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, inclement weather or other environmental anomalies.
  - .1 Provide a safety board mounted in a visible location on the project site, with the following information included thereon:
    - .1 Notice of Project.
    - .2 Site specific Safety Policy.
    - .3 Copy of Ontario Health and Safety Act.
    - .4 Building Schematic showing emergency exits.
    - .5 Building emergency procedures.
    - .6 Contact list for NRC, Contractor and all involved sub-contractors.
    - .7 Any related MSDS sheets.
    - .8 NRC Emergency phone number.
- .8 The Contractor shall provide competent personnel to implement its safety program and those of any Health and Safety Act legislation applicable at this project location, and to ensure they are being complied with.
- .9 The Contractor shall provide safety orientation to all its employees as well as those of any sub-contractors under its jurisdiction.

- .10 The Departmental Representative will monitor to ensure that safety requirements are met and that safety records are properly kept and maintained. Continued disregard for safety standards can cause the contract to be cancelled and the Contractor or sub-contractors removed from the site.
- .11 The Contractor will report to the Departmental Representative and jurisdictional authorities, any accident or incident involving Contractor or NRC personnel or the public and/or property arising from the Contractor's execution of the work.
- .12 If entry to a laboratory is required as part of the work of the Contractor, a safety orientation shall be provided to all his employees as well as those of any sub-contractors regarding lab safety requirements and procedures, as provided by the Researcher or the Departmental Representative.

## **2. FIRE SAFETY REQUIREMENTS**

### **.1 Authorities**

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



- .4 Carbon Dioxide (CO<sub>2</sub>) 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 Fire and Smoke Hazard Management:**

- .1 Contractor shall identify “Designated Roofing Marshall” for duration of construction activities. “Designated Roofing Marshall” shall be responsible for the following:
  - .1 Perform NRC Daily Fire and Smoke Risk Hazard Assessment each day prior to commencement of roofing activities.
  - .2 Provide completed NRC Daily Fire and Smoke Risk Hazard Assessment to Departmental Representative every morning by email prior to commencement of roofing activities.
  - .3 Follow behind any torch activities with a thermal scanner periodically to identify any hot spots and rectify immediately. Interval for periodic thermal scanning to be approved on site with Departmental Representative.

.2 Any proposed changes to “Designated Roofing Marshall” must be reviewed and approved by Departmental Representative.

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

.6 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 38°C (100°F) such as naphtha or gasoline as solvents or cleaning agents.
- .7 Store flammable waste liquids for disposal in approved container located in a safe, ventilated area. Waste flammable liquids are to be removed from the site on a regular basis.
- .8 Where flammable liquids, such as lacquers or urethane are used, ensure proper ventilation and eliminate all sources of ignition. Inform the Departmental Representative prior to, and at the cessation of such work.

### **3. QUESTIONS OR CLARIFICATIONS**

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

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 REFERENCES**

- .1 Canadian Construction Documents Committee (CCDC)
  - .1 CCDC 2-2008, Stipulated Price Contract.
- .2 Project Supplementary Conditions

### **1.2 CASH ALLOWANCES**

- .1 Refer to CCDC 2, GC 4.1.
- .2 Include in Contract Price specified cash allowances.
- .3 Cash allowances, unless otherwise specified, cover net cost to Contractor of services, products, construction machinery and equipment, freight, handling, unloading, storage and other authorized expenses incurred in performing Work.
- .4 Contract Price, and not cash allowance, includes Contractor's overhead and profit in connection with such cash allowance.
- .5 Contract Price will be adjusted by written order to provide for excess or deficit to each cash allowance.
- .6 Where costs under a cash allowance exceed amount of allowance, Contractor will be compensated for excess incurred and substantiated plus allowance for overhead and profit as set out in Contract Documents.
- .7 Include progress payments on accounts of work authorized under cash allowances in Consultant's monthly certificate for payment.
- .8 Prepare schedule jointly with Consultant and Contractor to show when items called for under cash allowances must be authorized by Consultant for ordering purposes so that progress of Work will not be delayed.
- .9 Amount of each allowance, for Work specified in respective specification Sections is as follows:
  - .1 Section 25 - \$20,000.00 (Ainsworth Controls)

## **PART 2- PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

**PART 3 - EXECUTION**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**



**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Section 01 10 00 - General Instructions Ontario

**1.2                ADMINISTRATIVE**

- .1            Submit to Departmental Representative for review, shop drawings, product data and samples specified within two weeks after contract award.
  - .1            Submit promptly and in orderly sequence to not cause delay in Work
  - .2            Failure to submit in the prescribed time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2            Do not proceed with Work affected by submittal until review is complete.
- .3            Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .4            Where items or information is not produced in SI Metric units converted values are acceptable.
- .5            Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .6            Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7            Verify field measurements and affected adjacent Work are co-ordinated.
- .8            Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.
- .9            Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.
- .10           Keep one reviewed copy of each submission on site.

**1.3                SHOP DRAWINGS AND PRODUCT DATA**

- .1            The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2            Submit shop drawings bearing stamp and signature of qualified professional engineer registered or licensed in Province of Ontario, Canada.

- .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .4 Allow 5 week days for Departmental Representative's review of each submission.
- .5 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental in writing of revisions other than those requested.
- .7 Accompany submissions with transmittal letter, containing:
  - .1 Date.
  - .2 Project title and number.
  - .3 Contractor's name and address.
  - .4 Identification and quantity of each shop drawing, product data and sample.
  - .5 Other pertinent data.
- .8 Submissions include:
  - .1 Date and revision dates.
  - .2 Project title and number.
  - .3 Name and address of:
    - .1 Subcontractor.
    - .2 Supplier.
    - .3 Manufacturer.
  - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
  - .5 Details of appropriate portions of Work as applicable:
    - .1 Fabrication.
    - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
    - .3 Setting or erection details.
    - .4 Capacities.
    - .5 Performance characteristics.
    - .6 Standards.
    - .7 Operating weight.
    - .8 Wiring diagrams.
    - .9 Single line and schematic diagrams.
    - .10 Relationship to adjacent work.

- .9 After Departmental Representative's review, distribute copies.
- .10 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.
- .11 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.
- .12 Submit electronic copies of test reports for requirements requested in specification Sections and as requested by Departmental Representative.
  - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
  - .2 Testing must have been within [3] years of date of contract award for project.
- .13 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
  - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
  - .2 Certificates must be dated after award of project contract complete with project name.
- .14 Submit electronic copies of manufacturer's instructions for requirements requested in specification Sections and as requested by Departmental Representative.
  - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .15 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.
  - .1 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .16 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.
- .17 Delete information not applicable to project.
- .18 Supplement standard information to provide details applicable to project.
- .19 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .20 The review of shop drawings by National Research Council Canada (NRC) is for sole purpose of ascertaining conformance with general concept.

- .1 This review shall not mean that NRC approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.
- .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of Work of sub-trades.

#### **1.4 SAMPLES**

- .1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Departmental Representative's business address.
- .3 Notify Departmental Representative Engineer Consultant in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

#### **1.5 MOCK-UPS**

- .1 Construct field mock-ups at locations acceptable to Departmental Representative.
- .2 Reviewed mock-ups will become standards of workmanship and material against which installed work will be checked on the project.

**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 Related Requirements
  - .1 Section 01 91 31 – Commissioning (Cx) Plan
  - .2 Section 01 91 33 – Commissioning Forms
  - .3 Section 01 91 41 – Commissioning Training
- .3 Acronyms:
  - .1 AFD - Alternate Forms of Delivery, service provider.
  - .2 BMM - Building Management Manual.
  - .3 Cx - Commissioning.
  - .4 EMCS - Energy Monitoring and Control Systems.
  - .5 O&M - Operation and Maintenance.
  - .6 PI - Product Information.
  - .7 PV - Performance Verification.
  - .8 TAB - Testing, Adjusting and Balancing.

### **1.2 GENERAL**

- .1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:
  - .1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
  - .2 Ensure appropriate documentation is compiled into the BMM.
  - .3 Effectively train O&M staff.
- .2 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.
  - .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.
  - .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
- .3 Design Criteria: as per client's requirements or determined by designer. To meet Project functional and operational requirements.

### 1.3 COMMISSIONING OVERVIEW

- .1 Section 01 91 31 - Commissioning (Cx) Plan.
- .2 For Cx responsibilities refer to Section 01 91 31 - Commissioning (Cx) Plan.
- .3 Cx to be a line item of Contractor's cost breakdown.
- .4 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .5 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built 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 or hold-back assessments.

### 1.5 PRE-CX REVIEW

- .1 Before Construction:
  - .1 Review contract documents, confirm by writing to Departmental Representative.
    - .1 Adequacy of provisions for Cx.
    - .2 Aspects of design and installation pertinent to success of Cx.
- .2 During Construction:
  - .1 Co-ordinate provision, location and installation of provisions for Cx.
- .3 Before start of Cx:

- .1 Have completed Cx Plan up-to-date.
  - .2 Ensure installation of related components, equipment, sub-systems, systems is complete.
  - .3 Fully understand Cx requirements and procedures.
  - .4 Have Cx documentation shelf-ready.
  - .5 Understand completely design criteria and intent and special features.
  - .6 Submit complete start-up documentation to Departmental Representative.
  - .7 Have Cx schedules up-to-date.
  - .8 Ensure systems have been cleaned thoroughly.
  - .9 Complete TAB procedures on systems, submit TAB reports to Departmental Representative for review and approval.
  - .10 Ensure "As-Built" system schematics are available.
- 4 Inform Departmental Representative in writing of discrepancies and deficiencies on finished works.

## 1.6 CONFLICTS

- .1 Report conflicts between requirements of this section and other sections to Departmental Representative before start-up and obtain clarification.
- .2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

## 1.7 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 00 10 00 – General Instructions.
  - .1 Submit no later than 4 weeks after award of Contract:
    - .1 Name of Contractor's Cx agent.
    - .2 Draft Cx documentation.
    - .3 Preliminary Cx schedule.
- .2 Request in writing to Departmental Representative for changes to submittals and obtain written approval at least 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.

- .4 Provide all missing Cx forms and submit to Departmental Representative for approval.
- .5 Complete all Cx forms that re provided in Section 01 91 33 00, if information is missing.

## **1.9 COMMISSIONING SCHEDULE**

- .1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 00 10 00 – General Instructions.
- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
  - .1 Approval of Cx reports.
  - .2 Verification of reported results.
  - .3 Repairs, retesting, re-commissioning, re-verification.
  - .4 Training.

## **1.10 COMMISSIONING MEETINGS**

- .1 Convene Cx meetings following project meetings.
- .2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.
- .3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .4 At 60% construction completion stage. Cx Agent to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
  - .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
  - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .6 Meeting will be chaired by Cx Agent, who will record and distribute minutes.
- .7 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

## **1.11 STARTING AND TESTING**

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



### 1.12 WITNESSING OF STARTING AND TESTING

- .1 Provide 14 days notice prior to commencement.
- .2 Departmental Representative to witness of start-up and testing.
- .3 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

### 1.13 MANUFACTURER'S INVOLVEMENT

- .1 Factory testing: manufacturer to:
  - .1 Coordinate time and location of testing.
  - .2 Provide testing documentation for approval by Departmental Representative.
  - .3 Arrange for Departmental Representative to witness tests.
  - .4 Obtain written approval of test results and documentation from Departmental Representative before delivery to site.
- .2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Departmental Representative.
  - .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
  - .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
- .3 Start-up, PV and Cx, manufacturer to:
  - .1 Provide trained personnel to assist in start-up, PV and commissioning of equipment where specified.
- .4 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.
- .5 Qualifications of manufacturer's personnel:
  - .1 Experienced in design, installation and operation of equipment and systems.
  - .2 Ability to interpret test results accurately.
  - .3 To report results in clear, concise, logical manner.

### 1.14 PROCEDURES

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in following distinct phases:
  - .1 Included in delivery and installation:
    - .1 Verification of conformity to specification, approved shop drawings and

- completion of PI report forms.
- .2 Visual inspection of quality of installation.
- .2 Start-up: follow accepted start-up procedures.
- .3 Operational testing: document equipment performance.
- .4 System PV: include repetition of tests after correcting deficiencies.
- .5 Post-substantial performance verification: to include fine-tuning.
  
- .3 Correct deficiencies and obtain approval from Departmental Representative after distinct phases have been completed and before commencing next phase.
  
- .4 Document require tests on approved PV forms.
  
- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Departmental Representative. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:
  - .1 Minor equipment/systems: implement corrective measures approved by Departmental Representative.
  - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Departmental Representative.
  - .3 If evaluation report concludes that major damage has occurred, Departmental Representative shall reject equipment.
    - .1 Rejected equipment to be remove from site and replace with new.
    - .2 Subject new equipment/systems to specified start-up procedures.

### **1.15 START-UP DOCUMENTATION**

- .1 Assemble start-up documentation and submit to Departmental Representative for approval before commencement of commissioning.
  
- .2 Start-up documentation to include:
  - .1 Factory and on-site test certificates for specified equipment.
  - .2 Pre-start-up inspection reports.
  - .3 Signed installation/start-up check lists.
  - .4 Start-up reports,
  - .5 Step-by-step description of complete start-up procedures, to permit Departmental Representative to repeat start-up at any time.

### **1.16 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS**

- .1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.
  
- .2 With assistance of manufacturer develop written maintenance program and submit Departmental Representative for approval before implementation.
  
- .3 Operate and maintain systems for length of time required for commissioning to be completed.

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

### **1.17 TEST RESULTS**

- .1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.
- .2 Provide manpower and materials, assume costs for re-commissioning.

### **1.18 START OF COMMISSIONING**

- .1 Notify Departmental Representative at least 21 days prior to start of Cx.
- .2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

### **1.19 INSTRUMENTS / EQUIPMENT**

- .1 Submit to Departmental Representative for review and approval:
  - .1 Complete list of instruments proposed to be used.
  - .2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.
- .2 Provide the following equipment as required:
  - .1 2-way radios.
  - .2 Ladders.
  - .3 Equipment as required to complete work.

### **1.20 COMMISSIONING PERFORMANCE VERIFICATION**

- .1 Carry out Cx:
  - .1 Under actual and 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 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 It is necessary to complete Cx of occupancy, weather, and seasonal sensitive equipment and systems 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 Provide manpower and instrumentation to verify up to 50% of reported results, unless specified otherwise in other sections.
- .2 Number and location to be at discretion of Departmental Representative.
- .3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.
- .4 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.
- .5 Perform additional commissioning until results are acceptable to Departmental Representative.

### **1.26 REPEAT VERIFICATIONS**

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

### **1.27 SUNDRY CHECKS AND ADJUSTMENTS**

- .1 Make adjustments and changes which become apparent as Cx proceeds.
- .2 Perform static and operational checks as applicable and as required.

### **1.28 DEFICIENCIES, FAULTS, DEFECTS**

- .1 Correct deficiencies found during start-up and Cx to satisfaction of Departmental Representative.
- .2 Report problems, faults or defects affecting Cx to Departmental Representative in writing. Stop Cx until problems are rectified. Proceed with written approval from Departmental Representative.

### **1.29 COMPLETION OF COMMISSIONING**

- .1 Upon completion of Cx leave systems in normal operating mode.
- .2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.
- .3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by Departmental Representative.

### **1.30 ACTIVITIES UPON COMPLETION OF COMMISSIONING**

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

### **1.31 TRAINING**

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

### **1.32 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS**

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

### **1.33 OCCUPANCY**

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

### **1.34 INSTALLED INSTRUMENTATION**

- .1 Use instruments installed under Contract for TAB and PV if:
  - .1 Accuracy complies with these specifications.
  - .2 Calibration certificates have been deposited with Departmental Representative.
- .2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

### **1.35 PERFORMANCE VERIFICATION TOLERANCES**

- .1 Application tolerances:
  - .1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within +/- 10% of specified values.
- .2 Instrument accuracy tolerances:
  - .1 To be of higher order of magnitude than equipment or system being tested.
- .3 Measurement tolerances during verification:
  - .1 Unless otherwise specified actual values to be within +/- 2 % of recorded values.

### **1.36 OWNER'S PERFORMANCE TESTING**

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

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

**PART 3 - EXECUTION**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 01 91 33 – Commissioning Forms.

### **1.2 REFERENCES**

- .1 American Water Works Association (AWWA)
- .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 Facility user and O&M personnel have been fully trained in aspects of installed systems.
  - .3 Complete documentation relating to installed equipment and systems.
- .2 Term "Cx" in this section means "Commissioning".
- .3 Use this Cx Plan as master planning document for Cx:
  - .1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.
  - .2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.
  - .3 Sets out deliverables relating to O&M, process and administration of Cx.
  - .4 Describes process of verification of how built works meet design requirements.
  - .5 Produces a complete functional system prior to issuance of Certificate of Occupancy.
  - .6 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:
    - .1 Overview of Cx.
    - .2 General description of elements that make up Cx Plan.
    - .3 Process and methodology for successful Cx.
- .4 Acronyms:



- .1 Cx - Commissioning.
  - .2 EMCS - Energy Monitoring and Control Systems.
  - .3 MSDS - Material Safety Data Sheets.
  - .4 PI - Product Information.
  - .5 PV - Performance Verification.
  - .6 TAB - Testing, Adjusting and Balancing.
  - .7 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 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.
- .2 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 2 weeks during construction phase. At each revision, indicate revision number and date.
- .3 Submit each revised Cx Plan to Departmental Representative for review and obtain written approval.
- .4 Include testing parameters at full range of operating conditions and check responses of equipment and systems.

#### **1.6 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM**

- .1 Departmental Representative to maintain overall responsibility for project and is sole point of contact between members of commissioning team.
- .2 Project Manager will select Cx Team consisting of following members:
  - .1 Departmental Representative: during construction, will conduct periodic site

- reviews to observe general progress.
- .2 Departmental Representative: ensures Cx activities are carried out to ensure delivery of a fully operational project including:
  - .1 Review of Cx documentation from operational perspective.
  - .2 Review for performance, reliability, durability of operation, accessibility, maintainability, operational efficiency under conditions of operation.
  - .3 Protection of health, safety and comfort of occupants and O&M personnel.
  - .4 Monitoring of Cx activities, training, development of Cx documentation.
  - .5 Work closely with members of Cx Team.
- .3 Departmental Representative is responsible for:
  - .1 Organizing Cx.
  - .2 Monitoring operations Cx activities.
  - .3 Ensuring implementation of final Cx Plan.
  - .4 Performing verification of performance of installed systems and equipment.
  - .5 Implementation of Training Plan.
- .4 Construction Team: contractor, sub-contractors, suppliers and support disciplines, is responsible for construction/installation in accordance with contract documents, including:
  - .1 Testing.
  - .2 TAB.
  - .3 Performance of Cx activities.
  - .4 Delivery of training and Cx documentation.
  - .5 Assigning one person as point of contact with Contractor's Cx agent and Departmental Representative for administrative and coordination purposes.
- .5 Contractor's Cx agent implements specified Cx activities including:
  - .1 Preparation, submission of test reports.
  - .2 Witnessing, certifying accuracy of reported results.
  - .3 Witnessing and certifying TAB and other tests.
  - .4 Demonstrations.
  - .5 Training.
  - .6 Testing.
- .6 Property Manager: represents lead role in Operation Phase and onwards and is responsible for:
  - .1 Receiving facility.
  - .2 Day-To-Day operation and maintenance of facility.

## 1.7 CX PARTICIPANTS

- .1 Employ the following Cx participants to verify performance of equipment and systems:
  - .1 Installation contractor/subcontractor:
    - .1 Equipment and systems except as noted.
- .2 Equipment manufacturer: assist in start-up, PV, and Cx of equipment where specified.
- .3 Specialist subcontractor: equipment and systems supplied and installed by specialist

subcontractor.

- .4 Specialist Cx agency:
  - .1 Possessing specialist qualifications and installations providing environments essential to client's program but are outside scope or expertise of Cx specialists on this project.
- .5 Client: responsible for intrusion and access security systems.
- .6 Ensure that Cx participant:
  - .1 Could complete work within scheduled time frame.
  - .2 Available for emergency and troubleshooting service during first year of occupancy by user for adjustments and modifications outside responsibility of O&M personnel, including:
    - .1 Changes to heating or cooling loads beyond scope of EMCS.
    - .2 Changes to EMCS control strategies beyond level of training provided to O&M personnel.
- .7 Provide names of participants to Departmental Representative and details of instruments and procedures to be followed for Cx 3 months prior to starting date of Cx for review and approval.

## 1.8 EXTENT OF CX

- .1 Commission mechanical systems and associated equipment:
  - .1 Energy Recovery Ventilator (ERV).
  - .2 Duct heater.
  - .3 Seismic restraint and control measures for all new mechanical systems.
  - .4 EMCS for all new and modified control systems.
- .2 Commission electrical systems and equipment:
  - .1 Low voltage below 750 V:
    - .1 Low voltage equipment.
    - .2 Low voltage distribution systems.

## 1.9 DELIVERABLES RELATING TO O&M PERSPECTIVES

- .1 General requirements:
  - .1 Compile English documentation.
  - .2 Documentation to be computer-compatible format ready for inputting for data management.
- .2 Provide deliverables:
  - .1 Warranties.
  - .2 Project record documentation.
  - .3 Inventory of spare parts, special tools and maintenance materials.
  - .4 Maintenance Management System (MMS) identification system used.
  - .5 WHMIS information.
  - .6 MSDS data sheets.
  - .7 Electrical Panel inventory containing detailed inventory of electrical circuitry for

each panel board. Duplicate of inventory inside each panel.

### 1.10 DELIVERABLES RELATING TO THE CX PROCESS

- .1 General:
  - .1 Start-up, testing and Cx requirements, conditions for acceptance and specifications form part of relevant technical sections of these specifications.
- .2 Definitions:
  - .1 Cx as used in this section includes:
    - .1 Cx of components, equipment, systems, subsystems, and integrated systems.
    - .2 Factory inspections and performance verification tests.
- .3 Deliverables: provide:
  - .1 Cx Specifications.
  - .2 Startup, pre-Cx activities and documentation for systems, and equipment.
  - .3 Completed installation checklists (ICL).
  - .4 Completed product information (PI) report forms.
  - .5 Completed performance verification (PV) report forms.
  - .6 Results of Performance Verification Tests and Inspections.
  - .7 Description of Cx activities and documentation.
  - .8 Description of Cx of integrated systems and documentation.
  - .9 Training Plans.
  - .10 Cx Reports.
  - .11 Prescribed activities during warranty period.
- .4 Departmental Representative to witness and certify tests and reports of results provided to Departmental Representative.
- .5 Departmental Representative to participate.

### 1.11 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION

- .1 Items listed in this Cx Plan include the following:
  - .1 Pre-Start-Up inspections: by Departmental Representative prior to permission to start up and rectification of deficiencies to Departmental Representative's satisfaction.
  - .2 Departmental Representative to use approved check lists.
  - .3 Departmental Representative will monitor some of these pre-start-up inspections.
  - .4 Include completed documentation with Cx report.
  - .5 Conduct pre-start-up tests: conduct pressure, static, flushing, cleaning, and "bumping" during construction as specified in technical sections. To be witnessed and certified by Departmental Representative and does not form part of Cx specifications.
  - .6 Departmental Representative will monitor some of these inspections and tests.
  - .7 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 prior to start of 30 day Final Acceptance Test period.
    - .5 Perform final Cx and operational tests during demonstration period and 30 day test period.
    - .6 Only additional testing after foregoing have been successfully completed to be "Off-Season Tests".

#### 1.12 START-UP

- .1 Start up components, equipment and systems.
- .2 Equipment manufacturer, supplier, installing specialist sub-contractor, as appropriate, to start-up, under Contractor's direction, following equipment, systems:
  - .1 Air cooled chiller
  - .2 Chilled water pumps
  - .3 Control systems
- .3 Departmental Representative to monitor some of these start-up activities.
  - .1 Rectify start-up deficiencies to satisfaction of Departmental Representative.
- .4 Performance Verification (PV):
  - .1 Approved Contractor's Cx Agent to perform.
    - .1 Repeat when necessary until results are acceptable to Departmental Representative.
  - .2 Use procedures modified generic procedures to suit project requirements.
  - .3 Departmental Representative to witness and certify reported results using approved PI and PV forms.
  - .4 Departmental Representative to approve completed PV reports.
  - .5 Departmental Representative reserves right to verify up to 50% of reported results at random.
  - .6 Failure of randomly selected item shall result in rejection of PV report or report of system startup and testing.

### **1.13 CX ACTIVITIES AND RELATED DOCUMENTATION**

- .1 Perform Cx by specified Cx agency using procedures developed by Cx Agent 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 reserves right to verify a percentage of reported results at no cost to contract.

### **1.14 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION**

- .1 Cx to be performed by specified Cx specialist, using procedures developed by Cx Agent and approved by Departmental Representative.
- .2 Tests to be witnessed by Departmental Representative and documented on approved report forms.
- .3 Upon satisfactory completion, Cx specialist to prepare Cx Report, to be certified by Cx Agent and submitted to Departmental Representative for review.
- .4 Departmental Representative reserves right to verify percentage of reported results.
- .5 Integrated systems to include:
  - .1 All cooling and ventilation systems.
- .6 Identification:
  - .1 In later stages of Cx, before hand-over and acceptance Departmental Representative, Contractor, and Cx Agent to co-operate to complete inventory data sheets and provide assistance to NRC in full identification system of components, equipment, sub-systems, systems.

### **1.15 INSTALLATION CHECK LISTS (ICL)**

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

### **1.16 PRODUCT INFORMATION (PI) REPORT FORMS**

- .1 Contractor's Cx Agent to provide for approval by Departmental Representative all Product Information (PI) forms. Forms are to be approved by Departmental Representative prior to use.

### 1.17 PERFORMANCE VERIFICATION (PV) REPORT

- .1 Contractor's Cx Agent to provide for approval by Departmental Representative any missing PV forms. Forms are to be approved by Departmental Representative prior to use.

### 1.18 CX SCHEDULES

- .1 Prepare detailed Cx Schedule and submit to Departmental Representative for review and approval same time as project Construction Schedule. Include:
  - .1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:
    - .1 Design criteria, design intents.
    - .2 Pre-TAB review: 28 days after contract award, and before construction starts.
    - .3 Cx agents' credentials: 60 days before start of Cx.
    - .4 Cx procedures: 3 months after award of contract.
    - .5 Cx Report format: 3 months after contract award.
    - .6 Discussion of cooling loads for Cx: 3 months before start-up.
    - .7 Submission of list of instrumentation with relevant certificates: 21 days before start of Cx.
    - .8 Notification of intention to start TAB: 21 days before start of TAB.
    - .9 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.
    - .10 Notification of intention to start Cx: 14 days before start of Cx.
    - .11 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 14 days before start of integrated system Cx.
    - .12 Identification of deferred Cx.
    - .13 Implementation of training plans.
    - .14 Cx reports: immediately upon successful completion of Cx.
  - .2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to Facility Manager.
  - .3 6 months in Cx schedule for verification of performance in all seasons and wear conditions.
- .2 After approval, incorporate Cx Schedule into Construction Schedule.
- .3 Contractor's Cx agent will monitor progress of Cx against this schedule.

### 1.19 CX REPORTS

- .1 Submit reports of tests, witnessed and certified by Cx Agent to Departmental Representative who will verify reported results.
- .2 Include completed and certified PV reports in properly formatted Cx Reports.
- .3 Before reports are accepted, reported results to be subject to verification by Departmental Representative.

## **1.20 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.

## **1.21 TRAINING PLANS**

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

## **1.22 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**



1. Energy Recovery Ventilator (ERV)

<b>ERV Information</b>		
<b>Manufacturer</b>	<b>Model No.</b>	<b>Serial No.</b>
<b>Equipment Tag.</b>	<b>Location</b>	<b>Service</b>
<b>Fluid</b>	<b>Motor HP</b>	<b>Electrical (Voltage/Phase/Frequency)</b>

<b>Measured Element</b>	<b>Instrument (portable/BAS /local)</b>	<b>Design</b>	<b>Measured</b>	<b>Comments</b>
Outside Air Flow rate (CFM)				
Return Air Flow rate (CFM)				
Supply Air Flow rate (CFM)				
Supply Air External Static Pressure (in w.g.)				
Exhaust Air External Static Pressure (in w.g.)				
Voltage				
Amperage				
Fuse/Breaker Rating				

<b>Items to be verified</b>	<b>Status</b>	<b>Comments</b>
ERV installation and start-up form completed and report attached (Y/N)		
Local protection/interlocks/alarms are functional (Y/N)		
Verifications of abnormal noise and vibration (Y/N)		
Controller Online (Y/N)		
From BAS, command CWV Closed (mA)		
From BAS, command CWV Open (mA)		
Graphics Created (Y/N)		
Link to written sequence (Y/N)		
Equipment shown on BAS Floor Plan (Y/N)		
Network layout shown on BAS Floor Plan (Y/N)		
SAP Equipment ID Used (Y/N)		
BAS Controller Labelled (Y/N)		
Power Source Labelled on Controller (Y/N)		

<b>Control Sequence Verification</b>		
<b>Sequence</b>	<b>Status</b>	<b>Comments</b>
<b>System stopped :</b>		
1. TBC		

**Participants in Executing (E), Verifying (V) and Approving (A) the Tests:**

<b>Company / Position</b>	<b>Name</b>	<b>Signature</b>	<b>Date</b>

<b>System start-up:</b> 1. TBC		
<b>Normal mode:</b> 1. TBC		
<b>Control points:</b> 1. TBC		
<b>Local Protection:</b> 1. TBC		
<b>Alarms:</b> 1. TBC		

TBC – To be completed by Cx Agent based on the control sequence.

**Participants in Executing (E), Verifying (V) and Approving (A) the Tests:**

Company / Position	Name	Signature	Date

2. Electric Duct Heater (EDH)

<b>EDH Information</b>			
<b>Manufacturer</b>	<b>Model No.</b>	<b>Serial No.</b>	<b>Service</b>
<b>Equipment Tag.</b>	<b>Location</b>	<b>Electrical (Voltage/Phase/Frequency)</b>	<b>Fluid</b>

<b>Measured Element</b>	<b>Instrument (portable/BAS /local)</b>	<b>Design</b>	<b>Measured</b>	<b>Comments</b>
Air Flow Rate (CFM)				
Temperature (°C)				
Pressure differential (kPa) at full flow				
kW Rating				
Voltage				
Amperage				
Fuse/Breaker Rating				

<b>Items to be verified</b>	<b>Status</b>	<b>Comments</b>
EDH installation and start-up form completed and report attached (Y/N)		
Local protection/interlocks/alarms are functional (Y/N)		
Verifications of abnormal noise and vibration (Y/N)		
Pressure gauges, valves, and strainers installed (Y/N)		
Operation with integral VFD and sensorless control verified (Y/N)		
Controller Online (Y/N)		
Graphics Created (Y/N)		
Link to written sequence (Y/N)		
Equipment shown on BAS Floor Plan (Y/N)		
Network layout shown on BAS Floor Plan (Y/N)		
SAP Equipment ID Used (Y/N)		
BAS Controller Labelled (Y/N)		
Power Source Labelled on Controller (Y/N)		

**Control Sequence Verification**

**Participants in Executing (E), Verifying (V) and Approving (A) the Tests:**

<b>Company / Position</b>	<b>Name</b>	<b>Signature</b>	<b>Date</b>

Sequence	Status	Comments
<b>System stopped :</b> 1. TBC		
<b>System start-up:</b> 1. TBC		
<b>Normal mode:</b> 1. TBC		
<b>Control points:</b> 1. TBC		
<b>Local Protection:</b> 1. TBC		
<b>Alarms:</b> 1. TBC		

TBC – To be completed by Cx Agent based on the control sequence.

**Participants in Executing (E), Verifying (V) and Approving (A) the Tests:**

Company / Position	Name	Signature	Date

## **PART 1 - GENERAL**

### **1.1 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 Operation and Maintenance (O&M) manuals 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.

### **1.2 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 O&M manuals 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.
- .3 The equipment shop drawings may be used as the PI forms.

### **1.3 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.

#### **1.4 SAMPLES OF COMMISSIONING FORMS**

- .1 Departmental Representative will develop and provide to Contractor required project-specific Commissioning forms in electronic format complete with specification data.
- .2 Revise items on Commissioning forms to suit project requirements.
- .3 Samples of Commissioning forms and a complete index of produced to date will be attached to this section.
- .4 Complete all forms missing information and provide all the required forms that are not attached but required for this project.

#### **1.5 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.

#### **1.6 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.
- .13 Forms to be both hard copy and electronic format with typed written results.

## **1.7 LANGUAGE**

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

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 TRAINEES**

- .1 Trainees: personnel selected for operating and maintaining this facility. Includes Facility Manager, building operators, maintenance staff, security staff, and technical specialists as required.
- .2 Trainees will be available for training during later stages of construction for purposes of familiarization with systems.

### **1.2 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.

### **1.3 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.

### **1.4 TRAINING MATERIALS**

- .1 Instructors to be responsible for content and quality.



- .2 Training materials to include:
  - .1 "As-Built" Contract Documents.
  - .2 Operating Manual.
  - .3 Maintenance Manual.
  - .4 Management Manual.
  - .5 TAB and PV Reports.
- .3 Project Manager, Commissioning Manager and Facility Manager will review training manuals.
- .4 Training materials to be in a format that permits future training procedures to same degree of detail.
- .5 Supplement training materials:
  - .1 Transparencies for overhead projectors.
  - .2 Multimedia presentations.
  - .3 Manufacturer's training videos.
  - .4 Equipment models.

## **1.5 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.

## **1.6 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.

## **1.7 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.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

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**Part 1 GENERAL**

**1.1 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.

**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**

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**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.

**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.
- .6        Zipper closure, heavy duty, 75mm, self-adhesive zipper.

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

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**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      Reinststate the interior finishes affected by this work to the satisfaction of the Departmental Representative.

**END OF SECTION**

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**Part 1            GENERAL**

**1.1                Reference Standards**

- .1 Do work in accordance with elastomeric membrane manufacturer's printed application instructions, except where specified otherwise.

**1.2                Quality Assurance**

- .1 Membrane: applied by applicator trained and approved by manufacturer for application of its products.
- .2 Applicators: minimum 5 years proven experience.
- .3 Manufacturers representative:
  - .1 Inspect substrate prior to commencement of work, during application of membrane and upon completion of work.
  - .2 Provide technical assistance to applicator and assist where required in correct installation of membrane.

**Part 2            PRODUCTS**

**2.1                Materials**

- .1 Modified bitumen cold applied self-adherant sheet membrane such as Colphene 1000 GSA from Soprema, Blue Skin SSA from Bakor, Perm-A-Barrier System 4000 from Grace or equal approved by the Departmental Representative.
- .2 Primer or surface conditioner as recommended by air-barrier membrane manufacturer.
- .3 Mastic, adhesive tape and sealant as recommended by air-barrier membrane manufacturer.

**2.2                Compatibility**

- .1 Use same membrane throughout whole project.
- .2 All products to be from same manufacturer or to be approved by him.

---

**Part 3 EXECUTION**

**3.1 Preparation**

- .1 Carefully inspect surfaces to be covered with air barrier membrane. Remove dirt, dust, peeling paint, or other substances that might impair adherence to air barrier.
- .2 Remove sharp protuberances and round sharp angles.
- .3 Secure unsound substrate, fill holes and cracks and even surface repaired.

**3.2 Primer**

- .1 Follow manufacturer's printed instructions.
- .2 Prime a surface area no bigger than what can be covered with air barrier within recommended setting time limits for primer used on the job.
- .3 Re-prime surface areas where primer has set before being covered with membrane.

**3.3 Application of Membrane**

- .1 Install air barrier membrane plumb and on straight lines. Stagger end joints. Overlap as recommended.
- .2 Provide positive seal at overlaps.
- .3 Repair damages to air barrier as soon as they are discovered.
- .4 Redo areas that prove to be unacceptable due to inadequate substrate preparation, deficient priming, defective materials, lack of bonding and/or improper installation.

**3.4 Inspection**

- .1 Allow enough time to Departmental Representative for review of membrane installed before covering it with new insulation.

**END OF SECTION**



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**Part 1            General**

**1.1                RELATED SECTIONS**

- .1    Division 22 Plumbing: Plumbing work above ceilings.
- .2    Division 23 Heating, Ventilating and Air Conditioning: HVAC work above ceilings.
- .3    Division 26 Electrical: Electrical work above ceilings; trim for recessed light fixtures: sound masking system.
- .4    Division 27 Communications: Work above ceilings; trim for recessed fixtures.

**1.2                REFERENCES**

- .1    American Society for Testing and Materials International (ASTM)
  - .1    ASTM C423-09a, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
  - .2    ASTM C635-07, Specifications for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
  - .3    ASTM C636-08, Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
  - .4    ASTM E1264-08, Standard Classification for Acoustical Ceiling Products.
  - .5    ASTM E1414-11ae1 Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum.
  - .6    ASTM E1477-98a(2008), Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.
- .2    Canadian General Standards Board (CGSB)
  - .1    CAN/CGSB-92.1-M89, Sound Absorptive Prefabricated Acoustical Units.
- .3    Underwriter's Laboratories of Canada (ULC)
  - .1    CAN/ULC-S102-2007, Surface Burning Characteristics of Building Materials and Assemblies.

**1.3                DESIGN REQUIREMENTS**

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

**1.4                SEISMIC DESIGN CRITERIA**

- .1    Provide seismic restraint for ceiling suspension systems in accordance with the requirements of the NBC, and in accordance with requirements of ASTM E580 and good engineering practice.
  - .1    Contractor to provide third party seismic design and installation review by a professional Engineer licensed to practice in Ontario.
  - .2    Include provisions for all fixtures incorporated into or suspended from ceiling suspension system.

- .2 Provide ceiling suspension systems capable of withstanding effects of earthquake motions determined in accordance with NBC for site specific conditions.
  - .1 Provide connections and bracing as required to satisfy seismic criteria.

### **1.5 SUBMITTALS**

- .1 Provide all listed submittals in accordance with submittal procedures of Section 01 33 00.
- .2 Submit triplicate 150 mm x 150 mm samples of each type of acoustical units, except as follows.
  - .1 Submit triplicate full size samples of acoustical unit type .
- .3 Submit one representative model of each type ceiling suspension system.
- .4 Submit manufacturer's product literature describing specified products, including their technical and physical properties.
  - .1 Include manufacturer's certificate of mix formulation compliance, including certification that products contain no more than 0.5% asbestos.
  - .2 Include WHMIS and Material Safety Data Sheets.

### **1.6 QUALITY ASSURANCE**

- .1 Mock-up:
  - .1 Construct mock-ups in accordance with quality assurance requirements of Section 01 33 00.
  - .2 Construct ceiling suspension system mockup to show basic construction and assembly, treatment at walls, recessed fixtures, sound masking devices, splicing, interlocking, finishes, acoustical unit installation.
  - .3 Submit mock-up of each combination of suspension system and acoustical ceiling panel, in two typical application areas such as offices, meeting rooms, corridors, special areas.
    - .1 Construct mock-up 10 m2 minimum of each type acoustical panel ceiling including one inside corner and one outside corner where applicable.
    - .2 Construct mock-ups where directed.
  - .4 Allow 48 hours for inspection of mock-up by Departmental Representative before proceeding with ceiling work.
  - .5 When accepted, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of the finished work.

### **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver materials in original unopened packaging with labels intact.
- .2 Label cartons and packages indicating contents and locations for which each item is intended.
- .3 Do not deliver panels to job site until shortly before installation.

- .4 Protect on site stored or installed absorptive material from moisture and all other forms of damage.
- .5 Remove damaged or deteriorated materials from the site.
- .6 Store extra materials required for maintenance, where directed by Owner's representative Departmental Representative.

## **1.8 ENVIRONMENTAL REQUIREMENTS**

- .1 Permit wet work to dry before beginning to install.
- .2 Maintain uniform minimum temperature of 15 degrees C and humidity of 20- 40% before and during installation.
- .3 Store materials in work area 48 hours prior to installation.

## **1.9 EXTRA MATERIALS**

- .1 Provide extra materials of acoustic units in accordance with closeout requirements of Section 01 10 00.
- .2 Provide suspension system components amounting to 2% of gross ceiling area for each type required for project. Extra materials are from same production run as installed materials. Clearly identify each type.
- .3 Extra material shall be from the same production run as installed materials, in unopened packages. Clearly identify each type of acoustic unit, including colour and texture.
- .4 Deliver to Departmental Representative, upon completion of the work of this section.

## **1.10 SEQUENCING AND SCHEDULING**

- .1 Do not install acoustical panels and tiles until work above ceiling has been inspected by Departmental Representative.
- .2 Do not commence installation until mechanical and electrical work above ceiling is complete.

## **1.11 COORDINATION**

- .1 Coordinate installation of suspended ceiling system with construction of ceiling bulkheads.
- .2 Coordinate installation of suspended ceiling system with mechanical, electrical and other work so that interference is prevented and items such as diffusers, grilles, lights, fixtures and other items are properly located and supported as indicated or as directed by Departmental Representative.
- .3 Coordinate installation of ceiling suspension system and curved trim with erection of partition framing and installation of wallboard to ensure uniform width of reveal between curved trim and partition.

- .1 Manufacturer recommends installation of ceiling suspension system and curved trim prior to erection of adjacent partition and bulkhead framing to allow adjustment of curved partition to pre-fabricated curved trim.

## **Part 2 Products**

### **2.1 SOURCE OF SUPPLY**

- .1 Provide all suspension systems and acoustic panels as products of the same single manufacturer.

### **2.2 ACOUSTICAL SUSPENSION SYSTEM**

- .1 Provide intermediate duty system to ASTM C635, as specified for each respective system.
- .2 Basic materials for suspension system: commercial quality cold rolled steel, zinc coated.
- .3 Provide acoustical suspension system specified for each respective acoustical ceiling panel, and as follows.
- .4 Exposed tee bar grid components: Components die cut. Main tee with double web, rectangular bulb and 25 mm rolled cap on exposed face, colour white. Cross tee with rectangular bulb; web extended to form positive interlock with main tee webs; lower flange extended and offset to provide flush intersection.
- .5 Hanger wire: galvanized soft annealed steel wire, 2.6 mm diameter.
- .6 Hanger inserts: purpose made drilled threaded twist-expanded sleeve anchors suitable for rod or hanger wire installation, as applicable. Do not use inserts or anchors requiring powder activated driver.
- .7 Carrying channels: 38 x 12.7 mm channel, of 3 mm thick painted galvanized steel.
- .8 Accessories: splices, clips, wire ties, retainers and wall moulding as indicated complete with pre-fabricated corners, to complement suspension system components, as recommended by system manufacturer.

### **2.3 ACOUSTIC CEILING PANEL (ACP) AND SUSPENSION**

- .1 Acoustic ceiling panel for suspended ceiling system: to CAN2-92.1.
  - .1 Flame spread rating of 25 or less.
  - .2 Noise reduction coefficient (NRC) designation of 0.70 to 0.75.
  - .3 Ceiling Attenuation Class (CAC): minimum 35.
  - .4 Light reflectance range: Actual LR of 0.85.
  - .5 Edge type: square.
  - .6 Colour: white.
  - .7 Standard size: 610 mm x 1 220 mm x 19 mm thick and 610 mm x 610 mm x 19 mm thick, as indicated.
  - .8 Custom size: to be field cut and edge finished as required and as indicated.

- .9 Shape: flat.
- .10 Acceptable products and manufacturers:
  - .1 Armstrong Ultima;
  - .2 CGC Mars.
  - .3 Certaineed Symphony M.
- .2 Suspension Systems for Use with ACP:
  - .1 Acceptable products and manufacturers:
    - .1 Prelude XL as manufactured by Armstrong.
    - .2 Donn DX/DXL as manufactured by CGC Inc.,
    - .3 Classic Stab as manufactured by Certaineed
  - .2 Colour: flat white

## **2.4 SUSPENSION SYSTEM TRIM**

- .1 Suspension trim system, straight and custom curved to suit installation, as indicated and as specified:
  - .1 Acceptable product and manufacturer: Compasso Suspension Trim as manufactured by CGC.
  - .2 Acceptable alternate product and manufacturer: Axiom Perimeter Trim as manufactured by Armstrong World Industries.
  - .3 Acceptable alternate product and manufacturer: Cloud Perimeter Trim as manufactured by Certaineed.
- .2 Trim: vertical face width to suit application unless indicated otherwise, with horizontal legs to match ceiling grid, with hems formed for attachment to mounting clips, complete with all necessary manufacturer's standard trim and accessories.
- .3 Splice plate: steel finished to match trim, snap-in fit.
- .4 Attachment clips: Hot dipped galvanized and finished to match trim, snap-in fit.

## **2.5 SEISMIC SUPPORT COMPONENTS**

- .1 Provide all necessary seismic components in accordance with approved shop drawings, including but not limited to compression posts, stainless steel aircraft cable, turnbuckles, eyebolts, clips, cross-tee connections and anchors.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Prior to beginning ceiling installation work, examine the installation areas and identify all areas of potential interference between ceiling components and components of other trades. Report all areas so designated to the Departmental Representative Departmental Representative.

- .2 Do not commence installation work in areas of interference until interference has been resolved or accepted. Commencement of the work in areas of interference signifies acceptance of the conditions.

### **3.2 SUSPENSION SYSTEM INSTALLATION**

- .1 Installation: in accordance with ASTM C636 except where specified otherwise.
- .2 Install suspension system to manufacturer's instructions and Certification Organizations tested design requirements.
- .3 Do not erect ceiling suspension system until work above ceiling has been inspected by Departmental Representative.
- .4 Secure hangers to overhead structure using attachment methods as indicated acceptable to Departmental Representative.
  - .1 Do not use powder actuated fastening devices at any time or place in this Work.
- .5 Install hangers spaced at maximum 1200 mm centres and within 150 mm from ends of main tees.
- .6 Lay out centre line of ceiling both ways, to provide balanced borders at room perimeter with border units not less than 50% of standard unit width system according to reflected ceiling plan.
- .7 Ensure suspension system is co-ordinated with location of related components.
- .8 Install wall moulding to provide correct ceiling height.
- .9 Completed suspension system to support super-imposed loads, such as lighting fixtures, diffusers, grilles and speakers.
- .10 Support at light fixtures and diffusers with additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
- .11 Interlock cross member to main runner to provide rigid assembly.
- .12 Frame at openings for light fixtures, air diffusers, speakers and at changes in ceiling heights.
- .13 Finished ceiling system to be square with adjoining walls and level within 1:1000.

### **3.3 INSTALLATION OF TRIM**

- .1 Install in accordance with approved shop drawings and manufacturer's instructions.
- .2 Use attachment clips to secure trim to each main tee.
- .3 Use splice plates for joining adjacent trim pieces.
- .4 Use 90 degree corner trim pieces at corners.

- .5 Finished installation to be smoothly curving line to accurate radius, free of distortion and kinks, and shall form a reveal of uniform width at partitions and bulkheads.

### **3.4 SEISMIC RESTRAINT**

- .1 Install seismic restraint for suspended ceiling system and all associated fixtures in accordance with approved shop drawings.
- .2 Minimum seismic tension bracing for ceilings shall be installed as follows:
  - .1 At perimeter of each suspended ceiling and at the end of each grid run, install additional hanger wire splayed upward at 45 degrees and attached to structure.
  - .2 In field of ceiling, install hanger wires at points 12 feet OC in both directions splayed upward 45 degrees from each point in four directions and secured to the underside of the structure.
- .3 Tighten bracing wires without deforming the ceiling grid beyond specified tolerances.
- .4 Seismic tension bracing is not required in areas in which the maximum horizontal dimension is less than or equal to 12 feet and which are bounded on all sides by partitions anchored to floor slab and underside of structural deck with seismic anchorage.
- .5 The professional engineer responsible for the production of the shop drawings setting out the requirements for seismic restraint of the suspension systems shall provide periodic field review during construction and shall submit reports in accordance with quality assurance requirements of this specification. The cost of this field inspection shall be included in the Guaranteed Price.

### **3.5 ACOUSTICAL PANEL INSTALLATION**

- .1 Install acoustical panels in ceiling suspension system, supported on all edges, in accordance with manufacturer's current printed instructions.
- .2 Touch up edges of panels cut to fit site conditions to conceal core and to match face.

### **3.6 INTERFACE WITH OTHER WORK**

- .1 Co-ordinate ceiling work to accommodate components of other sections, such as light fixtures, diffusers, speakers, to be built into acoustical ceiling components.

### **3.7 TOUCH-UP AND CLEANING**

- .1 Touch up scratches, abrasions, voids and other defects in surfaces.
- .2 Replace damaged units that cannot be touched up to satisfaction of Departmental Representative.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

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

**1.2 SUBMITTALS**

- .1 Submittals: in accordance with Section 00 10 00 – General Instructions.
- .2 Shop drawings to show:
  - .1 Mounting arrangements.
  - .2 Operating and maintenance clearances.
- .3 Shop drawings and product data accompanied by:
  - .1 Detailed drawings of bases, supports, and anchor bolts.
  - .2 Acoustical sound power data, where applicable.
  - .3 Points of operation on performance curves.
  - .4 Manufacturer to certify current model production.
  - .5 Certification of compliance to applicable codes.
- .4 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.

### **1.3 DEFINITIONS**

- .1 For purposes of this the Mechanical Division the following:
  - .1 "Concealed" - mechanical services and equipment in suspended ceilings and in chases and furred spaces.
  - .2 "Exposed" - will mean not concealed as defined above.

#### **1.4 EXAMINATION OF THE SITE**

- .1 Carefully examine conditions at the site which the site 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

#### **1.5 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 00 10 00 – General Instructions.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 00 10 00 – General Instructions and 00 15 45 – General Safety Section and Fire Instructions.

#### **1.6 MAINTENANCE**

- .1 Furnish spare parts in accordance with Section 00 10 00 – General Instructions.

#### **1.7 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.

#### **1.8 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.

#### **1.9 PERMITS, CERTIFICATES & FEES**

- .1 Display all required permits on worksite and include copies of inspection certificates in operating and maintenance instruction manuals.
- .2 Obtain "Hot Work Permit" from the Engineer prior to commencement of soldering, welding or other high temperature work.
- .3 Comply with all requirements of Section 00 10 00 – General Instructions..

#### **1.10 CLEANING & FINAL ADJUSTMENT**

- .1 During construction, keep the site reasonably clear of rubbish and waste material resulting from your work on a daily basis to the satisfaction of the Engineer. Notify the general contractor of any requirements for a waste receptacle for disposal of waste materials.

- .2 Clean interior and exterior of all systems including strainers, and vacuum interior of air handling units.
- .3 Clean and refurbish all equipment and leave in first class operating condition including replacement of all filters in all air and piping systems.
- .4 Balance and adjust all systems and each piece of equipment to operate as designed.

**1.11 PROTECTION OF EQUIPMENT & MATERIALS** Properly protect all of your equipment and materials on site from damage due to the elements, your work and the work of other trades, to the approval of the Engineer.

- .2 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.

**1.12 STORAGE OF EQUIPMENT & MATERIALS**

- .1 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.
- .2 Bring prefabricated materials on the job site as and when required to be installed.

**1.13 HOISTING & SCAFFOLDING**

- .1 Provide all necessary hoists and scaffolds required for your work.
- .2 Design and construction of scaffolding to be in accordance with CSA S269.2

**Part 2 Products**

**2.1 MATERIALS**

- .1 Materials and products in accordance with Section 00 10 00 – General Instructions.

**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 in accordance with Section 00 10 00 – General Instructions and submit report as described in PART 1 - SUBMITTALS.
- .2 Manufacturer's Field Services:

- .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

### **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 Trial usage to apply to following equipment and systems:
- .3 Energy recovery ventilator and associated services.
- .4 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.
- .5 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .6 Instruction duration time requirements as specified in appropriate sections.
- .7 Determination of whether or not demonstration is required will be decided by Departmental Representative in consultation with end user (client).

### **3.4 PROTECTION**

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

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01 – Common Work Results- Mechanical

### **1.2 REFERENCES**

- .1 Canadian General Standards Board (CGSB).
  - .1 CAN/CGSB-1.60-M89, Interior Alkyd Gloss Enamel.
  - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.
- .2 Canadian Gas Association (CGA).
  - .1 CAN/CGA B149.1-M95.
  - .2 CAN/CGA B149.2-M91.
- .3 National Fire Protection Association
  - .1 NFPA 13-1989, Installation of Sprinkler Systems.
  - .2 NFPA 14-1986, Standpipe and Systems.

### **1.3 PRODUCT DATA**

- .1 Submit product data in accordance with Section 00 10 00 – General Instructions.
- .3 Product data to include paint colour chips, all other products specified in this section.

### **1.4 SAMPLES**

- .1 Submit samples in accordance with Section 00 10 00 – General Instructions.
- .2 Samples to include nameplates, labels, tags, lists of proposed legends.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES**

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers to be raised or recessed.
- .3 Information to include, as appropriate:
  - .1 Equipment: Manufacturer's name, model, size, serial number, capacity.
  - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

### **2.2 EXISTING IDENTIFICATION SYSTEMS**

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.
- .3 Before starting work, obtain written approval of identification system from NRC representative.

### **2.3 IDENTIFICATION DUCTWORK SYSTEMS**

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: Black, or co-ordinated with base colour to ensure strong contrast.

### **2.4 CONTROLS COMPONENTS IDENTIFICATION**

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates as specified in section 25 05 54 – EMCS Identification.

## **2.5 LANGUAGE**

- .1 Identification to be in English and French.
- .2 Use one nameplate, label, etc. for both languages.

## **PART 3 - EXECUTION**

### **3.1 TIMING**

- .1 Provide identification only after all painting specified Section 09 91 23 - Interior Painting has been completed.

### **3.2 INSTALLATION**

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC or CSA registration plates as required by respective agency.

### **3.3 NAMEPLATES**

- .1 Locations:
  - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
  - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection
  - .1 Do not paint, insulate or cover in any way.

### **3.4 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS**

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: At not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, other confined spaces, at entry and exit points, and at each access opening.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification to be easily and accurately readable from usual operating areas and from access points.
  - .1 Position of identification to be approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1        Section 21 05 01 – Common Work Results- Mechanical
- .2        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.
- .2        Department of Justice Canada (Jus).
  - .1        Canadian Environmental Protection Act, 1999, c. 33 (CEPA).
  - .2        Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).

**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 01 15 45 – General and Fire Safety Requirements.
- .2        Sustainable Requirements.

**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 DUCT HEATERS**

- .1 Duct heater: flanged type, CSA-C and CSA-US certified according to CSA standard C22.2 No. 155 and UL 1996.
- .2 Electric heaters shall be manufactured and approved for zero clearance for all combustible materials.
- .3 Acceptable products: Elios model DF or approved equal.
- .4 Elements:
  - .1 Helical coils of nickel chrome alloy resistance wire.
- .5 Staging:
  - .1 Electric heater shall be provided with one (1) SSR modulating stage.
- .6 Maximum temperature at discharge: 50 degrees Celcius.
- .7 Controls:
  - .1 Duct heater shall have: magnetic contactors; airflow switch, transformer with secondary fuse, and internal wiring for the disconnects indicated on the drawings.
  - .2 All the controls shall be integrated and pre-wired within a NEMA-1 control panel which will include a removable, hinged door to provide easy access or NEMA-12 certified control panel or NEMA-4 certified control panel or NEMA-4X certified control panel.
  - .3 Duct heater shall be supplied with high temperature cutout and air proving switch to stop the heater when there is no airflow.
- .8 Electrical:
  - .1 Duct heater rating:
    - .1 1.98 kW.
    - .2 120 voltage.
    - .3 1 phase.
- .9 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                RELATED REQUIREMENTS**

- .1        Section 21 05 01 – Common Work Results- Mechanical
- .2        Section 21 05 02 – Mechanical Identification

**1.2                REFERENCES**

- .1        American National Standards Institute (ANSI)
  - .1        ANSI/AMCA 210-1999, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
  - .2        ANSI/NFPA 90A-2002, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .2        Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1        Material Safety Data Sheets (MSDS).
- .3        Underwriter's Laboratories (UL)
  - .1        UL 181-2003, Factory-Made Air Ducts and Air Connectors.

**1.3                SUBMITTALS**

- .1        Product data: For each type or model of Energy Recovery Ventilator, include the following:
  - .1        Unit performance data for both Supply Air and Exhaust Air, with system operating conditions indicated.
  - .2        Enthalpy plate performance data for both summer and winter operation.
  - .3        Motor ratings and unit electrical characteristics.
  - .4        Dimensioned drawings for each type of installation, showing isometric and plan views, to include location of attached ductwork and service clearance requirements.
  - .5        Estimated gross weight of each installed unit.
  - .6        Filter types, quantities, and sizes
  - .7        Installation, Operating and Maintenance manual (IOM) for each model.
- .2        Shop Drawings: For air-to-air energy recovery ventilators, include plans, elevations, sections, details, and attachments to other work.
  - .1        Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - .2        Wiring Diagrams: For power, signal, and control wiring.
- .3        Operation and maintenance data for air-to-air energy recovery ventilator.

## **1.4 QUALITY ASSURANCE**

- .1 Source Limitations: Obtain Air-to-Air Energy Recovery Ventilator with all appurtenant components or accessories from a single manufacturer.
- .2 For the actual fabrication, installation, and testing of work under this section, use only thoroughly trained and experienced workers completely familiar with the items required and with the manufacturer's current recommended methods of installation.
- .3 The ERV core shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of ten (10) years from the date of purchase. The balance-of-unit shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of two (2) years from the date of installation.
- .4 Manufacturer shall be able to provide evidence of independent testing of the core by Underwriters Laboratory (UL), verifying a maximum flame spread index (FSI) of 25 and a maximum smoke developed index (SDI) of 50 thereby meeting NFPA90A and NFPA 90B requirements for materials in a compartment handling air intended for circulation through a duct system. The method of test shall be UL Standard 723.
- .5 Certifications:
  - .1 The energy recovery cores used in these products shall be third party Certified by AHRI under its Standard 1060 for Energy Recovery Ventilators. AHRI published certifications shall confirm manufacturer's published performance for airflow, static pressure, temperature and total effectiveness, purge air (OACF) and exhaust air leakage (EATR). Products that are not currently AHRI certified will not be accepted. OACF shall be no more than 1.02 and EATR shall be at 0% against balanced airflow.
  - .2 Entire unit shall be listed under UL 1812 Standard for Ducted Air to Air Heat Exchangers and comply with CSA Standard 22.2.
- .6 Every unit to be factory tested prior to shipping: Motor Dielectric Voltage-Withstand Bench Test, Unit Dielectric Voltage-Withstand Test, Continuity of Internal Control Circuits Test, Unit Amperage Test.

## **1.5 COORDINATION**

- .1 Coordinate size and location of all building penetrations required for installation of each Energy Recovery Ventilator and associated electrical systems.
- .2 Coordinate sequencing of construction for associated plumbing, HVAC, electrical supply.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 Manufacturer should be in business for minimum 10 years manufacturing energy recovery ventilators.

- .2 Acceptable manufacturer: RenewAire, or approved equivalent.

## **2.2 MANUFACTURED UNITS**

- .1 Air-to-Air Energy Recovery Ventilators shall be fully assembled at the factory and consist of a fixed-plate cross-flow heat exchanger with no moving parts, an insulated single wall G90 galvanized 20-gauge steel cabinet, motorized outside air intake damper, filter assemblies for both intake and exhaust air, enthalpy core, supply air blower assembly, motorized return air damper, exhaust air blower assembly and electrical control box with all specified components and internal accessories factory installed and tested and prepared for single-point high voltage connection. Entire unit with the exception of field-installed components shall be assembled and test operated at the factory.

## **2.3 CABINET**

- .1 Materials: Formed single wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.
- .2 Outside casing: 20 gauge, galvanized (G90) steel meeting ASTM A653 for components that do not receive a painted finish.
- .3 Access doors shall be hinged with airtight closed cell foam gaskets. Door pressure taps, with captive plugs, shall be provided for cross-core pressure measurement allowing for accurate airflow measurement.
- .4 Unit shall have factory-installed duct flanges on all duct openings.
- .5 Cabinet Insulation: Unit walls and doors shall be insulated with 1 inch, 4 pound density, foil/scrim faced, high density fiberglass board insulation, providing a cleanable surface and eliminating the possibility of exposing the fresh air to glass fibers, and with a minimum R-value of 4.3 (hr-ft<sup>2</sup>-F/BTU).
- .6 Enthalpy core: Energy recovery core shall be of the total enthalpy type, capable of transferring both sensible and latent energy between airstreams. Latent energy transfer shall be accomplished by direct water vapor transfer from one airstream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air. No condensate drains shall be allowed. The energy recovery core shall be designed and constructed to permit cleaning and removal for servicing. The energy recovery core shall have a ten year warranty. Performance criteria are to be as specified in AHRI Standard 1060.
- .7 Control center / connections: Energy Recovery Ventilator shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections to the non-fused disconnect.
- .8 Passive Frost Control: The ERV core shall perform without condensing or frosting under normal operating conditions (defined as outside temperatures above -10 F and inside relative humidity below 40%). Occasional more extreme conditions shall not affect the usual function, performance or durability of the core. No condensate drains will be allowed.

- .9 Motorized isolation dampers: Return and outside air motorized dampers of an AMCA Class I low leakage type shall be factory installed.
- .10 Dimensions: 1,250 mm (L) x 550 mm (W) x 890 mm (H).

## **2.4 BLOWER SECTION**

- .1 Blower section construction, Supply Air and Exhaust Air: Blower assemblies consist of a 120V / 1 Phase / 60 HZ, ECM motor, and a direct driven forward-curved blower.
- .2 Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.

## **2.5 MOTORS**

- .1 Blower motors shall be Premium Efficiency, EISA compliant for energy efficiency. The blower motors shall be totally enclosed (TEFC). Direct drive models (EV450 and HE1X models) shall be EISA-compliant for energy efficiency with open drip proof design and integral thermal protection.

## **2.6 SEQUENCE OF OPERATIONS**

- .1 Sequence of Operations is specified in Section 25 90 01 – EMCS: Site Requirements, Applications and Systems Sequence of Operation.

## **2.7 FILTER SECTION**

- .1 ERV shall have 2" thick MERV 8 disposable pleated filters located in the outdoor air and exhaust airstreams. All filters shall be accessible from the exterior of the unit.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Prior to start of installation, examine area and conditions to verify correct location for compliance with installation tolerances and other conditions affecting unit performance. See unit IOM.
- .2 Examine roughing-in of plumbing, electrical and HVAC services to verify actual location and compliance with unit requirements. See unit IOM.
- .3 Proceed with installation only after all unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- .1 Installation shall be accomplished in accordance with these written specifications, project drawings, manufacturer's installation instructions as documented in manufacturer's IOM, Best Practices and all applicable building codes.
- .2 Install unit with clearances for service and maintenance.

### **3.3 CONNECTIONS**

- .1 In all cases, industry Best Practices shall be incorporated. Connections are to be made subject to the installation requirements shown above.
  - .1 Duct installation and connection requirements are specified in Section 23 31 13.01 – Metal Ducts – Low Pressure to 500 Pa.
  - .2 Electrical installation requirements are specified in Division 26 of this document.

### **3.4 FIELD QUALITY CONTROL**

- .1 Contractor to inspect field assembled components and equipment installation, to include electrical and piping connections. Report results to Architect/Engineer in writing. Inspection must include a complete startup checklist to include (as a minimum) the following: Completed Start-Up Checklists as found in manufacturer's IOM. Insert any other requirements here.

### **3.5 START-UP SERVICE**

- .1 Contractor to perform startup service. Clean entire unit, comb coil fins as necessary, and install clean filters. Measure and record electrical values for voltage and amperage. Refer to Section 23 05 93 – Testing, Adjusting and Balancing for HVAC and comply with provisions therein.

### **3.6 DEMONSTRATION AND TRAINING**

- .1 Contractor to train owner's maintenance personnel to adjust, operate and maintain the entire Make-Up Air unit. Refer to Section 00 10 00 – General Instructions.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01 – Common Work Results- Mechanical

**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 Department of Justice Canada (Jus).
  - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33 .
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).
- .5 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.
  - .3 NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .6 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.
- .7 Transport Canada (TC).
  - .1 Transportation of Dangerous Goods Act (TDGA)

**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	A

- .2 Seal classification:
  - .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

#### **2.2 SEALANT**

- .1 Sealant: oil resistant, 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 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.

## 2.7 HANGERS AND SUPPORTS

- .1 Hangers and Supports:
  - .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 proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .5 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 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.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01 – Common Work Results- Mechanical
- .2 Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment

**1.2 REFERENCES**

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
  - .1 ANSI/ASME B31.1 / B31.3
- .2 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A125, Specification for Steel Springs, Helical, Heat-Treated.
  - .2 ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .3 ASTM A563, Specification for Carbon and Alloy Steel Nuts.
- .3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
  - .1 MSS SP58, Pipe Hangers and Supports - Materials, Design and Manufacture.
  - .2 ANSI/MSS SP69, Pipe Hangers and Supports - Selection and Application.
  - .3 MSS SP89, Pipe Hangers and Supports - Fabrication and Installation Practices. Underwriter's Laboratories of Canada (ULC)
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .6 Factory Mutual

**1.3 SYSTEM DESCRIPTION**

- .1 Design Requirements:
  - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
  - .2 Base maximum load ratings on allowable stresses prescribed by MSS SP58. ASME B31.1 or B31.3 as indicated.
  - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
  - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
  - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

- .2 Performance Requirements:
  - .1 Design supports, platforms, catwalks, hangers to withstand seismic events as specified Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.

#### **1.4 SUBMITTALS**

- .1 Submit shop drawings and product data for following items:
  - .1 Bases, hangers and supports.
  - .2 Connections to equipment and structure.
  - .3 Structural assemblies.
  - .4 Installation instructions
- .2 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into manual.

#### **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.
  - .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 the delivery of all material, tools or equipment.

### **Part 2 Products**

#### **2.1 GENERAL**

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

#### **2.2 PIPE HANGERS**

- .1 Finishes:
  - .1 Pipe hangers and supports: galvanized-exterior and painted with zinc-rich paint – interior after manufacture.
  - .2 Use hot dipped galvanizing process.

- .3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
  - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
    - .1 Rod: 9 mm UL listed
  - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed to MSS-SP58 and MSS-SP69.
- .3 Upper attachment structural: suspension from upper flange of I-Beam:
  - .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed to MSS SP69.
  - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed.
- .4 Upper attachment to concrete:
  - .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
  - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed to MSS SP69.
- .5 Hanger rods: threaded rod material to MSS SP58:
  - .1 Ensure that hanger rods are subject to tensile loading only.
  - .2 Provide linkages where lateral or axial movement of pipework is anticipated. Pipe attachments: material to MSS SP58:
    - .1 Attachments for steel piping: carbon steel [black][galvanized].
    - .2 Attachments for copper piping: copper plated black steel.
    - .3 Use insulation shields for hot pipework.
    - .4 Oversize pipe hangers and supports.
- .7 Adjustable clevis: material to MSS SP69 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
  - .1 Ensure "U" has hole in bottom for rivetting to insulation shields
- .8 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.
- .9 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.
  - .1 Finishes for steel pipework: galvanized.
  - .2 Finishes for copper, glass, brass or aluminum pipework: black with formed portion plastic coated or epoxy coated.

- .10 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69. Shop and field-fabricated assemblies.
  - .1 Trapeze hanger assemblies: MSS SP-89.
  - .2 Steel brackets: MSS SP-89.
  - .3 Sway braces for seismic restraint systems: to MSS SP-89.

## **2.3 RISER CLAMPS**

- .1 Steel or cast iron pipe: galvanized steel to MSS SP58, type 42, UL listed.
- .2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

## **2.4 INSULATION PROTECTION SHIELDS**

- .1 Insulated cold piping:
  - .1 64 kg/m<sup>3</sup> density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping:
  - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.

## **2.5 CONSTANT SUPPORT SPRING HANGERS**

- .1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).
- .2 Load adjustability: 10 % minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.



## **2.6 VARIABLE SUPPORT SPRING HANGERS**

- .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.
- .4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

## **2.7 EQUIPMENT ANCHOR BOLTS AND TEMPLATES**

- .1 Provide templates to ensure accurate location of anchor bolts.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Install in accordance with:
  - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
  - .1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.
- .3 Clamps on riser piping:
  - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
  - .2 Bolt-tightening torques to industry standards.
  - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
  - .4 Cast iron pipes: install below joint.
- .4 Clevis plates:
  - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.

- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .6 Use approved constant support type hangers where:
  - .1 vertical movement of pipework is 13 mm or more,
  - .2 transfer of load to adjacent hangers or connected equipment is not permitted.
- .7 Use variable support spring hangers where:
  - .1 transfer of load to adjacent piping or to connected equipment is not critical.
  - .2 variation in supporting effect does not exceed 25 % of total load.

### **3.3 HANGER SPACING**

- .1 Within 300 mm of each elbow.
- .2 Hydronic, steam, steam condensate, compressed air, rigid, and flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.

MAXIMUM HANGER SPACING AND MINIMUM ROD SIZE

O.D		STEEL PIPE				COPPER TUBE		ROD SIZE	
INCHES	mm	WATER		STEAM / AIR		FT	METER	INCH	mm
		FT	METER	FT	METER				
<= 1/2	12.7	7	2.13	8	2.44	5	1.52	1/4'	6.4
3/4'	19.1	7	2.13	9	2.74	5	1.52	1/4'	6.4
1	25.4	7	2.13	9	2.74	6	1.83	1/4'	6.4
1-1/4'	31.7	8	2.44	10	3.05	7	2.13	1/4'	6.4
1-1/2'	38.1	9	2.74	12	3.66	8	2.44	3/8'	9.5
2	50.8	10	3.05	13	3.96	8	2.44	3/8'	9.5
2-1/2'	63.5	11	3.35	14	4.27	9	2.74	3/8'	9.5
3	76.2	12	3.66	15	4.57	10	3.05	3/8'	9.5
4	101.6	14	4.27	17	5.18	12	3.66	1/2'	12.7
6	152.4	17	5.18	21	6.40	14	4.27	1/2'	12.7
8	203.2	19	5.79	24	7.31	16	4.88	5/8'	15.8
10	254.0	20	6.10	26	7.92	18	5.49	3/4'	19.0
12	304.8	23	7.01	30	9.14	19	5.79	7/8'	22.2
14	355.6	25	7.62	32	9.75			1	25.4
16	406.4	27	8.23	35	10.67			1	25.4
18	457.2	28	8.53	37	11.28			1-1/4'	31.7
20	508.0	30	9.14	39	11.89			1-1/4'	31.7

**3.4 HANGER INSTALLATION**

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

**3.5 HORIZONTAL MOVEMENT**

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

**3.6 FINAL ADJUSTMENT**

- .1 Adjust hangers and supports:

- .1 Ensure that rod is vertical under operating conditions.
- .2 Equalize loads.
- .2 Adjustable clevis:
  - .1 Tighten hanger load nut securely to ensure proper hanger performance.
  - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
  - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
  - .1 Hammer jaw firmly against underside of beam.

**3.7 FIELD QUALITY CONTROL**

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 21 05 01 – Common Work Results for Mechanical.

### **1.2 REFERENCES**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .2 National Building Code of Canada (NBC) - 2015

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals: in accordance with Section 00 10 00 – General Instructions.
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 00 10 00 – General Instructions. Include product characteristics, performance criteria, and limitations.
    - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).
- .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 and hired by the Contractor. The shop drawings must also include a report on the evaluation and mitigation of seismic effects related to the seismic force resisting systems.
  - .2 The hired Professional Engineer shall demonstrate recognized expertise in seismic protection.
  - .3 Provide separate shop drawings for each isolated system and system shop drawings complete with performance and product data.
  - .4 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 The Professional Engineer who prepared the evaluation and mitigation of seismic effects report shall inspect the work related to the seismic force resisting systems.
  - .3 Obtain from the Seismic Engineer a written and signed certification indicating that the seismic force resisting systems have been installed as per the report and the amendments to the report. Submit this certification before submitting the work certificate of compliance.

## 1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with Section 00 10 00 – General Instructions.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .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 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 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.

## 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.

## 2.7 SEISMIC CONTROL MEASURES

- .1 General:
  - .1 Following systems and/or equipment to remain operational during and after earthquakes:
    - .1 Energy Recovery Ventilator including associated equipment and ducting.
  - .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:
      - .1 Install tight to structure.
      - .2 Cross brace in every direction.
      - .3 Brace back to structure.
      - .4 Cable restraint system.
    - .3 Seismic restraints:
      - .1 Cushioning action gentle and steady.
      - .2 Never reach metal-like stiffness.
- .3 Vibration isolated equipment:
  - .1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.
  - .2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.
- .4 Bracing methods:
  - .1 Approved by Departmental Representative.
  - .2 Structural angles or channels.
  - .3 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points. Incorporate neoprene into cable connections to reduce shock loads.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Seismic control measures to meet requirements of NBC.



- .2 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.
- .3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .4 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:
  - .1 Up to 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 Obtain from the Seismic Professional Engineer a written and signed certification indicating that the seismic force resisting systems have been installed as per the report and, if applicable, amendment to the report.

### **3.4 CLEANING**

- .1 Proceed in accordance with Section 00 10 00 – General Instructions.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Section 21 05 01 – Common Work Results- Mechanical

**1.2                PURPOSE OF TAB**

- .1            Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads
- .2            Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3            Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

**1.3                EXCEPTIONS**

- .1            TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

**1.4                CO-ORDINATION**

- .1            Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
- .2            Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

**1.5                PRE-TAB REVIEW**

- .1            Review contract documents before project construction is started and confirm in writing to Departmental Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2            Review specified standards and report to Departmental Representative in writing proposed procedures which vary from standard.
- .3            During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

**1.6                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.

### **1.7 OPERATION OF SYSTEMS DURING TAB**

- .1 Operate systems for length of time required for TAB and as required by Departmental Representative for verification of TAB reports.

### **1.8 START OF TAB**

- .1 Notify Departmental Representative 7 days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
- .3 Installation of ceilings, doors, windows, other construction affecting TAB.
- .4 Application of weatherstripping, sealing, and caulking.
- .5 Pressure, leakage, other tests specified elsewhere Division 23.
- .6 Provisions for TAB installed and operational.
- .7 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
  - .1 Proper thermal overload protection in place for electrical equipment.
  - .2 Air systems:
    - .1 Filters in place, clean.
    - .2 Duct systems clean.
    - .3 Ducts are airtight to within specified tolerances.
    - .4 Correct ERV fan rotation.
    - .5 Duct heater installed and operational.

### **1.9 APPLICATION TOLERANCES**

- .1 Do TAB to following tolerances of design values:
  - .1 HVAC systems: plus or minus 5 %.

### **1.10 ACCURACY TOLERANCES**

- .1 Measured values accurate to within plus or minus 2 % of actual values.

### **1.11 INSTRUMENTS**

- .1 Prior to TAB, submit to Departmental Representative list of instruments used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.

## **1.12 SUBMITTALS**

- .1 Submit, prior to commencement of TAB:
- .2 Proposed methodology and procedures for performing TAB if different from referenced standard.

## **1.13 TAB REPORT**

- .1 Format in accordance with referenced standard.
- .2 TAB report to show results in SI units and to include:
  - .1 Project record drawings.
  - .2 System schematics.
- .3 Submit 6 copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.

## **1.14 VERIFICATION**

- .1 Reported results subject to verification by Departmental Representative.
- .2 Provide personnel and instrumentation to verify up to 30 % of reported results.
- .3 Number and location of verified results as directed by Departmental Representative.
- .4 Pay costs to repeat TAB as required to satisfaction of Departmental Representative.

## **1.15 SETTINGS**

- .1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

## **1.16 COMPLETION OF TAB**

- .1 TAB considered complete when final TAB Report received and approved by Departmental Representative.

## **1.17 AIR SYSTEMS**

- .1 Standard: TAB to most stringent of this section or TAB standards of AABC, NEBB, SMACNA and ASHRAE.
- .2 Do TAB of systems, equipment, components, controls specified Division 23.
- .3 Qualifications: personnel performing TAB [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 as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .6 Locations of equipment measurements: to include as appropriate:
  - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
  - .2 At controllers, controlled device.
- .7 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

**Part 2 Products**

**2.1 NOT USED**

- .1 Not used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not used.

**END OF SECTION**

**Part 1      General**

**1.1      RELATED REQUIREMENTS**

- .1      Section 21 05 01 – Common Work Results- Mechanical

**1.2      REFERENCES**

- .1      Definitions:
  - .1      For purposes of this section:
    - .1      "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
    - .2      "EXPOSED" - means "not concealed" as previously defined.
    - .3      Insulation systems - insulation material, fasteners, jackets, and other accessories.
  - .2      TIAC Codes:
    - .1      CRD: Code Round Ductwork,
    - .2      CRF: Code Rectangular Finish.
- .2      Reference Standards:
  - .1      American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
    - .1      ANSI/ASHRAE/IESNA 90.1-04, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
  - .2      ASTM International Inc.
    - .1      ASTM B209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
    - .2      ASTM C335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
    - .3      ASTM C411-05, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
    - .4      ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
    - .5      ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.
    - .6      ASTM C553-02e1, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
    - .7      ASTM C612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
    - .8      ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
    - .9      ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
  - .3      Canadian General Standards Board (CGSB)

- .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .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.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 00 10 00 – General Instructions.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.
    - .1 Description of equipment giving manufacturer's name, type, model, year and capacity.
    - .2 Details of operation, servicing and maintenance.
    - .3 Recommended spare parts list.
- .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, and cleaning procedures.

### **1.4 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 and member of TIAC.

### **1.5 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, paddling, and packaging materials.

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**Part 2            Products**

**2.1                FIRE AND SMOKE RATING**

- .1    To CAN/ULC-S102:
  - .1    Maximum flame spread rating: 25.
  - .2    Maximum smoke developed rating: 50.

**2.2                INSULATION**

- .1    Mineral fibre: as specified includes glass fibre, rock wool, slag wool.
- .2    Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.
- .3    TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).
- .4    TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
  - .1    Mineral fibre: to ASTM C553.
  - .2    Jacket: to CGSB 51-GP-52Ma.
  - .3    Maximum "k" factor: to ASTM C553.

**2.3                JACKETS**

- .1    Canvas:
  - .1    220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .2    Lagging adhesive: compatible with insulation.

**2.4                ACCESSORIES**

- .1    Vapour retarder lap adhesive:
  - .1    Water based, fire retardant type, compatible with insulation.
- .2    Indoor Vapour Retarder Finish:
  - .1    Vinyl emulsion type acrylic, compatible with insulation.
- .3    Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.
- .4    ULC Listed Canvas Jacket:
  - .1    220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .5    Outdoor Vapour Retarder Mastic:
  - .1    Vinyl emulsion type acrylic, compatible with insulation.
  - .2    Reinforcing fabric: Fibrous glass, untreated 305 g/m<sup>2</sup>.



- .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 mm wide, 0.5 mm thick stainless steel.
- .11 Facing: 25 mm galvanized steel hexagonal wire mesh stitched on one face of insulation with expanded metal lath on other face.
- .12 Fasteners: 2 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.
- .5 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
  - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.

### 3.4 DUCTWORK INSULATION SCHEDULE

.1 Insulation types and thicknesses: conform to following table:

	TIAC Code	Vapour Retarder	Thickness (mm)
Outside air duct (between louver and ERV)	C-1	yes	25
Exhaust air duct (between louver and ERV)	C-1	no	25
Rectangular dual temperature supply air duct	C-1	yes	50
Round dual temperature supply air duct	C-2	yes	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.

.1 Finishes: conform to following table:

	TIAC Code	Round
	Rectangular	Round
Indoor, concealed	none	none

### 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                RELATED REQUIREMENTS**

- .1            Section 21 05 01 – Common Work Results- Mechanical

**1.2                REFERENCES**

- .1            Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .1            SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 2005.

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

- .1            Submit in to NRC Representative for review.
- .2            Product Data:
  - .1            Submit manufacturer's instructions, printed product literature and data sheets for air duct accessories and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2            Indicate instrument test ports.

**Part 2            Products**

**2.1                GENERAL**

- .1            Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

**2.2                ACCESS DOORS IN DUCTS**

- .1            Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2            Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3            Gaskets: neoprene.
- .4            Hardware:
  - .1            Up to 300 x 300 mm: two sash locks complete with safety chain.
  - .2            301 to 450 mm: four sash locks complete with safety chain.
  - .3            451 to 1000 mm: piano hinge and minimum two sash locks.
  - .4            Doors over 1000 mm: piano hinge and two handles operable from both sides.
  - .5            Hold open devices.
  - .6            300 x 300 mm glass viewing panels.

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## **2.3 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.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air duct accessories installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied .

### **3.2 INSTALLATION**

- .1 Access Doors and Viewing Panels:
  - .1 Size:
    - .1 600 x 600 mm for person size entry.
    - .2 450 x 450 mm for servicing entry.
    - .3 300 x 300 mm for viewing.
    - .4 As indicated.
  - .2 Locations:
    - .1 Fire and smoke dampers.
    - .2 Control dampers.
    - .3 Devices requiring maintenance.
    - .4 Required by code.
    - .5 Reheat coils.
    - .6 Elsewhere as indicated.
- .2 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.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

Section 21 05 01 – Common Work Results- Mechanical

**1.2                REFERENCES**

.1            Sheet Metal and Air Conditioning National Association (SMACNA)  
SMACNA HVAC Duct Construction Standards, Metal and Flexible-[2013].

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

.1            Submit in accordance with Section 00 10 00 – General Instructions.

Product Data:

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

**1.4                CLOSEOUT SUBMITTALS**

.2            Submit in accordance with Section 00 10 00 – General Instructions.

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

**1.5                DELIVERY, STORAGE AND HANDLING**

.4            Deliver, store and handle materials in accordance with Section 00 10 00 – General Instructions and with manufacturer's written instructions.

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

.6            Storage and Handling Requirements:

.1            Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

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

.1            Replace defective or damaged materials with new.

.7            Packaging Waste Management: remove for reuse in accordance with Section 00 10 00 – General Instructions.

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**Part 2**            **Products**

**2.1**                **GENERAL**

- .1            Manufacture to SMACNA standards.

**2.2**                **SINGLE BLADE DAMPERS**

- .1            Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2            Size and configuration to recommendations of SMACNA, except maximum height 100 mm as indicated.
- .3            Locking quadrant with shaft extension to accommodate insulation thickness.
- .4            Inside and outside bronze end bearings.
- .5            Channel frame of same material as adjacent duct, complete with angle stop.

**Part 3**            **Execution**

**3.1**                **EXAMINATION**

- .1            Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for damper installation in accordance with manufacturer's written instructions.
- .2            Visually inspect substrate in presence of Departmental Representative.
- .3            Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .4            Proceed with installation only after unacceptable conditions have been remedied.

**3.2**                **INSTALLATION**

- .1            Install where indicated.
- .2            Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3            Locate balancing dampers in each branch duct, for supply, return and exhaust systems.
- .4            Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .5            Dampers: vibration free.
- .6            Ensure damper operators are observable and accessible.
- .7            Corrections and adjustments conducted by Departmental Representative.

**3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 00 10 00 – General Instructions.
- .2 Leave Work area clean at end of each day.
- .3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 00 10 00 – General Instructions.

**END OF SECTION**



**Part 1            General**

**1.1                RELATED SECTIONS**

- .1        Section 21 05 01 – Common Work Results- Mechanical
- .2        Section 21 05 02 – Mechanical Identification

**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.
- .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 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.
- .6 Refer to drawing 6136-M01 for diffuser and grille schedule(s), basis of design and acceptable material.

## **2.2 MANUFACTURED UNITS**

- .1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

## **2.3 RETURN GRILLES**

- .1 Type RG1: aluminum, 19 mm border, single 0 degrees deflection, horizontal face bars. Acceptable Material: EH Price Model 80 Series Egg Crate Return Grille 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 stainless steel screws in countersunk holes where fastenings are visible.

### **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            RELATED SECTIONS**

- .1            Section 21 05 01 – Common Work Results- Mechanical

**1.2            REFERENCES**

- .1            American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA)
  - .1            ANSI/NFPA 96-04, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
  - .2            American Society for Testing and Materials International (ASTM)
    - .1            ASTM E90-04, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
  - .3            Health Canada/Workplace Hazardous Materials Information System (WHMIS)
    - .1            Material Safety Data Sheets (MSDS).
  - .4            Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .5            Society of Automotive Engineers (SAE)

**1.3            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.

**1.4            SUBMITTALS**

- .1            Product Data:
  - .1            Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 00 10 00 – General Instructions.
  - .2            Indicate following:
    - .1            Pressure drop.
    - .2            Face area.
    - .3            Free area.
  - .2            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.
  - .3            Test Reports:

- .1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

## **1.5 QUALITY ASSURANCE**

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 00 15 45 – General and Fire Safety Requirements.

## **1.6 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: 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 FIXED LOUVRES - ALUMINUM**

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: extruded aluminum alloy 6063-T5.
- .3 Blades: 150 mm deep, stormproof pattern with centre watershed in blade, reinforcing bosses, minimum 2.06 mm thick.
- .4 Frame, head, sill and jamb: 150 mm deep one piece extruded aluminum, minimum 3, 2.06 mm thick with approved caulking slot, integral to unit.
- .5 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
- .6 Screen: 12mm exhaust, and 19] mm intake mesh aluminum birdscreen on inside face of louvres in formed U-frame.
- .7 Finish: factory applied enamel. Colour: to Departmental Representative approval.

## **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       In accordance with manufacturer's and SMACNA recommendations.
- .2       Reinforce and brace as indicated.
- .3       Anchor securely into opening. Seal with caulking to ensure weather tightness.

**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 RELATED REQUIREMENTS**

- .1 Section 25 05 01 – EMCS: General Requirements.

### **1.2 DEFINITIONS**

- .1 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.
- .2 AEL: ratio between total test period less any system downtime accumulated within that period and test period.
- .3 Downtime: results whenever EMCS is unable to 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 ACTION AND INFORMATIONAL SUBMITTALS**

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

- .2 Final Report: submit report to Departmental Representative.
  - .1 Include measurements, final settings and certified test results.
  - .2 Bear signature of commissioning technician and supervisor
  - .3 Report format to be approved by Departmental Representative before commissioning is started.
- .2 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 Instructions.
- .3 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 00 10 00 – General Instructions.

### **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 Cx Agent and in presence of Departmental Representative and Cx Agent.
- .3 Inform, and obtain approval from, Departmental Representative in writing at least 14 days prior to commissioning or each test. Indicate:
  - .1 Location and part of system to be tested or commissioned.
  - .2 Testing/commissioning procedures, anticipated results.
  - .3 Names of testing/commissioning personnel.
- .4 Correct deficiencies, re-test in presence of Departmental Representative until satisfactory performance is obtained.
- .5 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.
- .6 Load system with project software.
- .7 Perform tests as required.

### **1.7 COMPLETION OF COMMISSIONING**

- .1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by Departmental Representative.

## **1.8 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION**

- .1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

## **PART 2 - PRODUCTS**

### **2.1 EQUIPMENT**

- .1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.
- .2 Instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.
- .3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 2 months prior to tests.
- .4 Locations to be approved, readily accessible and readable.
- .5 Application: to conform to normal industry standards.

## **PART 3 - EXECUTION**

### **3.1 PROCEDURES**

- .1 Test each system independently and then in unison with other related systems.
- .2 Commission each system using procedures prescribed by the Departmental Representative.
- .3 Commission integrated systems using procedures prescribed by Departmental Representative.
- .4 Debug system software.
- .5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.
- .6 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.



### 3.2 FIELD QUALITY CONTROL

- .1 Pre-Installation Testing.
  - .1 General: consists of field tests of equipment just prior to installation.
  - .2 Testing may be on site or at Contractor's premises as approved by Departmental Representative.
  - .3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of Building Controller's including MCU's, LCU's, and TCU's.
  - .4 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).
  - .5 Additional instruments to include:
    - .1 DP transmitters.
    - .2 VAV supply duct SP transmitters.
    - .3 DP switches used for dirty filter indication and fan status.
  - .6 In addition to test equipment, provide inclined manometer, digital micro-manometer, milli-amp meter, source of air pressure infinitely adjustable between 0 and 500 Pa, to hold steady at any setting and with direct output to milli-amp meter at source.
  - .7 After setting, test zero and span in 10% increments through entire range while both increasing and decreasing pressure.
  - .8 Departmental Representative to mark instruments tracking within 0.5% in both directions as "approved for installation".
  - .9 Transmitters above 0.5% error will be rejected.
  - .10 DP switches to open and close within 2% of setpoint.
- .2 Completion Testing.
  - .1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.
  - .2 Include following activities:
    - .1 Test and calibrate field hardware including stand-alone capability of each controller.
    - .2 Verify each A-to-D convertor.
    - .3 Test and calibrate each AI using calibrated digital instruments.
    - .4 Test each DI to ensure proper settings and switching contacts.
    - .5 Test each DO to ensure proper operation and lag time.
    - .6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.
    - .7 Test operating software.
    - .8 Test application software and provide samples of logs and commands.
    - .9 Verify each CDL including energy optimization programs.
    - .10 Debug software.
    - .11 Blow out flow measuring and static pressure stations with high pressure air at 700 kPa.
    - .12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on commissioning technician and Departmental Representative. This document will be used in final startup

testing.

- .3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Departmental Representative and provide:
  - .1 2 technical personnel capable of re-calibrating field hardware and modifying software.
  - .2 Detailed daily schedule showing items to be tested and personnel available.
  - .3 Departmental Representative's acceptance signature to be on executive and applications programs.
  - .4 Commissioning to commence during final startup testing.
  - .5 O&M personnel to assist in commissioning procedures as part of training.
  - .6 Commissioning to be supervised by qualified supervisory personnel and Departmental Representative.
  - .7 Commission systems considered as life safety systems before affected parts of the facility are occupied.
  - .8 Operate systems as long as necessary to commission entire project.
  - .9 Monitor progress and keep detailed records of activities and results.
- .4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.
  - .1 Prior to beginning of 30 day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.
    - .1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.
  - .2 Test to last at least 30 consecutive 24 hour days.
  - .3 Tests to include:
    - .1 Demonstration of correct operation of monitored and controlled points.
    - .2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.
  - .4 System will be accepted when:
    - .1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.
    - .2 Requirements of Contract have been met.
  - .5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.
  - .6 Correct defects when they occur and before resuming tests.
- .5 Departmental Representative to verify reported results.

### 3.3 ADJUSTING

- .1 Final adjusting: upon completion of commissioning as reviewed by Departmental

Representative, set and lock devices in final position and permanently mark settings.

### **3.4 DEMONSTRATION**

- .1 Demonstrate to Departmental Representative operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs in accordance with Section 00 10 00 – General Instructions.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 2505 01 – EMCS: General Requirements.

### **1.2 DEFINITIONS**

- .1 CDL - Control Description Logic.
- .2 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 00 10 00 – General Instructions, supplemented and modified by requirements of this Section.
- .2 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to Departmental Representative 30 days prior to anticipated date of beginning of training.
  - .1 List name of trainer, and type of visual and audio aids to be used.
  - .2 Show co-ordinated interface with other EMCS mechanical and electrical training programs.
- .2 Submit reports within one week after completion of training program that training has been satisfactorily completed.

### **1.4 QUALITY ASSURANCE**

- .1 Provide competent instructors thoroughly familiar with aspects of EMCS installed in facility.

### **1.5 INSTRUCTIONS**

- .1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of EMCS installed.
- .2 Training to be project-specific.

### **1.6 TIME FOR TRAINING**

- .1 Number of days of instruction to be as specified in this section (1 day = 8 hours including two 15 minute breaks and excluding lunch time).

## 1.7 TRAINING MATERIALS

- .1 Provide equipment, visual and audio aids, and materials for classroom training.
- .2 Supply manual for each trainee, describing in detail data included in each training program.
  - .1 Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

## 1.8 TRAINING PROGRAM

- .1 To be in 2 phases over 6 month period.
- .2 Phase 1: 2 day program to begin before 30 day test period at time mutually agreeable to Contractor, Departmental Representative.
  - .1 Train O&M personnel in functional operations and procedures to be employed for system operation.
  - .2 Supplement with on-the-job training during 30 day test period.
  - .3 Include overview of system architecture, communications, operation of computer and peripherals, report generation.
  - .4 Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system, and elementary preventive maintenance.
- .3 Phase 2: 5 day program to begin 8 weeks after acceptance for operators, equipment maintenance personnel and programmers.
  - .1 Provide multiple instructors on pre-arranged schedule. Include at least following:
    - .1 Operator training: provide operating personnel, maintenance personnel and programmers with condensed version of Phase 1 training.
    - .2 Equipment maintenance training: provide personnel with 2 days training within 5 day period in maintenance of EMCS equipment, including general equipment layout, trouble shooting and preventive maintenance of EMCS components, maintenance and calibration of sensors and controls.
    - .3 Programmers: provide personnel with 2 days training within 5 day period in following subjects in approximate percentages of total course shown:

Software and architecture: 10%
Application programs: 15%
Controller programming: 50%
Trouble shooting and debugging: 10%
Colour graphic generation: 15%

## 1.9 MONITORING OF TRAINING

- .1 Departmental Representative to monitor training program and may modify schedule and content.

**PART 2 - PRODUCTS**

**2.1 NOT USED**

.1 Not Used.

**PART 3 - EXECUTION**

**3.1 NOT USED**

.1 Not Used.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 25 05 54 - EMCS: Identification.
- .2 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

### **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).
- .9 Transport Canada (TC).
  - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

### **1.3 DESIGNATED CONTRACTOR**

- .1 Hire the services of Ainsworth or its authorized representative to complete the work of all EMCS sections.

## 1.4 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.



## 1.5 DEFINITIONS

- .1 Point: may be logical or physical.
  - .1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.
  - .2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.
- .2 Point Name: composed of two parts, point identifier and point expansion.
  - .1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25 character field for each point identifier. "System" is system that point is located on.
    - .1 Area descriptor: building or part of building where point is located.
    - .2 System descriptor: system that point is located on.
    - .3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be shortforms or acronyms. Database must provide 25 character field for each point identifier.
  - .2 Point expansion: comprised of three fields, one for each descriptor. Expanded form of shortform or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide [32] character field for each point expansion.
  - .3 Bilingual systems to include additional point identifier expansion fields of equal capacity for each point name for second language.
    - .1 System to support use of numbers and readable characters including blanks, periods or underscores to enhance user readability for each of the above strings.
- .3 Point Object Type: points fall into following object types:
  - .1 AI (analog input).
  - .2 AO (analog output).
  - .3 DI (digital input).
  - .4 DO (digital output).
  - .5 Pulse inputs.
- .4 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.
  - .1 Printouts: to ANSI/IEEE 260.1.
  - .2 Refer also to Section 25 05 54 - EMCS: Identification.

## 1.6 SYSTEM DESCRIPTION

- .1 Refer to control schematics for system architecture.
- .2 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following:
  - .1 Building Controllers.
  - .2 Control devices as 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 Wiring interface co-ordination of equipment supplied by others.
  - .11 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 as indicated.
  - .5 Metric references: in accordance with CAN/CSA Z234.1.
- .4 Language Operating Requirements:
- .1 Provide English operator selectable access codes.
  - .2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in English.
  - .3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English.
  - .4 System manager software: include in English system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.
  - .5 Include, in English:
    - .1 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-definitions).
    - .2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in English at specified OWS and to be able to operate one terminal in English and second in French. Point name expansions in both languages.
    - .3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

## 1.7 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 00 10 00 – General Instructions and

25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

- .2 Submit for review:
  - .1 Equipment list and systems manufacturers within 48h after award of contract.
  - .2 List existing field control devices to be re-used included in tender, along with unit price.
  
- .3 Quality Control:
  - .1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
  - .2 Where CSA certified equipment is not available 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.
  - .8 Existing devices intended for re-use: submit test report.

## 1.8 QUALITY ASSURANCE

- .1 Have local office within 50 km 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.

## 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: in accordance with Section 00 10 00 – General

Instructions.

## **1.10 EXISTING- CONTROL COMPONENTS**

- .1 Utilize existing control wiring 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 applicable portions of EMCS as approved by Departmental Representative.
- .7 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 There is an existing Schneider (Ainsworth) system presently installed in the building. All materials must be selected to ensure compatibility with the existing system.

## **2.2 EQUIPMENT**

- .1 Control Network Protocol and Data Communication Protocol: to ASHRAE STD 135.
- .2 Complete list of equipment and materials to be used on project and forming part of tender documents by adding manufacturer's name, model number and details of materials, and submit for approval.

## **2.3 ADAPTORS**

- .1 Provide adaptors between metric and imperial components.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S RECOMMENDATIONS**

- .1 Installation: to manufacturer's recommendations.

### **3.2 PAINTING**

- .1 Restore to new condition, finished surfaces too extensively damaged to be primed and touched up to make good.
- .2 Clean and prime exposed hangers, racks, fastenings, and other support components.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 25 05 01 – EMCS: General Requirements.
- .2 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 DESIGN REQUIREMENTS**

- .1 Preliminary Design Review: to contain following contractor and systems information.
  - .1 Location of local office.
  - .2 Description and location of installing and servicing technical staff.
  - .3 Location and qualifications of programming design and programming support staff.
  - .4 List of spare parts.
  - .5 Names of sub-contractors and site-specific key personnel.
  - .6 Sketch of site-specific system architecture.
  - .7 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.
  - .8 Descriptive brochures.
  - .9 Sample CDL and graphics (systems schematics).
  - .10 Response time for each type of command and report.
  - .11 Item-by-item statement of compliance.
  - .12 Proof of demonstrated ability of system to communicate utilizing BACnet.

### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 00 10 00 – General Instructions and coordinate with requirements in this Section.
- .2 Submit preliminary design document within 5 working days after contract award, for review by Departmental Representative.
- .3 Shop Drawings to consist of 3 hard copies and 1 soft copy of design documents, shop drawings, product data and software.
- .4 Hard copy to be completely indexed and coordinated package to assure compliance with contract requirements and arranged in same sequence as specification and cross-referenced to specification section and paragraph number.

- .5 Soft copy to be in Autocad - latest version and Microsoft Word latest version format, structured using menu format for easy loading and retrieval on OWS.

## 1.5 PRELIMINARY SHOP DRAWING REVIEW

- .1 Submit preliminary shop drawings within 30 working days of award of contract and include following:
  - .1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.
  - .2 Detailed system architecture showing all points associated with each controller including signal levels, pressures where new EMCS ties into existing control equipment.
  - .3 Spare point capacity of each controller by number and type.
  - .4 Controller locations.
  - .5 Auxiliary control cabinet locations.
  - .6 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.

## 1.6 DETAILED SHOP DRAWING REVIEW

- .1 Submit detailed shop drawings within 60 working days after award of contract and before start of installation and include following:
  - .1 Corrected and updated versions (hard copy only) of submissions made during preliminary review.
  - .2 Wiring diagrams.
  - .3 Piping diagrams and hook-ups.
  - .4 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.
  - .5 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:
    - .1 Sensing element type and location.
    - .2 Transmitter type and range.
    - .3 Associated field wiring schematics, schedules and terminations.
    - .4 Complete Point Name Lists.
    - .5 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
    - .6 Software and programming details associated with each point.
    - .7 Manufacturer's recommended installation instructions and procedures.
    - .8 Input and output signal levels or pressures where new system ties into existing control equipment.
  - .6 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.
  - .7 Graphic system schematic displays of air and water systems with point identifiers

- and textual description of system, and typical floor plans as specified.
- .8 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.
- .9 Listing and example of specified reports.
- .10 Listing of time of day schedules.
- .11 Mark up to-scale construction drawing to detail control room showing location of equipment and operator work space.
- .12 Type and size of memory with statement of spare memory capacity.
- .13 Full description of software programs provided.
- .14 Sample of "Operating Instructions Manual" to be used for training purposes.
- .15 Outline of proposed start-up and verification procedures. Refer to Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

## **1.7 QUALITY ASSURANCE**

- .1 Preliminary Design Review Meeting: Convene meeting within 45 working days of award of contract to:
  - .1 Undertake functional review of preliminary design 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 Contractor's programmer to attend meeting.
- .3 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 RELATED REQUIREMENTS**

- .1 Section 25 05 01 – EMCS: General Requirements.
- .2 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
- .3 Section 25 05 02 - EMCS: Submittals and Review Process.

### **1.2 DEFINITIONS**

- .1 BECC - Building Environmental Control Centre.
- .2 OWS - Operator Work Station.
- .3 For additional acryonyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 00 10 00 – General Instructions, supplemented and modified by requirements of this Section.
- .2 Submit As-built drawings and Operation and Maintenance Manual to Departmental Representative in English.
- .3 Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders.
  - .1 Binders to be 2/3 maximum full.
  - .2 Provide index to full volume in each binder.
  - .3 Identify contents of each manual on cover and spine.
  - .4 Provide Table of Contents in each manual.
  - .5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

### **1.4 AS-BUILTS**

- .1 Provide 1 copy of detailed shop drawings generated in Section 25 05 02 - EMCS: Submittals and Review Process and include:
  - .1 Changes to contract documents as well as addenda and contract extras.
  - .2 Changes to interface wiring.
  - .3 Routing of conduit, wiring and control air lines associated with EMCS installation.
  - .4 Locations of obscure devices to be indicated on drawings.
  - .5 Listing of alarm messages.

- .6 Panel/circuit breaker number for sources of normal/emergency power.
  - .7 Names, addresses, telephone numbers of each sub-contractor having installed equipment, local representative for each item of equipment, each system.
  - .8 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports as specified in Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
  - .9 Basic system design and full documentation on system configuration.
- .2 Submit for final review by Departmental Representative.
  - .3 Provide before acceptance 4 hard and 1 soft copy incorporating changes made during final review.

## 1.5 O&M MANUALS

- .1 Custom design O&M Manuals (both hard and soft copy) to contain material pertinent to this project only, and to provide full and complete coverage of subjects referred to in this Section.
- .2 Provide 2 complete sets of hard and soft copies prior to system or equipment tests
- .3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.
- .4 Functional description to include:
  - .1 Functional description of theory of operation.
  - .2 Design philosophy.
  - .3 Specific functions of design philosophy and system.
  - .4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.
  - .5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.
  - .6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented [or planned] for implementation in automatic mode.
- .5 System operation to include:
  - .1 Complete step-by-step procedures for operation of system including required actions at each OWS.
  - .2 Operation of computer peripherals, input and output formats.
  - .3 Emergency, alarm and failure recovery.
  - .4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including key strokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.

- .6 Software to include:
  - .1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.
  - .2 Detailed descriptions of program requirements and capabilities.
  - .3 Data necessary to permit modification, relocation, reprogramming and to permit new and existing software modules to respond to changing system functional requirements without disrupting normal operation.
  - .4 Software modules, fully annotated source code listings, error free object code files ready for loading via peripheral device
  - .5 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, program execution.
  - .6 Software for each Controller and single section referencing Controller common parameters and functions.
- .7 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including calibration, maintenance, repair of sensors, transmitters, transducers, controller and interface firmware's, plus diagnostics and repair/replacement of system hardware.
- .8 System configuration document:
  - .1 Provisions and procedures for planning, implementing and recording hardware and software modifications required during operating lifetime of system.
  - .2 Information to ensure co-ordination of hardware and software changes, data link or message format/content changes, sensor or control changes in event that system modifications are required.
- .9 Programmer control panel documentation: provide where panels are independently interfaced with BECC, including interfacing schematics, signal identification, timing diagrams, fully commented source listing of applicable driver/handler.

## **PART 2 - PRODUCTS**

### **2.1 NOT USED**

- .1 Not Used.

## **PART 3 - EXECUTION**

### **3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 25 05 01 – EMCS: General Requirements.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International).
  - .1 CSA C22.1-02, The Canadian Electrical Code, Part I (19th Edition), Safety Standard for Electrical Installations.

### **1.3 DEFINITIONS**

- .1 For acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

### **1.4 SYSTEM DESCRIPTION**

- .1 Language Operating Requirements: provide identification for control items in English.

### **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

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

- .1 Identify by Plastic laminate, 3 mm thick, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.
- .2 Sizes: 25 x 67mm minimum.
- .3 Lettering: minimum 7mm high, black.
- .4 Inscriptions: machine engraved to identify function.

## **2.2 NAMEPLATES FOR FIELD DEVICES**

- .1 Identify by plastic encased cards attached by chain.
- .2 Sizes: 50 x 100 mm minimum.
- .3 Lettering: minimum 5 mm high produced from laser printer in black.
- .4 Data to include: point name and point address.
- .5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

## **2.3 WARNING SIGNS**

- .1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.
- .2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS" as reviewed by Departmental Representative's.

## **2.4 WIRING**

- .1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.
- .2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.
- .3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

## **2.5 CONDUIT**

- .1 Colour code EMCS conduit.
- .2 Pre-paint box covers and conduit fittings.
- .3 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 Related Requirements
  - .1 Section 25 05 01 – ECMS: General Requirements.
- .2 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 BC(s) - Building Controller(s).
- .2 OWS - Operator Work Station.
- .3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 00 10 00 – General Instructions.
- .2 Submit detailed preventative maintenance schedule for system components to Departmental Representative.
- .3 Submit detailed inspection reports to Departmental Representative.
- .4 Submit dated, maintenance task lists to Departmental Representative and include the following sensor and output point detail, as proof of system verification:
  - .1 Point name and location.
  - .2 Device type and range.
  - .3 Measured value.
  - .4 System displayed value.
  - .5 Calibration detail
  - .6 Indication if adjustment required,
  - .7 Other action taken or recommended.
- .5 Submit network analysis report showing results with detailed recommendations to correct problems found.
- .6 Records and logs: in accordance with Section 00 10 00 – General Instructions.
  - .1 Maintain records and logs of each maintenance task on site.

- .2 Organize cumulative records for each major component and for entire EMCS chronologically.
- .3 Submit records to Departmental Representative, after inspection indicating that planned and systematic maintenance have been accomplished.
- .7 Revise and submit to Departmental Representative in accordance with Section 00 10 00 – General Instructions "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

#### **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 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.
- .4 Work requests: record each service call request, when received separately on approved form and include:
  - .1 Serial number identifying 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.
- .5 Provide system modifications in writing.
  - .1 No system modification, including operating parameters and control settings, to be made without prior written approval of Departmental Representative.

#### **PART 2 - PRODUCTS**



## 2.1 NOT USED

- .1 Not Used.

## PART 3 - EXECUTION

### 3.1 FIELD QUALITY CONTROL

- .1 Perform as minimum (3) three minor inspections and one major inspection (more often if required by manufacturer) per year. Provide detailed written report to Departmental Representative as described in Submittal article.
- .2 Perform inspections during regular working hours, 0800 to 1630 h, Monday through Friday, excluding statutory holidays.
- .3 Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:
  - .1 Perform calibrations using test equipment having traceable, certifiable accuracy at minimum 50% greater than accuracy of system displaying or logging value.
  - .2 Check and calibrate each field input/output device in accordance with Canada Labour Code - Part I and CSA Z204.
  - .3 Provide dated, maintenance task lists, as described in Submittal article, as proof of execution of complete system verification.
- .4 Minor inspections to include, but not limited to:
  - .1 Perform visual, operational checks to BC's, peripheral equipment, interface equipment and other panels.
  - .2 Check equipment cooling fans as required.
  - .3 Visually check for mechanical faults, air leaks and proper pressure settings on pneumatic components.
  - .4 Review system performance with Departmental Representative to discuss suggested or required changes.
- .5 Major inspections to include, but not limited to:
  - .1 Minor inspection.
  - .2 Clean OWS(s) peripheral equipment, BC(s), interface and other panels, micro-processor interior and exterior surfaces.
  - .3 Check signal, voltage and system isolation of BC(s), peripherals, interface and other panels.
  - .4 Verify calibration/accuracy of each input and output device and recalibrate or replace as required.
  - .5 Provide mechanical adjustments, and necessary maintenance on printers.
  - .6 Run system software diagnostics as required.
  - .7 Install software and firmware enhancements to ensure components are operating at most current revision for maximum capability and reliability.
    - .1 Perform network analysis and provide report as described in Submittal article.

- .6 Rectify deficiencies revealed by maintenance inspections and environmental checks.
- .7 Continue system debugging and optimization.
- .8 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.
  - .1 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 25 05 01 – EMCS – General Requirements.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International).
  - .1 CSA T529-95(R2000), Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/TIA/EIA-568-A with modifications).
  - .2 CSA T530-99(R2004), Commercial Building Standard for Telecommunications Pathways and Spaces (Adopted ANSI/TIA/EIA-569-A with modifications).
- .2 Institute of Electrical and Electronics Engineers (IEEE)/Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements.
  - .1 IEEE Std 802.3TM -2002, Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.
- .3 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)
  - .1 TIA/EIA-568-March 2004, Commercial Building Telecommunications Cabling Standards Set, Part 1 General Requirements Part 2 Balanced Twisted-Pair Cabling Components Part 3 Optical Fiber Cabling Components Standard.
  - .2 TIA/EIA-569-A-December 2001, Commercial Building Standard for Telecommunications Pathways and Spaces.
- .4 Treasury Board Information Technology Standard (TBITS).
  - .1 TBITS 6.9-2000, Profile for the Telecommunications Wiring System in Government Owned and Leased Buildings - Technical Specifications.

### **1.3 DEFINITIONS**

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS - General Requirements.

### **1.4 SYSTEM DESCRIPTION**

- .1 Data communication network to link Operator Workstations and Master Control Units (MCU) in accordance with CSA T530.
  - .1 Provide reliable and secure connectivity of adequate performance between different sections (segments) of network.
  - .2 Allow for future expansion of network, with selection of networking technology and communication protocols.

- .2 Data communication network to include, but not limited to:
  - .1 EMCS-LAN.
  - .2 Modems.
  - .3 Network interface cards.
  - .4 Network management hardware and software.
  - .5 Network components necessary for complete network.

## 1.5 DESIGN REQUIREMENTS

- .1 EMCS Local Area Network (EMCS-LAN).
  - .1 High speed, high performance, local area network over which MCUs and OWSs communicate with each other directly on peer to peer basis in accordance with IEEE 802.3/Ethernet Standard.
  - .2 EMCS-LAN to: BACnet.
  - .3 Each EMCS-LAN to be capable of supporting at least 50 devices.
  - .4 Support of combination of MCUs and OWSs directly connected to EMCS-LAN.
  - .5 High speed data transfer rates for alarm reporting, quick report generation from multiple controllers, upload/download information between network devices. Bit rate to be 10 Megabits per second minimum.
  - .6 Detection and accommodation of single or multiple failures of either OWSs, MCUs or network media. Operational equipment to continue to perform designated functions effectively in event of single or multiple failures.
  - .7 Commonly available, multiple sourced, networking components and protocols to allow system to co-exist with other networking applications including office automation.
- .2 Dynamic Data Access.
  - .1 LAN to provide capabilities for OWSs, either network resident or connected remotely, to access point status and application report data or execute control functions for other devices via LAN.
  - .2 Access to data to be based upon logical identification of building equipment.
- .3 Network Medium.
  - .1 Network medium: twisted cable compatible with network protocol to be used within buildings.

## PART 2 - PRODUCTS

### 2.1 NOT USED

- .1 Not Used.

## PART 3 - EXECUTION

**3.1 NOT USED**

.1 Not Used.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 25 05 01 – EMCS: General Requirements.
- .2 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
- .3 Section 25 05 03 - EMCS: Project Record Documents.
- .4 Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

### **1.2 REFERENCES**

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).
  - .1 ASHRAE 2003, Applications Handbook, SI Edition.
- .2 Canadian Standards Association (CSA International).
  - .1 C22.2 No.205-M1983(R1999), Signal Equipment.
- .3 Institute of Electrical and Electronics Engineers (IEEE).
  - .1 IEEE C37.90.1-02, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
- .4 Public Works and Government Services Canada (PWGSC)/Real Property Branch/Architectural and Engineering Services.
  - .1 MD13800-September 2000, Energy Management and Control Systems (EMCS) Design Manual. English: <ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanical/me214-e.pdf>

### **1.3 DEFINITIONS**

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

### **1.4 DESCRIPTION**

- .1 General: Network of controllers comprising of MCUs to be provided to support building systems and associated sequence(s) of operations as detailed in these specifications.
  - .1 Provide sufficient controllers to meet intents and requirements of this section.
  - .2 Controller quantity, and point contents to be approved by Departmental Representative at time of preliminary design review.
- .2 Controllers: stand-alone intelligent Control Units.

- .1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.
- .2 Incorporate communication interface ports for communication to LANs to exchange information with other Controllers.
- .3 Capable of interfacing with operator interface device.
- .4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controller. Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).
  - .1 Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

## 1.5 DESIGN REQUIREMENTS

- .1 To include:
  - .1 Scanning of AI and DI connected inputs for detection of change of value and processing detection of alarm conditions.
  - .2 Perform On-Off digital control of connected points, including resulting required states generated through programmable logic output.
  - .3 Perform Analog control using programmable logic, (including PID) with adjustable dead bands and deviation alarms.
  - .4 Control of systems as described in sequence of operations.
  - .5 Execution of optimization routines as listed in this section.
- .2 Total spare capacity for MCUs: at least 25% of each point type distributed throughout the MCUs.
- .3 Field Termination and Interface Devices:
  - .1 To: CSA C22.2 No.205.
  - .2 Electronically interface sensors and control devices to processor unit.
  - .3 Include, but not be limited to, following:
    - .1 Programmed firmware or logic circuits to meet functional and technical requirements.
    - .2 Power supplies for operation of logics devices and associated field equipment.
    - .3 Lockable wall cabinet.
    - .4 Required communications equipment and wiring (if remote units).
    - .5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.
    - .6 Input Output interface to accept as minimum AI, AO, DI, DO functions as specified.
    - .7 Wiring terminations: use conveniently located screw type or spade lug terminals.
- .4 AI interface equipment to:
  - .1 Convert analog signals to digital format with 10 bit analog-to-digital resolution.
  - .2 Provide for following input signal types and ranges:
    - .1 4 - 20 mA;

- .2 0 - 10 VDC;
- .3 100/1000 ohm RTD input;
- .3 Meet IEEE C37.90.1 surge withstand capability.
- .4 Have common mode signal rejection greater than 60 dB to 60 Hz.
- .5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.
- .5 AO interface equipment:
  - .1 Convert digital data from controller processor to acceptable analog output signals using 8 bit digital-to-analog resolution.
  - .2 Provide for following output signal types and ranges:
    - .1 4 - 20 mA.
    - .2 0 - 10 VDC.
  - .3 Meet IEEE C37.90.1 surge withstand capability.
- .6 DI interface equipment:
  - .1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.
  - .2 Meet IEEE C37.90.1 surge withstand capability.
  - .3 Accept pulsed inputs up to 2 kHz.
- .7 DO interface equipment:
  - .1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 VAC.
  - .2 Switch up to 5 amps at 220 VAC using optional interface relay.
- .4 Controllers and associated hardware and software: operate in conditions of 0 degrees C to 44 degrees C and 20 % to 90 % non-condensing RH.
- .5 Controllers (MCU): mount in wall mounted cabinet with hinged, keyed-alike locked door.
  - .1 Provide for conduit entrance from top, bottom or sides of panel.
  - .2 Mounting details as approved by Departmental Representative for ceiling mounting.
- .6 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.
- .7 Provide surge and low voltage protection for interconnecting wiring connections.

## 1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 00 10 00 – General Instructions and Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
  - .1 Submit product data sheets for each product item proposed for this project.

## 1.7 MAINTENANCE

- .1 Provide manufacturers recommended maintenance procedures for insertion in Section 25 05 03 - EMCS: Project Record Documents.



## PART 2 - PRODUCTS

### 2.1 MASTER CONTROL UNIT (MCU)

- .1 General: primary function of MCU is to provide co-ordination and supervision of subordinate devices in execution of optimization routines such as demand limiting or enthalpy control.
- .2 Include high speed communication LAN Port for Peer to Peer communications with OWS(s) and other MCU level devices.
  - .1 MCU must support BACnet.
- .3 MCU local I/O capacity as follows:
  - .1 MCU I/O points as allocated in I/O Summary Table referenced in MD13800.
- .4 Central Processing Unit (CPU).
  - .1 Processor to consist of minimum 16 bit microprocessor capable of supporting software to meet specified requirements.
  - .2 CPU idle time to be more than 30% when system configured to maximum input and output with worst case program use.
  - .3 Minimum addressable memory to be at manufacturer's discretion but to support at least performance and technical specifications to include but not limited to:
    - .1 Non-volatile EEPROM to contain operating system, executive, application, sub-routine, other configurations definition software. Tape media not acceptable.
    - .2 Battery backed (72 hour minimum capacity) RAM (to reduce the need to reload operating data in event of power failure) to contain CDLs, application parameters, operating data or software that is required to be modifiable from operational standpoint such as schedules, setpoints, alarm limits, PID constants and CDL and hence modifiable on-line through operator panel or remote operator's interface. RAM to be downline loadable from OWS.
  - .4 Include uninterruptible clock accurate to plus or minus 5 secs/month, capable of deriving year/month/day/hour/minute/second, with rechargeable batteries for minimum 72 hour operation in event of power failure.
- .5 Local Operator Terminal (OT): Provide OT for each MCU unless otherwise specified in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.
  - .1 Mount access/display panel in MCU or in suitable enclosure beside MCU as approved by Departmental Representative.
  - .2 Support operator's terminal for local command entry, instantaneous and historical data display, programs, additions and modifications.
  - .3 Display simultaneously minimum of 16 point identifiers to allow operator to view single screen dynamic displays depicting entire mechanical systems. Point identifiers to be in English.
  - .4 Functions to include, but not be limited to, following:
    - .1 Start and stop points.
    - .2 Modify setpoints.

- .3 Modify PID loop parameters.
- .4 Override PID control.
- .5 Change time/date.
- .6 Add/modify/start/stop weekly scheduling.
- .7 Add/modify setpoint weekly scheduling.
- .8 Enter temporary override schedules.
- .9 Define holiday schedules.
- .10 View analog limits.
- .11 Enter/modify analog warning limits.
- .12 Enter/modify analog alarm limits.
- .13 Enter/modify analog differentials.
- .5 Provide access to real and calculated points in controller to which it is connected or to other controller in network. This capability not to be restricted to subset of predefined "global points" but to provide totally open exchange of data between OT and other controller in network.
- .6 Operator access to OTs: same as OWS user password and password changes to automatically be downloaded to controllers on network.
- .7 Provide prompting to eliminate need for user to remember command format or point names. Prompting to be consistent with user's password clearance and types of points displayed to eliminate possibility of operator error.
- .8 Identity of real or calculated points to be consistent with network devices. Use same point identifier as at OWS's for access of points at OT to eliminate cross-reference or look-up tables.
- .6 All MCUs to be BACnet BTL certified.

## 2.2 SOFTWARE

- .1 General.
  - .1 Include as minimum: operating system executive, communications, application programs, operator interface, and systems sequence of operation - CDL's.
  - .2 Include "firmware" or instructions which are programmed into ROM, EPROM, EEPROM or other non-volatile memory.
  - .3 Include initial programming of Controllers, for entire system.
- .2 Program and data storage.
  - .1 Store executive programs and site configuration data in ROM, EEPROM or other non-volatile memory.
  - .2 Maintain CDL and operating data including setpoints, operating constants, alarm limits in battery-backed RAM or EEPROM for display and modification by operator.
- .3 Programming languages.
  - .1 Program Control Description Logic software (CDL) using English like or graphical, high level, general control language.
  - .2 Structure software in modular fashion to permit simple restructuring of program modules if future software additions or modifications are required. GO TO constructs not allowed unless approved by Departmental Representative.

- .4 Operator Terminal interface.
  - .1 Operating and control functions include:
    - .1 Multi-level password access protection to allow user/manager to limit workstation control.
    - .2 Alarm management: processing and messages.
    - .3 Operator commands.
    - .4 Reports.
    - .5 Displays.
    - .6 Point identification.
  
- .5 Pseudo or calculated points.
  - .1 Software to provide access to value or status in controller or other networked controller in order to define and calculate pseudo point. When current pseudo point value is derived, normal alarm checks must be performed or value used to totalize.
  - .2 Inputs and outputs for process: include data from controllers to permit development of network-wide control strategies. Processes also to permit operator to use results of one process as input to number of other processes (e.g. cascading).
  
- .6 Control Description Logic (CDL):
  - .1 Capable of generating on-line project-specific CDLs which are software based, programmed into RAM or EEPROM and backed up to OWS. Owner must have access to these algorithms for modification or to be able to create new ones and to integrate these into CDLs on BC(s) from OWS.
  - .2 Write CDL in high level language that allows algorithms and interlocking programs to be written simply and clearly. Use parameters entered into system (e.g. setpoints) to determine operation of algorithm. Operator to be able to alter operating parameters on-line from OWS and BC(s) to tune control loops.
  - .3 Perform changes to CDL on-line.
  - .4 Control logic to have access to values or status of points available to controller including global or common values, allowing cascading or inter-locking control.
  - .5 Energy optimization routines including enthalpy control, supply temperature reset, to be MCU resident functions and form part of CDL.
  - .6 MCU to be able to perform following pre-tested control algorithms:
    - .1 Two position control.
    - .2 Proportional Integral and Derivative (PID) control.
  - .7 Control software to provide ability to define time between successive starts for each piece of equipment to reduce cycling of motors.
  - .8 Provide protection against excessive electrical-demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
  - .9 Power Fail Restart: upon detection of power failure system to verify availability of Emergency Power as determined by emergency power transfer switches and analyze controlled equipment to determine its appropriate status under Emergency power conditions and start or stop equipment as defined by I/O Summary. Upon resumption of normal power as determined by emergency power transfer switches, MCU to analyze status of controlled equipment, compare with normal occupancy scheduling, turn equipment on or off as

necessary to resume normal operation.

- .7 Event and Alarm management: use management by exception concept for Alarm Reporting. This is system wide requirement. This approach will insure that only principal alarms are reported to OWS. Events which occur as direct result of primary event to be suppressed by system and only events which fail to occur to be reported. Such event sequence to be identified in I/O Summary and sequence of operation. Examples of above are, operational temperature alarms limits which are exceeded when main air handler is stopped, or General Fire condition shuts air handlers down, only Fire alarm status shall be reported. Exception is, when air handler which is supposed to stop or start fails to do so under event condition.
- .8 Energy management programs: include specific summarizing reports, with date stamp indicating sensor details which activated and or terminated feature.
  - .1 MCU to provide for the following energy management routines:
    - .1 Time of day scheduling.
    - .2 Calendar based scheduling.
    - .3 Holiday scheduling.
    - .4 Temporary schedule overrides.
    - .5 Optimal start stop.
    - .6 Night setback control.
    - .7 Enthalpy (economizer) switchover.
    - .8 Peak demand limiting.
    - .9 Temperature compensated load rolling.
    - .10 Fan speed/flow rate control.
    - .11 Cold deck reset.
    - .12 Hot deck reset.
    - .13 Hot water reset.
    - .14 Chilled water reset.
    - .15 Condenser water reset.
    - .16 Chiller sequencing.
    - .17 Night purge.
  - .2 Programs to be executed automatically without need for operator intervention and be flexible enough to allow customization.
  - .3 Apply programs to equipment and systems as specified or requested by the Departmental Representative.
- .9 Function/Event Totalization: features to provide predefined reports which show daily, weekly, and monthly accumulating totals and which include high rate (time stamped) and low rate (time stamped) and accumulation to date for month.
  - .1 MCUs to accumulate and store automatically run-time for binary input and output points.
  - .2 MCU to automatically sample, calculate and store consumption totals on daily, weekly or monthly basis for user-selected analog or binary pulse input-type points.
  - .3 MCU to automatically count events (number of times pump is cycled off and on) daily, weekly or monthly basis.
  - .4 Totalization routine to have sampling resolution of 1 min or less for analog inputs.

- .5 Totalization to provide calculations and storage of accumulations up to 99,999.9 units (eg. kWh, litres, tonnes, etc.).
- .6 Store event totalization records with minimum of 9,999,999 events before reset.
- .7 User to be able to define warning limit and generate user-specified messages when limit reached.

### **2.3 LEVELS OF ADDRESS**

- .1 Upon operator's request, EMCS to present status of any single 'point', 'system' or point group, entire 'area', or entire network on printer or OWS as selected by operator.
  - .1 Display analog values digitally to 1 place of decimals with negative sign as required.
  - .2 Update displayed analog values and status when new values received.
  - .3 Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm.
  - .4 Updates to be change-of-value (COV)-driven or if polled not exceeding 2 second intervals.

### **2.4 POINT NAME SUPPORT**

- .1 Controllers (MCU) to support point naming convention as defined in Section 25 05 01 - EMCS: General Requirements.

## **PART 3 - EXECUTION**

### **3.1 LOCATION**

- .1 Location of Controllers to be approved by Departmental Representative.

### **3.2 INSTALLATION**

- .1 Install Controllers in secure locking enclosures.
- .2 Provide necessary power from local 120V branch circuit panel for equipment.
- .3 Install tamper locks on breakers of circuit breaker panel.
- .4 Use uninterruptible Power Supply (UPS) and emergency power when equipment must operate in emergency and co-ordinating mode.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
- .2 Section 25 05 01 – EMCS: General Requirements.
- .3 Section 25 05 02 - EMCS: Submittals and Review Process.
- .4 Section 25 05 54 - EMCS: Identification.
- .5 Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.
- .6 Section 26 05 00 - Common Work Results for 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 B 148-97(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 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with

Section 25 05 02 - EMCS: Submittals and Review Process.

- .2 Pre-Installation Tests.
  - .1 Submit samples at random from equipment shipped, as requested by 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: -40 to 40 degrees C with 10 - 90% RH (non-condensing) unless otherwise specified.
- .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.
- .6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.
- .8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.
- .9 Range: including temperature, humidity, pressure, as indicated in I/O summary in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

## 2.2 TEMPERATURE TRANSMITTERS

- .1 Requirements:
  - .1 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0degrees C, platinum resistance detector type sensors.
  - .2 Power supply: 24 V DC into load of 575ohms. Power supply effect less than 0.01degrees C per volt change.
  - .3 Output signal: 4 - 20mA into 500ohm 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 25mA.
  - .8 Integral zero and span adjustments.
  - .9 Temperature effects: not to exceed plus or minus 1.0% of full scale/ 50degrees 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.

## 2.3 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 - 20mA into 500ohm 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.

## 2.4 LIQUID FLOW METERS

- .1 Inline ultrasonic flow sensor: inline meter with four transducers/emitters/acoustic mirrors utilizing time technology with glycol and temperature compensation.
- .2 Performance:



- .1 Media: chilled water
  - .2 Velocity range: 0.03 to 3.02 m/s.
  - .3 Volumetric flow: 0.004 to 45.0 L/s
  - .4 Accuracy: within +/- 2% of full scale at 25°C and pure water over flow range.
  - .5 Linearity: Within 1.2% of full scale over flow range.
  - .6 Repeatability: within +/- 0.5% of full scale over flow range.
  - .7 Ambient temperature: -30 to 50°C.
  - .8 Maximum process temperature: 120°C
  - .9 Maximum pressure: 2482 kPa at 38°C
  - .10 Max Pressure drop: 1.75psi at 100mm and 24L/s.
- .3 Construction:
- .1 Sensor housing: Forged brass, nickel-plated
  - .2 Connection: Flange ANSI 125.
  - .3 Inlet/outlet: 100mm.
  - .4 Polyphenylene sulfide (PPS) with Viton seal.
  - .5 Electrical Connection: 900mm, 18GA appliance cable.
- .4 Transmitter:
- .1 Power supply: 24VAC/DC, 0.5W/1VA
  - .2 Output signal: 0-10VDC with 1.25mV resolution
  - .3 Enclosure Material: Polycarbonate with tongue and groove, with neoprene sealed cover.
  - .4 NEMA Type 2 enclosure
  - .5 Linearity less than 2%.
  - .6 Operating Temperature: -20 to 120°C.

## 2.5 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.

## 2.6 CURRENT TRANSDUCERS

- .1 Requirements:
  - .1 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.
  - .2 Frequency insensitive from 10 - 80 hz.
  - .3 Accuracy to 0.5% full scale.
  - .4 Zero and span adjustments. Field adjustable range to suit motor applications.
  - .5 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

## 2.7 CONTROL VALVES

- .1 Under NPS 2 (valves associated with air handling and fan coil units): Globe style valve:
  - .1 Flow characteristic as indicated on control valve: equal percentage.
  - .2 Flow factor (KV) as indicated on control valve schedule. CV in imperial units.
  - .3 Normally closed or normally open, as indicated.
  - .4 Two 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.
  - .9 Disc, replaceable, material to suit application.
  - .10 Screwed National Pipe Thread (NPT) tapered female connections.
  - .11 Valve to ANSI Class 250, valves to bear ANSI mark.
  - .12 Rangeability 50:1 minimum.
- .2 Under NPS 2 (by-pass valve for minimum chiller flow): Ball style valve:
  - .1 Ball valve shall have female NPT type fittings. Refer to drawings for dimensions.
  - .2 The valve shall have a forged brass body, chrome-plated brass ball with brass stem or stainless steel ball and stem; and EPDM O-ring seals.
  - .3 Valve shall contain glass-filled PTFE ball valve seals or integral seals and flow characteristics to provide **a linear** control characteristics.
  - .4 Ball shall utilize a 90 degree rotation for control and shall provide automated flow control of chilled water.
  - .5 Two port, as indicated.
  - .6 Flow factor (KV) as indicated on control valve schedule. CV in imperial units.
  - .7 Normally open.
  - .8 Leakage rate ANSI class IV, 0.01% of fully open valve capacity.
  - .9 Valve to ANSI Class 250, valves to bear ANSI mark.

## 2.8 ELECTRONIC / ELECTRIC VALVE ACTUATORS

- .1 Requirements:
  - .2 Construction: steel, cast iron, aluminum.

- .3 Control signal: 0-10V DC or 4-20 mA DC.
- .4 Positioning time: to suit application. 90 sec maximum.
- .5 Fail to normal or closed position as indicated.
- .6 Scale or dial indication of actual control valve position.
- .7 Size actuator to meet requirements and performance of control valve specifications.
- .8 Provide with dry contact to send signal back to BAS to indicate if valve is 100% open or closed.

## 2.9 PANELS

- .1 Wall mounted enamelled steel cabinets with hinged and key-locked front door.
- .2 Multiple panels as required to handle requirements with additional space to accommodate 25% additional capacity as required by Departmental Representative without adding additional cabinets.
- .3 Panels to be lockable with same key.

## 2.10 REFRIGERANT MONITORING SENSOR

- .1 Refrigerant gas detector transmitter/sensor, meets ASHRAE 15 and CSA B52 requirements.
- .2 Designed with infrared technology to facilitate specific gas type refrigerant detection without any cross-sensitive interferences. The sensing technology shall be non-contact, non-depleting form of concentration measurement that has a sensor life of over ten (10) years.
- .3 Sensor includes a digital display, three (3) user configurable relays, buzzer, horn/strobe output and non-intrusive calibration.
- .4 Sensor housing shall be thermally controlled at elevated temperatures to eliminate errors due to condensate formation and from temperature fluctuations allowing operation in temperatures from -45C to 65C.
- .5 Unit must be compatible with existing M-Controller from QEL through RS-485 digital communication allowing for cost effective wiring installation.
- .6 Gas Type: R-410A; Range: 0-1000ppm.
- .7 Characteristics:
  - .1 Input Power:
    - .1 24 VDC nominal, range 18 to 30 VDC.
    - .2 24 VAC nominal, range 15 to 24 VAC.
  - .2 Enclosure materials:
    - .1 Polycarbonate / ABS blend
    - .2 IP66
    - .3 NEMA 4X

- .3 Temperature: -45 to 65C.
- .4 Humidity:
  - .1 Continuous: 5-95% RH, non-condensing.
  - .2 Intermittent: 0-99% RH, non-condensing.
- .5 Sensor type: Infra-red temperature controlled
- .6 Sensor life: 14 years
- .7 Pressure: atmospheric +/- 10%.
- .8 Response time: less than 30 seconds for 90% of step change.
- .9 Accuracy: +/- 3% of reading
- .10 Repeatability: +/- 1% of full scale.
- .11 Factory set range: 0-1000ppm
- .12 Display: 2x8 character display c/w backlight
- .13 Keypad: 4 magnetic sensors with magnet tool
- .14 Panel indicators: 5 status LEDs
- .15 Output signal: Digital RS-485 to QEL controllers
- .16 Relay: three, single pole double throw (SPDT); 1.0A max at 30VDC (resistive load), 0.3A max at 125VAC (resistive load)
- .17 Buzzer: 80 db at 10cm, 2700 Hz
- .18 Time delays:
  - .1 Actuation: 0 to 60 minutes in 1 minute increments.
  - .2 De-actuation: 0 to 60 minutes in 1 minute increments.

## 2.11 WIRING

- .1 In accordance with Section 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.
  - .2 Analog input and output: shielded #18 minimum solid copper.

## 2.12 FLOW SWITCH

- .1 Vaporproof SPDT, NEMA 4X switch.
- .2 10.5bar (150psi), -29C to 121C, with 25mm NPT connection for upright mounting in horizontal pipe.
- .3 Flow switch must be compatible with chiller's control panel.

## 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, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.
- .4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
- .5 Electrical:
  - .1 Complete installation in accordance with Section 26 05 00 - Common Work Results for Electrical.
  - .2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
  - .3 Refer to electrical control schematics included as part of control design schematics on drawings. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by Departmental Representative before beginning Work.
  - .4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
  - .5 Install communication wiring in conduit.
    - .1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).
    - .2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
    - .3 Maximum conduit fill not to exceed 40%.
    - .4 Design drawings do not show conduit layout.
  - .6 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Departmental Representative to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.

### 3.2 TEMPERATURE 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 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 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.

### **3.5 IDENTIFICATION**

- .1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.

### **3.6 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 REFERENCES**

- .1 Public Works and Government Services Canada (PWGSC) / Real Property Branch / Architectural and Engineering Services.
  - .1 MD13800-September 2000, Energy Management and Control Systems (EMCS) Design Manual. English: <ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanical/me214-e.pdf>

### **1.2 SEQUENCING**

- .1 DCC CONTROLLER:
  - .1 Controller with integral LCD readout for changing set points and monitoring unit operation.
  - .2 Provided with required sensors and programming.
  - .3 Factory programmed, mounted, and tested.
  - .4 Integral USB and Ethernet ports for updating programs and retrieving log files.
- .2 BMS INTERFACE:
  - .1 BACnet MS/TP
- .3 GENERAL OPERATION:
  - .1 Power up
    - .1 When the unit main disconnect is closed a delay of 10 seconds (adjustable) occurs for the controller to come online.
- .4 ERV UNIT START COMMAND:
  - .1 An input signal is required to enable the unit operation. The unit will be commanded on by:
    - .1 Enable via controller display
  - .2 All types of input that are enabled must be true before the unit will start.
    - .1 The exhaust fan starts after a 3 second delay (adjustable). The exhaust fan will not start until the damper actuator end switch closes.
    - .2 The supply fan starts after a 6 second delay (adjustable). The supply fan will not start until the damper actuator end switch closes.
    - .3 The supply fan, exhaust fan are controlled based on the chosen unit operating modes and air conditions.
- .5 ERV UNIT STOP COMMAND:
  - .1 The unit can then be commanded off by:
    - .1 Disable via controller display

- .2 Supply fan and exhaust fan are de-energized.
- .3 All dampers are unpowered and spring return to their default position after a 10 second delay (adjustable).
- .6 SUPPLY FAN OPERATION:
  - .1 The supply fan speed will be controlled for:
    - .1 Fixed percentage of max speed (0%-100%)
  - .2 The unit will attempt to start the supply fan when the supply fan delay timer expires. When the supply fan starts the supply fan adjustable current switch should close and remain closed until the fan is turned off.
- .7 SUPPLY FAN STATUS:
  - .1 After a delay of 90 seconds (adjustable) from supply fan start signal, if the supply fan current switch is still open the supply fan alarm should be set to true. The supply fan status shall be set to true only when the supply fan output is on and supply fan current switch is closed. The supply fan status shall be false in all other circumstances.
- .8 FIXED FAN SPEED OPTION
  - .1 The analog voltage command to the supply fan ECM can be set from the unit controller display or provided by the BMS. The adjustable range of 0% to 100% correspond to the minimum and maximum fan operating speed. This supply fan operation mode can be used to field balance the supply air flow rate.
- .9 EXHAUST FAN OPERATION:
  - .1 The exhaust fan speed will be controlled for:
    - .1 Fixed percentage of max speed (0%-100%)
  - .2 The unit will attempt to start the exhaust fan when the exhaust fan delay timer expires. When the exhaust fan starts the exhaust fan adjustable current switch should close and remain closed until the fan is turned off.
- .10 EXHAUST FAN STATUS
  - .1 After a delay of 90 seconds (adjustable) from exhaust fan start signal, if exhaust fan current switch is still open the exhaust fan alarm should be set to true. The exhaust fan status shall be set to true only when the exhaust fan output is on and exhaust fan current switch is closed. The exhaust fan status shall be false in all other circumstances.
- .11 FIXED FAN SPEED OPTION:
  - .1 The analog voltage command to the exhaust fan ECM can be set from the unit controller display or provided by the BMS. The adjustable range of 0% to 100% correspond to the minimum and maximum fan operating speed (0 VDC minimum to 10 VDC maximum, adjustable). This exhaust fan operation mode can be used to field balance the exhaust air flow rate.



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**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 White letters on a red background for fire alarm device.
- .3 Light fixtures are the only exceptions for electrical equipment identification (except as noted in 8.14 below). They are not to be identified.
- .4 Identify with lamicoid nameplates all electrical equipment shown on the drawings and/or mentioned in the specification such as motor control centers, switchgear, splitters, fused switches, isolation switches, motor starting switches, starters, panelboards, transformers, high voltage cables, industrial type receptacles, junction boxes, control panels, etc.,

regardless of whether or not the electrical equipment was furnished under this section of the specification.

- .5 Coordinate names of equipment and systems with other Divisions to ensure that names and numbers match.
- .6 Wording on lamicoïd nameplates to be approved by the NRC Departmental Representative prior to fabrication.
- .7 Provide two sets of lamicoïd nameplates for each piece of equipment; one in English and one in French.
- .8 Lamicoïd 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 Lamicoïd nameplates shall be rigid lamicoïd, 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 lamicoïd nameplates, mount nameplates using two-sided tape.
- .12 For all exterior lamicoïd 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 lamicoïd nameplates to be 3.7 mm (3/16") diameter to allow for expansion of lamicoïd 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 lamicoïd 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.

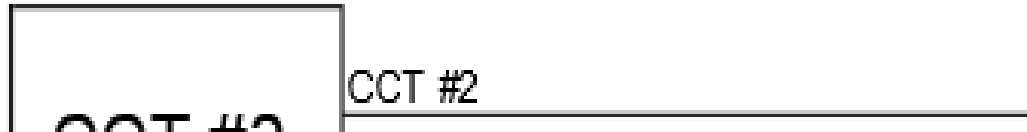
## **9 WIRING IDENTIFICATION**

- .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.
- .5 Identify all electrical circuits in every junction box and pull box on the box cover with 9mm letter size P-touch label. Identify all electrical circuits on each conduit end where conduit penetrates a wall ,enclosure ,junction box or pull box , and halfway of each conduit run between walls ,enclosures ,junction boxes or pull boxes with 3mm letter size P-touch label..

- .6 Identify electrical circuit on each cable 250MCM or larger with lamacoid nameplate, or cable 4/0 or smaller with P-touch label, on every splitter, every 30m of each cable run and cable end where cable penetrates a wall, enclosure, junction box or pull box.
- .7 Sample diagram shown as below:



## **11 MANUFACTURER'S & APPROVALS LABELS**

- .1 Ensure that manufacturer's registration plates are properly affixed to all apparatus showing the size, name of equipment, serial number, and all information usually provided, including voltage, cycle, phase and the name and address of the manufacturer.
- .2 Do not paint over registration plates or approval labels. Leave openings through insulation for viewing the plates. Contractor's or sub-contractor's nameplate not acceptable.

## **12 WARNING SIGNS AND PROTECTION**

- .1 Provide warning signs, as specified or to meet requirements of Authorized Electrical Inspection Department and NRC Departmental Representative.
- .2 Accept the responsibility to protect those working on the project from any physical danger due to exposed live equipment such as panel mains, outlet wiring, etc. Shield and mark all live parts with the appropriate voltage. Caution notices shall be worded in both English and French.

## **13 LOAD BALANCE**

- .1 Measure phase current to new panelboards with normal loads operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes, and revise panelboard schedules.
- .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

## **14 MOTOR ROTATION**

- .1 For new motors, ensure that motor rotation matches the requirements of the driven equipment.
- .2 For existing motors, check rotation before making wiring changes in order to ensure correct rotation upon completion of the job.

**15                    GROUNDING**

- .1 Thoroughly ground all electrical equipment, cabinets, metal supporting frames, ventilating ducts and other apparatus where grounding is required in accordance with the requirements of the latest edition of the Canadian Electrical Code Part 1, C.S.A. C22.1 and corresponding Provincial and Municipal regulations. Do not depend upon conduits to provide the ground circuits.
- .2 Run separate green insulated stranded copper grounding conductors in all electrical conduits including those feeding toggle switches and receptacles.

**16                    TESTS**

- .1 Provide any materials, equipment and labour required and make such tests deemed necessary to show proper execution of this work, in the presence of the NRC Departmental Representative.
- .2 Correct any defects or deficiencies discovered in the work in an approved manner at no additional expense to the Owner.
- .3 Megger all branch circuits and feeders using a 600V tester for 240V circuits and a 1000V tester for 600V circuits. If the resistance to ground is less than permitted by Table 24 of the Code, consider such circuits defective and do not energize.
- .4 The final approval of insulation between conductors and ground, and the efficiency of the grounding system is left to the discretion of the local Electrical Inspection Department.

**17                    COORDINATION OF PROTECTIVE DEVICES**

- .1 Ensure circuit protective devices such as overcurrent trips, fuses, are installed to values and settings as indicated on the Drawings.

**18                    WORK ON LIVE EQUIPMENT & PANELS**

- .1 NRC requires that work be performed on non-energized equipment, installation, conductors and power panels. For purposes of quotation assume that all work is to be done after normal working hours and that equipment, installation, conductors and power panels are to be de-energized when worked upon.
- .2 Coordinate all shutdowns with the NRC departmental representative. High voltage (more than 1KV) grounding must be provided by certified electrician.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED WORK SPECIFIED ELSEWHERE**

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

**1.2                MATERIALS**

- .1            Provide only new equipment and materials, without blemish or defect, bearing Canadian Standards Association or Authorized Electrical Inspection Department labels, and subject to the approval of the NRC Departmental Representative.
- .2            After a contract is awarded, utilize alternative methods and/or materials only after receiving the NRC Departmental Representative's approval.

**Part 2            Products**

**2.1                BUILDING WIRES AND GENERAL REQUIREMENTS**

- .1            Conductor material for branch circuit wiring and grounding:
  - .1            Stranded copper.
  - .2            Neutral wire: continuous throughout its length without breaks.
  - .3            Separate insulated green grounding conductors in all electrical conduits.
  - .4            All wire and cable insulation shall meet the C.S.A. Standards for the types and services hereinafter specified. Colours as per section 4-036 of Electrical Code.
  - .5            Unless otherwise specified, use wire and cable types as follows:
    - .1            Type R90 XLPE cross-link polyethylene stranded for applications using wires sized No. 8 and larger.
    - .2            Type T90 stranded for applications using wires sized No. 10 and smaller.
    - .3            For fire alarm wiring refer to Section 283100.
    - .4            Approved heat resistant wire for wiring through and at lighting and heating fixtures. Where insulation types are shown on the drawings other types shall not be used unless the specification is more restrictive.
  - .6            Use AC90 (BX) cable **only** under the following conditions:
    - .1            Wiring from a junction box to a recessed lighting fixture in suspended ceilings. Cable length not to exceed 1.5 m (5'), or
    - .2            Wiring switches or receptacles in existing or new hollow gypsum partitions, vertical runs only with cable length not to exceed 3.5m (12'), or
    - .3            When specifically called for on drawings or approved in writing by departmental representative.
    - .4            AC90 shall not be used in isolated walls or masonry walls.
    - .5            Only AC90 cable of No. 12 AWG will be accepted.
  - .7            Use stranded wire no smaller than No. 12 AWG for lighting and power and no smaller than No. 16 AWG for control wiring.



- .8 Conductors shall be soft copper properly refined and tinned having a minimum conductivity of 98%.

**Part 3 Execution**

**3.1 BUILDING WIRES**

- .1 Install building wires as follows:
  - .1 Make joints, taps and splices in approved boxes with solderless connectors. Joints and/or splices are not acceptable inside a panelboard.
  - .2 Ensure the lugs accommodate all the strands of the conductor.
  - .3 Replace any wire or cable showing evidence of mechanical injury.
  - .4 Use No. 10 AWG for branch circuit wiring extending more than 30 m (100 ft.) to farthest outlet from panel.
  - .5 Circuit numbers indicated on the drawing are intended as a guide for the proper connection of multi-wire circuits at the panel.
  - .6 Take care to keep the conductors free from twisting.
  - .7 Use an approved lubricant for pulling in conduit.
  - .8 Leave sufficient slack on all runs to permit proper splicing and connection of electrical devices.
  - .9 Branch circuit wiring of 120 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       Copper compression connectors to CSA C22.2 N0.65 are required sized for conductors
- .2       When used in hazardous area, connectors should be certified for such location in Class, Division and Group.
- .3       For conductors size of 8 AWG or larger, use bolted or compression solderless type connectors.
- .4       Use high temperature connectors and insulation on all connections of high temperature conductors.
- .5       Where connector types are called for on the drawings or in the specification, do not use other types.
- .6       Lugs, terminals, screws used for termination of wiring to be suitable for copper conductors.
- .7       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                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



- .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**



**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 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 Notwithstanding 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 than 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.



<b>Section</b>	<b>Page</b>	<b>Heading</b>
GC1	1	Interpretation
GC2	2	Successors and Assigns
GC3	2	Assignment of Contract
GC4	2	Subcontracting by Contractor
GC5	2	Amendments
GC6	3	No Implied Obligations
GC7	3	Time of Essence
GC8	3	Indemnification by Contractor
GC9	3	Indemnification by Her Majesty
GC10	3	Members of House of Commons Not to Benefit
GC11	4	Notices
GC12	4	Material, Plant and Real Property Supplied by Her Majesty
GC13	5	Material, Plant and Real Property Become Property of Her Majesty
GC14	5	Permits and Taxes Payable
GC15	6	Performance of Work under Direction of Departmental Representative
GC16	6	Cooperation with Other Contractors
GC17	7	Examination of Work
GC18	7	Clearing of Site
GC19	7	Contractor's Superintendent
GC20	8	National Security
GC21	8	Unsuitable Workers
GC22	8	Increased or Decreased Costs
GC23	9	Canadian Labour and Material
GC24	9	Protection of Work and Documents
GC25	10	Public Ceremonies and Signs
GC26	10	Precautions against Damage, Infringement of Rights, Fire, and Other Hazards
GC27	11	Insurance
GC28	11	Insurance Proceeds
GC29	12	Contract Security
GC30	12	Changes in the Work
GC31	13	Interpretation of Contract by Departmental Representative
GC32	14	Warranty and Rectification of Defects in Work
GC33	14	Non-Compliance by Contractor
GC34	14	Protesting Departmental Representative's Decisions
GC35	15	Changes in Soil Conditions and Neglect or Delay by Her Majesty
GC36	16	Extension of Time
GC37	16	Assessments and Damages for Late Completion
GC38	17	Taking the Work Out of the Contractor's Hands
GC39	18	Effect of Taking the Work Out of the Contractor's Hands
GC40	18	Suspension of Work by Minister
GC41	19	Termination of Contract
GC42	19	Claims Against and Obligations of the Contractor or Subcontractor
GC43	21	Security Deposit – Forfeiture or Return
GC44	22	Departmental Representative's Certificates
GC45	23	Return of Security Deposit
GC46	24	Clarification of Terms in GC47 to GC50
GC47	24	Additions or Amendments to Unit Price Table
GC48	24	Determination of Cost – Unit Price Table
GC49	25	Determination of Cost – Negotiation
GC50	25	Determination of Cost – Failing Negotiation
GC51	26	Records to be kept by Contractor
GC52	27	Conflict of Interest
GC53	27	Contractor Status



## **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 of 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 “superintendent” 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 this 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 to 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 provided 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 GC30.3 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, at 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 writing 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 than

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 in 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 Contractor.

### **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 INSURANCE 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
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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 CS2.1.2 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 at 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.





Contract Number / Numéro du contrat
Security Classification / Classification de sécurité

**SECURITY REQUIREMENTS CHECK LIST (SRCL)  
LISTE DE VÉRIFICATION DES EXIGENCES RELATIVES À LA SÉCURITÉ (LVERS)**

**PART A - CONTRACT INFORMATION / PARTIE A - INFORMATION CONTRACTUELLE**

1. Originating Government Department or Organization / Ministère ou organisme gouvernemental d'origine	2. Branch or Directorate / Direction générale ou Direction
3. a) Subcontract Number / Numéro du contrat de sous-traitance	3. b) Name and Address of Subcontractor / Nom et adresse du sous-traitant

4. Brief Description of Work / Brève description du travail

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?  No / Non  Yes / Oui  
(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)

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 <input type="checkbox"/>	NATO / OTAN <input type="checkbox"/>	Foreign / Étranger <input type="checkbox"/>
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7. b) Release restrictions / Restrictions relatives à la diffusion

No release restrictions / Aucune restriction relative à la diffusion <input type="checkbox"/>	All NATO countries / Tous les pays de l'OTAN <input type="checkbox"/>	No release restrictions / Aucune restriction relative à la diffusion <input type="checkbox"/>
Not releasable / À ne pas diffuser <input type="checkbox"/>		
Restricted to: / Limité à: <input type="checkbox"/>	Restricted to: / Limité à: <input type="checkbox"/>	Restricted to: / Limité à: <input type="checkbox"/>
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 <input type="checkbox"/>	NATO UNCLASSIFIED / NATO NON CLASSIFIÉ <input type="checkbox"/>	PROTECTED A / PROTÉGÉ A <input type="checkbox"/>
PROTECTED B / PROTÉGÉ B <input type="checkbox"/>	NATO RESTRICTED / NATO DIFFUSION RESTREINTE <input type="checkbox"/>	PROTECTED B / PROTÉGÉ B <input type="checkbox"/>
PROTECTED C / PROTÉGÉ C <input type="checkbox"/>	NATO CONFIDENTIAL / NATO CONFIDENTIEL <input type="checkbox"/>	PROTECTED C / PROTÉGÉ C <input type="checkbox"/>
CONFIDENTIAL / CONFIDENTIEL <input type="checkbox"/>	NATO SECRET / NATO SECRET <input type="checkbox"/>	CONFIDENTIAL / CONFIDENTIEL <input type="checkbox"/>
SECRET / SECRET <input type="checkbox"/>	COSMIC TOP SECRET / COSMIC TRÈS SECRET <input type="checkbox"/>	SECRET / SECRET <input type="checkbox"/>
TOP SECRET / TRÈS SECRET <input type="checkbox"/>		TOP SECRET / TRÈS SECRET <input type="checkbox"/>
TOP SECRET (SIGINT) / TRÈS SECRET (SIGINT) <input type="checkbox"/>		TOP SECRET (SIGINT) / TRÈS SECRET (SIGINT) <input type="checkbox"/>

Security Classification / Classification de sécurité
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**PART A (continued) / PARTIE A (suite)**

8. Will the supplier require access to PROTECTED and/or CLASSIFIED COMSEC information or assets?  No  Yes  
 Le fournisseur aura-t-il accès à des renseignements ou à des biens COMSEC désignés PROTÉGÉS et/ou CLASSIFIÉS?  Non  Oui  
 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  Yes  
 Le fournisseur aura-t-il accès à des renseignements ou à des biens INFOSEC de nature extrêmement délicate?  Non  Oui  
 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

<input type="checkbox"/> RELIABILITY STATUS COTE DE FIABILITÉ	<input type="checkbox"/> CONFIDENTIAL CONFIDENTIEL	<input type="checkbox"/> SECRET SECRET	<input type="checkbox"/> TOP SECRET TRÈS SECRET
<input type="checkbox"/> TOP SECRET- SIGINT TRÈS SECRET - SIGINT	<input type="checkbox"/> NATO CONFIDENTIAL NATO CONFIDENTIEL	<input type="checkbox"/> NATO SECRET NATO SECRET	<input type="checkbox"/> COSMIC TOP SECRET COSMIC TRÈS SECRET
<input type="checkbox"/> SITE ACCESS ACCÈS AUX EMBLEMES			

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  Yes  
 Du personnel sans autorisation sécuritaire peut-il se voir confier des parties du travail?  Non  Oui  
 If Yes, will unscreened personnel be escorted?  
 Dans l'affirmative, le personnel en question sera-t-il escorté?  No  Yes  
 Non  Oui

**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  Yes  
 Le fournisseur sera-t-il tenu de recevoir et d'entreposer sur place des renseignements ou des biens PROTÉGÉS et/ou CLASSIFIÉS?  Non  Oui

11. b) Will the supplier be required to safeguard COMSEC information or assets?  No  Yes  
 Le fournisseur sera-t-il tenu de protéger des renseignements ou des biens COMSEC?  Non  Oui

**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  Yes  
 Les installations du fournisseur serviront-elles à la production (fabrication et/ou réparation et/ou modification) de matériel PROTÉGÉ et/ou CLASSIFIÉ?  Non  Oui

**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  Yes  
 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?  Non  Oui

11. e) Will there be an electronic link between the supplier's IT systems and the government department or agency?  No  Yes  
 Disposera-t-on d'un lien électronique entre le système informatique du fournisseur et celui du ministère ou de l'agence gouvernementale?  Non  Oui



**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			CONFIDENTIAL / CONFIDENTIEL	SECRET	TOP SECRET / TRÈS SECRET
											A	B	C			
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?  No  Yes  
 La description du travail visé par la présente LVERS est-elle de nature PROTÉGÉE et/ou CLASSIFIÉE?  Non  Oui

**If Yes, classify this form by annotating the top and bottom in the area entitled "Security Classification".**  
**Dans l'affirmative, classifiez 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?  No  Yes  
 La documentation associée à la présente LVERS sera-t-elle PROTÉGÉE et/ou CLASSIFIÉE?  Non  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, classifiez le présent formulaire en indiquant le niveau de sécurité dans la case intitulée « Classification de sécurité » au haut et au bas du formulaire et indiquez qu'il y a des pièces jointes (p. ex. SECRET avec des pièces jointes).**



Contract Number / Numéro du contrat
Security Classification / Classification de sécurité

**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
Telephone No. - N° de téléphone	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel	Date
14. Organization Security Authority / Responsable de la sécurité de l'organisme			
Name (print) - Nom (en lettres moulées)		Title - Titre	Signature
Telephone No. - N° de téléphone	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel	Date
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?			<input type="checkbox"/> No / Non <input type="checkbox"/> Yes / Oui
16. Procurement Officer / Agent d'approvisionnement			
Name (print) - Nom (en lettres moulées) Collin Long		Title - Titre Senior Contracting Officer	Signature
Telephone No. - N° de téléphone	Facsimile No. - N° de télécopieur	E-mail address - Adresse courriel Collin.Long@nrc-cnrc.gc.ca	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

Security Classification / Classification de sécurité
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