NRC·CNRC Administrative Services and Property Management

SPECIFICATIONS

SOLICITATION #: 16-22094

BUILDING: M-50
1200 Montreal Road
Ottawa, Ontario

PROJECT: M50- Fume Exhaust System Retrofit

PROJECT #: 5029

Date: October 2016

National Research Council Canada | Conseil national de recherches Canada

Canada

SPECIFICATION

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NRC·CNRC

From **Discovery** to **Innovation...**

Directions to the Ottawa Research Facilities — Montreal Road

1200 Montréal Road
Ottawa, Ontario, Canada K1A 0R6

Tel: 613-993-9101

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By Road, from the OTTAWA International Airport

1. From the airport take the AIRPORT PARKWAY to RIVERSIDE DR EAST
2. Follow RIVERSIDE DR EAST to HIGHWAY 417 EAST
3. Take HIGHWAY 417 EAST, past the ST-LAURENT BLVD exit, where HIGHWAY 417 splits, continue LEFT on HIGHWAY 174 (ROCKLAND)
4. Exit HIGHWAY 174 on BLAIR RD NORTH
5. Proceed on BLAIR RD NORTH, cross OGILVIE RD, and continue on to the traffic lights at the intersection of BLAIR and MONTREAL RD
6. Turn left onto MONTREAL RD and take the first immediate right onto the ramp leading down to the traffic circle. Stop at Building M-1 on the north side of the traffic circle. Ask the commissionaires in M-1 for directions to the NRC building, institute or staff member you seek.

By Road, from MONTRÉAL

1. Take MÉTROPOLITAIN 40 WEST and follow signs for OTTAWA and HIGHWAY 417 WEST
2. Follow 417 WEST to reach OTTAWA
3. Exit at HIGHWAY 174 EAST (ROCKLAND) when entering OTTAWA
4. Follow 174 EAST and exit at BLAIR RD NORTH (first exit after entering 174 EAST)
5. Follow BLAIR RD NORTH, cross OGILVIE RD, and continue on to the traffic lights at the intersection of BLAIR and MONTREAL RD
6. Turn left onto MONTREAL RD and take the first immediate right onto the ramp leading down to the traffic circle. Stop at Building M-1 on the north side of the traffic circle. Ask the commissionaires in M-1 for directions to the NRC building, institute or staff member you seek.


1 Sussex Facilities
2 Montreal Road Facilities
3 Uplands Facilities
4 NRC-CSTT
N
GATINEAU
OTTAWA
QUÉBEC
ONTARIO
Outaouais
Aylmer
Taché
Rockcliffe
Montréal
Vanier
Aviation
Blair
Sussex
Wellington
Bank
Bronson
Island Park
Ottawa River
Carling
Fisher
Prince of Wales
Walkley
Heron
Hawthorne
Hunt Club
Baseline
Riverside
Conroy
Airport
Uplands
Lester
Davidson
Albion
Hunt Club (W)
Merivale
Woodroffe
Greenbank
Fallowfield
Leitrim
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NRC Institute
Trans Canada HWY
Major HWY
Secondary HWY
Airport
Train Station
Ferry
Bus Station
Metro


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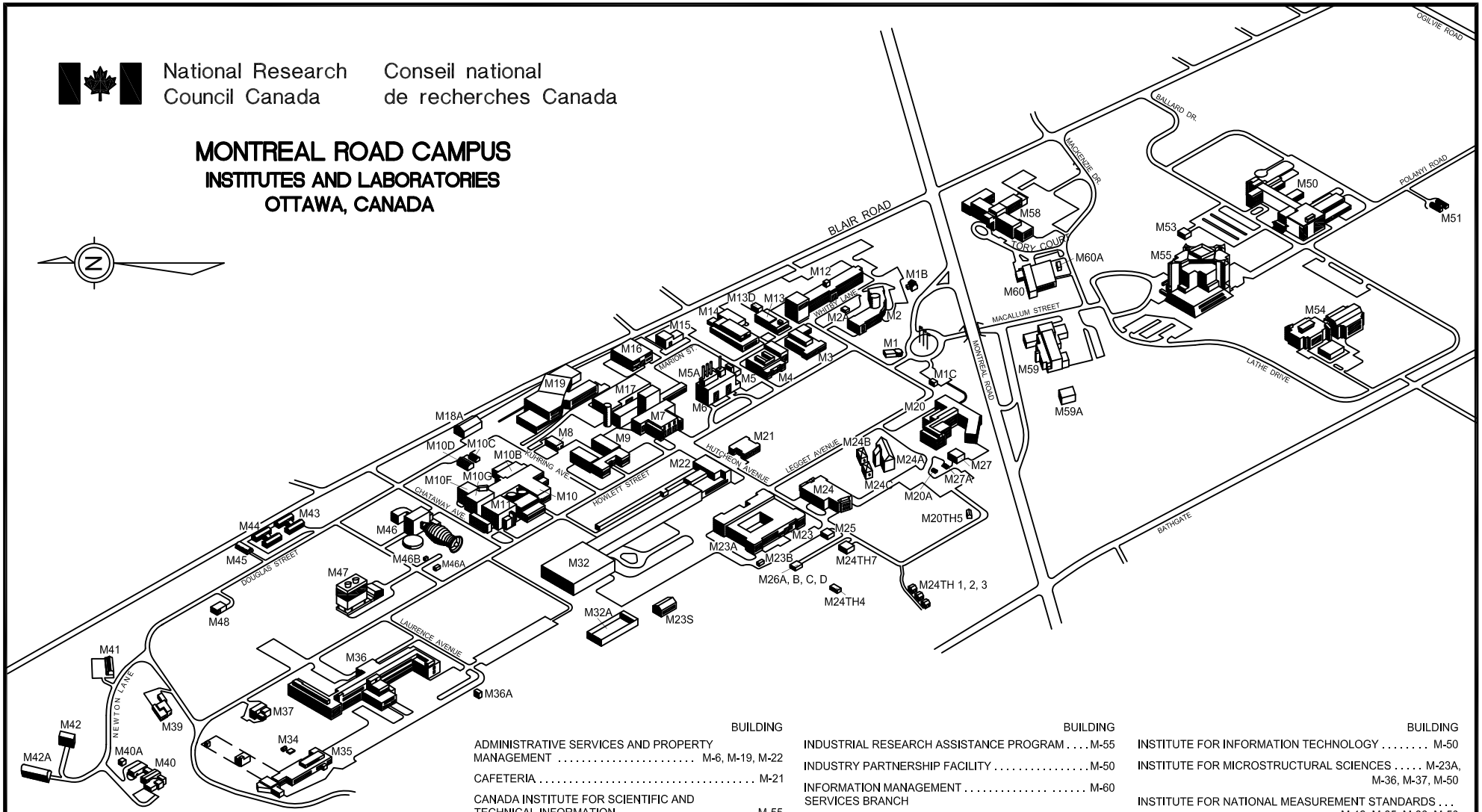
Airport
Ferry
Metro
Trans Canada HWY
Secondary HWY
Train Station
Bus Station

National Research Council Canada | Conseil national de recherches Canada

MONTREAL ROAD CAMPUS
INSTITUTES AND LABORATORIES
OTTAWA, CANADA



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Updated: July 2008

National Research Council Canada	Conseil national de recherches Canada
Administrative Services & Property management Branch (ASPM)	Direction des services administratif et gestion de l'immobilier (SAGI)

Construction Tender Form

Project Identification **M50- Fume Exhaust System Retrofit**

Tender No.: **16-22094**

1.2 **Business Name and Address of Tenderer**

Name_____

Address_____

_____

Contact Person(Print Name)_____

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

1.3 Offer

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

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

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

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

1.3.1 Offer (continued)

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

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

1.4 Acceptance and Entry into Contract

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

1.5 Construction Time

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

1.6 Bid Security

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

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

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

1.7 Contract Security

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

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

1.8 Appendices

This Tender Form includes Appendix No. _____N/A_____.

1.9 Addenda

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

NUMBER	DATE	NUMBER	DATE

(Tenderers shall enter numbers and dates of addenda)

1.10 Execution of Tender

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

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

_____

(Type or print the business name of the Tenderer)

AUTHORIZED SIGNATORY (IES)

_____

(Signature of Signatory)

_____

(Print name & Title of Signatory)

_____

(Signature of Signatory)

_____

(Print name & Title of Signatory)

SEAL

BUY AND SELL NOTICE

M50- Fume Exhaust System Retrofit

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

Replace a make-up air and fume exhaust system with a new system. Provide a natural gas boiler, a hot and chilled water make-up air unit, a glycol heat recovery system, fume exhaust fans, and associated piping and ductwork.

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 November 8th and November 10th, 2016 at **9:00** . Meet Allan Smith 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 November 24th , 2016 at 14:00.

4. TENDER RESULTS

Following the Tender closing, the tender results will be sent by facsimile 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: http://ssi-iss.tpsgc-pwgsc.gc.ca/ssi-iss-services/eso-oss-eng.html

5.2 VERIFICATION OF SECURITY CLEARANCE AT BID CLOSING

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

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

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

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

6.0 WSIB (WORKPLACE SAFETY AND INSURANCE BOARD)

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

7.0 OFFICE OF THE PROCUREMENT OMBUDSMAN

1 Dispute Resolution Services
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, on request or consent of the parties to participate in an alternative dispute resolution process to resolve any dispute between the parties respecting the interpretation or application of a term and condition of this contract and their consent to bear the cost of such process, provide to the parties a proposal for an alternative dispute resolution process to resolve their dispute. The Office of the Procurement Ombudsman may be contacted by telephone at 1-866-734-5169 or by e-mail at boa.opo@boa-opo.gc.ca.

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 supplier or the contractor or the name of the entity awarded this contract*] respecting administration of this 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, and the interpretation and application of the terms and conditions and the scope of the work of this contract are not in dispute. The Office of the Procurement Ombudsman may be contacted by telephone at 1-866-734-5169 or by e-mail at boa.opo@boa-opo.gc.ca.

3 The Office of the Procurement Ombudsman (OPO) was established by the Government of Canada to provide an independent avenue for suppliers to raise complaints regarding the award of contracts under $25,000 for goods and under $100,000 for services. You have the option of raising issues or concerns regarding the solicitation, or the award resulting from it, with the OPO by contacting them by telephone at 1-866-734-5169 or by e-mail at boa.opo@boa-opo.gc.ca. You can also obtain more information on the OPO services available to you at their website at www.opo-boa.gc.ca.

The Departmental Representative or his designate for this project is: **Allan Smith,**
Telephone: **613 993-4926.**

Contracting Authority for this project is: **Alain Leroux alain.leroux@nrc-cnrc.gc.ca**
Telephone**: 613 991-9980.**

INSTRUCTIONS TO BIDDERS

Article 1 – Receipt of Tender

1a) Tenders must be received not later than the specified tender 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 letter or printed telecommunication provided that such amendments are received not later than the specified tender closing time.

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

All such amendments are to be addressed to:
National Research Council of Canada
Alain Leroux, Senior Contracting Officer
Building M-22
Montreal Road, Ottawa, Ontario
K1A 0R6

Fax: (613) 991-3297

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 coloured seal must be affixed beside each signature.

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

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

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

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

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 in sealed envelopes to:
National Research Council Canada
Administrative Services and Property Management Branch
1200 Montreal Road
Building M-22
Ottawa, ON
K1A 0R6

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) a certified cheque payable to the Receiver General for Canada and drawn on a member of the Canadian Payments Association or a local cooperative credit society that is a member of a central cooperative credit society having membership in the Canadian Payments Association; **OR**

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

iii) 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.

2a) 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 Security must be in the ORIGINAL form. Fax or photocopies and NOT acceptable. FAILURE TO PROVIDE THE REQUIRED BID SECURITY SHALL INVALIDATE THE TENDER.

2b) If the tender is not accepted, the Bid Security submitted pursuant to Article 8 shall be returned to the tenderer.

3a) The successful tenderer is required to provide security within 14 days of receiving notice of tender acceptance. The tenderer must furnish EITHER:

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

ii) a Performance Bond and a Labour and Material Payment Bond – each in the amount of 50% of the amount payable under the contract.

3b) Should it not be possible to obtain a Labour Material Payment Bond as required under 3(a) above, on making application thereof to at least two acceptable Bonding Companies, an additional Security Deposit of a straight 10% of the amount payable under the contract must be furnished.

3c) Where a tender has been accompanied by a Security Deposit, as described in 1(b) above, the amount of the Security Deposit required under 3(a) above may be reduced by the amount of the Security Deposit which accompanied the tender.

3d) 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-22, Montreal Road, Ottawa, Ontario, K1A 0R6.

Article 6 – Interest On Security Deposits

1) Tenderers are notified that they must make their own arrangements with their bankers as to the interest, if any, on the amount of the certified cheque accompanying their tender. The Council will not pay interest on said cheque pending the awarding of the contract nor be responsible for the payments of interest under any arrangement made by the tenderers.

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.

2) 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-22, 1200 Montreal Road, Ottawa, Ontario, K1A 0R6, Canada, unsigned copies of the insurance requirements as covered by the Insurance Conditions of the General Specification.

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

Article 12 – Harmonized Sales Tax

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

Non-resident contractors

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

Publication Archived

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

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

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

Non-Resident Contractor Defined

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

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

Registration and Guarantee Deposit

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

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

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

Letter of Compliance

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

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

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

Calculation of RST

Fair Value

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

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

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

Machinery and Equipment - Leased

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

Machinery and Equipment - Owned by Contractor

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

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

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

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

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

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

   net book value at date of import × tax rate

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

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

(See Completion of Contract section)

Manufacturing for Own Use

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

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

(See RST Guide 401 - Manufacturing Contractors)

Contracts with the Federal Government

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

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

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

Exemptions

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

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

Status Indians, Indian Bands and Band Councils

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

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

Completion of Contract

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

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

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

All returns are subject to audit.

Legislative References

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

For More Information

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

Acceptable Bonding Companies

Published September 2010

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

1. Canadian Companies

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

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

2. Provincial Companies

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

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

3. Foreign Companies

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

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

A1 Contract Documents

A2 Date of Completion of Work and Description of Work

A3 Contract Amount

A4 Contractor's Address

A5 Unit Price Table

Articles of Agreement

These Articles of Agreement made in duplicate this day of .

Between

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

and

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

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

A1 Contract Documents

(23/01/2002)

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

1.1.1 these Articles of Agreement,

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

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

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

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

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

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

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

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

1.1.10

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

1.2 **In the contract**

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

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

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

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

A2 Date of Completion of Work and Description of Work

(23/01/2002)

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

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

A3 Contract Amount

(23/01/2002)

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

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

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

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

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

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

A4 Contractor’s Address

(23/01/2002)

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

A5 Unit Price Table

(23/01/2002)

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

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

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

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

Articles of Agreement

Signed on behalf of Her Majesty by

_____

as Senior Contracting Officer

and_____

as_____

of the **National Research Council Canada**

on the_____

day of _____

Signed, sealed and delivered by

_____

as_____and
Position

by_____

as_____
Position

Seal

of

on the_____

day of_____

SPECIFICATIONS TABLE OF CONTENTS

END OF TABLE

DRAWING INDEX

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

ARCHITECTURAL

A01 – ARCHITECTURAL DETAILS

MECHANICAL

M01 – DEMOLITION PLAN
M02 – NEW LAYOUT PLAN
M03 – SECTIONS AND DETAILS
M04 – PART FLOOR PLANS AND SECTIONS THROUGH BUILDING
M05 – PART FLOOR PLANS AND SECTIONS THROUGH BUILDING
M06 – SYSTEM SCHEMATIC AND CONTROL POINTS LIST
M01 – EQUIPMENT SCHEDULES AND MISCELLANIOUS DETAILS

ELECTRICAL

E01 – ELECTRICAL LAYOUT – NEW WORK
E02 – ELECTRICAL LAYOUT – DEMOLITION

END OF DRAWING INDEX

1. SCOPE OF WORK

.1 Work under this contract covers the Fume Exhaust System Retrofit in the Council's Building M50 of the National Research Council.

2. DRAWINGS

.1 Refer to the index for a list of the drawings that illustrate the work and form part of the contract documents.

3. COMPLETION

.1 Complete all work by March 31, 2017.

4. GENERAL

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

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

5. SPECIFIED ACCEPTABLE & ALTERNATIVE EQUIPMENT & MATERIALS

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

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

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

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

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

6. MINIMUM STANDARDS

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

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

7. WORKPLACE HAZARDOUS MATERIAL INFORMATION SYSTEM (WHMIS)

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

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

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

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

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

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

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

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 Does not apply to this project.

9. COST BREAKDOWN

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

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

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

10. SUB-TRADES

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

11. PERSONNEL SECURITY AND IDENTIFICATION

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

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

12. WORKING HOURS AND SECURITY

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

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

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

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

13. SCHEDULE

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

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

.[___10___] day(s) before the scheduled completion date, arrange to do an interim inspection with the Departmental Representative.

14. PROJECT MEETINGS

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

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

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

15. SHOP DRAWINGS

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

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

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

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

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

16. SAMPLES AND MOCK-UPS

.1 Submit samples in sizes and quantities as specified.

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

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

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

17. MATERIALS AND WORKMANSHIP

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

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

18. WORK & MATERIALS SUPPLIED BY OWNER

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

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

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

.4 General Contractor's duties:

.1 Unload at site.

.2 Promptly inspect products and report damaged or defective items.

.3 Give written notification to the Departmental Representative for items accepted in good order.

.4 Handle at site, including uncrating and storage.

.5 Repair or replace items damaged on site.

.6 Install, connect finished products as specified.

19. SITE ACCESS

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

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

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

.4 Provide and maintain access to site.

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

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

20. USE OF SITE

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

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

.3 Restrict parking to the designated areas.

21. ACCEPTANCE OF SITE

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

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

22. SITE OFFICE & TELEPHONE

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

.2 Install and maintain a telephone, if necessary.

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

23. SANITARY FACILITIES

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

24. TEMPORARY SERVICES

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

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

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

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

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

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

25. DOCUMENTS REQUIRED AT WORK SITE

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

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

26. CO-OPERATION

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

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

.3 Have schedule approved by the Departmental Representative.

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

27. PROTECTION AND WARNING NOTICES

.1 Provide all materials required to protect existing equipment.

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

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

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

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

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

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

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

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

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

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

28. BILINGUALISM

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

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

29. LAYOUT OF WORK

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

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

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

30. DISCREPANCIES & INTERFERENCES

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

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

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

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

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

31. MANUFACTURER'S INSTRUCTIONS

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

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

32. TEMPORARY HEATING AND VENTILATING

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

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

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

.1 Facilitate progress of work.

.2 Protect work and products against dampness and cold.

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

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

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

.4 Maintain minimum temperature of 10 ^{o}C (50 ^{o}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.

33. CONNECTIONS TO AND INTERRUPTIONS TO EXISTING SERVICES

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

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

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

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

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

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

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

34. CUTTING AND PATCHING

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

.2 Remove all items as shown or specified.

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

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

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

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

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

35. FASTENING DEVICES

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

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

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

36. OVERLOADING

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

37. DRAINAGE

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

38. ENCLOSURE OF STRUCTURES

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

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

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

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

.5 Provide keys to NRC security personnel when required.

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

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

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

39. STORAGE

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

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

40. GENERAL REVIEW

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

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

41. INSPECTION OF BURIED OR CONCEALED SERVICES

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

42. TESTING

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

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

43. PARTIAL OCCUPANCY

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

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

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

44. DISPOSAL OF WASTES

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

45. CLEAN-UP DURING CONSTRUCTION

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

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

46. FINAL CLEAN-UP

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

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

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

47. WARRANTY AND RECTIFICATION OF DEFECTS IN WORK

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

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

48. MAINTENANCE MANUALS

.1 Provide three (3) bilingual copies of maintenance manuals or two English and two French maintenance manuals 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:

.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 subcontractors 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 subcontractors 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;

.2 Telephone the following emergency phone number as appropriate:

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

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

.5 Interior and Exterior Fire protection & Alarm Systems

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

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

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

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

.6 Fire Extinguishers

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

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

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

.3 Provide fire extinguishers equipped as below:

c. Pinned and sealed;
d. With a pressure gauge;
e. With an extinguisher tag signed by a fire extinguisher servicing company.

.4 Carbon Dioxide (C02) 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 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^{o}C (450 ^{o}F).

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

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

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

.2 Mops:

.1 Use only glass fibre roofing mops.

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

.3 Torch Applied Systems:

.1 DO NOT USE TORCHES NEXT TO WALLS.

.2 DO NOT TORCH MEMBRANES TO EXPOSED WOOD OR CAVITY

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

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

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

.8 Welding / Grinding Operations

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

.9 **Fire Watch**

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

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

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

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

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

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

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

.11 Rubbish and Waste Materials

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

.2 Do not burn rubbish on site.

.3 Rubbish Containers

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

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

.4 Storage

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

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

.12 Flammable Liquids

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

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

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

.4 Transfer of flammable liquids is prohibited within buildings.

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

.6 Do not use flammable liquids having a flash point below 38 ^{o}C (100 ^{o}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 and/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 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

Part 1 GENERAL

1.1 Source Quality Control

.1 Identify lumber and plywood by grade stamp of an agency certified by Canadian Lumber Standards Administration Board and in accordance with applicable CSA standards.

Part 2 PRODUCTS

2.1 Lumber Material

.1 Except as indicated or specified otherwise lumber shall be softwood, S4S, moisture content (MC) not greater than 19% at time of installation, in accordance with following standards:

- .1 CSA O141-91.
- .2 NLGA Standard Grading Rules for Canadian Lumber.

.2 Furring, blocking, nailing strips, grounds, rough bucks:

- .1 Use S2S or S4S material.
- .2 Board sizes: C or D species, utility grade.
- .3 Dimension sizes: C or D species, utility grade.

.3 Nailers for roofing: C or D pine species, utility grade with pressure treated preservative.

.4 Plywood, exterior quality, GIS to CSA O121-M1978.

2.2 Fastenings & Hardware

.1 In accordance with Part 9 of NBC 1977 as supplemented by following requirement except where specific type is indicated.

.2 Nails, spikes and staples to NBC 9.23.3 except:

- .1 Use common spiral nails and spiral spikes except where indicated otherwise.
- .2 Use hot galvanized finish steel for exterior work, interior high humidity areas and for pressure treated lumber except where indicated otherwise.

.3 Bolt, nut, washer, screw and pin type fasteners: with hot-dip galvanized finish to CSA G164-M92 for exterior work, interior high humidity areas and for pressure treated lumber.

.4 Use surface fastenings of following types, except where specific type is indicated.

- .1 To hollow masonry, plaster and panel surfaces use toggle bolt.

.2 To solid masonry and concrete use expansion shield with lag screw, jute fibre or lead plug with wood screw.

.3 To structural steel use bolts through drilled hole, or welded stud-bolts or power driven self-drilling screws.

.5 Submit alternate fasteners for Departmental Representative's approval.

2.3 Wood Preservative

.1 Wood preservative: copper napthenate or pentachlorophenol base, water repellent wood preservative coloured.

Part 3 EXECUTION

3.1 Furring & Blocking

.1 Install furring and blocking as required to space-out and support surface applied materials or other work as indicated.

.2 Align and plumb faces of furring and blocking to tolerance of 1:600.

3.2 Nailers

.1 Install wood nailers as indicated.

.2 Except where indicated otherwise use material at least 40 mm (1-1/2") thick secured with 10 mm (3/8") bolts located within 300 mm (1 ft.) from ends of members and uniformly spaced at 1200 mm (4 ft.) between.

.3 Countersink bolts where necessary to provide clearance for other work.

3.3 Surface-Applied Wood Preservative

.1 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation.

END OF SECTION

Part 1 General

1.1 RELATED Work Specified Elsewhere

.1 Instructions to Bidders.

.2 General Conditions of Contract

.3 Rough Carpentry - Section 061000

.4 Metal Flashing and trim - Section 076200

.5 Mechanical - Section 154000

1.2 General

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

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

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

1.3 References

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

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

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

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

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

.6 CRCA Canadian Roofing Contractors' Association Metric Specification Manual

1.4 Preperation

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

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

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

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

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

Part 2 Products

2.1 Performance Criteria

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

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

2.2 Roof Assembly

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

The Typical Roof Assembly shall be:
Vapour Barrier
Min.75mm Rigid Insulation (sloped as indicated on drawing)
6mm Asphalt Core Board
2 Ply Modified Bitumen Membrane.

2.3 Membrane Floashing

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

2.4 Inspection and Testing

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

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

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

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

2.5 Precautions

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

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

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

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

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

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

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

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

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

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

2.6 Storage

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

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

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

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

2.7 Compatibility

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

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

2.8 Cutting, Patching and Making Good

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

.2 Remove all items as shown or specified.

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

2.9 Examination

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

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

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

2.10 Clean-Up

.1 Clean up as work progresses.

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

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

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

2.11 Coordination

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

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

2.12 Warranty

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

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

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

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

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

Part 3 Products

3.1 Sheating

.1 See Section 06 10 0 for product and application requirements

3.2 Primer

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

3.3 Vapour Barrier

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

3.4 Insulation

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

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

3.5 Sloped Insulations

.1 In drain sumps, rigid closed cell polyisocyanurate insulation bonded on upper and lower surfaces to an organic \ inorganic facer. Material shall meet CAN/CGSB-51.26-M86 and CAN\UL-S126-M. The boards shall be distributed in **1200mm x 1200mm** panels, pre-wrapped to prevent moisture ingression. Standard of Acceptance shall be E'NRG'Y3 or approved equal.

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

.3 Modules shall be factory cut to correct slopes

3.6 Adhesives

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

- .1 an asphalt extended vulcanized adhesive.
- .2 a single component urethane adhesive, dispensed from a portable pre-pressurized container requiring no external power source.
- .3 a single component solvent free moisture curing adhesive.
- .4 a two component, elastomeric, moisture cured; low rise urethane foam adhesive that contains no solvents.

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

3.7 Joint Tape

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

3.8 Overlay Board

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

3.9 Modified Bitumen Membrane

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

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

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

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

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

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

3.10 Accessories

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

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

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

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

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

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

Part 4 Application

4.1 Asphalt Primer

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

4.2 Vapour Barrier

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

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

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

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

4.3 Insulation

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

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

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

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

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

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

4.4 Base Sheet

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

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

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

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

4.5 Cap Sheet

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

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

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

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

4.6 Membrane Flashing

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

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

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

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

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

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

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

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

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

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

4.7 Pavers

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

4.8 Grounding Wire Flashing

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

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

4.9 Spun Aluminium Flashings

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

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

.3 Install batt insulation between vent and aluminum flashing.

.4 Caulk as detailed.

4.10 Lighting Cable Reinstatement

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

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

.3 Submit certification to consultant

4.11 Completion Of Days Work

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

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

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

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

4.12 General

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

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

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

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

END OF SECTION

Part 1 GENERAL

1.1 Related Work specified Elsewhere

.1 Modified Bitumen Membrane Roofing - Section 07 53 50

1.2 General

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

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

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

1.3 References

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

.2 ASTM Specifications A563/A563M-03

1.4 Workmanship

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

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

1.5 Warranty

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

Part 2 PRODUCTS

2.1 Metal Flashing

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

2.2 Starter Strip

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

2.3 Fasteners

.1 Non-corrosive colour to match exposed flashings.

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

.3 Exposed: screws with neoprene washers under the heads

.4 Cadmium plated screws, coloured head.

2.4 Sealant

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

2.5 Sheet Metal:

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

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

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

.3 Unexposed: galvanized nails.

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

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

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

Part 3 APPLICATION

3.1 General

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

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

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

.4 Lock seams at all corners.

3.2 Anchors and Fasteners

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

3.3 Counter Flashings

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

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

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

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

3.4 Cap Flashing

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

.2 Use concealed fastenings except where approved by Consultant.

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

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

3.5 Clean Up

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

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

Part 4 EXECUTION

4.1 Execution

.1 Form sheet metal on a bending brake.

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

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

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

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

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

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

END OF SECTION

Part 1 GENERAL

1.1 General

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

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

.3 Exclude the following other sections of specifications;

.1 076200 - Flashing and Sheet Metal,

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

Part 2 PRODUCTS

2.1 Materials

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

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

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

.4 Primers: sealant manufacturer's type.

.5 Cleaners: as recommended by sealant manufacturers.

Part 3 EXECUTION

3.1 Preparation

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

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

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

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

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

3.2 Application

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

.2 Apply sealant as per manufacturer's recommendations.

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

.4 Immediately clean surplus compound from adjacent surfaces.

END OF SECTION

PART 1 - GENERAL

1.1 Reference Standards

.1 Do plumbing systems work in accordance with the Plumbing Code under the Ontario Water Resources Act and local authority having jurisdiction except where specified otherwise.

1.2 Shop Drawings

.1 Submit shop drawings in accordance with Sections 001000 and 230501.

.2 Submit shop drawings for the following:
.1 water piping vacuum breaker;
.2 water piping backflow preventer;

PART 2 - PRODUCTS

2.1 Reference

.1 Refer to PART 2 of the Section entitled "Basic Materials and Methods" in this Division of the Specification for products which apply to Plumbing Systems work.

2.2 Drainage Piping Cleanouts

.1 Cleanout plugs (cast iron): heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing- caulked lead seat or neoprene gasket, with cover to suit the floor finish.

.2 Bronze or copper cleanout tee with a bronze ferrule.

2.3 Water Hammer Arrestors

.1 Stainless steel construction, bellows type: to Plumbing and Drainage Institute Standard PDI-WH-201-77, sized to suit the fixture units in the group.

2.4 Backflow Preventers

.1 Protect entire potable water distribution system against contamination due to back flow from non-potable sources.

.2 Watts Regulator of Canada Ltd. #9D certified in accordance with CSA B64.3 continuous pressure type backflow preventer with a brass body, stainless steel working parts, an integral strainer, and an intermediate atmospheric vent.

.3 Watts Regulator of Canada Ltd. No. 909, certified in accordance with CSA B64.4 reduced pressure principle backflow preventer with a bronze body, stainless steel working parts, bronze strainer and ball valve test cocks.

.4 Acceptable manufacturers are Watts Regulator of Canada Ltd., Braukmann Controls Co. Ltd. and Beeco Hersey.

2.5 Trap Seal Primers

.1 Bronze automatic trap primer complete with sediment strainer, union and access door for concealed installations.

.2 Acceptable manufacturers are Enpoco, Rototech-Smith Inc., Wade Industries Ltd., and Zurn Industries Canada Ltd.

2.6 Vacuum Breakers

.1 Watts Regulator of Canada Ltd. #NF8 or equal C.S.A. certified vacuum breaker.

PART 3 - EXECUTION

3.1 Reference

.1 Refer to PART 3 of the Section entitled "Basic Materials and Methods" in this Division of the Specification for execution requirements which apply to Plumbing Systems work.

3.2 Drainage and Vent Piping Installation Requirements

.1 Provide all required drainage and vent piping. Pipe shall be as follows:

.1 for pipe inside the building and above ground in sizes larger than 75mm (3") diameter (unless otherwise noted) - Class 4000 cast iron;
.2 for pipe inside the building and above ground in sizes to and including 75 mm (3") diameter - type DWV copper;
.3 for condensate and other drainage piping from equipment drain pans, etc., type "L" copper;

.2 Unless otherwise noted, slope horizontal drainage piping above ground in sizes up to and including 75 mm (3") diameter 25mm (1") in 1.2m (4') (i.e. 2%) and pipe 100mm (4") diameter and larger 25mm (1") in 2.4m (8') (i.e. 1%).

.3 Install and slope underground drainage piping to inverts or slopes indicated on the drawings to provide straight and true gradients between the points shown. Verify available slopes before installing the piping.

.4 Slope horizontal branches of vent piping down towards the fixture or pipe to which they connect with a minimum pitch of 25 mm (1") in 1.2 m (4') (i.e. 2%).

3.3 Installation of Drainage Piping Cleanouts

.1 Provide drainage piping cleanouts at locations as follows:

.1 at locations where required by code;
.2 where indicated on the drawings.

.2 Building drain cleanout and stack base cleanouts: line size to maximum 100 mm (4") diameter.

.3 Cleanouts in vertical piping shall be cleanout tees, cast iron in piping 75 mm (3") diameter and larger, copper or bronze in piping smaller than 75 mm (3") diameter.

.4 Cleanouts in horizontal piping shall consist of TY fittings. Cleanouts in horizontal inaccessible piping such as underground piping shall consist of TY fittings extended up to cleanout terminations set flush with the finished floor. In waterproof areas, each termination shall be equipped with a flashing clamp device. Cleanout terminations shall suit the floor finish. Provide all required cleanout terminations.

.5 Bring cleanouts to wall or finished floor unless serviceable from below floor.

3.4 Domestic Water Requirements

.1 Provide all required domestic water piping. Piping Installation Pipe shall be as follows:
.1 for domestic water piping underground inside the building - type 'K' soft copper;
.2 for all domestic hot water distribution piping, and for domestic cold water distribution piping inside the building and above ground - type "L" hard copper.

.2 Slope all piping so that it can be completely drained.

.3 Provide ball type shut-off valves to isolate all equipment and wherever else shown.

3.5 Installation of Backflow Preventer

.1 Provide a backflow preventer assembly in make-up water piping to mechanical plant circulating systems. Backflow preventers in piping to and including 20mm (3/4") diameter shall be continuous pressure type. Backflow preventers in piping 25mm (1") diameter and larger shall be reduced pressure type.

.2 Install in accordance with manufacturer’s instructions.

.3 Pipe discharge to nearest drain.

3.6 Installation of Vacuum Breakers

.1 Provide a vacuum breaker in piping connecting a hose bibb or any other fitting to which a hose can be attached, unless a vacuum breaker is provided integral with the hose bibb, fitting, etc.

3.7 Compressed Air Piping Installation Requirements

.1 Does not apply to this project.

1 General

.1 This section covers items common to all sections of Division 23 and is intended only to supplement the requirements of Division 01.

2 Definitions

.1 For purposes of Division 23 the following definitions shall apply:
.1 "Concealed" - mechanical services and equipment in suspended ceilings and in chases and furred spaces.
.2 "Exposed" - will mean not concealed as defined above.

3 Examination of the Site

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

4 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.

5 Shop Drawings

.1 Submit shop drawings for review by Engineer in accordance with Section 01000.

.2 Certify all shop drawings "Correct for Review by Engineer".

.3 Shop drawings to include all descriptive data for mechanical equipment and components.

.4 Each shop drawing shall clearly indicate:
.1 Name of project
.2 Name of contractor
.3 Name of component
.4 Name of manufacturer and model number
.5 Name of service or system
.6 Date of delivery confirmed by the manufacturer

.5 Information on shop drawings shall include:

.1 Overall dimensions, roughing-in dimensions and clearance dimensions where applicable.
.2 Operating weights
.3 Certified performance data
.4 Noise Levels
.5 Factory test standards
.6 Compliance with codes
.7 Electrical characteristics
.8 Extended warranty coverage
.9 Gauge of materials, type of finish and other pertinent data

.6 Submit applicable control diagrams and descriptive sequence of operations for each control system. (This applies both to the controls contractor and to the manufacturers of packaged equipment).

6 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 01000.

7 Federal Halocarbon Regulation

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

.2 Tag equipment with duplicate of halocarbon record.

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

8 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.

9 Protection of Equipment & Materials

.1 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.

10 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.

11 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.

12 As-Built Drawings

.1 Provide "as-built" documents in accordance with Section 001000.

.2 When work begins at the site, clearly and accurately mark on a bound set of white prints of the contract drawings, on a daily basis, all changes and deviations from the routing of piping and ductwork and locations of equipment shown on the contract drawings. Turn the marked-up white prints over to the Engineer upon substantial completion of the work.

.3 Pay particular attention to accurately dimensioning the exact location of all services terminated for future extension, all buried work and services, and work concealed within the building in concealed locations.

13 Operating & Maintenance Manuals

.1 Submit Operating and Maintenance Manuals in accordance with Section 001000.

.2 Each Operating and Maintenance Manual shall contain the following:

.1 Index of contents

.2 Complete list of names and addresses of sub-contractors to this trade (prepared by the Mechanical Contractor).

.3 Bulletins shall contain the equipment installed on this job only. General bulletins describing any items of equipment not installed on this job are not acceptable.

.4 All instructions shall be prefaced by simple descriptions of entire systems, explaining their purposes and operation so that a person completely unfamiliar with the building can operate all systems by following the instructions. Preparation of such instructions shall be the responsibility of this Division and not of the equipment suppliers. Instructions shall include system diagrams where applicable with clear reference to components contained in this Manual.

.5 Each manual to be compiled in three basic parts: Part 1: System and Equipment Operation Part 2: System and Equipment Maintenance Part 3: System and Equipment Parts Lists

.6 Part 1: System and Equipment Operation to include the following categories:

.1 Location: The location of major units and controls in the building.

.2 Equipment: Details of major equipment which make up the system.

.3 Start-Up: Step-by-step instructions for the start-up of a system from the non-operating condition.

.4 Shut-Down: Step-by-step instructions for the shut-down of a system to a non-operative state which will ensure the safety and maintainability of the equipment.

.5 Emergency Operation: Step-by-step instructions for the operation of systems which must continue to run despite equipment breakdown, power supply failure, etc.

.6 Charts and Diagrams: System schematics, flow charts.

.7 Part 2: System and equipment maintenance to include the following categories:

.1 System Maintenance: Information describing special maintenance requirements and instructions for draining, charging, filling, lubrication, inspection, access safety, etc.

.2 System Adjustment: Step-by-step instructions needed to maintain system within specified operative limits incuding manufacturer's recommended maintenance instructions.

.3 Warranties: Listing of components of the

systems which are covered by manufacturer extended warranties indicating effective dates and expiry dates.

.4 Balancing Report: Air and water - reports shall outline balancing parameters and approach.

.5 Approach must follow minimum as outlined by ASHRAE and include fan and pump performance curves and system schematics.

.6 Inspection Certificates: Include copies of all inspection certificates issued by governing authorities.

.8 Part 3: System and equipment part list to include the following categories:

.1 Equipment Part Lists: Manufacturer's parts lists, preceded by an index. Include names and addresses of local suppliers for all items included in maintenance manuals.

.2 Spare Parts: Receipts for maintenance spare parts turned-over to Owner.

.3 Controls: Technical Bulletins and As-Built Control Diagrams.

.4 Testing Reports: Include manufacturer's report certifying acceptance of this equipment installation and performance.

.5 Shop Drawings: Technical data in the form of reviewed shop drawings.

14 Operating & Maintenance Instructions

.1 Supply certified personnel to instruct Owner's operating and maintenance personnel.

.2 Provide instruction during regular work hours prior to acceptance and turn-over.

.3 Use operation and maintenance manual for instruction purposes.

15 Equipment List

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

16 Work & Materials Supplied By Owner

.1 Does not apply to this project.

17 Metric & Imperial Measurements

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

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

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

PART 1 - GENERAL

1.1 Application

.1 This Section applies to and is a part of all succeeding Sections of this Division of the Specification. This Section includes specifications for products, common criteria and characteristics, and methods and execution that are common to one (1) or more Sections of Division 23, and it is intended as a supplement to each section and shall be read accordingly.

1.2 Shop Drawings

.1 Submit shop drawings in accordance with Sections 001000 and 230501.

.2 Submit shop drawings for the following:
.1 valves;
.2 pressure gauges, thermometers and accessories;
.3 vibration isolation apparatus.

PART 2 - PRODUCTS

2.1 Pipe Link Seals

.1 Pipe Link seals: at points where pipes pass through masonry or concrete.

.2 Modular seal assembly suitable for direct ground burial. Unless noted otherwise temperature range shall be -40 to +250F. Install in accordance with manufacturer's instructions.

.3 Acceptable products: Link-Seal model "C", "L" or "T".

2.2 Pipe Escutcheon Plates

.1 Chrome plated brass solid type with set screws.

.2 Outside diameter shall cover opening or sleeve.

2.3 Fastening and Securing Hardware

.1 Concrete inserts - Crane Canada Inc. #4M or equal for single or double pipe or duct runs and for equipment, Unistrut or equal inserts for multiple support systems.

.2 Concrete fasteners - "WEJ-IT" or equal anchors, lead cinch anchors and/or "STARR" or "PHILLIPS" self-drilling anchors.

.3 Masonry inserts - "WEJ-IT" or equal expansion shields and machine bolts, or, for light loads, fiber or lead plugs and screws.

.4 Drywall or plaster wall and/or ceiling fasteners - two-wing spring toggles.

.5 Structural steel fasteners - Grinnell or equal beam clamps.

2.4 Pipe, Fittings and Joints

.1 Cast Iron:

.1 Class 4000 cast iron pipe and fittings to C.S.A. B70 with heavy bituminous coating and with hub and spigot joints to CGSB77-GP-1M with cold caulking compound or mechanical joints with neoprene or butyl rubber couplings with stainless steel clamps. Use for interior U/G drainage & vent piping, all sizes, & for drainage & vent piping 65mm (2-1/2") and larger inside building above ground.

.2 Copper:

.1 DWV grade hard temper copper to ASTM B306 with wrought copper solder type drainage fittings to C.S.A. B15.81 and ANSI B16.29 and 50% lead, 50% tin solder joints to ASTM B32, type 50A for drainage & vent piping inside building above ground in sizes to and including 50mm (2") dia.

.2 Type "L" hard drawn seamless copper tubing to ASTM B88M, with wrought copper and bronze fittings to ANSI B16.22, and 95% tin, 5% antimony solder joints to ASTM B32 for domestic hot and cold water piping, chilled water piping, heating water piping and condenser water piping and brazed joints made with "Sil-Fos" silver brazing alloy for fuel oil, compressed air and control air piping.

.3 Steel:

.1 Schedule 40 mild steel, galvanized to ASTM A53, Grade A or B electric resistance weld or seamless complete with galvanized Class 150 malleable iron screwed fittings to ANSI B16.3 and screwed joints. Use for 100mm (4") and up DCW piping inside building and drainage pump discharge piping

.2 Black steel to ASTM A53, Grade A or B electric resistance weld or seamless, for pipe with screwed joints and mill or site bevelled for pipe with welded joints. Use for heating water, condenser water, chilled water; Steam & condensate piping; Fuel oil piping; Natural or LP gas piping; Compressed air piping. Generally, steel pipe to 50mm (2") dia. is to be screwed. Steel pipe 65mm (2-1/2) dia. and larger is to be welded.

.3 Threaded fittings shall be Class 150 or Class 300 malleable iron threaded fittings to ANSI B16.3. Use Class 300 fittings for all condensate piping and high pressure 414 kPa (60 psi) and up steam piping.

.4 Welding fittings shall be Class 150 or Class 300 cast or forged steel pipe flanges and flanged fittings to ANSI B16.5 and Schedule 40 or Schedule 80 butt welding fittings to ANSI B16.9.

.5 Grooved End Steel:

.1 Schedule 40 mild black carbon steel pipe, ASTM A53, with factory or site grooved ends square cut to requirements of CSA B242.

.2 Couplings shall be roll grooved end pipe couplings consisting of housing, gaskets, nuts and bolts. Housings shall be malleable iron to ASTM A47M or ductile iron to ASTM A536, cast in two (2) or more parts and secured together by heat treated carbon steel bolts and nuts to ANSI B18.2.1 and ANSI B18.2.2. Gaskets shall be rolled grooved coupling gaskets, type EPDM for temperature range minus 35°C (-31oF) to plus 100°C (212oF).

.3 Schedule 40 couplings for piping risers, mains, and in equipment rooms shall be rigid type to CSA B242.

.4 Acceptable manufacturers of grooved end piping systems are Victaulic, Gruvlock, Shurjoint and Couplox.

.5 Grooved end steel piping may be used for sprinkler and standpipe system piping, chilled and condenser water piping.

2.5 Unions

.1 For use in copper piping, wrought copper unions to ANSI B16.22 with soldered or threaded ends.

.2 For use in steel piping, malleable iron, ground joint, brass to iron ground seat screwed unions to ANSI B16.39 with a minimum pressure rating of 2070 kPa (300 psi) steam.

2.6 Dielectric Couplings

.1 To be compatible with and to suit pressure rating of piping system.

.2 Where pipes of dissimilar metals are joined.

.3 Pipes 50mm (2") and under: isolating unions.

.4 Pipes 65mm (2 1/2") and over: isolating flanges.

2.7 Drain Valves

.1 Minimum 20 mm (3/4") unless otherwise specified: straight pattern bronze ball valve with hose end male thread adapter and complete with cap and chain.

.2 Acceptable products: Jenkins Fig. 901CJ and Toyo Red & White Fig. No. 5046.

2.8 Automatic Air Vents

.1 Spirotherm Model Spirotop 1/2" high compression valve mechanism automatic air vent, with a non- ferrous metal body.

.2 Provide isolation valve at air vent.

2.9 Gate, Globe & Swing-Type Check Valves - General

.1 All valves shall be, to the extent possible, the product of a single manufacturer and shall have the manufacturer's name, pressure rating and size clearly marked on the outside of the body.

.2 Except for high pressure (equal to or greater than 110 kPa (16 psi)) steam service, valves 50mm (2") and smaller shall be constructed of bronze. Valves 65mm (2½") and larger shall have iron bodies and bronze mountings.

.3 Valves for high pressure steam service shall be constructed of forged or cast steel.

.4 The bronze in bodies and bonnets of all bronze valves shall conform to ASTM B-62 for valves rated up to 1035 kPa (150 psi) steam pressure.

.5 Bodies and bonnets of iron body valves shall conform to ASTM A-126, Class B.

.6 Bodies and bonnets of forged steel valves shall conform to ASTM A105N.

.7 Bodies and bonnets of cast steel valves shall conform to ASTM A216-WCB.

.8 Generally, valves 50mm (2") and smaller shall be complete with screwed ends, except for bronze valves installed in copper piping which shall be complete with soldering ends. Generally, valves 65mm (2½") and larger shall be complete with flanged ends.

.9 Wheels on bronze gate and globe valves, unless otherwise noted, shall be non-heating malleable iron finished in baked enamel. Wheels on iron body valves

shall be cast iron substantially constructed wheels suitable for easy valve operation. Wheels in steel body valves shall be malleable iron or steel.

2.10 Gate Valves Bronze & Iron

.1 For installation in steam piping at a pressure less than 110 kPa (16 psi), condensate, domestic water, chilled water, condenser water, heating water, glycol solution, compressed air, fuel oil piping.

.2 50mm (2") and under, soldered ends:

.1 For all services identified above, except steam and condensate.

.2 Rising stem, solid wedge disc, 2070 kPa (300 psi) W.O.G. pressure rated.

.3 Acceptable product: Crane No. 1334, Jenkins Fig. 813J, Toyo Red & White Fig. 299, and Kitz No. 43.

.3 50mm (2") and under, threaded ends:

.1 For all services identified above.

.2 Rising stem, solid wedge disc, 1035 kPa (150 psi) steam pressure rated.

.3 Acceptable product: Crane No. 431 UB, Jenkins Cat. 2810 J, Toyo Red & White Fig. 298, Kitz No. 42.

.4 65mm (2-1/2") and over, flanged ends:

.1 For all services identified above.

.2 O.S. & Y., solid wedge disc, bronze trim, 860 kPa (125 psi) steam pressure rated.

.3 Acceptable product: Crane No. 465 1/2, Jenkins Cat. 454J, Toyo Red & White Fig. 421A, Kitz No. 72.

2.11 Globe Valves Bronze & Iron

.1 For installation in steam piping at a pressure less than 110 kPa (16 psi), condensate, domestic water, chilled water, condenser water ,heating water, glycol solution, compressed air, fuel oil piping.

.2 50mm (2") and under, soldered ends:

.1 For all services identified above, except steam and condensate.

.2 Renewable teflon disc, 2070 kPa (300 psi) W.O.G. pressure rated.

.3 Acceptable product: Crane No. 1310, Jenkins Cat. 106 BPJ, Toyo Red & White Fig. 212, and Kitz No. 10.

.3 50mm (2") and under, threaded ends:

.1 For all services identified above.

.2 Renewable teflon disc, 1035 kPa (150 psi) steam pressure rated.

.3 Acceptable product: Crane No. 7TF, Jenkins Cat. 106 BJ, Toyo Red & White Fig. 221, Kitz No. 09.

.4 65mm (2-1/2") and over, flanged ends:

.1 For all services identified above.

.2 O.S. & Y., renewable seat and disc, bronze trim, 860 kPa (125 psi) steam pressure rated.

.3 Acceptable product: Crane No. 351, Jenkins Cat. 2342J, Toyo Red & White Fig. 400A and Kitz No. 76.

2.12 Check Valves Bronze & Iron

.1 For installation in steam piping at a pressure less than 110 kPa (16 psi), condensate, domestic water, chilled water, condenser water, heating water, glycol solution, compressed air, fuel oil piping.

.2 50mm (2") and under, soldered ends:
.1 For all services identified above, except steam and condensate.
.2 Y-pattern bronze body design with integral seat, 2-piece hinge disc construction and free rotating disc, 2070 kPa (300 psi) W.O.G. pressure rated.
.3 Acceptable product: Crane No. 1342, Jenkins Cat. 4093J, Toyo Red & Whie No. 237 and Kitz No. 30.

.3 50mm (2") and under, threaded ends:
.1 For all services identified above.
.2 Y-pattern bronze body design with integral seat, 2-piece hinge disc construction and free rotating disc, 2070 kPa (300 psi) W.O.G. pressure rated.
.3 Acceptable product: Crane No. 137, Jenkins Cat. 4092J, Toyo Red & White No. 238, and Kitz No. 29.

.4 65mm (2-1/2") and over, flanged ends:
.1 For all services identified above.
.2 Cast iron body and cap, solid bronze discs, replaceable bronze seat rings, hinge-pin and bushings, 860 kPa (125 psi) steam pressure rated.
.3 Acceptable product: Crane No. 373, Jenkins Cat. 587J, Toyo Red & White No. 435A, and Kitz No. 78.

2.13 Gate Valves Forged & Cast Steel

.1 For installation in steam piping at a pressure of 110 kPa (16 psi) or greater.
.1 50mm (2") and under, threaded ends:
.1 Forged steel body, O.S. & Y., solid wedge disc of chrome stainless steel to ASTM A182 Gr. F6, 13% chrome stainless steel trim, bolted bonnet, hard faced seats, full bore, 5520 kPa (800 psi) steam pressure rated.
.2 Acceptable product: Crane No. FB-3604XU-T, Velan S-2064B, Newman Hattersly 18TFS2 and Vogt 13111.
.2 65mm (2-1/2") and over, flanged ends:
.1 Cast steel body, O.S. & Y., flexible wedge disc, faced with 13% Cr, bolted bonnet, hard faced seats, full bore, 2070 kPa (300 psi) steam pressure rated.
.2 Acceptable product: Crane No. 33XU, Jenkins Fig. J1010B8F, Kitz 300 SCLS, Newman Hattersly 13FCB2 and Velan F-1064C-02TY.

2.14 Globe Valves Forged & Cast Steel

.1 For installation in steam piping at a pressure of 110 kPa (16 psi) or greater.

.2 50mm (2") and under, threaded ends:
.1 Forged steel body, O.S. & Y., plug disc of chrome stainless steel to ASTM A182 Gr. F6, 13% chrome stainless steel trim, bolted bonnet, 5520 KPa (800 psi)

steam pressure rated.
.2 Acceptable product: Crane No. FB-3644XU-T, Velan S-2074B, Newman Hattersly 28TFS2and Vogt 12141.

.3 65mm (2-1/2") and over, flanged ends:
.1 Cast steel body, O.S. & Y., plug disc of chrome stainless steel, 13% chrome stainlees steel trim, bolted bonnet, 2070 kPa (300 psi) steam pressure rated.
.2 Acceptable product: Crane No. 151XU, Jenkins Fig. J1042B2, Kitz 300 SCJ, Newman Hattersly 23FCB2 and Velan F-1074C-02TY.

2.15 Check Valves Forged & Cast Steel

.1 For installation in steam piping at a pressure of 110 kPa (16 psi) or greater.

.2 50mm (2") and under, threaded ends:
.1 Forged steel, swing type, 13% chrome stainlees steel trim, hard faced seat, bolted cap, 5520 kPa (800 psi) steam pressure rated.
.2 Acceptable product: Crane No. FB-3675XU-T, Velan S-114B, Newman Hattersly 48TFS2 and Vogt 4835.

.3 65mm (2-1/2") and above, flanged ends:
.1 Cast steel, swing type, 13% chrome stainless steel trim, bolted cap, 2070 kPa (300 psi) steam pressure rated.
.2 Acceptable product: Crane No. 159XU, Jenkins J1026B2, Kitz 300 SCO, Newman Hattersly 33FCB2 and Velan F-1114C-02TY.

2.16 Ball Valves

.1 For installation in domestic waterchilled waterheating watercondenser water compressed airfuel oil piping.

.2 50mm (2") and under, soldered ends:
.1 2-piece body, large bore, blowout-proof stem, 4140 kPa (600 psi) W.O.G. pressure rated.
.2 Acceptable product: Crane No. 9322, Jenkins Fig. No. 904J, Toyo Red & White Fig. 5049A, and Kitz No. 59.

.3 50mm (2") and under, threaded ends:
.1 2-piece body, large bore, blowout-proof steam, 4140 kPa (600 psi) W.O.G. pressure rated.
.2 Acceptable product: Crane No. 9302, Jenkins Fig. No. 903J, Toyo Red & White Fig. 5044A and Kitz No. 58.

2.17 Butterfly Valves

.1 Lug style with ductible iron body threaded for retaining bolts in both flanges, ANSI Class 150 rated, with extended neck for insulation.

.2 Two-piece stainless steel stem sealed from service without a packing gland and engaging a bronze disc without bolting or pinning.

.3 Resilient elastomer seat, bonded to a rigid backup ring and field replaceable, suitable for temperatures to 135 degrees C (275 degrees F) and pressures to 1965 kPa (285 psi).

.4 Valves up to and including 150mm (6") shall be equipped with 10 position lever handle. Valves 200mm (8") and larger shall be equipped with wheels and gear operators.

.5 Acceptable product: Demco Type NE-C, Crane.

2.18 Circuit Balancing Valves

.1 For balancing and shut-off service in domestic water, chilled water, heating water, condenser water, glycol solution piping.

.2 Sizes 12mm (1/2") and 20mm (3/4"), soldered ends:
.1 Y-pattern, bronze body c/w two brass metering ports, memory feature and capable of precise flow measurement, flow balancing and drip tight shut-off.
.2 Acceptable product: Armstrong CVB-M,S and Tour & Andersson TBV-S.

.3 50mm (2") and under:
.1 Y-pattern, bronze body c/w two brass metering ports, memory feature and capable of precise flow measurement, flow balancing and drip tight shut-off.
.2 Provide c/w pre-formed insulated container to double as insulation after valve is installed.
.3 Acceptable product: Armstrong CBV-S and Tour & Andersson STAD for valves with soldered ends, Armstrong CBV-T and Tour & Andersson STADA for valves with threaded ends.

.4 65mm (2-1/2") and over, flanged ends:
.1 Y-pattern, cast iron body with industry standard grooved ends and flanged adaptor or flanged ends c/w two metering ports, memory feature and capable of precise flow measurement, flow balancing and drip tight shut-off.
.2 Acceptable product: Armstrong CBV-G, and Tour & Andersson STAF.

2.19 Pipeline Strainers

.1 For installation in domestic water, chilled water, condenser waterh, eating water, glycol solution, compressed air, fuel oil piping.

.1 50mm (2") and under, soldered ends:
.1 Bronze "Y" strainer minimum 1380 kPa (200 psi) steam pressure rated, Type 304 20 mesh stainless steel screen.
.2 Acceptable product: Mueller #353-1/2M and Spirax Sarco TBT.

.2 50mm (2") and under, threaded ends:
.1 Bronze "Y" strainer, 1725 kPa (250 psi) steam pressure rated, Type 304 20 mesh stainless steel screen.
.2 Acceptable product: Armstrong F1SC, Spirax Sarco BT, Toyo Red & White No. 380 and Mueller #352M.

.3 65mm (2-1/2") and over, flanged ends:
.1 Cast iron "Y" strainer, 860 kPa (125 psi) steam pressure rated, Type 304 20 mesh stainless steel screen, bolted cap with blowdown connection, Class 125 flanges.
.2 Acceptable product: Armstrong A1FL, Mueller #751, Spirax Sarco CI-125 and Toyo Red & White No. 381A.

.2 For installation in steam piping at a pressure less than 414 kPa (60 psi) and all condensate piping.

.1 50mm (2") and under, threaded ends:
.1 Cast iron "Y" strainer, 1725 kPa (250 psi) steam pressure rated, Type 304 20 mesh stainless steel screen.
.2 Acceptable product: Armstrong A1SC Mueller #11-FCB and Spirax Sarco IT.

.2 65mm (2-1/2") and above, flanged ends:
.1 Cast iron "Y" strainer, 860 kPa (125 psi) steam pressure rated, Type 304 20 mesh stainless steel screen, bolted cap with blowdown connection, Class 125 flanges.
.2 Acceptable product: Armstrong A1FL, Mueller #751 and Toyo Red & White No. 381A.

.3 For installation in steam piping at a pressure of 414 kPa (60 psi) and above.

.1 50mm (2") and under, threaded ends:
.1 Cast steel "Y" strainer, minimum 4140 kPa (600 psi) steam pressure rated, Type 304 20 mesh stainless steel screen.
.2 Acceptable product: Armstrong B1SC, Mueller #861 and Spirax Sarco CT.

.2 65mm (2-1/2") and above, flanged ends:
.1 Cast steel "Y" strainer, 4140 kPa (600 psi) steam pressure rated, Type 304 20 mesh stainless steel screen, Class 300 flanges.
.2 Acceptable product: Armstrong B1FL, Mueller #764 and Spirax Sarco Fig. 34.

2.20 Pipe Hangers & Supports

.1 Fabricate hangers and supports in accordance with ANSI B31.1 and MSS-SP58.

.2 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, suspend hangers from steel channels or angles. Provide all supplementary structural members as necessary.

.3 Upper attachments for connecting to structural member shall be Grinnell or equal, suitable in all respects for the application.

.4 For horizontal piping - adjustable steel clevis hangers and/or adjustable roller hangers as required.

.5 For vertical piping - for steel or cast iron pipe: carbon steel to MSS-SP58-1983, type 42, ULC listed; for copper pipe: carbon steel copper finished to MSS-SP58-1983, type 42.

.6 For groups of pipe having the same slope - black

structural steel angle wall brackets and/or black steel channels or angles of proper dimension supported by hanger rods and/or Unistrut Ltd. or equal support assemblies.

.7 Hanger rods shall be black steel, round, threaded, to ASTM A-36, sized to suit the loading, complete with captive machine nuts with washers at hangers.

.8 Acceptable manufacturers of pipe hanger and support hardware are Grinnell, Crane Canada Ltd., Myatt and Apex.

2.21 Access Doors

.1 Supply access doors to concealed mechanical equipment for operating, inspecting and servicing.

.2 Access doors: flush mounted 600 x 600mm (24" x 24") for body entry and 300 x 300mm (12" x 12") for hand entry unless otherwise noted. Doors to open 180o, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.

.1 General: prime coated steel.

.3 Acceptable manufacturers are Buensod, Le Hage, Marfab and Zurn.

2.22 Pressure Gauges & Thermometers

.1 Pressure Gauges:

.1 Trerice 700LF Series or equal, 100mm (4") dial size with stainless steel or black phenol case, bayonet ring and glass window, stainless steel rotary type movement and Bourdon tube and socket to CGSB 91-GP-3.

.2 Dial face shall be white with black figures reading in both metric and imperial units; pointer shall be micrometer adjustable type. Accuracy to be no less than 1% of full scale.

.3 Gauge shall be filled with glycerin or silicone-according to ambient temperature requirements.

.4 Provide bronze stop cocks, iron coil siphon for steam service, snubber for pulsating service and diaphragm protection seals to protect pressure/vacuum-sensing devices.

.2 Thermometers:

.1 Trerice BX9 Series or equal, universal, adjustable angle type 225mm (9") scale case, red reading mercury in-glass with cast aluminum case, clear acrylic window and separable well, to CGSB 14-GP-2a.

.2 For copper pipe use copper or bronze wells, for steel pipe use brass wells.

.3 Pressure gauges and thermometer scale ranges shall be such that the working temperature or pressure of the system for which the instrument is provided is at the approximate mid-point of the instrument scale.

.4 Acceptable manufacturers of pressure gauges and thermometers are Trerice, Weiss, Ashcroft and Winters.

2.23 Equipment Drive Guards

.1 Provide guards for unprotected drives.

.2 Guards for belt drives:
.1 Expanded metal screen welded to steel frame.
.2 Minimum 1.0mm thick (#20 gauge) galvanized sheet metal tops and bottoms.
.3 40mm (1½") dia holes on both shaft centres for insertion of tachometer.
.4 Removable for servicing.

.3 With guards in place, provide means to permit lubrication and use of test instruments.

.4 Install belt guards to permit movement of motors for adjusting belt tension.

.5 Flexible coupling guards: removable, "U" shaped, minimum 1.6mm thick (#16 gauge) galvanized mild steel.

.6 Provide on unprotected fan inlet or outlet: minimum 20mm (3/4") galvanized wire or expanded metal screen. Net free area of guard to be not less than 80% of fan openings.

2.24 Belt Drives

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

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

.3 For motors to 7.5 kW (10 HP): standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified RPM.

.4 For motors over 7.5 kW (10 HP): sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.

.5 Minimum drive rating: 1.5 times nameplate rating on

motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

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

.7 Tension belts to manufacturer's recommendations before start-up using calibrated belt tensioning gauge.

2.25 Electric Motors

.1 Provide CSA approved motors for mechanical equipment as specified.

.2 If delivery of specified motor will delay delivery or installation of any equipment, install an acceptable motor for temporary use. Final acceptance of equipment will not occur until specified motor is installed.

.3 Motors under 373 W (½ HP): continuous duty, built-in overload protection, resilient mount, single phase, 115 V, unless otherwise specified or indicated.

.4 Motors 373W (½ HP) and larger: EEMAC Class B, squirrel cage induction, 1725 RPM continuous duty, drip proof, ball bearing, maximum temperature rise 40°C (72oF), 3 phase, unless otherwise specified or indicated.

.5 Motors shall meet the Ontario Hydro High Efficient Standard.

.6 Each motor shall be suitable for direct coupling or V-belt drive as required, and shall be suitable in all respects for the type of motor starter provided.

.7 Bearings, unless otherwise noted, shall be grease lubricated with readily accessible plugs or fittings to allow "in-service" re-greasing. Bearings shall be ball type, double shielded, single row width.

.8 Acceptable motor manufacturers are Westinghouse Canada Inc., Canadian General Electric Co. Ltd., Lincoln Electric Co. Ltd., and Toshiba International Corp.

2.26 Motor Starters (In Division 26)

.1 Motor starters for mechanical equipment, except for starters integral with packaged equipment, starters integral with control panels supplied with equipment, and starters specifically required to be supplied with equipment, will be provided as part of the electrical work of Division 26.

2.27 Vibration Isolation Materials

.1 Spring Hangers

.1 Colour coded springs, rust resistant, painted box type hangers. Swivel arrangement to permit hanger box or rod to move through a 20o arc without metal to metal contact.

.2 Acceptable manufacturers are Burgess Vibro Acoustics Ltd., Vibron, Korfund and Masdom Corp. Ltd.

2.28 Flexible Connections

.1 For pipe sizes 50mm (2") and under:

.1 Hydro-Flex PCM-X, flexible piping connector with Type 321 stainless steel

PART 3 - EXECUTION

3.1 Installation of Pipe Link Seals

.1 Does not apply to this project.

3.2 Installation of Pipe Escutcheon Plates

.1 On pipes passing through walls, partitions, floors and ceilings in finished areas.

.2 Install the plates so that they are tight against the building surface concerned, and ensure that the plates completely cover pipe sleeves and/or openings.

.3 Where sleeve extends above finished floor, escutcheons or plates shall cover sleeve extension.

3.3 Installation of Fastening & Securing Hardware

.1 Provide all fastening and securing hardware required for supporting and/or securing your work unless otherwise noted.

.2 Where inserts are required in set concrete work, drill a neat hole of the proper diameter and depth in the concrete and insert an anchor into the hole to accept the hanger rod, bolt, etc., or where concrete mass permits, use self-drilling concrete anchors.

.3 Fasten hanger and support provisions to masonry with expansion shields and machine bolts, or, for light loads, use lead plugs and screws.

.4 In drywall or plaster walls and/or ceilings use two-wing toggles and for heavy loads, provide steel anchor plates with two (2) or more toggles to spread the load.

.5 Provide beam clamps for attaching hanging and/or support provisions to structural steel, or where approved by the Engineer weld the hanging and support provisions to the structural steel.

.6 Do not use explosive powder actuated fasteners.

3.4 General Piping & Ductwork Installation Requirements

.1 Install concealed pipes and ductwork close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping and ductwork parallel to walls. Group piping wherever practical.

.2 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.

.3 Provide a drain valve at the base of each piping riser conveying a liquid (except drainage piping), in drainage connections to equipment, at low points in piping and wherever else shown and/or specified.

.4 Provide a manual or automatic air vent as specified and properly sized piping air chamber at all high points of all water piping systems, at equipment connections, and wherever else shown and/or specified.

.5 Provide unions or flanges in piping at all connections to valves, strainers, pressure reducing valve, backflow preventers and similar piping system components which may need maintenance or repair, at all equipment connections, and wherever else indicated on the drawings.

.6 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated and unless such instructions contradict governing codes and standards.

.7 Carefully clean all ducts, pipe and fittings prior to installation. Temporarily cap or plug ends of duct, pipe and equipment which are open and exposed during construction to prevent debris from entering the ductwork, piping or equipment.

.8 Install piping and ductwork which is to be insulated such that it has sufficient clearance to permit insulation to be applied continuously and unbroken around the pipe or duct except at fire barriers, in which case, terminate the insulation at each side of the fire barrier.

.9 Provide anchors to secure pipework to the structure. Anchors shall be of a size and type to securely anchor the pipe at the point shown. Submit details of anchors for review.

.10 Compensate for pipe expansion by the use of swing joints or expansion loops unless otherwise noted. Generally, expansion facilities are indicated on the drawings but exact expansion compensation facilities shall suit the piping as installed and exact detail drawings of expansion compensation facilities must be submitted for review.

3.5 Pipe Joint Requirements

.1 Ream pipes, clean scale and dirt, inside and outside, before and after assembly.

.2 Threads in screwed steel piping shall be coated with Teflon tape or pulverized lead paste.

.3 Steel pipe to be welded shall be site or mill beveled. Remove all scale and oxide from the bevels and leave same smooth and clean. Ensure that personnel doing welding work are licensed welders, hold a valid certificate issued by the authorities having jurisdiction, and are qualified for the particular pressure application worked on.

.4 Use welding tees or welding outlet fittings for piping branches off mains. The branch outlet shall be welded or socket type for pipes with welded fittings and threaded type for pipes with screwed fittings.

.5 Saddle type branch fittings may be used on mains, if branch line is half size or smaller than main. Hole saw or drill and ream main to maintain full inside diameter of branch line prior to welding saddle.

.6 Make all flanged joints with gaskets to suit the application to ANSI B16.21, ANSI B16.20 or ANSI A21.11. Gaskets to be by Garlock or Chesterton.

.7 Bolts and nuts: to ANSI B-18.2 and ANSI B18.2.2.

.8 Provide suitable washers between each bolt head and the flange and between each nut and the flange.

.9 Make all soldered joints in copper piping using flux suitable for and compatible with the type of solder being used. Clean the outside of the pipe end and inside of the fitting, valve, etc., prior to soldering.

.10 Install mechanical joint fittings and couplings in accordance with the manufacturer's recommendations. If Victaulic fittings and couplings are used, ensure that all valves and piping accessories are suitable. Grooves in Schedule 40 pipe shall be cut.

.11 Adhere to the manufacturer's recommendations with respect to support, anchoring and guiding of the grooved piping system.

3.6 Installation of Gate, Globe & Swing Type Check Valves

.1 Install valves with stems upright unless approved otherwise.

.2 Install gate valves at all branch take-offs at connection to main and to isolate each piece of equipment, and as indicated. Gate valves shall not be used for throttling service.

.3 Install globe valves for balancing and in bypass around control valves, unless indicated otherwise.

.4 Provide swing check valves on discharge of pumps and as indicated.

.5 On system piping where joints are made with "Sil-Fos" silver brazing alloy, use threaded valves with threaded to sweat adaptors to avoid heat damage to the valve.

3.7 Installation of Ball Valves

.1 Provide ball valves in piping in sizes 65mm (2-1/2") and under associated with the following systems:

domestic water systems;
hot water heating system;
chilled water system;
condenser water system;
glycol heating system;
natural gas system;

.2 Do not use ball valves to replace globe valves for throttling or balancing service.

.3 On system piping where joints are made with "Sil-Fos" silver brazing alloy, use threaded valves with threaded to sweat adaptors to avoid heat damage to the valve.

3.8 Installation of Butterfly Valves

.1 Provide butterfly valves in lieu of gate valves in piping in sizes 65mm (2-1/2") and above associated with the following systems:

chilled water system;
condenser water system;
glycol solution system.

.2 Do not use butterfly valves to replace globe valves for throttling or balancing service.

3.9 Installation of Circuit Balancing Valves

.1 Provide circuit balancing valves where shown on the drawings and where specified herein.

.2 Coordinate locations with the trade performing the balancing work.

.3 Balance water systems to equipment flows indicated on drawings.

3.10 Installation of Pipeline Strainers

.1 Provide strainers in piping where shown on the drawings and where specified herein.
.2 Equip strainers 50mm (2") diameter and larger with valved blowdown piping. Terminate blowdown piping over the nearest funnel and floor drain unless otherwise noted.
.3 Locate strainers so they are easily accessible for service.

3.11 Installation of Pipe Hangers & Supports

.1 Provide all required hangers and supports unless otherwise noted. For insulated pipe, size the hanger or support to suit the insulated pipe and install the hanger or support on the outside of the insulation.

.2 Hang and/or support horizontal steel and copper pipe above ground by means of hangers and/or supports specified hereinbefore in this Section, spaced in accordance with the following schedule:

PIPE SIZE: NPS	ROD DIAMETER	MAXIMUM SPACING: STEEL	MAXIMUM SPACING: COPPER
Up to 1-1/4	10mm (3/8")	2.1m (7')	1.8m (6')
1-1/2	10mm	2.7m (9')	2.4m (8')
2	10mm	3.0m (10')	2.7m (9')
2-1/2	10mm	3.6m (12')	3.0m (10')
3	10mm	3.6m (12')	3.0m (10')
3-1/2	10mm	3.9m (13')	3.3m (11')
4	16mm (5/8")	4.2m (14')	3.6m (12')

.3 Hang and/or support other horizontal piping above ground by means of hangers and/or supports spaced according to the following:

PIPE SIZE: NPS	PIPE MATERIAL	MAXIMUM SPACING
All	Cast iron	At every joint - maximum 2.4m (8') intervals
All	Plastic	In accordance with pipe manufacturer's recommendations
All	Glass	In accordance with pipe manufacturer's recommendations

.4 Support vertical pipes by means of supports specified hereinbefore in this Section at maximum 3.6m (12') intervals or at every floor whichever is lesser.

.5 Support vertical cast iron and cement-asbestos hub and spigot pattern piping at the hubs by means of a clamp bolted around the pipe and anchored to the floor or wall at each floor level.

.6 Support all vertical cast iron plain end pipe (mechanical joint type), as for hub and spigot pipe but secure the clamp around the pipe under a flange integral with the pipe for vertical support purposes, or provide a length of hub and spigot pipe to facilitate proper support.

.7 Provide roller hangers or supports for all suspended or bottom supported hot piping, 50mm (2") diameter and larger with horizontal movement in excess of 25mm (1") due to expansion and contraction. Equip the piping with steel protection saddle with insulation under the saddle.

.8 Provide pipe covering shields, sized to suit insulated pipe, between insulated pipe and the pipe hanger or support for all piping. Ensure that on cold piping the insulation vapour barrier remains intact.

.9 Support bare copper tubing using specially made copper or plastic coated copper tubing hangers, or provide proper plastic inserts or tape to isolate the ferrous hangers and supports from the bare copper tubing. Cloth backed rubber adhesive tapes (i.e. duct tape)are not acceptable.

.10 Where pipes having the same slope are grouped and a common hanger or support is used, hanger or support spacing shall suit the spacing requirement of the smallest pipe in the group.

.11 Where pipes change direction, either horizontally or vertically, provide a hanger or support on the horizontal pipe not more than 300mm (12") from the elbow. Where pipes drop from tee branches, support the tees in both directions not more than 50mm (2") on each side of the tee.

.12 Provide all additional structural steel channels, angles, etc., required to support pipes. All materials shall be machine cut square and true and shall be prime coat painted as a minumum and finish painted if exposed.

.13 Do not use perforated band, wire, chain or solid ring hangers.

.14 Offset hanger so that rod is vertical in operating position.

.15 Adjust hangers to equalize load.

3.12 Installation of Pressure Gauges & Thermometers

.1 Install a pressure gauge in piping at the following locations:

.1 Suction and discharge of pumps.
.2 Upstream and downstream of PRV's.
.3 Upstream and downstream of control valves.
.4 Inlet and outlet of water side of coils and heat exchangers.
.5 In other locations as indicated.

.2 Install thermometers in the following locations:
.1 Inlet and outlet of heat exchangers.
.2 Inlet and outlet of water heating and cooling coils.
.3 Inlet and outlet of cooling towers.
.4 Inlet and outlet of DHW tanks.
.5 In other locations as indicated.

.3 Locate direct reading thermometers and gauges for reading from floor.

.4 Use extensions where pressure gauges and thermometers are installed through insulation.

3.13 Installation of Equipment Drive Guards & Accessories

.1 Protect all exposed rotating parts such as belt drives, couplings, fly wheels, and fan wheels on all mechanical equipment with a guard approved by the Workmen's Compensation Board to meet Provincial Department of Labour Safety requirements.

.2 Secure guards to the equipment or equipment base but do not bridge sound or vibration isolation.

.3 Where equipment oil level gauges, oil reservoirs,

grease cups or grease fittings are integral with the equipment but are not easily accessible for service, extend to accessible locations.

3.14 Installation of Vibration Isolation Materials

.1 Install vibration isolation equipment in accordance with manufacturer's instructions and adjust mountings to level equipment.

.2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping and ducting passage through walls and floors do not transmit vibrations.

3.15 Identification

.1 Provide pipe, duct and equipment identification as specified hereinafter.

.2 Equipment:
.1 Manufacturer's nameplates:
.1 Provide metal nameplate on each piece of equipment, mechanically fastened with raised or recessed letters.
.2 Manufacturer's nameplate to indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors.
.3 Locate nameplates so that they are easily read. Do not insulate or paint over plates.
.2 System nameplates:
.1 Provide laminated plastic plates with black face and white centre of minimum size 90 x 40 x 2.5mm nominal thickness (3 1/2" x 1 1/2" x 3/32") engraved with 6mm (1/4") high lettering. Use 25mm (1") lettering for major equipment.
.2 Fasten nameplates securely in conspicuous place. Where nameplates cannot be mounted on cool surface, provide standoffs.
.3 Identify equipment type and number (eg. Pump No. 2), service and areas or zone of building served, (eg. South Zone Chilled Water).
.4 Submit list of nameplates for review prior to engraving.
.3 Piping:
.1 Identify medium in piping with markers showing name and service including temperature, pressure and directional flow arrows in accordance with CGSB 24-GP-3a.

.2 Identification colour coding and lettering shall conform to existing standards.

.4 Ductwork:

.1 Use 50mm (2") high black stenciled letters, identifying system and directional flow (i.e. A/C System #2).
.2 Maintain maximum 15m (50') distance between markings.
.3 Identify ducts each side of dividing walls or partitions and beside each access door.
.4 Stencil over final finish only.

3.16 Finish Painting of Mechanical Work

.1 Equipment items including pumps, air handling units, unit heaters, etc. where specified to be painted shall have prime and final paint coats factory applied.

.2 Other equipment fabricated from iron or steel including access doors, metal radiation enclosures and fire hose cabinets shall have a prime coat of paint applied at factory. Touch up any damage resulting from shipping or installation and leave ready for final painting by Division 9.

.3 Apply at least one coat of corrosion resistant primer paint to ferrous supports, hangers and site fabricated work.

.4 Prime and touch up marred finished paintwork to match original.

.5 Restore to new condition, finishes which have been damaged to extensively to be merely primed and touched up.

3.17 Pipe Leakage Testing

.1 *General for all pipe leakage testing:*

.1 After piping has been placed in position and all branch piping installed, but before the piping has been concealed, and before equipment, fixtures and fittings have been connected, test all piping in the presence of the governing authorities, if required, and the Engineer or his qualified representative. Test results will be documented and co-signed by the Engineer or his representative and by the installer.
.2 Testing and witnessing procedures shall be in accordance with the Class of piping installation as specified hereinafter.
.3 Bear all costs required for inspection test fees, apparatus, equipment, testing medium, freeze protection, retesting and making good any damage.
.4 Remove and re-install materials, controls, or equipment that can be damaged from excessive pressure or test medium. Test piping in sections or install filler sections required to test piping in one network. Suitable precautions in the event of piping system rupture shall be taken to eliminate hazards to personnel in the proximity of piping being tested.

.5 Provide a test gauge and a valved connection point for owner's recorder or gauge in each test section of piping. Pressure range of gauge shall not exceed 150% of the specified test pressure. I.E., test pressure 690 kPa (100 psi) - maximum gauge range 1035 kPa (150 psi).
.6 Generally, pneumatic testing shall not be used unless the Engineer specifically permits its use as an alternative to hydrostatic testing. Pneumatic testing will only be considered if the piping systems are designed so that they cannot be filled with water or if the piping systems are to be used in services where traces of water cannot be tolerated.
.7 Pneumatic testing, where permitted by the Engineer, shall be done in strict accordance with the ASME Code for Power Piping, B31.1.
.8 When permitted by the Engineer, test medium supplied from cylinders or other high pressure sources shall be introduced to the system by means of a mechanical pressure regulator. The gas used as the test medium shall be non-flammable and non-toxic.
.9 Make tight leaks found during tests while the piping is under pressure, and if this is impossible, remove and refit the piping and reapply the test until satisfactory results are obtained.
.10 Where leaks occur in threaded joints in steel piping, no caulking of these joints will be allowed under any conditions.

.2 *Piping Leakage Test Classification:*
.1 Class "A" - Piping installations in new construction or renovation work which require witness and approval of the Engineer, or the Engineer's qualified representative and a representative of a recognized authority having jurisdiction as follows:

- Plumbing - City of Ottawa, City of Gloucester
- Fire Protection Systems - Regional Office of Fire Commission of Canada
- Pressure Vessels, Steam, H.P. Gases, Power Piping - Ontario Ministry of Consumer's and Commercial Relations (M.C.C.R.) Fuels Safety Branch
- Natural and Propane Gas - M.C.C.R. Fuels Safety Branch
- Flammable or Combustible Liquids
  - Regional Fire Commissioner's Office, HRDC, Labour Program

.2 Class "B" - Piping installations in new construction or renovation work which require witness and approval of the Engineer or the Engineer's qualified representative only.
.3 Class "C" - Piping installations in renovation work only which are short in developed length, small in scope of

work, or a valved part or section of an existing single pipe distribution system, which requires witness and approval by the Engineer or the Engineer's qualified representative only.

.3 *Pipe Leakage Testing Procedures - Classes "A" & "B":*
.1 *Drainage & Vent Piping:*
.1 Hydrostatically test new drainage and vent piping by securely closing all openings and pipe ends, and filling piping with water up to the highest level and ensuring the water stands at the same level for a minimum of four (4) hours.
.2 *Domestic Water Piping:*
.1 Test piping with cold water at a pressure of 1½ times normal working pressure but not less than 690 kPa (100 psi) and maintain the pressure for a minimum of four (4) hours.
.3 *Sprinkler & Standpipe System Piping:*
.1 Test piping with cold water at a pressure of 1380 kPa (200 psi) for four (4) hours.
.4 *Heating Water, Glycol Solution, Chilled Water, Process Water, Condenser Water & Pumped Discharge Piping:*
.1 Test piping with cold water at a pressure of 1½ times normal working pressure but not less than 690 kPa (100 psi) for four (4) hours.
.5 *Steam and Condensate Piping:*
.1 Test piping with cold water for a minimum of four (4) hours at the following pressures:
.1 low pressure to 414 kPa (60 psi) piping - 690 kPa (100 psi).
.2 high pressure 414 kPa (60 psi) and above piping - 1380 kPa (200 psi)

.6 *Compressed Air Piping:*
.1 Test piping with cold water at a pressure of 1-1/2 times the normal working pressure but not less than 345 kPa (50 psi) for four (4) hours.
.2 Following completion of the test, completely drain the water from the piping system and using compressed air, purge all residual water.
.7 *Natural Gas Piping:*
.1 Test piping with dry compressed air in accordance with the requirements of CANl-B149.1 but not less than the following:
.1 low pressure to 14 kPa (2 psi) piping - 100 kPa (15 psi) for a minimum of four (4) hours;
.2 medium pressure 14 kPa to 230 kPa (2 psi to 33 psi) piping - 345 kPa (50 psi) for a minimum of four (4) hours;
.3 high pressure over 230 kPa (33 psi) piping - 1½ times the maximum operating pressure for a minimum of four (4) hours.
.2 Check all piping joints and connections for leaks with a water/soap solution while the piping is under pressure.
.8 *Propane Gas Piping:*
.1 Test piping with dry compressed air in accordance with the requirements of CAN1-B149.2 but not less than the following:
.1 low pressure to 14 kPa (2 psi) piping - 100 kPa (15 psi) for a minimum of four (4) hours;

.2 medium pressure 14 kPa to 230 kPa (2 psi to 33 psi) piping - 345 kPa (50 psi) for a minimum of four (4) hours;
.3 high pressure over 230 kPa (33 psi) piping - 1-1/2 times the maximum operating pressure for a minimum of four (4) hours.
.2 Check all piping joints and connections for leaks with a water/soap solution while the piping is under pressure.
.9 *Laboratory Gas Piping:*
.1 Test piping with dry nitrogen at a pressure of 345 kPa (50 psi) for a minimum of eight (8) hours.
.10 *Distilled Water Piping:*
.1 When the piping has been properly flushed and cleaned, test with distilled water or nitrogen in accordance with the pipe manufacturer's recommendations. Under no circumstances use raw water for testing purposes. If distilled water is used as the testing medium, drain all water from the system when the test is complete. Test pressure shall be 690 kPa (100 psi) or as recommended by the manufacturer.

.4 Pipe Leakage Testing Procedures - Class "C"
.1 Drainage and Vent Piping:
.1 Test new piping by a flow test for a minimum of 15 minutes. Piping to be no less than 75% full by volume during the flow test.
.2 Domestic Water Piping:
.1 Test piping with cold water at normal working pressures for a minimum of four (4) hours.
.3 Standpipe System Piping:
.1 Perform a system static pressure test.

.5 Identification of Piping Class:
.1 Testing and witnessing procedures for piping systems on this project shall conform to the following schedule:

SERVICE	CLASS OF TEST
Drainage & Vent	B
Domestic Water	B
Heating Water	B
Chilled Water	B
Glycol Solution	B
Process Water	B
Condenser Water	B
Pumped Discharge	B
Steam - low pressure	B
Steam - high pressure	B
Condensate	B
Compressed Air	B

3.18 Equipment Supports

.1 Equipment support products supplied by equipment manufacturers: specified elsewhere in Division 23.

.2 Equipment supports not supplied by equipment manufacturer: fabricate from structural grade steel, prime coated and painted.

.3 Mount base mounted equipment on chamfered edge housekeeping pads a minimum of 100mm (4") high and 100mm (4") larger than equipment dimensions all around.

.4 Supply anchor bolts and templates for installation by other divisions.

3.19 Concrete Work (By Others)

.1 Concrete for equipment housekeeping pads, bases, and any other concrete work required for mechanical work will be provided as part of the work of another Division, including formwork and reinforcing as required.

3.20 Cutting & Patching

.1 Refer to the article entitled "Cutting and Patching" of Section 01000 for general requirements.

.2 Accurately and carefully mark out the location and extent of cutting or drilling required and coordinate with the trade(s) performing the work.

.3 Size openings to leave 12mm (½") clearance around the pipes or pipe insulation. Pack and seal the void between the opening for the length of the opening with material as described in Section 01000.

.4 Note that where drilling is required in water-proof slabs, size the openings to permit installation of pipe sleeves as described hereinbefore.

3.21 Disconnecting & Removal Work

.1 Where indicated on the drawings, disconnect and remove items of existing mechanical work. Where piping, ductwork and other equipment are removed, disconnect at the point of supply, remove obsolete connecting services and make the system safe.

.2 Unless otherwise noted, all materials which are not to be relocated or reused shall become your property and shall be removed from the site and disposed of.

3.22 Interruptions To & Shut Downs of Mechanical Service & Systems

.1 All shut-downs and interruptions to existing mechanical services and systems shall be coordinated fully with and performed at times acceptable to the owner.

.2 Do not operate any NRC equipment or plant. Prior to each shut-down or service interruption, inform the Engineer in writing of this requirement and he will arrange to have the shut-down performed by the owner's personnel.

.3 Note that work associated with shut-downs and interruptions shall be carried out as continuous operations to minimize the shut-down time and to reinstate the systems as soon as possible, and, prior to any shutdown, ensure that all materials and labour required to complete the work for which the shut-down is required are available at the site.

3.23 Mechanical Connection For Equipment Supplied By Others

.1 Does not apply to this project.

PART 1 - GENERAL

1.1 Shop Drawings

.1 Submit shop drawings in accordance with Sections 001000 and 230502.

.2 Submit shop drawings for the following:
.1 dampers

PART 2 - PRODUCTS

2.1 Reference

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

2.2 Stainless Steel Ductwork

.1 Prime quality type 316 stainless sheet steel with metal gauges in accordance with SMACNA standards to suit the duct configuration and classification.

2.3 PVC Ductwork

.1 Does not apply to this project.

2.4 Flexible Ductwork - Uninsulated

.1 Does not apply to this project.

2.5 Balancing & Shut-Off Dampers

.1 Unless noted otherwise dampers for round st. stl. duct shall be butterfly type, 0.050" type 316 st. stl. full diameter blade, and Duro Dyne code AL-1255 regulator set with st. stl. locking regulator, st. stl. bearings, shaft & and shaft seals. Provide a visual indication

of damper position from the duct exterior.

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

PART 3 - EXECUTION

3.1 Reference

.1 Refer to Part 3 of the section entitled "Basic Materials and Methods" in this Division of the Specification for execution requirements which apply to Air Distribution work.

3.2 Fabrication & Installation of Ductwork

.1 Provide all required stainless steel & PVC ductwork and suitable fittings and adapters for a complete installation from the tie in points to new equipment.

.2 Unless specifically noted otherwise, all stainless steel duct, bends, elbows, transformations, branch fittings, etc. shall be fabricated, sealed and installed in accordance with the -4" water gauge (-1.0 kPa) pressure class (nonabrasive) of the latest edition of SMACNA Round Industrial Duct Construction Standards.

3.3 Installation of Flexible Ductwork

.1 Does not apply to this project.

3.4 Installation of Balancing Dampers

.1 Provide volume type dampers in all open end ductwork and wherever else shown.

.2 Install the dampers such that the

operating mechanism is positioned for easy operation, and such that the dampers cannot move or rattle.

3.6 Air Quantity Balancing & Testing

.1 Perform air quantity balancing and testing for the fume exhaust system.

.2 Air quantity balancing and testing of any system must not begin until the system is complete and fully operational.

.3 Testing shall be performed by a qualified independent testing and balancing company satisfactory to the Engineer, as a Sub-Contractor to you.

.4 Generally, balance and test exhaust systems as follows:
.1 adjust new main and branch exhaust air ducts to within 8% of design.
.2 provide pitot tube openings with approved caps where necessary to obtain accurate flow readings.

.5 Prepare and submit to the Engineer for review, four (4) complete bound, typewritten records of the results of air quantity balancing and testing in an approved manner and format.

PART 1 - GENERAL

1.1 General

.1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do all other work as specified in this section.

1.2 Qualifications of TAB Personnel

.1 Names of all personnel proposed to perform TAB to be submitted to and approved by the Departmental representative within 90 days of award of contract.

.2 Provide documentation confirming qualifications, successful experience.

1.3 Purpose of TAB

.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.

.2 Adjust and regulate equipment and systems so as to meet specified performance requirements and to achieve specified interaction with all other related systems under all normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 Exceptions

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

1.5 Co-ordination

.1 Schedule time required for TAB (including repairs,

re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.6 Pre-TAB Review

.1 Review contract documents before project construction is started and confirm in writing to Engineer adequacy of provisions for TAB and all other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to Engineer in writing all proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of all TAB devices, equipment, accessories, measurement ports and fittings.

1.7 Start-up

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

.2 Follow special start-up procedures specified elsewhere in Division 23.

1.8 Operation of Systems During TAB

.1 Operate systems for length of time required for TAB and as required by Engineer for verification of TAB reports.

1.9 Start of TAB

.1 Notify the Departmental Representative 7 days prior to start of TAB.

.2 Verify the proper, normal and safe operation of all mechanical and associated electrical and control systems affecting TAB including but not limited to:
.1 Proper thermal overload protection in place for electrical equipment.
.2 Air systems:
.1 Filters in place, clean.
.2 Duct systems clean.
.3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.

.4 Correct fan rotation.
.5 Fire, smoke, volume control dampers installed and open.
.6 Coil fins combed, clean.
.7 Access doors, installed, closed.
.8 All outlets installed, volume control dampers open.

.3 Liquid systems:
.1 Flushed, filled, vented.
.2 Correct pump rotation.
.3 Strainers in place, baskets clean.
.4 Isolating and balancing valves installed, open.
.5 Calibrated balancing valves installed, at factory settings.
.6 Chemical treatment systems complete, operational.

1.10 Application Tolerances

.1 Do TAB to following tolerances of design values:
.1 Laboratory HVAC systems: plus 5%, minus 0 %.
.2 All other HVAC systems: plus 5%, minus 5 %.
.3 Hydronic systems: plus or minus 10%.

1.11 Accuracy Tolerances

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

1.12 Instruments

.1 Prior to TAB, submit to Engineer list of instruments to be used together with serial numbers.

.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.3 Calibrate within 3 months of TAB. Provide certificate of calibration to Engineer.

1.13 Submittals

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

1.14 Preliminary TAB Report

.1 Submit for checking and approval of Engineer, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
- .1 Details of instruments used.
- .2 Details of TAB procedures employed.
- .3 Calculations procedures.
- .4 Summaries.

1.15 TAB Report

.1 Format to be in accordance with referenced standard.

.2 TAB report to show all results in SI units and to include:
- .1 Project record drawings.
- .2 System schematics.

.3 Submit 3 hard copies and 1 electronic copy of TAB Report to Engineer for verification and approval.

1.16 Verification

.1 All reported results subject to verification by Engineer.

.2 Provide manpower and instrumentation to verify up to 30 % of all reported results.

.3 Number and location of verified results to be at discretion of Engineer.

.4 Bear costs to repeat TAB as required to satisfaction of Engineer.

1.17 Settings

.1 After TAB is completed to satisfaction of Engineer, replace drive guards, close all access doors, lock all devices in set positions, ensure sensors are at required settings.

.2 Permanently mark all settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

1.18 Completion of TAB

.1 TAB to be considered complete only when final TAB Report received and approved by Engineer.

1.19 Air Systems

.1 Standard: TAB to be to most stringent of this section or TAB standards of AABC, NEBB, SMACNA and ASHRAE.

.2 Do TAB of all systems, equipment, components, controls specified Division 23.

.3 Qualifications: personnel performing TAB to be current member in good standing of AABC or NEBB.

.4 Quality assurance: Perform TAB under direction of supervisor qualified by AABC or NEBB.

.5 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

.6 Locations of equipment measurements: To include, but not be limited to, following as appropriate:
.1 Inlet and outlet of each damper, filter, coil, humidifier, fan, other equipment causing changes in conditions.
.2 At each controller, controlled device.

.7 Locations of systems measurements to include, but not be limited to, following as appropriate: Each main duct, main branch, sub-branch, run-out (or grille, register or diffuser).

1.20 Hydronic Systems

.1 Definitions: for purposes of this section, to include low pressure hot water heating, chilled water, condenser water, glycol systems.

.2 Standard: TAB to be to most stringent of this section or TAB standards of AABC, NEBB, SMACNA and ASHRAE.

.3 Do TAB of all systems, equipment, components, controls specified Division 23.

.4 Qualifications: personnel performing TAB to be current member in good standing of AABC or NEBB.

.5 Quality assurance: perform TAB under direction of supervisor qualified by AABC or NEBB.

.6 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: Flow rate, static pressure, pressure drop (or loss), temperature, specific gravity, density, RPM,

electrical power, voltage, noise, vibration.

.7 Locations of equipment measurement: To include, but not be limited to, following as appropriate:
.1 Inlet and outlet of each heat exchanger (primary and secondary sides), boiler, chiller, coil, humidifier, cooling tower, condenser, pump, PRV, control valve, other equipment causing changes in conditions.
.2 At each controller, controlled device.

.8 Locations of systems measurements to include, but not be limited to, following as appropriate: Supply and return of each primary and secondary loop (main, main branch, branch, sub-branch of all hydronic systems, inlet connection of make-up water.

1.21 Domestic HWC Systems

.1 Does not apply to this project.

PART 2 - PRODUCTS

PART 3 - EXECUTION

PART 1 - GENERAL

1.1 Reference Standards

.1 Components of insulation system to have maximum flame spread rating of 25 and maximum smoke developed rating of 50 in accordance with CAN/ULC-5102.

.2 Materials to be tested in accordance with ASTM C411.

PART 2 - PRODUCTS

2.1 Reference

.1 Refer to the Section entitled "Basic Materials and Methods" in this Division of the Specification for products which apply to Thermal Insulation work.

2.2 Pipe Insulation Materials

.2 Fiberglass:

.1 Rigid, moulded sectional pipe insulation made from inorganic glass fibers to CGSB 51-GP-9M with a factory applied all-service jacket to CGSB 51-GP-52M and a self-sealing lap.

.2 Acceptable product: Knauf ASJ-SSL, Johns Manville and Manson Alley K APT.

.3 Flexible Elastomeric:

.1 Closed-cell fire-retardent sectional pipe insulation, to CGSB-51.40.

.2 Acceptable product: Armstrong World Industries "Armaflex".

2.3 Duct Insulation Materials

.1 Fiberglass Board:

.1 Rigid board insulation made from inorganic glass fibers to CGSB-51-GP-10M with a factory-applied reinforced vapour retarder to CGSB 51-GP-52M.

.2 Acceptable product: Knauf Insulation Board, Johns Manville and Manson AK Board FSK.

.2 Fiberglass Blanket:

.1 Flexible blanket type insulation made from inorganic glass fibers to CGSB 51-GP-11M with a

factory-applied vapour barrier facing to CGSB 51-GP-52M.
.2 Acceptable products: Knauf Duct Wrap FSK, Johns Manville and Manson Alley-Wrap FSK.

.3 Spray Applied Foam:
.1 2 psf density closed cell polyurethane foam and UV resistant coating, conforming to CAN/ULC-S705. Finish with exterior grade latex paint.
.2 The spray foam insulation system shall be applied by a Canadian Urethane Foam Contractors Association licensed installer.

2.4 Equipment Insulation Materials

.1 Fiberglass Board:
.1 Semi-rigid fiberglass board insulation in roll form to CGSB 51-GP-10M with a glass mat facing.
.2 Acceptable product: Knauf Pipe and Tank and Manson AK Flex.

.2 Fiberglass Blanket:
.1 Flexible blanket type insulation made from inorganic glass fibers to CGSB 51-GP-11M with a factory-applied vapour barrier facing to CGSB 51-GP-52M.
.2 Acceptable product: Knauf Duct Wrap FSK and Manson Alley-Wrap FSK.

.3 Calcium Silicate:
.1 Moulded, sectional high temperature insulation made from hydrous calcium silicate to CGSB 51-GP-2M, plain or scored to suit the application.

.4 Flexible Elastomeric:
.1 Closed-cell fire retardent sheet insulation, to CGSB-51.40.
.2 Acceptable product: Armstrong World Industries "Armaflex".

2.5 Insulation Cements

.1 Insulation cement to CGSB 51-GP-6M and finish- ing cement to CGSB 51-GP-7MP.

2.6 Fastenings

.1 Tape: self-adhesive, aluminum, ULC listed for less than 25 flame spread and less than 50 smoke developed.

.2 Contact adhesive: quick-setting for seams and joints.

.3 Lap seal adhesive: quick setting for joints and lap

sealing of vapour barriers.

.4 Lagging adhesive: fire retardent coating.

.5 Adhesives shall be waterproof, fire resistive when wet and dry, and approved by the authorities concerned for the use intended.

.6 Acceptable manufacturers are Flintkote Co., 3M Co. Ltd., Benjamin Foster, Chicago Mastic, and Childers.

2.7 Accessories

.1 Wire - No. 15 gauge galvanized annealed wire.

.2 Twine - jute or fibrous glass twine.

.3 Mesh - 25mm (1") hexagonal mesh constructed of No. 15 gauge galvanized annealed wire.

.4 Aluminum strap - 12mm (½") wide, 0.50mm (0.020") thick.

.5 Steel strap - 12mm (½") wide, 0.40mm (0.015") thick galvanized.

.6 Duro Dyne spotter pins - 2mm (3/32") diameter, for installation prior to applying insulation. Length to suit thickness of insulation. Nylon retain clips 32mm (1¼") square.

2.8 Jackets

.1 Canvas:
.1 ULC listed plain weave cotton fabric at 220 g/m² (0.05 lb./ft²).
.2 Acceptable product: Alpha Maritex 3451-RW, Clairmont Diplag 60 and S. Fattal Thermocanvas.

.2 Aluminum:
.1 Smooth aluminum jacket, 0.40mm (.016") thick, with die shaped factory made albows and fittings to match.
.2 Acceptable product: Alcan Thermaclad.

.3 PVC:
.1 PVC jacket with one-piece, pre-molded elbow and fitting covers to match, manufactured to ASTM E84.
.2 Acceptable manufacturers: Childer's, Proto Corp. and Sure-Fit.

PART 3 - EXECUTION

3.1 Reference

.1 Refer to Part 3 of the Section entitled "Basic Materials and Methods" in this Division of the Specification for execution requirements which apply to Thermal Insulation work.

3.2 General Insulation Application Requirements

.1 Apply insulation after required tests have been completed and approved by Engineer. Insulation and surfaces shall be clean and dry when installed and during application of any finish. Apply insulation materials, accessories and finishes in accordance with manufacturer's recommendations and as specified.

.2 Install insulation directly over pipes and ducts and not over hangers and supports.

.3 Provide proper insulation shields, sized to suit the insulated pipe, between the pipe insulation and the pipe hanger or support for all piping.

.4 Install duct insulation continuous through walls, partitions, and similar surfaces except at fire dampers.

.5 For all hot piping 65mm (2-1/2") diameter and larger, steel protection saddles will be supplied and installed as part of the piping work. Pack the saddle voids with fiberglass insulation.

.6 When insulating "cold" piping and equipment, extend insulation up valve bodies and other such projections as far as possible, and protect the insulation jacketing from the action of condensation at its junction with the metal.

.7 On hot piping, omit insulation from flanges, unions and other components requiring regular maintenance. Using insulating cement, bevel away from the components to permit use of tools without damage to insulation. On cold piping, install insulation and finish to permit easy disassembly and replacement without damage to adjacent insulation and finish.

.8 Seal and finish exposed ends and other terminations with insulating cement.

.9 Where existing insulation work is damaged as a result of mechanical work, repair the damaged insulation work to new work standards.

3.3 Pipe Insulation Requirements - Fiberglass

.1 Insulate piping with fiberglass pipe insulation according to the following schedule:

SERVICE	INSULATION THICKNESS
Domestic cold water piping	25mm (1")
Domestic hot water piping	25mm (1")
Domestic hot water recirculation piping	25mm (1")
Horizontal storm drainage piping to the point where the main vertical riser extends down, and 1m (3') down the vertical riser	25mm (1")
Chilled water piping, supply & return, to 100mm (4") diameter	25mm (1")
Chilled water piping, supply & return, larger than 100mm (4") diameter	40mm (1½")
Hot water heating piping, supply & return, to 100mm (4") diameter	25mm (1")
Hot water heating piping, supply & return, larger than 100mm (4") diameter	50mm (2")
Glycol solution piping, supply & return, to 100mm (4") diameter	25mm (1")
Glycol solution piping, supply & return, larger than 100mm (4") diameter	40mm (1½")
Low pressure steam (to 414 kPa (60 psi)) piping, to 100mm (4") diameter	25mm (1")
Low pressure steam to 414 kPa (60 psi)) piping, larger than 100mm (4") diameter	50mm (2")
High pressure steam (414 kPa (60 psi) and above) piping,	

to 50mm (2") diameter	25mm (1")
High pressure steam (414 kPa (60 psi) and above) piping, larger than 50mm (2") diameter	50mm (2")
All condensate piping	25mm (1")

.2 Firmly butt together adjoining sections of the insulation and secure in place by tape at each end and centre of each section, but not greater than 450mm (18") on centres. Make longitudinal joints by closing the pressure tape or alternatively, secure the overlap flap with a full coverage of adhesive. Cover the butt joints with 75mm (3") wide vapour barrier tape.

.3 Wrap elbows, valves, flanges and similar fittings with blanket insulation to a thickness and insulating value equal to that of the sectional insulation for piping to 100mm (4") diameter. Laminate in place with adhesive and secure with twine. For piping larger than 100mm (4"), provide mitred segments of pipe insulation and laminate in place with adhesive and secure with twine. Cover the fitting with vapour barrier tape to match the finish of the adjacent insulation.

.4 For piping which shall receive a canvas finish, coat each fitting with two 3mm (1/8") coats of vapour barrier mastic, reinforced with glass fabric to produce a smooth, hard finish. At your option, in lieu of glass fabric and mastic, apply PVC fitting cover, taking care to ensure that the insulation completely fills the inside of the cover, so that it is fully supported. Secure the fitting cover by tack fastening, taping or banding.

3.4 Ductwork System Insulation Requirements - Fiberglass

.1 Insulate the following ductwork with fiberglass insulation of the thickness noted:

SERVICE	INSULATION THICKNESS
Supply ductwork from air conditioning supply units from fans to all diffusers, etc., and end of duct runs. This is to include any ductwork with air temperatures	

of less than 18.3 degrees C (65 degrees F)	25mm (1")
Supply ductwork and supply air plenums from fan coil units to all diffusers, etc. and end of duct runs	25mm (1")
All plenums and ductwork with untreated outdoor air	50mm (2")
All exhaust discharge ductwork and plenums. Plenums shall be entirely insulated with the duct work being insulated up to 3m (10') back from the plenum	50mm (2")

.2 Insulation for casings, plenums and rectangular ductwork shall be rigid board type. Insulation for round ductwork shall be blanket type.

.3 Securely butt together adjoining sections of rigid insulation. Secure the insulation in place with a full coverage of adhesive on all surfaces, and on vertical and suspended surfaces with spotter pins, welded to the ductwork on 300mm (12") to 450mm (18") centres with the insulation applied overtop the pin and secured in place with clips. Ensure that the insulation does not sag or bulge. Cut off excess length of spotter pin flush with clip and re-cover the clip with foil faced vapour barrier tape.

.4 Flexible insulation shall be wrapped tightly on to the ductwork with all circumferential joints butted and longitudinal joints overlapped a minimum of 50mm (2"). Insulation shall be adhered to duct surface with adhesive, applied in strips 150mm (6") wide and 300mm (12") on centre.

.5 Make joints in vapour barrier facings with 75mm (3") wide overlap strips of pressure sensitive vapour barrier tape.

.6 Insulate silencers located in ductwork systems to the same insulation standard as the ductwork.

.7 Do not apply insulation to casings, ducts or plenums which have been lined with acoustic insulation, unless indicated otherwise. External insulation shall extend 300mm (12") over acoustic lining.

.8 Apply 1.0mm (0.04") thick galvanized sheet metal corners to ductwork in mechanical rooms.

3.5 Ductwork System Insulation requirements - Spray-Applied Foam

.1 Insulate exhaust ductwork located outdoors with 2" thick spray-applied polyurethane foam and UV resistant coating recommended by manufacturer for outdoor locations.

3.6 Equipment Insulation Requirements - Fiberglass

.1 Insulate equipment with glass blanket type insulation with vapour barrier backing of the thickness noted:

SERVICE	INSULATION THICKNESS
Chilled water pump casings	40mm (1½")

.2 Wrap the equipment with insulation to a thickness and insulating value equal to an equivalent thickness of sectional pipe insulation. Laminate the insulation in place with adhesive and secure with wire or twine. Make joints in vapour barrier facings with 75mm (3") wide strips of pressure sensitive vapour barrier tape.

.3 Insulate the following equipment with semi-rigid board type fiberglass insulation (without vapour barrier backing) of the thickness noted:

SERVICE	INSULATION THICKNESS
Heat exchangers	40mm (1½")
Condensate receivers	40mm (1½")

.4 Wrap the insulation as required to fit the shape and contour of the equipment. Secure the insulation in place with adhesive, and with steel or aluminum straps on 450mm (18") centres. Point all open mitres, scores, joints and gaps with insulating cement. Cover the insulation with wire mesh secured to the metal bands. Lace edges of the wire mesh together. Apply a 6mm (¼") thick skim coat of insulating cement, then, when the

insulating cement has dried, apply a 6mm (¼") thick coat of finishing cement trowelled smooth.

.5 Supply removable and replaceable insulated metal covers for all equipment with removable heads.

3.7 Insulation Finish Requirements

.1 For piping and ductwork in concealed locations, no insulation finish is required.

.2 Jacket all piping insulation work in exposed locations with an aluminum jacket secured in place with aluminum bands on 450mm (18") centres and with 50mm (2") overlap at butt joints and longitudinal seams. Apply aluminum die shaped fitting covers to elbows and similar fittings.

.3 Jacket all ductwork insulation work in exposed locations inside the building with canvas secured with a full 100% covering coat of lagging adhesive. Neatly trim all canvas joints and shrink the canvas tight in place.

.4 Jacket all equipment insulation work with an aluminum jacket secured in place with aluminum bands on 450mm (18") centres and with 50mm (2") overlap at joints. Jacket irregular surfaces with canvas secured with a full 100% covering coat of lagging adhesive. Neatly trim all canvas joints and shrink the canvas tight in place.

.5 Finish all exposed flexible elastomeric insulation work with finish supplied by the insulation manufacturer. Apply one (1) coat for insulation inside the building, and two (2) coats for insulation work outside the building. Apply the finish in accordance with the manufacturer's recommendations and instructions.

PART 1 - GENERAL

1.1 General

.1 All general conditions of the entire work and all clauses of the Mechanical General Provisions shall form part of this work. This Contractor shall refer to them and be governed accordingly.

.2 All work shall conform to the requirements of the National Building Code of Canada. Installation shall be in accordance with local and provincial regulations and shall conform to the Canadian Electrical Code.

.3 All equipment and material to be new, UL or CSA certified, manufactured to minimum standard quoted including additional specified requirements. If equipment is not UL/CSA certified, submit such equipment to Inspection Authorities for special inspection and approval.

.4 Where installation procedures or recomendations, are required to be in accordance with the recommendations of the product manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Departmental Representative during the shop drawing submission.

1.2 Instructions to Bidder

.1 The Contractor shall co-ordinate this work with the work of other trades to assure proper installation of the materials for all trades.

.2 Prior to submitting a tender, this Contractor shall visit the site and verify all dimensions and conditions which may affect his tender. No allowance will be made for additional work dictated by site conditions. The Contractor shall submit his

tender based on the system described in these drawings and specifications.

1.3 Controls Contractor

.1 The Controls Contractor must have a staff of factory trained personnel to provide instruction and routine/emergency service on the installed BAS.

.2 The Controls Contractor must have local facilities, within 50 kilometres of project site, to coordinate all service, warranty, supply of material and software application and service/warranty work.

.3 He must have a proven record of similar DDC/BAS installations with at least five years of project installation experience. The BAS contractor shall also have experience in remote communication of BAS data transfer applications through the use of a standard telephone modem and personal computer. It shall be possible to modify all software and analyze all system data from the Contractor's or the Departmental representative's office.

.4 Airtron Canada shall be considered as Base Bid for this project. Any alternate Controls Contractor wishing to submit a quotation to execute the work shall submit a pre-qualification proposal to the Engineer for evaluation, 7 working days prior to tender closing. Tenders submitted without prequalification will not be accepted. Approved alternatives will be added by a pre-tender addendum.

1.4 Inspection and Fees

.1 Furnish a Certificate of Acceptance from the Authorized Electrical Inspection Department on completion of work.

.2 Request and obtain Special Inspection approval from the Authorized Electrical

Inspection Department for any non-CSA approved control panels or other equipment fabricated by the contractor as part of this contract.

.3 Pay all fees required for inspections.

1.5 System Description

.1 The Building Automation System (BAS) shall consist of PC-based workstations and microcomputer controllers of modular design providing distributed processing capability, and allowing future expansion of both input/output points and processing/control functions.

.2 For this project the system shall consist of the following components:
.1 Operator Workstation(s). The BAS shall use existing Operator Workstation Computers and printer(s) as described in Part 2 of the specification. These workstations must be running the standard workstation software developed and tested by the manufacturer of the network controllers and the standalone controllers. No third party front-end workstation software will be acceptable.
.2 Ethernet-based Network Controller (s). The BAS Contractor shall furnish Ethernet-based network controllers as described in Part 2 of the specification. These controllers will connect directly to the Operator Workstation over Ethernet, provide communication to the Standalone Digital Control Units and/or other Input/Output Modules and serve as a gateway to equipment furnished by others (if applicable).
.3 Standalone Digital Control Units (SDCUs). Provide the necessary quantity and types of SDCUs to meet the requirements of the project for mechanical equipment control including air handlers, central plant control, and terminal unit control. Each SDCU will operate completely standalone, containing all of the I/O and programs to control its associated equipment.

1.6 Code compliance

.1 Provide BAS components and ancillary equipment, which are UL-916 listed and labeled.

.2 All equipment or piping used in conditioned air streams, spaces or return air plenums shall comply with NFPA 90A Flame/Smoke/Fuel contribution rating of 25/50/0 and all applicable building codes or requirements.

.3 All wiring shall conform to the National Electrical Code.

.4 All smoke dampers shall be rated in accordance with UL 555S.

1.7 Scope of Work

.1 The work of this section shall include all labour, electrical permits, materials, tools, cartage, hoisting, equipment, controls instrumentation, calibration, commissioning, wiring, etc., required for the installation and functional operation of a complete and fully operational Energy Management Control System as described in these specifications and as shown on the drawings.

.2 Except as otherwise noted, the control system shall consist of all Ethernet Network Controllers, Standalone Digital Control Units, workstations, software, sensors, transducers, relays, valves, dampers, damper operators, PE and EP switches, control panels, dryer, filter drains, air pressure reducing stations, compressed air supply piping and other accessory equipment, along with a complete system of electrical interlocking wiring and pneumatic piping to fill the intent of the specification and provide for a complete and operable system. Except as otherwise specified, provide

operators for equipment such as dampers if the equipment manufacturer does not provide these. Coordinate requirements with the various Contractors.

.3 The BAS contractor shall review and study all HVAC drawings and the entire specification to familiarize himself with the equipment and system operation and to verify the quantities and types of dampers, operators, alarms, etc. to be provided.

.4 This specification covers the minimum hardware and performance requirements for a microprocessor based distributed digital control Building Automation System (BAS).

.5 The BAS contractor must have a proven record of similar DDC/BAS installations with at least five years of project installation experience. The BAS contractor shall also have experience in remote communication of BAS data transfer applications through the use of a standard telephone modem and personal computer. It shall be possible to modify all software and analyze all system data from the Contractor's or the Engineer's office.

.6 The BAS shall be fully user programmable requiring no special computer education for operation. All necessary instruction manuals and user training shall be supplied by the BAS Contractor.

.7 All work performed under this section of the specifications will comply with all codes, laws and governing bodies. If the drawings and/or specifications are in conflict with governing codes, the Contractor shall submit a proposal with appropriate modifications to the project to meet code restrictions. If this specification and associated drawings exceed governing code requirements, the specification will govern. The Contractor shall obtain and pay for all necessary construction permits and licenses.

.8 Provide services and manpower necessary for commissioning of system in coordination with the HVAC Contractor, Balancing Contractor and Owner's representative.

.9 The work includes, but is not necessarily limited to the following:

.1 The complete computerized BAS to monitor and control the heating, cooling, ventilation and pressure control systems as described herein and as shown on the drawings.

.2 The 120VAC wiring and conduit from emergency power electrical panels to each DDC Control Panel.

.3 All interlocking, wiring and installation of control devices associated with the equipment listed below shall be provided under this Contract. When the BAS system is fully installed and operational, the BAS Contractor and representatives of the Owner shall review and check out the system. Repeat this review at least once during each of the following 4 seasons. At these times, the BAS contractor shall demonstrate the operation of the system and prove that it complies with the intent of the drawings and specifications.

.4 All hardware and software necessary for the complete control system operation as specified herein.

.5 All necessary software to accomplish the sequences of operation as specified herein.

.6 All necessary input/output interface devices, including transducers, sensors and relays.

.7 All electric or pneumatic damper actuators and valve operators.

.8 Work associated with the local Operator Workstation personal computer and alarm/report printer.

.9 All sensors and control devices as shown on the drawings and specified herein

1.8 Work by Others

.1 The BAS Contractor shall cooperate with other contractors performing work on this project necessary to achieve a complete and neat installation. To that end, each contractor shall consult the drawings and specifications for all trades to determine the nature and extent of others' work.

.2 The BAS Contractor shall furnish all control valves, sensor wells, flow meters and other similar equipment for installation by the Mechanical Contractor, except where specifically noted otherwise.

1.9 Shop Drawings for Review

.1 The Contractor shall include the following in his submittal of material and equipment for review within 14 days after award of the contract. Three hard copies and one software copy of drawings shall be submitted in 1 package.

- Specification sheets of all applicable products
- Sensors/transmitters
- Valve and Damper Actuators
- Terminal Unit Controllers
- Control Relays and Current Relays
- Local Control Units
- Personal Computer Workstation/Operator Graphics
- Control Drawings (input/outputs)
- Wiring Diagrams

- Sequence of Operation
- Flow Diagram of System Architecture
- Valves and Dampers
- Software Configurations

.2 All shop drawings shall be prepared in Visio Professional or AutoCAD software. In addition to the drawings, the Contractor shall furnish a diskette containing the identical information. Drawings shall be B size or larger.

.3 Shop drawings shall include a riser diagram depicting locations of all controllers and workstations, with associated network wiring. Also included shall be individual schematics of each mechanical system showing all connected points with reference to their associated controller. Typical details will be allowed where appropriate.

.4 Submittal data shall contain manufacturer's data on all hardware and software products required by the specification. Valve, damper and air flow station schedules shall indicate size, configuration, capacity and location of all equipment.

.5 Software submittals shall contain narrative descriptions of sequences of operation, program listings, point lists, and a complete description of the graphics, reports, alarms and configuration to be furnished with the workstation software. Information shall be bound or in a three ring binder with an index and tabs.

.6 The Departmental Representative will make corrections, if required, and return to the Contractor. The Contractor will then resubmit with the corrected or additional data. This procedure shall be repeated until all corrections are made to the satisfaction

of the Engineer and the submittals are fully approved.

1.10 As-Built Drawings

.1 The Contractor shall supply the Departmental Representative with one software copy of as-built documentation showing apparatus and equipment as actually installed.

.2 This documentation shall be forwarded to the Engineer prior to final inspection, and shall constitute a precondition for final inspection.

1.11 Operation & Maintenance Manuals

.1 Three (3) complete sets of manufacturer's Operating Maintenance instruction Manuals, bound and indexed, shall be provided to the Departmental Representative. These shall contain all instructions for safe and efficient operation and maintenance of all equipment and systems.

.2 The operation and maintenance manuals shall contain all information necessary for the operation, maintenance, replacement, installation, and parts procurement for the entire BAS. This documentation shall include specific part numbers and software versions and dates. A complete list of recommended spare parts shall be included with the lead time and expected frequency of use of each part clearly identified.

1.12 Software

.1 Supply software manuals which describe programming and testing, starting with a system over view and proceeding to a detailed description of each software feature. Preliminary manuals shall be turned over to the Owner 120 days after Contract is awarded. The manual shall instruct the user on programming or reprogramming any portion

of the BAS.

.2 This shall include all control programs, algorithms, mathematical equations, variables, set points, time periods, messages, passwords and other information necessary to load, alter, test and execute the system.

1.13 System Commissioning

.1 Each point in the system shall be tested for both hardware and software functionality. In addition, each mechanical and electrical system under control of the BAS will be tested against the appropriate sequence of operation specified herein. Successful completion of the system test shall constitute the beginning of the warranty period. A written report will be submitted to the Departmental Representative indicating that the installed system functions in accordance with the plans and specifications.

.2 The BAS contractor shall commission and set in operating condition all major equipment and systems, such as the chilled water, hot water and all air handling systems, in the presence of the equipment manufacturer's representatives, as applicable, and the Owner’s representatives.

.3 The BAS Contractor shall provide all manpower and engineering services required to assist the HVAC Contractor and Balancing Contractor in testing, adjusting, and balancing all systems in the building. The BAS Contractor shall have a trained technician available on request during the balancing of the systems. The BAS Contractor shall coordinate all requirements to provide a complete air balance with the Balancing Contractor and shall include all labor and materials in his contract.

1.14 Training

.1 This Contractor shall provide the services of competent instructors who will give full instructions to the designated personnel in the operation, maintenance and programming of the BAS. The training shall be oriented specifically to the installed system rather than a general training course. Instructors shall be completely familiar with the subject matter which they are teaching.

.2 Training shall be designed for two levels of operators:

.1 Level 1 shall cover the following: - operate computer at elementary level - understand & respond to alarms - access reports & color graphics - preliminary trouble shooting

.2 Level 1 training shall have a minimum duration of 1 working day after acceptance of the BAS.

.3 Level 2 shall cover the following:

- all functions in level 1 plus
- alter equipment schedules and setpoints
- create history logging and trending
- alter passwords of level 1 operators
- uploading of BAS software
level 2 training shall have a minimum duration of 1 working day after acceptance of the BAS.

.4 The training programs shall include all training manuals, and other visual material required for classroom training.

1.15 Expansion Capabilities

.1 The modular design of the BAS shall allow for future expansion. Each panel shall have the minimum of one spare digital input, one spare

analog input, one spare digital output and one spare analog output. These spare points shall be capable of providing the programmable capabilities as outlined in these specifications.

.2 The BAS shall offer expansion modules as follows:

.1 Input/output units (IOU) with standalone control capability. All IOU functions are supported by the BAS Network Controller.

.2 Local Control Units (LCU) which provide full standalone microprocessor and RAM memory to support all local control loop functions. LCU's shall report all internal data back to the BAS coordinator for centralization of report and data logging functions, integrated control and alarming.

.3 Expansion Modules (EMX) which provide onboard plug in expansion of any combination of analog/digital inputs and outputs.

1.16 Materials

.1 The BAS shall use solid state computer based digital and analog technology. All materials and equipment used shall be standard components manufactured for this and/or other systems and not custom designed especially for this project. All Network Communication Controllers, Local Standalone Controllers, Terminal Unit Controllers and Input/Output Devices shall be manufactured by one and the same manufacturer. Different DDC/BAS processor system components networked via "gateway" or translation devices will not be accepted.

1.17 Warranty

.1 The BAS contractor shall warrant the system for 12 months after system acceptance and beneficial use by the owner. During the

warranty period, the BAS contractor shall be responsible for all necessary revisions to the software as required to provide a complete and workable system consistent with the letter and intent of the Sequence of Operation section of the specification.

.2 Updates to the manufacturer's software shall be provided at no charge during the warranty period.

PART 1 - GENERAL

1.1 Scope of Work

.1 The intended sequences of operation for the mechanical and electrical systems are outlined in this section.

.2 Provide all labour and materials required to design, install and commission the specified sequences. If portions of the intended sequence are specified to be installed by others such as by the mechanical contractor, coordinate this work as outlined in the mechanical specification sequences by providing engineering data and control equipment as may be required, otherwise complete the work as outlined.

.3 Use the system schematics and point definition sheets along with the written sequence to develop the program structure.

.4 Allow a reasonable amount of time for program changes, which NRC may require due to unforeseen conditions with equipment performance, installation conditions or design intent.

1.2 Standard Routines

.1 Turn off the equipment controlled by a local controller on a power interruption at the controller, as if a signal to stop the equipment had been given, unless the equipment is wired through normally closed contacts. On a return from power failure, restart or stop the equipment in an orderly fashion with time delays between each major system.

.2 If the power interruption has been to more than one local controller, the equipment start up shall be delayed between controllers.

.3 When equipment is in the off state, whether through program function, operator command or equipment failure, the following events must occur unless specified otherwise in the sequence.

- close outside air, relief and exhaust dampers.
- set control valves on water heating coils to allow some flow if the outside temperature is below freezing.
- turn off humidification systems.
- turn off interlocked equipment such as refrigeration equipment serving that unit only.
- position variable speed or inlet dampers to minimum value.
- close steam converter or heating coil valves.

- issue alarms to indicate the status of the equipment that does not match the commanded state.

.4 Execute Control sequences if the associated equipment is operating. For example, if the operator puts a supply fan in the hand position, and the fan is capable of operating as there are no external interlocks or safeties that would prevent it from operating such as an end switch, the sequence shall execute as if the BAS system had initiated the start up.

.5 Structure programs and loop control such that integral windup does not occur.

1.3 Alarms, Alarm and Event Messages

.1 Equipment failure shall be deemed to have occurred when the status point does not correspond with the commanded status. An alarm shall be generated.

.2 Whenever an input point or an output point has failed, is over ranged or not connected, the EMCS shall disable the input point and place all outputs dependent on the disabled input to a safe state. An alarm shall be generated for each occurrence.

.3 Allow programming labour for the generation of 2 alarm messages per major system.

.4 Provide room high and low temperature alarms set for 15 and 25 degrees.

.5 Designate alarms level 3 type unless specified otherwise.

1.4 Set Points

.1 All set points, time delay values and hours of operation as indicated in the sequence of operation or points list are for initial set up of the system. During the commissioning process and building operation, the set points are to be adjusted as deemed necessary to optimize HVAC system operation.

.2 Virtual set points shall be operator adjustable by commanding the point to the desired value.

PART 2 – SEQUENCE OF OPERATION

2.1 Laboratory MUA and Fume Exhaust Systems Coordination

.1 Provide overall RUN/STOP control for the MUA and Fume Exhaust Systems as selected by the BAS operator.

.2 Activate the BAS controls, start the Fume Exhaust system, then the MUA system and the HVAC control system in sequence on initial start-up, and in reverse order on shut down.

2.2 Laboratory make-up air (MUA)System

.1 Provide virtual HAND/OFF/AUTO control for the MUA fan, as selected by the BAS operator.

.2 Open the fan inlet isolation dampers, the outdoor air inlet damper, and start the supply air fan at minimum speed through its VFD on start-up, then modulate the fan speed to maintain the supply air duct static pressure set point (adjustable, initially 500 Pa).

.3 Monitor the speed feedback and general alarm for the VFD. Issue a BAS level 2 alarm if the fan fails, and Issue a BAS level 3 maintenance alarm if a fault is indicated.

.7 Communicate with the MUA supply fan VFD through its BACnet interface, to monitor or remotely control the critical functions and alarms as selected by NRC Facilities Maintenance.

.4 Monitor the outside air and MUA air temperatures. Modulate the hot glycol heating coil control valve and the chilled water cooling coil control valve in sequence to maintain a MUA temperature set point. Reset the MUA temperature between 65°F and 73°F according to a schedule relative to the outdoor air temperature. If the MUA falls below 36°F, shut down the supply fan and issue a level 1 BAS alarm.

.5 Monitor the outdoor air humidity. Drive the chilled water cooling coil control valve to 100% open when the outdoor air temperature is above 50°F, and the sum of the outdoor air temperature (°F) and the outdoor air humidity ratio (%RH) is greater than 110.

.6 Monitor the outdoor air and the MUA air humidity, and the humidifier run status and fault status. When the outdoor air temperature is below 50°F, enable the humidifier and modulate the humidifier output to maintain a MUA humidity set point (adjustable, initially 40%). Reset the MUA humidity set point

according to a schedule relative to the outdoor air temperature. Issue a level 2 BAS alarm if the humidifier is not energized after 10 minutes when commanded on, and a BAS level 3 maintenance alarm if a general fault is indicated.

.7 Connect the humidity high limit and airflow safety switches, supplied with the humidifier, to the humidifier internal controller.

.8 Monitor the pressure drop across the bank of MUA filters, and issue a level 3 maintenance alarm should the air filters require changing, as indicated by a pressure drop greater than 1.5 in. WG (adjustable).

.9 Reinstall the existing smoke detector on the MUA discharge duct. This device shall be hardwired under Division 16 to the VFD to shutdown the MUA fan in an emergency.

2.3 Laboratory Fume Exhaust System

.1 Provide virtual HAND/OFF/AUTO control for each fume exhaust fan, as selected by the BAS operator.

.2 Open the intake duct isolation damper, the outdoor air inlet damper in the heat recovery unit airhandler (HRU), and start the duty exhaust fan on system start-up, then modulate the outdoor air inlet damper to maintain an exhaust duct static pressure set point (adjustable, initially 800 Pa).

.3 Monitor the status of each exhaust fan and cycle the fans with duty/standby programming for equal run time and automatic switch over should the duty fan fail, and issue a level 2 alarm in the event the lead fan fails, and a level 1 alarm should both fans for the same system fail.

2.4 Heat Recovery Water/Glycol System

.1 Provide virtual HAND/OFF/AUTO control for the heat recovery glycol pump, as selected by the BAS operator.

.2 In auto mode run the heat recovery system pump when the make-up air and fume exhaust systems are energized, and the outside air temperature is below 58°F or above 78°F.

.3 Monitor the status of the pump with a current sensor, and issue a level 2 alarm should the pump fail.

.4 Monitor the supply glycol temperature to the HRU unit heat recovery coil, and keep this temperature above 45ºF to prevent condensation by modulating the 3-way control valve at the MUA unit, to divert some glycol flow back to the heat extraction coil.

.5 Issue a level 2 alarm should the supply water/glycol temperature fall below 32ºF for a minimum of 10 minutes.

2.5 Heating Glycol System

.1 System Start-up:
Start the system when the following two conditions are satisfied:
.1 The Glycol Heating Season must be ON, initially set at a start date of September 1st and an end date of June 30th
.2 The Outdoor Air temperature must be below the Glycol Boiler Enable setpoint, initially set to 65°F

.2 Modulate the supply glycol temperature setpoint according to a schedule relative to the outdoor air temperature as follows:

OAT ºF	SP °F
60	85
-13	135

.3 Reset the boiler’s glycol temperature SP from the MAU hot glycol coil control valve position as follows:
.1 If the valve is greater than 90% reset the setpoint up.
.2 If the valve is less than 85% reset the setpoint dowm.

.4 Provide virtual HAND/OFF/AUTO control for the glycol circulating pump, as selected by the BAS operator. Start the pump in AUTO mode according to the system start-up sequence.

.3 Monitor and display the status of the glycol circulating pump with a current sensor, and issue a level 2 alarm if no pump operates when the system has been commanded on for 5 minutes.

.4 Monitor the general alarm contact supplied in the glycol boiler control panel, and issue a BAS level 3 maintenance alarm if a general alarm is indicated.

2.6 Cooling Water System (Existing)

.1 Monitor and display the chilled water supply and return temperatures at the pipelines to the MUA cooling coil.

2.7 Interface with Fire Alarm

.1 Monitor the IPF Wing zone status of the existing fire alarm system, and the room air pressure in the 3rd floor lab space. Upon receiving a signal indicating a fire within the zone; shut down the make-up air system and reset the fume exhaust duct static pressure set point to ensure the pressure in the 3rd floor lab space does not fall below -20 Pa.

.2 Upon receiving a signal from the fire alarm system indicating the fire emergency is over; start the make-up air system and reset the fume exhaust duct static pressure set point to its original value.

PART 1- GENERAL

1.1 RELATED REQUIREMENTS

.1 n/a

1.2 REFERENCES

.1 ASME Boiler and Pressure Vessel Code (BPVC), Section VII-[2013].
.2 ASTM A 47/A 47M-[99(2009)], Standard Specification for Ferritic Malleable Iron Castings.
.3 ASTM A 278/A 278M-[01(2011)], Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).
.4 ASTM A 516/A 516M-[10], Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
.5 ASTM A 536-[84(2009)], Standard Specification for Ductile Iron Castings.
.6 ASTM B 62-[09], Standard Specification for Composition Bronze or Ounce Metal Castings.

.2 CSA Group
.1 CSA B51-[09], Boiler, Pressure Vessel, and Pressure Piping Code.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 230501.

.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for expansion tanks, air vents, separators, valves, and strainers and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:
.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 230501.

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

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

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

.3 Storage and Handling Requirements:
.1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect hydronic specialties from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

PART 2- PRODUCTS

2.1 DIAPHRAGM TYPE EXPANSION TANK

.1 Vertical steel pressurized diaphragm type expansion tank.

.2 Capacity: as indicated.

.3 Size: as indicated.

.4 Diaphragm sealed in EPDM suitable for 115 degrees C operating temperature.

.5 Working pressure: 860 kPa with ASME stamp and certification.

.6 Air precharged to 84 kPa (initial fill pressure of system).

.7 Base mount for vertical installation.

.8 Supports: provide supports with hold down bolts and installation templates incorporating seismic restraint systems.

2.2 AUTOMATIC AIR VENT

.1 Standard float vent: brass body and NPS 1/8 connection and rated at 620 kPa working pressure.

.2 Industrial float vent: cast iron body and NPS 1/2 connection and rated at 860 kPa working pressure.

.3 Float: solid material suitable for 115 degrees C working temperature.

2.3 AIR SEPARATOR - BOILER MOUNTED

.1 Complete with dip tube.

.2 Working pressure: 860 kPa.

2.4 AIR SEPARATOR - EXPANSION TANK FITTING

.1 Complete with adjustable vent tube and built-in manual vent valve.

.2 Working pressure: 860 kPa.

2.5 AIR SEPARATOR - IN-LINE

.1 Working pressure: 860 kPa.

.2 Size: NPS 1 1/2.

2.6 COMBINATION SEPARATORS/ STRAINERS

.1 Steel, tested and stamped in accordance with ASME BPVC, for 860 kPa operating pressure, with galvanized steel integral strainer with 5 mm perforations, tangential inlet and outlet connections, and internal stainless steel air collector tube.

2.7 COMBINATION LOW PRESSURE RELIEF AND REDUCING VALVE

.1 Adjustable pressure setting: 206 kPa relief, 55 to 172 kPa reducing.

.2 Low inlet pressure check valve.

.3 Removable strainer.

2.8 AUTOMATIC FLUID GLYCOL FULL TANK

.1 Minimum Tank capacity: 50 us gal storage/mixing tank with cover

.2 Pump suction hose with inlet strainer

.3 Pressure pump with thermal cut-out

.4 Integral pressure switch, check valve, cord and plug; pre-charged accumulator tank with EPDM diaphragm.

.5 Manual diverter valve for purging air and agitating contents of storage tank.

.6 Pressure regulating valve adjustable (5 – 55 psig) complete with pressure gauge; integral replaceable strainer; built-in check valve; union connection; ½” x 36” long flexible connection hose with check valve; low level pump cut-out.

.7 Pressure pump shall be capable of running dry without damage.

.8 Power supply 115/60/1 0.7 A.

.9 Unit shall be completely pre-assembled and certified by a recognized testing agency to CSA standard C22.2 No 68.

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 data sheets.

3.2 GENERAL

.1 Run drain lines and blow off connections to terminate above nearest drain.

.2 Maintain adequate clearance to permit service and maintenance.

.3 Should deviations beyond allowable clearances arise, request and follow NRC Representative directive.

.4 Check shop drawings for conformance of tappings for ancillaries and for equipment operating weights.

3.3 STRAINERS

.1 Install in horizontal or down flow lines.

.2 Ensure clearance for removal of basket.

.3 Install ahead of each pump.

.4 Install ahead of each automatic control valve [larger than NPS 1] [and radiation] [except at radiation] and as indicated.

3.4 AIR VENTS

.1 Install at high points of systems.

.2 Install gate valve on automatic air vent inlet. Run discharge to nearest [drain] [or] [service sink].

3.5 EXPANSION TANKS

.1 Adjust expansion tank pressure to suit design criteria.

.2 Install lockshield type valve at inlet to tank.

3.6 PRESSURE SAFETY RELIEF VALVES

.1 Run discharge pipe to terminate above nearest drain.

3.7 CLEANING

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

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

PART 1- GENERAL

1.1 RELATED REQUIREMENTS

.1 n/a

1.2 REFERENCES

.1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)
.1 ANSI/ASHRAE/IES Standard 90.1-[2010], Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 CSA Group
.1 CAN/CSA-B214-[12], Installation Code for Hydronic Heating Systems.

.3 Electrical Equipment Manufacturers Association of Canada (EEMAC)

.4 National Electrical Manufacturers' Association (NEMA)
.1 NEMA MG 1-[2011], Motors and Generators.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 230501.

.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for pump, circulator, and equipment and include product characteristics, performance criteria, physical size, finish and limitations indicate point of operation, and final location in field assembly.

.3 Shop Drawings:
.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
.2 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 230501.

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

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

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

.3 Storage and Handling Requirements:
.1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect hydronic pumps from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

PART 2- PRODUCTS

2.1 EQUIPMENT

.1 Size and select components to: CAN/CSA-B214.

2.2 VERTICAL IN-LINE CIRCULATORS

.1 Volute: cast iron, radially split, with tapped openings for venting, draining and gauge connections, with screwed or flanged suction and discharge connections.

.2 Impeller: bronze.

.3 Shaft: stainless steel with bronze sleeve bearing, integral thrust collar.

.4 Seal assembly: mechanical for service to 135 degrees C.

.5 Coupling: flexible self-aligning.

.6 Motor: to NEMA MG 1 resilient mounted, drip proof, sleeve bearing, as scheduled.

.7 Capacity: as indicated.

.8 Design pressure: 1200 kPa.

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 data sheets.

3.2 INSTALLATION

.1 Install hydronic pumps to: [CAN/CSA-B214].

.2 In line circulators: install as indicated by flow arrows.
.1 Support at inlet and outlet flanges or unions.
.2 Install with bearing lubrication points accessible.

.3 Base mounted type: supply templates for anchor bolt placement.
.1 Include anchor bolts with sleeves. Place level, shim unit and grout.
.2 Align coupling in accordance with manufacturer's recommended tolerance.
.3 Check oil level and lubricate. [After run-in, tighten glands].

.4 Ensure that pump body does not support piping or equipment.
.1 Provide stanchions or hangers for this purpose.
.2 Refer to manufacturer's installation instructions for details.

.5 Pipe drain tapping to [floor] drain.

.6 Install volute venting pet cock in accessible location.

.7 Check rotation prior to start-up.

.8 Install pressure gauge test cocks.

3.3 START-UP

.1 General:
.1 General Requirements; supplemented as specified herein.
.2 In accordance with manufacturer's recommendations.

.2 Procedures:
.1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.
.2 After starting pump, check for proper, safe operation.
.3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
.4 Check base for free-floating, no obstructions under base.
.5 Run-in pumps for 12 continuous hours minimum.
.6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.
.7 Eliminate air from scroll casing.
.8 Adjust water flow rate through water-cooled bearings.
.9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.
.10 Adjust alignment of piping and conduit to ensure true flexibility.
.11 Eliminate cavitation, flashing and air entrainment.
.12 Adjust pump shaft seals, stuffing boxes, glands.
.13 Measure pressure drop across strainer when clean and with flow rates as finally set.
.14 Replace seals if pump used to degrease system or if pump used for temporary heat.

.15 Verify lubricating oil levels.

3.4 PERFORMANCE VERIFICATION (PV)

.1 General:
.1 General Requirements, supplemented as specified herein.

.2 Verify that manufacturer's performance curves are accurate.

.3 Ensure valves on pump suction and discharge provide tight shut-off.

.4 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.

.5 Commissioning Reports: in accordance and as specified herein. Reports to include:
.1 Record of points of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.
.2 Pump performance curves (family of curves).

3.5 CLEANING

.1 Progress Cleaning: Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 Shop Drawings

.1 Submit shop drawings in accordance with Sections 001000 and 230501.

.2 Submit shop drawings for the following:
.1 grilles and diffusers;
.2 air balancing dampers.

PART 2 - PRODUCTS

2.1 Reference

.1 Refer to Part 2 of the section entitled "Basic Materials and Methods" in this Division of the Specification for products which apply to Air Distribution work.

2.2 Steel Ductwork

.1 Prime quality galvanized sheet steel with metal gauges in accordance with SMACNA standards to suit the duct configuration and classification.

2.3 Aluminum Ductwork

.1 Does not apply to this project.

2.4 Flexible Connections

.1 Duro-Dyne of Canada Ltd. "Duralon" airtight and moisture proof flexible ductwork connection material.

.2 Acceptable manufacturers are Duro-Dyne Ltd., "Durolon" as above, Ventfabrics "Ventglas" and Elgen Engineering Ltd. "Neoprene".

2.5 Balancing Dampers for Steel Ductwork

.1 Nailor-Hart Industries Inc. opposed blade galvanized steel control damper, Model No. as specified on the drawings, each

complete with linkage shaft extension, and a suitable and secure damper operator with locking device and visual indication of damper position from the duct exterior.

.2 Acceptable manufacturers are Nailor-Hart Industries Inc., Controlled Air Manufacturing Ltd., Ruskin Ltd., and Air Specialties Manufacturing Ltd.

2.6 Balancing Dampers for Aluminum Ductwork

.1 Does not apply to this project.

2.7 Grilles, Registers & Diffusers

.1 Does not apply to this project.

PART 3 - EXECUTION

3.1 Reference

.1 Refer to Part 3 of the section entitled "Basic Materials and Methods" in this Division of the Specification for execution requirements which apply to Air Distribution work.

3.2 Installation of Duct, Damper & Similar Formed Openings

.1 Duct openings, air inlet and outlet openings, fire damper openings, etc. will be provided in poured concrete work, masonry, drywall surfaces, etc., by the trade responsible for the particular construction in which the opening is required.

3.3 Fabrication & Installation of steel and Aluminum Ductwork

.1 Provide all required steel and aluminum ductwork. Unless otherwise noted, ductwork shall be constructed of aluminum.

.2 Unless specifically noted otherwise, all duct, bends, elbows, transformations,

branch fittings, etc. shall be fabricated, sealed and installed in accordance with the 2" water gauge (0.5 kPa) pressure class of the latest edition of SMACNA HVAC Duct Construction Standards.

.3 Install automatic control dampers and similar duct mounted control components supplied as part of the work specified in Section 15900 "Automatic Controls & Instrumentation".

3.4 Installation of Flexible Connections

.1 Provide minimum 150 mm (6") of flexible connection material where indicated.

.2 Install in accordance with recommendations of SMACNA.

3.5 Installation of Balancing Dampers

.1 Provide volume type dampers in all open end ductwork and wherever else shown.

.2 Install the dampers such that the operating mechanism is positioned for easy operation, and such that the dampers cannot move or rattle.

3.6 Installation of Grilles, Registers & Diffusers

.1 Does not apply to this project.

3.7 Air Quantity Balancing & Testing

.1 Perform air quantity balancing and testing to achieve the air flows indicated on the “SYSTEM SCHEMATIC” drawing.

.2 Air quantity balancing and testing of any system must not begin until the system is complete and fully operational.

.3 Testing shall be performed by a qualified independent testing and balancing company satisfactory to the Engineer, as a Sub-Contractor to yourself.

.4 Adjust air flow in ducts to within 5% of design.

.5 Provide pitot tube openings with approved caps where necessary to obtain accurate flow readings.

.6 Prepare and submit to the Engineer for review, three hardcopy and one software copy of typewritten records of the results of air quantity balancing and testing in an approved manner and format.

PART 1 - GENERAL

1.1 Shop Drawings and Product Data

.1 Submit shop drawings in accordance with Section 001000 and Section 230501.

.2 Indicate the following:
- .1 motors;
- .2 wheels;
- .3 bearings;
- .4 shafts;
- .5 corrosion resistant coating.

1.2 Manufactured Items

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

PART 2 - PRODUCTS

2.1 General

.1. Capacity: flow rate, static pressure, bhp, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.

.2. Substitution of any product other than that specified, must ensure no deviation below the stated capacities, or air flow rate. Power requirements must not be exceeded, and where specifically defined, sound power levels must not be exceeded. Applications for "equal" or "alternate" must address these factors.

.3. Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.

.4. Sound ratings: comply with AMCA 301, tested to AMCA 300. Unit shall bear AMCA certified sound rating seal.

.5. Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, and ANSI/ASHRAE 51.

.6. Motors: suitable for use with variable speed controllers.

.7. Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt

guards, coupling guards.

.8. Scroll casing drains.

.9. Bearing lubrication extension tubes where bearings are not easily accessible.

10. Vibration isolation: spring isolators with seismic control designed to suit the combined loads of the fan, motor, structural base and exhaust stack.

11. Flexible connections: chemical resistant Teflon type.

12. Factory-supplied steel base-frames.

13. Alternate products must show savings and clearly indicate all areas where they do not meet specified product.

2.2 Centrifugal Fans

.1 Fan wheels:
Blades shall be die-formed to achieve accurate cross-section. Hubs shall be cast iron or fabricated steel, welded and/or bolted to the backplate. The complete fan wheel shall be of continuously welded construction, and shall be dynamically balanced to ANSI Standard S2.l9, Quality Grade 2.5.

.2 Spark Resistant Construction:
Fans shall be constructed so as to reduce the possibility of contact between two ferrous components to AMCA Type A, where nonferrous components are brass.

.3 Shaft:
Fan shafts to be AISI-Cl045 hot-rolled steel, turned to tight tolerance or turned, ground and polished. Fan shafts shall be designed so as to operate at no more than 80% of the first critical speed when the fan operates at the top of the fan class speed range

.4 Housing:
Fan housing shall be constructed of heavy gauge steel suitable for the Class of duty, reinforced with structural angle for rigidity. All seams and joints are to be continuously welded to eliminate leakage.

.5 Bearings:
Fan bearings to be pillow block anti-friction bearings, heavy-duty ball or roller type for

minimum AFBMA L50 of 125,000 hours when fan operates at the top of the fan class speed range.

.6 Standard features:
Fans are to be provided with an access door into the fan housing. Fans size 7300 and larger shall be equipped with a split housing, bolted and gasketed to minimize leakage. Class 3 fans to be equipped with punched flanged outlet. All grease lubricated bearings that are not directly accessible shall be fitted with extended grease leads terminating at an accessible location on the fan housing.

.7 Coatings:
Prepare fans with commercial blast cleaning and ensure they are thoroughly cleaned and degreased. Interior and exterior of fan to be coated with 1 prime coat Intergard 345 HB Epoxy and 1 finish coat Intergard 740 Epoxy with a total of 6 mils. All guards covering rotating components shall have a finish coat of Safety Yellow – these do not require any commercial sand blast.

.8 Factory Run-Test:
Fans to be completely assembled and run-tested prior to shipment. Filtered vibration levels taken at the bearing caps are not to exceed .15 in/sec. Fan Run-Test reports to be retained at the factory for record for a minimum of 2 years.

.9 Motor:
Motors are to be rated 575 volts, 60 cycle, 3 phase, TEFC, premium efficiency, with a minimum service factor of 1.10. Acceptable manufacturers are: Leeson, Baldor/Reliance, Toshiba, Hyundai and TECO. Type of enclosure and duty of motor to be suitable for any applicable hazardous site conditions.

.10 Warranty:
Fan manufacturer to provide warranty on materials and workmanship for a period of 12 months from date of shipment.

.11 Acceptable products:
Twin-City, Haakon/Cook, Northern Blower.

PART 3 - EXECUTION

3.1 Installation

.1 Install fans as indicated complete with resilient mountings, flexible electrical leads, and flexible connections.

.2 Provide sheaves and belts required for final air balance.

.3 Bearings and extension tubes shall be easily accessible.

.4 Access doors and access panels shall be easily accessible.

.5 Provide electrical grounding to prevent static electrical charge.

PART 1- GENERAL

1.1 RELATED REQUIREMENTS

.1 n/a.

1.2 REFERENCES

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

.2 Underwriters' Laboratories of Canada (ULC)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 230501.

.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for chimneys and stacks and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:
.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
.2 Indicate following:
.1 Methods of sealing sections.
.2 Methods of expansion.
.3 Supports.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 QUALITY ASSURANCE

.1 Regulatory Requirements: work to be performed in compliance with applicable Provincial/Territorial regulations.

.2 Certifications:
.1 Catalogued or published ratings: obtained from tests carried out by independent testing agency or manufacturer signifying adherence to codes and standards.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging,

labeled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect chimneys and stacks from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

PART 2- PRODUCTS

2.1 TYPE B GAS VENT

.1 ULC labelled, 288 degrees C rating maximum, atmospheric gas vent only.

.2 Sectional, prefabricated, double wall with 13 mm air space. Aluminum inner wall. Galvanized steel outer wall. Mated fittings and couplings.

2.2 ACCESSORIES

.1 Cleanouts: bolted, gasketted type, full size of breeching, as indicated.

.2 Hangers and supports: in accordance with SMACNA.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

.1 Follow manufacturer's and SMACNA installation recommendations for shop fabricated components.

3.2 CLEANING

.1 Progress Cleaning:
.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 n/a.

1.2 REFERENCES

.1 American Boiler Manufacturers Association (ABMA)

.2 ASME
- .1 ASME Boiler and Pressure Vessel Code (BPVC), Section VII-[2013].

.3 CSA Group
- .1 CAN1-3.1-[77(R2011)], Industrial and Commercial Gas-Fired Package Boilers.
- .2 CSA B51-[09], Boiler, Pressure Vessel, and Pressure Piping Code.
- .3 CSA B139-[09], Installation Code for Oil Burning Equipment.
- .4 CSA B140.7-[05(R2010)], Oil Burning Equipment: Steam and Hot-Water Boilers.
- .5 CSA B149.1-[10], Natural Gas and Propane Installation Code.
- .6 ANSI Z21.13-[10]/CSA 4.9-[10], Gas-Fired Low-Pressure Steam and Hot Water Boilers.

.4 Electrical and Electronic Manufacturers Association of Canada (EEMAC)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 230501.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for heating boilers and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:
- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .2 Indicate on drawings:
  - .1 General arrangement showing terminal points, instrumentation test connections.
  - .2 Clearances for operation, maintenance, servicing, tube cleaning, tube replacement.
  - .3 Foundations with loadings, anchor bolt arrangements.
  - .4 Piping hook-ups.
  - .5 Equipment electrical drawings.
  - .6 Burners and controls.
  - .7 All miscellaneous equipment.
  - .8 Flame safety control system.
  - .9 Breeching and stack configuration.
- .3 Engineering data to include:
  - .1 Boiler efficiency at 25%, 50%, 75%, 100%, [and 110%] of design capacity.
  - .2 Radiant heat loss at 100% design capacity.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 230501.

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

1.5 QUALITY ASSURANCE

.1 Regulatory Requirements: work to be performed in compliance with Provincial regulations.

1.6 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra materials:
- .1 Submit maintenance materials in accordance with Section 230501.
  - .1 Special tools for burners, access opening, handholes and Operation and Maintenance.
  - .2 Spare parts for 1 year of operation.
  - .3 Spare gaskets.
  - .4 Spare gauge glass inserts.
  - .5 Probes and sealants for electronic indication.
  - .6 Spare burner tips.
  - .7 Spare burner gun.
  - .8 Safety valve test gauge.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

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

.3 Storage and Handling Requirements:
- .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect boiler and equipment from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Packaged boiler:
- .1 Complete with burner and necessary accessories and controls.
- .2 Factory tested at rated capacity to, and bearing seal or nameplate certifying compliance with, CSA B140.7 or CAN1-3.1.
- .3 Ready for attachment to piping, electrical power, controls, flue gases exhaust.
- .4 Designed and constructed to ASME Boiler and Pressure vessel Code.
- .5 CRN (Canadian Registration Number), to CSA B51.
- .6 Boiler/burner package to bear ULC or CGA] label.

.2 Performance:
- .1 In accordance with American Boiler Manufacturers Association (ABMA), or ANSI Z21.13/CSA 4.9 (gas burning) testing procedures.
- .2 Capacity: as indicated.
- .3 Boiler efficiency: 90% minimum at 30% to 100% firing rates.
- .4 Flue gas temperature leaving boiler:
  - .1 Not to exceed 260 degrees C.
  - .2 Above dewpoint conditions at minimum firing rate.

.3 Electrical:
- .1 Power: as indicated.
- .2 Controls: 208 V, 3 phase, 60 Hz.
- .3 Electrical components: CSA approved.

.4 Controls: factory wired. Enclosed in EEMAC 1 steel cabinet.

.5 Thermal insulation:
- .1 50 mm thick mineral fibre. Seal insulation at handholes, access opening, mudholes, piping connections with insulating cement or asphaltic paint. Finish with heat resisting paint.

.6 Jackets: heavy gauge metal, finished with heat resisting paint.

.7 Mounting:
- .1 Structural steel base, lifting lugs.

.8 Start-up, instruction, on-site performance tests: 3 days per boiler.

.9 Trial usage:
- .1 NRC Representative may use boilers for test purposes prior to acceptance and commencement of warranty period.
- .2 Supply labour, materials and instruments required for tests.

2.2 MODULAR HOT WATER BOILER, NATURAL GAS PULSE FIRED, CONDENSING TYPE

.1 Heating boiler seasonal efficiency rating: 90%. Flue gas exhaust temperature: 45 to 55 degrees C, when operating in condensing mode.

.2 Flue gas: individually direct vented. Combustion air: individually drawn from outdoors through plastic pipes as indicated and as recommended by manufacturer.

.3 Factory-assemble each module to include:
- .1 Combustion air inlet chamber.
- .2 Pre-purge blower assembly.
- .3 Air-gas fuel control valve.
- .4 Cast pulse combustion chamber.
- .5 Welded absorption chamber with spiralled fire tubes and exhaust chamber.
- .6 House assembly in insulated jacket which includes boiler mounted electrical control panel enclosure with operation sequence indicator lights.
- .7 Provide condensate drain fitting on exhaust chamber.
- .8 Boiler materials will enable operation with flue gas temperature below dewpoint without corrosion.

.4 Absorption unit: constructed in accordance with ASME Boiler and Pressure Vessel Code for Low Pressure Heating Boilers.

.5 Controls for each module to include:
- .1 Solid state controller with auxiliary relay.
- .2 Fan prove pressure switch and pressure sensing flame safeguard system.
- .3 Provide combination gas control with:
  - .1 Manual shut off valve.
  - .2 System pressure controlled regulator.
  - .3 Automatic redundant shut off valves.
  - .4 High limit water temperature control with adjustable differential.
  - .5 ASME approved pressure relief valve and temperature/pressure indicator.

.6 Factory wire each module and operationally test.
- .1 Each module suitable for individual firing.
- .2 Step firing accomplished by firing individual modules without reducing their thermal efficiency.
- .3 Control system: designed and provided for heating plant by manufacturer.

2.3 AUXILIARIES

.1 Provide auxiliaries for each boiler and to meet ASME requirements.

.2 Hot water boilers:
- .1 Relief valve: ASME rated, set at maximum boiler working pressure.
- .2 Pressure gauge: 90 mm diameter complete with shut-off cock.
- .3 Thermometer: 115 mm diameter range 10 to 150 degrees C.
- .4 Low water cut-off: with visual and audible alarms.
- .5 Auxiliary low water cut-off: with separate cold water connection to boiler.
- .6 Isolating gate valves: on supply and return connections.
- .7 Drain valve.
- .8 Stack thermometer: range 65 to 400 degrees C.
- .9 1 set of cleaning tools.

2.4 GAS BURNERS

.1 General:
- .1 Forced draft with:
  - .1 Built-in blower to supply combustion air, complete with motor, silencer and damper.
  - .2 High voltage ignition transformer.
  - .3 Flame observation port.
  - .4 Easy access to nozzles and electrodes.

.2 Gas pilot:
- .1 To building code and provincial regulations including solenoid gas valve, pressure regulator, pressure gauge, manual shut-off valve.

.3 Main gas train:
- .1 To building code and provincial regulations including main shut-off valve, pressure regulator, motorized electric shut-off valve, downstream block-test valve with test connection and pressure gauge.

.4 Controls:
- .1 Electronic combustion control relay with flame detector for combustion control and flame supervision.
- .2 Control to shut off fuel upon pilot flame or main flame failure or upon signal of safety interlock and to ensure, when restarted, in sequence:
  - .1 Pre-purge.
  - .2 Pilot ignition and supervision.
  - .3 Main gas valve opening.
  - .4 Pilot cut-off. Pilot-proving period not to exceed 10 seconds.
  - .5 Burner operation.
  - .6 Post-purge burner shut-down.
- .3 Static pressure interlock. To shut off burner upon loss of combustion air pressure.
- .4 Fuel-air mixture: control through:
  - .1 2-position motor with end switch to provide for low-fire start and high fire run.
  - .2 2-position motor with linkage to control fuel and air and with end switches to prove low-fire

start and energize high fire solenoid valve for high-low fire operation.

.3 Modulating motor with end switch to provide for low-fire start and fully modulating operation down to 20% of design capacity.

.5 Immersion controllers:

.1 Operating: to start and stop burner, and operating between adjustable setpoints.

.2 Modulating: to modulate burner output.

.3 High limit: manual reset.

.4 Controller range: 30 to 121 degrees C.

.6 Visual and audible alarms: to indicate burner shutdown due to flame failure, low water level, high pressure or temperature, low air pressure, low gas pressure.

.7 Pilot lights: to indicate:

.1 Normal burner operation.

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 ASME Boiler and Pressure Vessels Code, regulations of Province having jurisdiction, except where specified otherwise, and manufacturers recommendations.

.2 Make required piping connections to inlets and outlets recommended by boiler manufacturer.

.3 Maintain clearances as indicated or if not indicated, as recommended by manufacturer for operation, servicing and maintenance without disruption of operation of any other equipment/system.

.4 Mount unit level.

.5 Pipe hot water relief valves full size to nearest drain.

.6 Natural gas fired installations: in accordance with CSA B149.1.

3.3 MOUNTINGS AND ACCESSORIES

.1 Safety valves and relief valves:
- .1 Run separate discharge from each valve.
- .2 Terminate discharge pipe as indicated.
- .3 Run drain pipe from each valve outlet and drip pan elbow to above nearest drain.

3.4 FIELD QUALITY CONTROL

.1 Commissioning:
- .1 Manufacturer to:
  - .1 Certify installation.
  - .2 Start up and commission installation.
  - .3 Carry out on-site performance verification tests.
  - .4 Demonstrate operation and maintenance.
- .2 Provide NRC Departmental Representative with at least 24 hours' notice prior to inspections, tests, and demonstrations. Submit written report of inspections and test results.

3.5 CLEANING

.1 Progress Cleaning:
- .1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment..

END OF SECTION

PART 1 - GENERAL

1.1 Shop Drawings

.1 Submit shop drawings in accordance with Section 001000 and Section 230501.

.2 Submit shop drawings for the following:
- .1 steam traps;
- .2 steam pressure reducing valves.

2.1 Reference

.1 Refer to Part 2 of the Section entitled "Basic Materials and Methods" in this Division of the Specification for products which apply to Liquid Heat Transfer work.

2.2 Steam Pressure Reducing Valves

.1 Industrial quality control valve as specified on the drawings, single port globe type body with unbalanced valve plug and guided cage, complete with diaphragm actuator, pressure controller, proportional reset and an air filter regulator.

.2 Up to and including 50 mm (2") - screwed ends; 65 mm (2-1/2") and over - flanged ends.

.3 Material, main valve:
- .1 Body: cast steel.
- .2 Seat Rings: 416 stainless steel.
- .3 Valve Plug: 416 stainless steel.
- .4 Cage: 17-4PH stainless steel.

.4 Material - Diaphragm actuator:
- .1 Diaphragm Casing: steel.
- .2 Diaphragm: nitrile or nylon.
- .3 Actuator Spring: alloy steel.
- .4 Spring Seat: steel.

.5 Acceptable manufacturer is Fisher.

2.3 Steam Pressure Relief Valves

.1 Does not apply to this project.

2.4 Drip Pan Elbows

.1 Does not apply to this project.

2.5 Float & Thermostatic Steam Traps

.1 Erwel "FT" Series float and thermostatic traps, each complete with a cast iron body and cover, a stainless steel float, a phosphor bronze thermostatic air vent with stainless steel head and seat and stainless steel valve mechanism.

.2 Acceptable manufacturers are Spirax, Erwel, Armstrong Machine Works and Honeywell Braukmann.

2.6 Inverted Bucket Steam Traps

.1 Erwel "C" Series inverted bucket steam traps complete with a 250 psi rated cast iron body and cover, a hardened stainless steel valve seat and head, a stainless steel mechanism, a stainless steel bucket, and an integral stainless steel strainer.

.2 Acceptable manufacturers are Erwel, Armstrong Machine Works, and Honeywell Braukmann.

2.7 Pipe Line Strainers

.1 Erwel Type "YS" or "NYS" cast iron Y strainer with screwed ends rated at 1725 kPa (250 psi) complete with 0.8 mm (1/32") perforated stainless steel screen.

.2 Erwel Type "NF" cast iron flanged Y strainer, rated at 1725 kPa (250 psi) complete with 0.8 mm (1/32") perforated stainless steel screen and flanged blow-down cover.

.3 Erwel Type "F-600" forged steel Y strainer with screwed ends, rated at 4140 kPa (600 psi), complete with 0.8 mm (1/32") perforated stainless steel screen.

.4 Erwel Type "M" cast steel Y strainer with screwed ends, rated at 4140 kPa (600 psi), complete with 0.8mm (1/32") perforated stainless steel screen.

.5 Erwel Type "YF" or "NYF" cast steel flanged Y strainer, rated at 2070 kPa (300 psi), complete with 0.8mm (1/32") perforated stainless steel screen.

.6 Acceptable manufacturers are Erwel, Armstrong Machine Works, and Spirax Ltd.

2.8 Pipe Expansion Joints

.1 For all steam and condensate piping up to and including 65mm (2-1/2") diameter high pressure expansion joints with multi-ply stainless steel bellows with internal guide, external bellow shroud, torque control and limit stops and complete with screwed ends.

.2 For low and medium pressure (less than 414 kPa (60 psi)) steam and condensate piping in sizes 75 mm (3") and up, corrugated expansion joints with equalizing rings, stainless steel bellows and complete with 1035 kPa (150 psi) flanged ends.

.3 For high pressure (414 kPa (60 psi) and above) steam and condensate piping in sizes 75 mm (3") and up, corrugated expansion joints with equalizing rings, stainless steel bellows and complete with 2070 kPa (300 psi) flanged ends.

.4 Acceptable manufacturers are Indrefab, Adsco and Flexonics.

PART 3 - EXECUTION

3.1 Reference

.1 Refer to the Section entitled "Basic Materials and Methods" in this Division of the Specification for execution requirements which apply to Liquid Heat Transfer work.

3.2 Heating, Chilled & Condenser Water Piping Installation Requirements

.1 Provide all required heating, chilled and condenser water piping. Piping shall be mild black steel, Schedule 40 for piping 2 -1/2" diameter and larger, heating and Type "L" copper for piping 2" diameter and smaller.

.2 Piping to and including 50 mm (2") diameter shall be screwed. Piping 65 mm (2-1/2") diameter and larger shall be welded or grooved end (Victaulic)joints.

.3 Slope horizontal mains to provide a minimum continuous up-grade of 25 mm (1") in 6 m (20') to high points. Slope branch supply and return piping connections to equipment a minimum of 25 mm in 1.2 m (1" in 4').

.4 Provide an automatic air relief vent at the high points of the piping systems where indicated.

.5 Provide a throttling globe type shut-off valve in the supply connection to and a gate type shut-off valve in the return connection from each piece of apparatus connected with heating, chilled or condenser water piping.

.6 At your option, lug body type butterfly valves may be used in lieu of gate valves in piping 75 mm (3") diameter and larger.

.7 At your option, ball valves may be used in lieu of gate valves in piping up to and including 50 mm (2") diameter.

.8 Install automatic control valves, piping wells and similar piping and/or equipment mounted control components required for automatic temperature control systems specified in the Section entitled "Automatic Controls and Instrumentation".

3.3 Steam & Condensate Piping Installation Requirements

.1 Generally, piping shall be designed in conformance with ANSI/ASME code B31.1 "Code for Pressure Piping", except for more stringent requirements as outlined herein.

.2 All piping shall be mild black carbon steel, Schedule 40 for steam piping at a pressure less than 414 kPa (60 psi), and Schedule 80 for steam piping at a pressure greater than 414 kPa (60 psi), and all condensate piping, except for buried steam and condensate piping, which shall conform to section 15521.

.3 Piping up to and including 50 mm (2") shall be screwed. Piping 65 mm (2-1/2") and larger shall be welded.

.4 Fittings for screwed steam piping at a pressure less than 414 kPa (60 psi) shall be malleable iron Class 150. Fittings for screwed steam piping at a pressure greater than 414 kPa (60 psi) and all condensate piping shall be malleable iron Class 300.

.5 Fittings for welded piping shall be forged steel butt welding fittings, Schedule 40 for steam piping at a pressure less than 414 kPa (60 psi) and Schedule 80 for steam piping at a pressure greater than 414 kPa (60 psi) and all condensate piping.

.6 Flanges for welded piping shall be forged steel, raised face flanges, Class 150 for steam at a pressure less than 414 kPa (60 psi) and Class 300 for steam piping at a pressure greater than 414 kPa (60 psi) and all condensate piping.

.7 Bolts for all welding flanges shall be chrome-molybdenum alloy heat treated steel studs to

ASTM A193-Grade E-7 with heat treated carbon steel, heavy semi-finished hexagon nuts to ASTM A194.

.8 Gaskets for welding flanges shall be heavy-duty non-asbestos compressed sheet, equivalent to Sepco Style 6234, minimum thickness 1/16".

.9 Unless otherwise noted, slope horizontal steam mains 25 mm in 6 m (1" in 20') in the direction of flow.

.10 Unless otherwise approved, slope horizontal condensate return mains 65 mm (2-1/2") and larger 25 mm in 6 m (1" in 20'). Slope smaller condensate return lines and condensate drip piping not less than 25 mm in 3 m (1" in 10'). All condensate piping slopes shall be in the direction of flow.

.11 Slope steam supply and condensate return branch connections to and from equipment a minimum of 25 mm in 1.8 m (1" in 6').

.12 Extend branch steam supply piping off the top of horizontal mains, either vertically or at a 45 degree angle, as space permits.

.13 Connect low pressure condensate drip piping from steam drip trap assemblies into condensate return piping unless otherwise shown on the drawings or specified herein.

.14 Make all changes in the pipe size in horizontal steam and condensate piping with eccentric reducing fittings. Install eccentric reducing fittings in steam piping with the flat on the bottom and in condensate piping with the flat on the top. Do not use bushings in any piping.

.15 Provide minimum 200 mm (8") long, minimum 25 mm (1") diameter valved (gate hose end drain valve) and capped dirt pockets at the bottom of steam and condensate risers.

.16 Provide a globe type shut-off valve and a vacuum breaker in the steam piping connection to each piece of equipment.

.17 Provide a gate type shut-off valve in the condensate return piping from each piece of equipment.

.18 Provide a steam drip trap assembly in the condensate return piping from each piece of equipment, at the base of each riser, and wherever it is necessary to raise the piping to avoid a reduction in ceiling height or minimum headroom allowances. Equip each drip trap with shut-off valve(s), a strainer and a dirt pocket.

.19 Drip traps in condensate piping at a pressure less than 103.5 kPa (15 psi), except as noted below, shall be float and thermostatic type sized in accordance with requirements but generally to correspond to condensate return piping sizes.

.20 Drip traps in condensate piping at a pressure less than 103.5 kPa (15 psi) at radiation units and motorized heaters shall be balanced pressure thermostatic type to suit requirements.

.21 Drip traps in condensate piping at a pressure greater than 103.5 kPa (15 psi) shall be inverted bucket type of the proper size.

.22 Provide all required steam vent piping. Pipe shall be Schedule 40 black steel. Confirm exact location of the roof opening prior to roughing-in.

.23 Check and test the operation of all steam relief valves and adjust as required.

.24 Install automatic control valves, piping wells and similar piping mounted control components as required for automatic temperature control systems specified in Section entitled "Automatic Controls and Instrumentation".

.25 Include for all required steam and condensate piping and accessories for connections to the Owner's equipment as shown and/or scheduled.

3.4 Piping Expansion & Contraction

.1 Provide expansion joints and compensators, flexible connections, pipe loops and offsets required for expansion and contraction of piping systems as detailed on the drawings.

.2 Support piping to prevent stress and strain on equipment connections.

.3 Install and guide expansion joints to manufacturer's instructions and as shown.

3.5 Installation of Steam Pressure Reducing Valves

.1 Provide steam pressure reducing valve stations with manual by-pass where shown and connect with piping. Each station shall be complete with pressure gauges, shut-off valves, dirt pockets, relief valves, reducers and pressure reducing valves.

.2 Pipe the discharge of the safety relief valve to atmosphere independent of other vents and in accordance

with applicable code.

.3 Adjust each station as required. Check relief valve operation and leave in perfect operating condition.

PART 1 - GENERAL

1.1 Shop Drawings

.1 Submit shop drawings in accordance with Section 01000 and Section 15010.

.2 Submit shop drawings for the following:
.1 humidifiers.

PART 2 - PRODUCTS

2.1 Reference

.1 Refer to Part 2 of the Section entitled "Basic Materials and Methods" in this Division of the Specification for products which apply to Liquid Heat Transfer work.

2.2 Radiator Shut-Off & Balancing Valves

.1 Not applicable to this project.

2.3 Steam Pressure Reducing Valves

.1 Not applicable to this project.

2.4 Steam Pressure Relief Valves

.1 Not applicable to this project.

2.5 Drip Pan Elbows

.1 Not applicable to this project.

2.6 Float & Thermostatic Steam Traps

.1 Erwel "FT" Series float and thermostatic traps, each complete with a cast iron body and cover, a stainless steel float, a phosphor bronze thermostatic air vent with stainless steel head and seat and

stainless steel valve mechanism.

.2 Acceptable manufacturers are Spirax Sarco, Erwel, Armstrong Machine Works and Honeywell Braukmann.

2.7 Balanced Pressure Thermostatic Steam Traps

.1 Not applicable to this project.

2.8 Inverted Bucket Steam Traps

.1 Not applicable to this project.

2.9 Pipe Line Strainers

.1 Erwel Type "YS" or "NYS" cast iron Y strainer with screwed ends rated at 1725 kPa (250 psi) complete with 0.8 mm (1/32") perforated stainless steel screen.

.2 Acceptable manufacturers are Erwel, Armstrong Machine Works, and Spirax Sarco Ltd.

2.10 Pipe Expansion Joints

.1 For all steam and condensate piping up to and including 65mm (2-1/2") diameter high pressure expansion joints with multi-ply stainless steel bellows with internal guide, external bellow shroud, torque control and limit stops and complete with screwed ends.

.2 For low and medium pressure (less than 414 kPa (60 psi)) steam and condensate piping in sizes 75 mm (3") and up, corrugated expansion joints with equalizing rings, stainless steel bellows and complete with 1035 kPa (150 psi) flanged ends.

.4 Acceptable manufacturers are Indrefab, Adsco and Flexonics.

2.11 Standard Continuous Wall Connectors	.1	Not applicable to this project.
2.12 Cabinet Convectors	.1	Not applicable to this project.
2.13 Horizontal Unit Heaters	.1	Not applicable to this project.
2.14 Vertical Unit Heaters	.1	Not applicable to this project.
2.15 Force Flow Heaters	.1	Not applicable to this project.
2.16 Fan Coil Units	.1	Not applicable to this project.
2.17 Steam Injection Humidifiers	.1	Not applicable to this project.
2.18 Steam to Steam Humidifiers	.1	Provide self-contained steam to steam generating humidifier as specified on the drawings. The humidifier shall be suitable for use with high purity reverse osmosis water, have nickel coated copper or stainless steel heat exchanger tubes, be equipped with electronic operating and diagnostic controls, and a modulating steam control valve with electronic actuator. It shall accept a proportional input signal from the building automation system for capacity control.
	.2	An optional air proving switch and an on/off duct mounting high limit humidistat

shall be supplied and turned over to the sheet metal contractor for installation in the ductwork. Coordinate installation with Division 16 who will make the electrical connections.

.3 Acceptable product:
Pure, Dri-Steam.

PART 3 - EXECUTION

3.1 Reference

.1 Refer to PART 3 of the Section entitled "Basic Materials and Methods" in this Division of the Specification for execution requirements which apply to Liquid Heat Transfer work.

3.2 Heating, Chilled & Condenser Water Piping Installation Requirements

.1 Not applicable to this project.

3.3 Steam & Condensate Piping Installation Requirements

.1 Generally, piping shall be designed in conformance with ANSI/ASME code B31.1 "Code for Pressure Piping", except for more stringent requirements as outlined herein.

.2 All piping shall be mild black carbon steel, Schedule 40 for steam piping at a pressure less than 414 kPa (60 psi) and Schedule 80 for steam piping at a pressure greater than 414 kPa (60 psi) and all condensate piping.

.3 Piping up to and including 50 mm (2") shall be screwed. Piping 65 mm (2-1/2")

and larger shall be welded.

.4 Fittings for screwed steam piping at a pressure less than 414 kPa (60 psi) shall be malleable iron Class 150. Fittings for screwed steam piping at a pressure greater than 414 kPa (60 psi) and all condensate piping shall be malleable iron Class 300.

.5 Fittings for welded piping shall be forged steel butt welding fittings, Schedule 40 for steam piping at a pressure less than 414 kPa (60 psi) and Schedule 80 for steam piping at a pressure greater than 414 kPa (60 psi) and all condensate piping.

.6 Flanges for welded piping shall be forged steel, raised face flanges, Class 150 for steam at a pressure less than 414 kPa (60 psi) and Class 300 for steam piping at a pressure greater than 414 kPa (60 psi) and all condensate piping.

.7 Bolts for all welding flanges shall be chrome-molybdenum alloy heat treated steel studs to ASTM A193-Grade E-7 with heat treated carbon steel, heavy semi-finished hexagon nuts to ASTM A194.

.8 Gaskets for welding flanges shall be heavy-duty non-asbestos compressed sheet, equivalent to Sepco Style 6234, minimum thickness 1/16".

.9 Unless otherwise noted, slope horizontal steam mains 25 mm in 6 m (1" in 20') in the direction of flow.

.10 Unless otherwise approved, slope horizontal condensate return mains 65 mm (2-1/2") and larger 25 mm in 6 m (1" in 20'). Slope smaller condensate return lines and condensate drip piping not less than 25 mm in 3 m (1" in 10'). All condensate piping slopes shall be in the direction of flow.

.11 Slope steam supply and condensate return branch connections to and from equipment a minimum of 25 mm in 1.8 m (1" in 6').

.12 Extend branch steam supply piping off the top of horizontal mains, either vertically or at a 45 degree angle, as space permits.

.13 Connect low pressure condensate drip piping from steam drip trap assemblies into condensate return piping unless otherwise shown on the drawings or specified herein.

.14 Make all changes in the pipe size in horizontal steam and condensate piping with eccentric reducing fittings. Install eccentric reducing fittings in steam piping with the flat on the bottom and in condensate piping with the flat on the top. Do not use bushings in any piping.

.15 Provide minimum 200 mm (8") long, minimum 25 mm (1") diameter valved (gate hose end drain valve) and capped dirt pockets at the bottom of steam and condensate risers.

.16 Provide a globe type shut-off valve and a vacuum breaker in the steam piping connection to each piece of equipment.

.17 Provide a gate type shut-off valve in the condensate return piping from each piece of equipment.

.18 Provide a steam drip trap assembly in the condensate return piping from each piece of equipment, at the base of each riser, and wherever it is necessary to raise the piping to avoid a reduction in ceiling height or minimum headroom allowances. Equip each drip trap with shut-off valve(s), a strainer and a dirt pocket.

.19 Drip traps in condensate piping at a

pressure less than 103.5 kPa (15 psi), except as noted below, shall be float and thermostatic type sized in accordance with requirements but generally to correspond to condensate return piping sizes.

.20 Drip traps in condensate piping at a pressure less than 103.5 kPa (15 psi) at radiation units and motorized heaters shall be balanced pressure thermostatic type to suit requirements.

.21 Drip traps in condensate piping at a pressure greater than 103.5 kPa (15 psi) shall be inverted bucket type of the proper size.

.22 Provide all required steam vent piping. Pipe shall be Schedule 40 black steel. Confirm exact location of the roof opening prior to roughing-in.

.23 Check and test the operation of all steam relief valves and adjust as required.

.24 Install automatic control valves, piping wells and similar piping mounted control components as required for automatic temperature control systems specified in Section entitled "Automatic Controls and Instrumentation".

.25 Include for all required steam and condensate piping and accessories for connections to the Owner's equipment as shown and/or scheduled.

3.4 Piping Expansion & Contraction

.1 Provide expansion joints and compensators, flexible connections, pipe loops and offsets required for expansion and contraction of piping systems as detailed on the drawings.

.2 Support piping to prevent stress and strain on equipment connections.

.3 Install and guide expansion joints to manufacturer's instructions and as shown.

3.5 Installation of Steam Pressure Reducing Valves

.1 Not applicable to this project.

3.6 Installation of Heating Convectors

.1 Not applicable to this project.

3.7 Installation of Unit Heaters

.1 Not applicable to this project.

3.8 Installation of Force Flow Heaters

.1 Not applicable to this project.

3.9 Installation of Fan Coil Units

.1 Not applicable to this project.

3.10 Installation of Steam Injection Humidifiers

.1 Not applicable to this project.

3.11 Installation of Steam to Steam Humidifiers

.1 Provide steam humidifiers as shown on the drawings.

.2 Mount the humidifier at the location shown with the supports provided with the unit and connect with process RO water and drain.

.3 Connect to the steam distributor in the ductwork or air handling unit. Seal the opening around the ductwork or wall and the distributor so as to be air-tight.

PART 1 - GENERAL

1.1 Shop Drawings and Product Data

.1 Submit shop drawings in accordance with Section 001000 and Section 230501.

.2 Indicate the following:
- .1 casing and door construction;
- .2 energy reclaim coils;
- .3 air filters;
- .4 motorized dampers;

1.2 Manufactured Items

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

PART 2 - PRODUCTS

2.1 General

.1. Air Handling Units shall be designed and manufactured to the specific requirements of this project and to the level of quality as herein specified and to the description on the Air Handling Unit Schedule.

.2. Substitution of any product other than that specified, must ensure no deviation below the stated capacities, air flow rate, heat transfer rate, filtration efficiency and air mixing quality. Power requirements must not be exceeded, and where specifically defined, sound power levels must not be exceeded. Applications for "equal" or "alternate" must address these factors. The following are to be used as selection criteria and are to be as specified: Air flow rates, external static pressures, water flow rates. The following are to be equaled or bettered:

Coil face velocities, filter face velocities, casing leakage rates. The following are to be met within 10% of specified values: Water pressure drops.

.3. Unless stated otherwise, air-handling units are to be shipped to the job in one piece, factory assembled. Units too large to fit on a standard tractor trailer may be shipped to site in sections. All equipment shall where specified and applicable, be pre-wired, and factory certified by CSA prior to shipment. Coils shall be ARI certified. Filter media shall be ULC listed.

.4. The air handling units and major components shall be products of manufacturers regularly engaged in the production of such equipment and with a minimum of fifteen continuous years of proven production experience.

.5. Alternate products must show savings and clearly indicate all areas where they do not meet the specified product.

2.1 Acceptable Products

.1 The following manufacturers are approved in principle subject to meeting the specifications and drawing schedules. Manufacturers are responsible for all co-ordination issues arising from dimensional variances between plans and site conditions.
York XTI, Haakon, Engineered Air, Racan Carrier

.2 Air handling unit manufacturer shall have factory weld certification for all structural welds in accordance with CSA W47.1 and CSA W59 and AWS D1.1.

2.3 Casing

2.3.1. Walls and roofs shall be constructed of 18 gauge galvanized steel 2" thick acoustic thermal panels. The inner liner

shall be 22 gauge solid type 316 stainless steel. Insulation shall be 2" thick 4.5 lb. density fibreglass. All permanently joined flanged panel surfaces shall be sealed with an individual strip of 1/8" X 3/8" tape sealer. Wall and roof seams shall be turned inward to provide a clean flush exterior finish. All panel seams shall be sealed during assembly to produce an airtight unit.

2.3.2. Outdoor units shall have roof panels broken outward to provide a lapped joint watertight seal. Outdoor roofs shall be sloped a minimum of 5/8" away from the access side.

2.3.3. On outdoor units, screws and other similar fastening devices shall not penetrate the roof deck or the top of standing seems.

2.4. Insulation

2.4.1. All insulation used in air handling unit walls, roof and base shall have a Flame spread rating of less than 25 and a Smoke Developed rating of less than 50 per ASTM E84 and UL 723 and Can/ULC S102-M88.

2.4.2. Insulation shall meet NFPA 90A and 90B.

2.5. Service Corridor

2.5.1. Does not apply

2.6. Structural Base Construction

2.6.1. Units shall be constructed from a minimum C6x8.2 lb./ft. channel structural steel perimeter base, with 2x2x1/4 intermediate structural steel channel and angle iron supports. Perimeter structural steel base shall be designed to directly support the weight of the walls. Intermediate structural steel and angle iron shall support the weight of all internal components (i.e. fans, coils, etc.). Maximum base deflection shall be ¼ inch on unsupported spans of 12 ft. Structural steel base shall be designed so that it can be point loaded or set on an unlevel surface and shimmed by the

contractor within 12 foot spans without deflecting more than ¼ inch. The structural steel base shall be either I-beam construction or C-channel (not box channel) so that the base will shed all water. Base shall be provided with lifting lugs, minimum four (4) per shipping split. Formed metal bases formed from sheet metal will not be acceptable. Base shall prevent wall panel joints from separating during lifting, transportation and rigging.

2.6.2. Lifting lugs shall be located and engineered to properly support the loads within. Manufacturers shall provide a load point calculation along with detailed lifting lug information as part of the shop drawing package.

2.6.3. A 0.12” thick aluminum checker plate floor shall be installed on the base. Floor seams shall be continuously welded providing a completely flat unit floor. Standing seems will not be accepted in any section.

2.6.4. The base shall be insulated with 3" thick, 1-1/2 lb. density fibreglass insulation and sheeted with a 22 gauge galvanized steel liner. The base liner shall be broken, tack welded and sealed for rigidity and vapour barrier integrity.

2.7. Access Doors

2.7.1. Access door construction and width shall match the rest of the unit casing. Corners shall be welded for rigidity. Spot welding of corner seems will not be accepted. 4.5 lb. density insulation shall be sandwiched between the outer and inner skins. A 10" x 10” (double pane) tempered glass window shall be provided in each door except for filter access only doors.

2.7.2. Provide two chrome plated “Ventlok” Model #310 high pressure latches operable from either side of the door, and a padlock hasp. Hinges shall be continuous piano type stainless steel. Door

openings shall be fully gasketed with continuous 1/2" closed cell hollow round black gasket with a metal encapsulated reinforced backing that mechanically fastens to the door opening perimeter. Door frames shall be framed from 16 gauge galvanized steel with the outside of the door flush to the unit. Minimum door width shall be as shown on the plans but in no case shall an access door be less than 18", excpt for filter access only doors. Door height shall be the maximum permitted by the height of the unit up to 72".

2.7.3. Doors shall open against positive pressure.

2.8. Fans — 2.8.1. Does not apply.

2.9. Motors — 2.9.1. Does not apply.

2.10. Airflow Measuring Probes — 2.10.1. Does not apply.

2.11. Airflow Display — 2.11.1. Does not apply.

2.12. Vibration Isolation — 2.12.1. Does not apply.

2.13. Coils — 2.13.1. Coils shall be fully enclosed within casing and mounted on frames manufactured to allow coils to be individually removed. Heat recovery coil racks shall be 12 Ga. 316 stainless steel.

2.13.2. Removable coil access panels shall be provided to remove coils through casing wall. Coil covers shall be double wall construction with all exposed edges of insulation covered with sheet metal including holes through the cover for coil header stub outs. Coils shall be individually removable towards (away from)

the access side.

2.13.3. All drain pans shall be double wall continuously welded 316 stainless steel. Intermediate drain pans shall be interconnected with stainless steel 1" down pipes. Condensate drain shall be a minimum 1-1/4" diameter stainless steel tube extending 1" out from unit for solder connection to trap. Drain pans shall be sloped within unit and fully drainable.

2.13.4. Coils shall be certified in accordance with ARI Standard 410.

2.13.5. Water/Glycol Coil Construction:
Tubes - Horizontal, copper.
Fins – Aluminum, mechanically bonded to tubes, maximum 10 fins per inch.
Headers - Seamless copper with vent and drain connections.
Casing - 16 gauge stainless steel, channels with 16 gauge center and end supports.
Connections - Same end, counterflow, with vent, drain, supply and return stubs extended to outside of unit casing with grommets for airtight casing. Roof mounted units shall have the centre of the bottom coil connections located 10” off the unit floor.
Corrosion Resistant Coating – coat all parts within the air stream with a Heresite or epoxy resinous coating to protect the coils against exposure to corrosive atmospheres. The process shall be accomplished by a multiple coat application of degreasing and etching, dipping and baking (four times), resulting in complete coating coverage of the fins, tubes, headers and casing.

2.14. Prefilters

2.14.1. Prefilters shall be 2"-50mm, medium efficiency, pleated, disposable type. The filter shall be listed by Underwriters Laboratories as Class 2.

2.14.2. Prefilters shall be installed in a

stainless steel channel rack.

2.14.3. Prefilters shall be slide out, using access doors on both sides to allow push through filter changing from outside of the casing.

2.15. Final Filters

2.15.1. Does not apply.

2.16. Drains

2.16.1. Provide 1 1/4" capped floor drain connections on the side of the unit for complete drainability of the base pan for the following sections:
Heat recovery coils

2.17. Lights

2.17.1. Does not apply.

2.18. Filter Gauges

2.18.1. Provide magnehelic filter gauges to indicate air pressure drop across the filter bank and the glycol coil.

2.19. Storm Louvers

2.19.1. Does not apply.

2.20. Aluminum Airfoil Dampers

2.20.1. Aluminum airfoil frames and blades shall be a minimum of 12 gauge extruded aluminum. Blades to be 6" wide single air foil design.

2.20.2. Frames shall be extruded aluminum channel with grooved inserts for seals. Standard frames 2" x 4" x 5/8" on linkage side, 1" x 4" x 1" on the other sides.

2.20.3. Pivot rods shall be 7/16" hexagon extruded aluminum interlocking into blade section. Bearings to be double sealed type with a Celcon inner bearing on a rod within a Polycarbonate outer bearing inserted into frame so that the outer bearing cannot rotate.

2.20.4. Bearing shall be designed so that there are no metal-to-metal or metal-to-bearing riding surfaces. Interconnecting linkage shall have a separate Celcon

bearing to eliminate friction in linkage.

2.20.5. Blade linkage hardware and the motorized actuator is to be installed out of the airstream. All hardware to be on non-corrosive reinforced material.

2.20.6. Damper seals shall be designed for minimum air leakage by means of overlapping seals.

2.20.7. Damper blades shall be maximum 40" long per section.

2.20.8. Dampers greater than 2 sections wide shall be provided with a jackshaft.

2.20.9. Acceptable product: T.A. Morrison "TAMCO series 1000 SW".

2.21. Test Ports

2.21.1. Provide 1″ diameter test ports for unit air stream testing in each plenum section between each component within the AHU. Test ports shall have a tube that extends between the inside and outside of the unit and a screwed cap on the exterior to allow access. The test ports shall have been flanged on the exterior to allow air seal and shall be flanged on the interior to cover the penetration of the casing

2.22. Steam Humidifiers

2.22.1. Does not apply.

2.23. Electrical

2.23.1. Due to the potential for caustic or flammable fume exhaust within the air stream, no electrical devices or wiring shall be installed inside the air handler.

2.24. Finish

2.24.1. Unit shall be finished painted with two components, etch bond primer and finish painted with alkyd enamel, color as selected by Owner. All uncoated steel shall be painted with grey enamel. All metal surfaces shall be prepainted with vinyl wash primer to ensure paint bonds to metal. Outdoor unit shall be finish coated with polyurethane paint. Paint for outdoor

units shall be tested to ATSM B117 for 5000hr salt spray endurance.

2.25. Pipe Work 2.25.1. Does not apply.

2.26. Pipe Supports 2.26.1. Does not apply.

2.27. Spare Parts 2.27.1 Provide 1 spare set of pre-filters.

PART 3 - EXECUTION

3.1 General 3.1.1. Install unit on factory-supplied roof curb.
3.1.2. Provide components furnished as per manufacturer's literature.
3.1.5. Provide drain valves and vent cocks to each coil.

PART 1 - GENERAL

1.1 Shop Drawings and Product Data

.1 Submit shop drawings in accordance with Section 001000 and Section 230501.

.2 Indicate the following:
- .1 casing and door construction;
- .2 supply fans;
- .3 cooling coils;
- .4 energy reclaim coils;
- .5 air filters;
- .6 motorized dampers;
- .7 glycol coils.

1.2 Manufactured Items

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

PART 2 - PRODUCTS

2.1 General

.1. Air Handling Units shall be designed and manufactured to the specific requirements of this project and to the level of quality as herein specified and to the description on the Air Handling Unit Schedule.

.2. Substitution of any product other than that specified, must ensure no deviation below the stated capacities, air flow rate, heat transfer rate, filtration efficiency and air mixing quality. Power requirements must not be exceeded, and where specifically defined, sound power levels must not be exceeded. Applications for "equal" or "alternate" must address

these factors. The following are to be used as selection criteria and are to be as specified: Air flow rates, external static pressures, water flow rates. The following are to be equaled or bettered: Coil face velocities, filter face velocities, casing leakage rates. The following are to be met within 10% of specified values: Water pressure drops.

.3. Unless stated otherwise, air-handling units are to be shipped to the job in one piece, factory assembled. Units too large to fit on a standard tractor trailer may be shipped to site in sections. All equipment shall where specified and applicable, be pre-wired, and factory certified by CSA prior to shipment. Coils shall be ARI certified. Filter media shall be ULC listed.

.4. Uncoated galvanized steel is not permitted within the make-up air stream.

.5. All electrical circuits shall undergo a dielectric strength test, and shall be factory tested and checked as to proper function.

.6. The air handling units and major components shall be products of manufacturers regularly engaged in the production of such equipment and with a minimum of fifteen continuous years of proven production experience.

.7. Alternate products must show savings and clearly indicate all areas where they do not meet the specified product.

2.1 Acceptable Products

.1 The following manufacturers are approved in principle subject to meeting the specifications and drawing schedules. Manufacturers are responsible for all co-ordination issues arising from dimensional variances between plans and site

conditions.
York XTI, Haakon, Engineered Air, Racan Carrier

.2 Air handling unit manufacturer shall have factory weld certification for all structural welds in accordance with CSA W47.1 and CSA W59 and AWS D1.1.

2.3 Casing

2.3.1. Walls and roofs shall be constructed of 18 gauge galvanized steel 2" thick acoustic thermal panels. The inner liner shall be 22 gauge solid galvanized steel. Insulation shall be 2" thick 4.5 lb. density fibreglass. All permanently joined flanged panel surfaces shall be sealed with an individual strip of 1/8" X 3/8" tape sealer. Wall and roof seams shall be turned inward to provide a clean flush exterior finish. All panel seams shall be sealed during assembly to produce an airtight unit.

2.3.2. Outdoor units shall have roof panels broken outward to provide a lapped joint watertight seal. Outdoor roofs shall be sloped a minimum of 5/8" away from the access side.

2.3.3. On outdoor units, screws and other similar fastening devices shall not penetrate the roof deck or the top of standing seems.

2.4. Insulation

2.4.1. All insulation used in air handling unit walls, roof and base shall have a Flame spread rating of less than 25 and a Smoke Developed rating of less than 50 per ASTM E84 and UL 723 and Can/ULC S102-M88.

2.4.2. Insulation shall meet NFPA 90A and 90B.

2.5. Service Corridor

2.5.1. Does not apply.

2.6. Structural Base Construction

2.6.1. Units shall be constructed from a minimum C6x8.2 lb./sq.ft. channel

structural steel perimeter base, with 2x2x1/4 intermediate structural steel channel and angle iron supports. Perimeter structural steel base shall be designed to directly support the weight of the walls. Intermediate structural steel and angle iron shall support the weight of all internal components (i.e. fans, coils, etc.). Maximum base deflection shall be ¼ inch on unsupported spans of 12 ft. Structural steel base shall be designed so that it can be point loaded or set on an unlevel surface and shimmed by the contractor within 12 foot spans without deflecting more than ¼ inch. The structural steel base shall be either I-beam construction or C-channel (not box channel) so that the base will shed all water. Base shall be provided with lifting lugs, minimum four (4) per shipping split. Formed metal bases formed from sheet metal will not be acceptable. Base shall prevent wall panel joints from separating during lifting, transportation and rigging.

2.6.2. Lifting lugs shall be located and engineered to properly support the loads within. Manufacturers shall provide a load point calculation along with detailed lifting lug information as part of the shop drawing package.

2.6.3. A 0.12″ thick aluminum, or painted steel, checker plate floor shall be installed on the base. Floor seams shall be continuously welded providing a completely flat unit floor. Standing seems will not be accepted in any section.

2.6.4. The base shall be insulated with 3" thick, 1-1/2 lb. density fibreglass insulation and sheeted with a 22 gauge galvanized steel liner. The base liner shall be broken, tack welded and sealed for rigidity and vapour barrier integrity.

2.7. Access Doors

2.7.1. Access door construction and width shall match the rest of the unit casing. Corners shall be welded for rigidity. Spot

welding of corner seems will not be accepted. 4.5 lb. density insulation shall be sandwiched between the outer and inner skins. A 10" x 10” (double pane) tempered glass window shall be provided in each door.

2.7.2. Provide two chrome plated “Ventlok” Model #310 high pressure latches operable from either side of the door. Hinges shall be continuous piano type stainless steel. Door openings shall be fully gasketed with continuous 1/2" closed cell hollow round black gasket with a metal encapsulated reinforced backing that mechanically fastens to the door opening perimeter. Door frames shall be framed from 16 gauge galvanized steel with the outside of the door flush to the unit. Minimum door width shall be as shown on the plans but in no case shall an access door be less than 18". Door height shall be the maximum permitted by the height of the unit up to 72".

2.7.3. Doors shall open against positive pressure.

2.8. Fans

2.8.1. All fans shall be tested in accordance with AMCA Standards 210-70 and 310 Test Codes for Air Moving Devices. Backward inclined fans shall bear the AMCA sticker for both air and sound performance.

2.8.2. Fan Wheels and Shafts: Provide air foil blades on all fans wheels. Provide forward curved blades where scheduled. Provide solid shafts keyed to the fan wheel. Coat fan shaft with rust inhibitor. Hollow shafts will not be acceptable.

2.8.3. Fan bearings shall be self aligning pillow block, grease lubricated, extra heavy duty anti-friction ball or spherical roller type selected for an L10 life of 200,000 hours at design operating conditions. Bearings are to be mounted on the integral fan scroll bracing.

2.8.4. Fan and motor shall be mounted on an

all welded, structural steel, prime coated and internal isolation base. The outlet of the fan shall be separated from the unit casing by means of a factory installed flexible connection. The internally mounted motor shall be provided on a slide rail base to allow proper adjustment of belt tension.

2.8.5. Provide an OSHA approved fully enclosed metal belt guard having side of galvanized steel and expanded metal face. Belt guard shall be sized to allow either sheave to be increased by two sizes.

2.8.6. Provide fixed pitch sheaves rated at 150% of motor nameplate H.P.

2.8.7. On air handling units with variable speed drives, factory mount the VSD on the unit. Factory wire between the VSD and fan motors. Ensure all casing penetrations are sealed to be air tight. Provide a terminal block within the VSD for field termination of line side wiring. The VSD shall be mounted inside service vestibule.

2.9. Motors

2.9.1. Motors shall be designed for severe duty in accordance with IEEE 841 standards and shall meet NEMA MG1 Part 31. Motors shall be operable at 600 Volts, 60 Hz, 3-phase.

2.9.2. Motor windings shall have class F insulation with class B temperature rise ratings. Windings shall be 200C inverter spike resistant wire. Motor windings shall withstand 2000V transients. Motor service factor shall be 1.15 on sine wave power and 1.0 on VFD power.

2.9.3. Bearings shall be greased without disassembly and provide for the elimination of purged grease. Bearing life shall be a minimum of L10 at 50000 hours. Bearing seals shall be Inpro or equivalent.

2.9.4. Motors shall be balanced to less than 0.08 inches per second (filter out) and the vibration test data shall be shipped with the motor.

2.9.5. Nameplates shall be stainless steel and contain both NEMA data and bearing data.

2.9.6. Motors used with variable frequency drives shall be provided with a brush system to electrically ground the shaft and discharge any induced voltage on the motor shaft, with a direct path to ground.

2.9.7. Motor shall be provided with a 3 year warranty.

2.9.8. Acceptable motor manufacturers are Reliance-Baldor, US Motors, and TECO-Westinghouse.

2.10. Airflow Measuring Probes

2.10.1. Provide on each fan, air flow measuring probes.

2.10.2. Each airflow probe shall contain multiple, averaged velocity pressure taps located symmetrically around the throat of the fan inlet and a single static pressure tap located on the fan housing. The entire airflow monitoring probe must be located outside the inlet throat as to not obstruct airflow.

2.10.3. The probes shall be capable of producing steady, non-pulsating signal of the velocity pressure, independent of the upstream static pressure without adversely affecting the performance of the fan. The sensing probes shall be accurate □3 actual fan airflow. The fan inlet sensing rings shall be FreeFlo Sensing Ring as manufactured by Haakon Industries Ltd or Air Monitor Voluprobe.

2.11. Airflow Display

2.11.1. Provide on indicated fans a method of displaying digitally, in real time, the fans current air flow.

2.11.2. For interaction with a controller, the display shall output one (1) 0-10VDC signal for each fan being monitored.

2.11.3. The output signal shall be accurate to □0. linearity, hysteresis and non-repeatability.

2.11.4. The display must be water tight

allowing for use in outdoor locations. If the display is not water tight it shall be enclosed in a weatherproof housing.

2.12. Vibration Isolation

2.12.1. An integral all weld steel vibration isolation base shall be provided for the fan and motor.
2.12.2. Provide open spring mounts with iso stiff springs, sound deadening pads and leveling bolts.
2.12.3. Horizontal stiffness shall be equal to vertical stiffness.
2.12.4. Spring deflection shall be 2".
2.12.5. Isolators shall have earthquake restraints. Upon request, the unit manufacturer shall submit a restraint detail certified by a professional engineer.

2.13. Coils

2.13.1. Coils shall be fully enclosed within casing and mounted on angle frames manufactured to allow coils to be individually removed. Cooling coil racks shall be 12 Ga. 304 stainless steel. Heating coils shall be mounted on painted steel angle racks.
2.13.2. Removable coil access panels shall be provided to remove coils through casing wall. Coil covers shall be double wall construction with all exposed edges of insulation covered with sheet metal including holes through the cover for coil header stub outs. Coils shall be individually removable towards (away from) the access side.
2.13.3. All drain pans shall be double wall continuously welded 304 stainless steel. Intermediate drain pans shall be interconnected with stainless steel 1" down pipes. Condensate drain shall be a minimum 1-1/4" diameter stainless steel tube extending 1" out from unit for solder connection to trap. Drain pans shall be sloped within unit and fully drainable.
2.13.4. Coils shall be certified in accordance with ARI Standard 410.

2.13.5. Water/Glycol Coil Construction:
Tubes - Horizontal, copper.
Fins - Aluminum mechanically bonded to tubes.
Headers - Seamless copper with vent and drain connections.
Casing - 16 gauge stainless steel for all coils, channels with 16 gauge center and end supports.
Connections - Same end, counterflow, with vent, drain, supply and return stubs extended to outside of unit casing with grommets for airtight casing. Roof mounted units shall have the centre of the bottom coil connections located 10” off the unit floor.

2.14. Prefilters

2.14.1. Prefilters shall be 2"-50mm, medium efficiency, pleated, disposable type. The filter shall be listed by Underwriters Laboratories as Class 2.
2.14.2. Prefilters shall be installed in a prefabricated channel rack.
2.14.3. Prefilters shall be lift out from upstream access section.

2.15. Final Filters

2.15.1. Final filters shall be high performance, AAF deep pleated 4" long cartridge disposable type. Each filter shall consist of glass fiber media; media support grid, contour stabilizer and enclosing frame.
2.15.2. Final filter media shall be of high density microfine glass fibers laminated to a non-woven synthetic backing to form a lofted filter blanket. The filter media shall have an average efficiency of 95 % on the ASHRAE Test Standard 52. The filter shall be listed by Underwriters Laboratories as Class 2.
2.15.3. Holding frames shall be factory fabricated of 16 gauge galvanized steel and shall be equipped with gaskets and 2

heavy duty positive sealing fasteners. Each fastener shall be capable of withstanding 25 lb. pressure without deflection. They will be capable of being attached or removed without the use of tools.

2.15.4. Final filters shall be lift out from upstream access section.

2.16. Drains

2.16.1. Provide 1 1/4" capped floor drain connections on the side of the unit for complete drainability of the base pan for the following sections:
Fresh Air Plenums
Humidifier Sections
Service Corridors
Sections with cooling coils

2.17. Lights

2.17.1. Marine lights with protective cast metal cage and glass globes complete with duplex receptacles shall be installed on the wall across from or beside the access doors. One (1) switch with an indicator light shall be installed on the exterior of the unit. Factory wire from switch to all lights in EMT conduit with liquid tight connections. Electrical power shall be 120V/1/60.

2.18. Filter Gauges

2.18.1. Provide electronic filter gauges which have a digital display and a 4-20mA or 0-10VDC signal to indicate air pressure drop. Power the gauges from the lighting circuit.

2.18.2. Magnehelic gauges shall be accurate to +/- 2% of full range.

2.18.3. Provide one gauge flush mounted into the casing for each filter bank.

2.19. Storm Louvers

2.19.1. Does not apply.

2.20. Aluminum Airfoil Dampers

2.20.1. Aluminum airfoil frames and blades shall be a minimum of 12 gauge extruded aluminum. Blades to be 6" wide single air foil design.

2.20.2. Frames shall be extruded aluminum channel with grooved inserts for vinyl

seals. Standard frames 2" x 4" x 5/8" on linkage side, 1" x 4" x 1" on the other sides.

2.20.3. Pivot rods shall be 7/16" hexagon extruded aluminum interlocking into blade section. Bearings to be double sealed type with a Celcon inner bearing on a rod within a Polycarbonate outer bearing inserted into frame so that the outer bearing cannot rotate.

2.20.4. Bearing shall be designed so that there are no metal-to-metal or metal-to-bearing riding surfaces. Interconnecting linkage shall have a separate Celcon bearing to eliminate friction in linkage.

2.20.5. Blade linkage hardware is to be installed in frame out of airstream. All hardware to be on non-corrosive reinforced material or cadmium plated steel.

2.20.6. Damper seals shall be designed for minimum air leakage by means of overlapping seals.

2.20.7. Damper blades shall be maximum 40" long per section.

2.20.8. Dampers greater than 2 sections wide shall be provided with a jackshaft.

2.20.9. Acceptable dampers are: T.A. Morrison "TAMCO series 1000" and "RUSKIN CD-50".

2.21. Test Ports

2.21.1. Provide 1″ diameter test ports for unit air stream testing in each plenum section between each component within the AHU. Test ports shall have a tube that extends between the inside and outside of the unit and a screwed cap on the exterior to allow access. The test ports shall have been flanged on the exterior to allow air seal and shall be flanged on the interior to cover the penetration of the casing

2.22. Steam Humidifiers

2.22.1. Does not apply.

2.23. Electrical

2.23.1. Factory wire and test all air handling units. Have units approved by CSA or ETLc.

2.23.2. Unit shall have a single point power

connection with non-fused disconnect switch, consisting of one @ 575 V/60 Hz/3 Ph power connection feeding the AHU power panel. The power panel shall feed all components inside the unit and include: ABB VFD for supply fan, lights, control power supply. Power panel shall include all required overcurrent protection for each device being fed. Provide a minimum 2kVA transformer fed from the main power source to power the lighting circuit.

2.23.3. Provide a separate 120 V/ 1 phase feed for a 20 amp convenience outlet.

2.23.4. Provide necessary circuit breakers and/or fuses for each type of electric device.

2.23.5. A bonding wire shall be provided between the motor loads and the electrical panel. Use of the air handling unit casing for a bond will not be accepted.

2.23.6. Label and number code all wiring and electrical devices in accordance with the unit electrical diagram. Mount the devices in a control panel inside the unit’s service enclosure or on the outside. Ensure the control panel meets the CSA or Canadian Electrical Code (CEC) standard for the specific installation.

2.23.7. Provide a system of motor control including all necessary terminal blocks, motor contactors, and motor overload protection, grounding lugs, auxiliary contactors and terminals for the connection of external control devices or relays. Individually fuse all fan and branch circuits.

2.23.8. Wire from the motors to the motor control in accordance with the local electrical code and contained by EMT conduit with liquid tight connections. Seal the casing penetrations in a manner that eliminates air leaks.

2.23.9. External disconnects shall be provided in a NEMA 4 enclosure for superior water protection. Disconnects must be interlocked with the electrical panels for added personnel safety.

2.24. Finish

2.24.1. Unit shall be finished painted with two components, etch bond primer and finish painted with alkyd enamel, color as selected by Owner. All uncoated steel shall be painted with grey enamel. All metal surfaces shall be prepainted with vinyl wash primer to ensure paint bonds to metal. Outdoor unit shall be finish coated with polyurethane paint. Paint for outdoor units shall be tested to ATSM B117 for 5000hr salt spray endurance.

2.25. Pipe Work

2.25.1. Does not apply.

2.27. Spare Parts

2.27.1 Provide 1 spare set of pre-filters.

PART 3 - EXECUTION

3.1 General

3.1.1. Install units on a flat surface level within 1/8 inch and of sufficient strength to support the units.
3.1.2. Provide components furnished as per manufacturer's literature.
3.1.3. Provide all water piping so water circuits are serviceable, without having to dismantle excessive lengths of pipe.
3.1.4. Provide valves in water piping upstream and downstream of each coil for isolating the coils for maintenance and to balance and trim the system.
3.1.5. Provide drain valves and vent cocks to each coil.
3.1.6. Provide strainers ahead of all pumps and automatic modulating valves.
3.1.7. Provide certified wiring schematics to the electrical division for the equipment and controls.
3.1.8. Provide all necessary control wiring as recommended by the manufacturer.
3.1.9. Provide condensate traps in

accordance with manufacturers recommendations.

3.1.10. Insulate all piping and equipment mounted inside the corridor.

1 REFERENCES

.1 Perform all work to meet or exceed the requirements of the Canadian Electrical Code, CSA Standard C22.1 - (latest edition).

.2 Consider CSA Electrical Bulletins in force at time of tender submission, while not identified and specified by number in this Division, to be forming part of related CSA Part II standard.

.3 Do overhead and underground systems in accordance with CSA C22.3 except where specified otherwise.

.4 Where requirements of this specification exceed those of above mentioned standards, this specification shall govern.

.5 Notify the NRC Departmental Representative as soon as possible when requested to connect equipment supplied by NRC which is not CSA approved.

.6 Refer to Sections 00 10 00 & 0015 45.

2 PERMITS AND FEES

.1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.

.2 Pay all fees required for the performance of the work.

3 START-UP

.1 Instruct the NRC Departmental Representative and operating personnel in the operation, care and maintenance of equipment supplied under this contract.

4 INSPECTION AND FEES

.1 Furnish a Certificate of Acceptance from the Authorized Electrical Inspection Department on completion of work.

.2 Request and obtain Special Inspection approval from the Authorized Electrical Inspection Department for any non-CSA approved control panels or other equipment fabricated by the contractor as part of this contract.

.3 Pay all fees required for inspections.

5 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.

6 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.

7 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, 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 Light fixtures are the only exceptions for electrical equipment identification (except as noted in 7.13 below). They are not to be identified.

.3 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.

.4 Coordinate names of equipment and systems with other Divisions to ensure that names and numbers match.

.5 Wording on lamicoid nameplates to be approved by the NRC Departmental Representative prior to fabrication.

.6 Provide two sets of lamicoid nameplates for each piece of equipment; one in English and one in French.

.7 Lamicoid nameplates shall identify the equipment, the voltage characteristics and the power source for the equipment. Example: A new 120/240 volt single phase circuit breaker panelboard, L16, is fed from panelboard LD1 circuit 10.

"PANEL L16
120/240 V
FED FROM LD1-10"

PANNEAU L16
120/240 V
ALIMENTE PAR LD1-10

.8 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.

.9 Lamicoid nameplates shall be rigid lamicoid, minimum 1.5 mm (1/16") thick with:

.1 Black letters engraved on a white background for normal power circuits.

.2 Black letters engraved on a yellow background for emergency power circuits.

.3 White letters engraved on a red background for fire alarm equipment.

.10 For all interior lamicoid nameplates, mount nameplates using two-sided tape.

.11 For all exterior lamicoid nameplates, mount nameplates using self-tapping 2.3 mm (3/32") dia. slot head screws - two per nameplate for nameplates under 75 mm (3") in height and a minimum of 4 for larger nameplates. Holes in lamicoid nameplates to be 3.7 mm (3/16") diameter to allow for expansion of lamicoid due to exterior conditions.

.1 No drilling is to be done on live equipment.

.2 Metal filings from drilling are to be vacuumed from the enclosure interiors.

.12 All lamicoid nameplates shall have a minimum border of 3 mm (1/8"). Characters shall be 9 mm (3/8") in size unless otherwise specified.

.13 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.

.14 Provide neatly typed updated circuit directories in a plastic holder on the inside door of new panelboards.

.15 Carefully update panelboard circuit directories whenever adding, deleting, or modifying existing circuitry.

8 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.

9 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 Security system – green conduit

.7 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 Security system – green

.7 Control system - black

.3 For system running with cable, half-lap wrap with dedicated colored PVC tape to 100 mm width, tape every 5 m and both sides where cable penetrates a wall.

.4 All other systems need not be coloured.

10 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.

11 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.

12 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.

13 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.

14 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.

15 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.

16 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.

17 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.

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 Where 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 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 or switches or 15 amp receptacles in partitions having removable wall panels, or
  - .3 When specifically called for on drawings.
- .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 Provide high quality extruded copper-free aluminium (0.4% or less) connectors for single and multi conductor cable. Steel and then zinc plated connectors for multi conductor cables.

.3 When used in hazardous area, connectors should be certified for such location in Class, Division and Group.

.4 For large conductor sizes, use bolted or compression solderless type connectors.

.5 Use high temperature connectors and insulation on all connections of high temperature conductors.

.6 Where connector types are called for on the drawings or in the specification, do not use other types.

.7 Lugs, terminals, screws used for termination of wiring to be suitable for copper conductors.

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 FITTINGS

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

.2 Steel coupling for EMT.

.3 Fittings for liquid-tight flexible conduits shall be liquid-tight connectors.

.4 Provide expansion couplings for all conduits running in slabs through expansion joints. These shall be the type approved for use in concrete with a bonding conductor.

.5 Factory bends are not permitted to be modified. Ensure conduit bends other than factory bends are made with an approved bender. Making offsets and other bends by cutting and rejoining factory bends are not permitted.

2.2 OUTLET BOXES

.1 Size boxes in accordance with CSA-C22.

.2 Unless otherwise specified, provide galvanized steel outlet boxes at least 40mm (1-1/2") deep, single or ganged style, of proper size to accommodate devices used and shall be equipped with covers as necessary of the type designed for the specified fittings. Pull boxes shall be steel and shall be galvanized or painted to prevent rusting. For lighting fixture outlets, use 100mm (4") octagon boxes.

.3 Equip with plaster rings for flush mounting devices in finished walls.

.4 Blank cover plates for boxes without wiring devices.

.5 Equip with centre fixture studs for light fixtures.

.6 Use cast boxes where indicated and for surface mounted wiring. In areas above hung ceilings where appearance is not significant, pressed steel surface boxes may be used.

.7 Supply all outlet boxes and pull boxes sized according to code requirements unless specified otherwise on the drawings.

2.3 SUPPORT HARDWARE

.1 Use 10mm (3/8") threaded rod for suspended unistrut and conduit.

.2 Unless otherwise specified, use 41mm x 41mm (1-5/8" x 1-5/8") galvanized steel unistrut for conduit support systems.

Part 3 Execution

3.1 INSTALLATION

.1 Install outlet boxes as follows:

.1 Support boxes independently of connecting conduits.

.2 Make necessary mounting adjustments to the outlet to match interior finish.

.3 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of construction material.

.4 Where more than one conduit enters a switch or receptacle box on the same side, provide a 100mm (4") minimum square box with a suitable plaster ring.

.5 Location and appearance to be to the NRC Departmental Representative's approval.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Common Work Results - Electrical Section 26 05 00

1.2 MATERIALS

.1 Provide only new equipment and materials, without blemish or defect, bearing Canadian Standards Association or Authorized Electrical Inspection Department labels, and subject to the approval of the NRC Departmental Representative.

.2 After a contract is awarded, utilize alternative methods and/or materials only after receiving the NRC Departmental Representative's approval.

Part 2 Products

2.1 RACEWAYS

.1 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 12mm (1/2").

.3 Conduit to be coloured as required for systems described in section 260500.9.

.2 Bushings and Connectors:

.1 Insulated type, with the insulation an integral part of the fitting.

.3 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.

.4 Pull Cord:

.1 Polypropylene cord in empty conduit.

.5 Unless specifically called for on the drawings, do not use flexible conduits but it is recognized that there may be applications where this material will be useful, such as equipment connections, etc. In such cases, obtain permission for its use from the NRC Departmental Representative. For tender purposes, assume that flexible conduits will not be permitted unless specifically called for on the drawings or equipment specifications. All flexible conduits for vapour-tight applications shall be liquid-tight flexible conduits (seal-tight).

.6 Provide expansion couplings for all conduits running in slabs through expansion joints. These shall be the type approved for use in concrete with a bonding conductor.

2.2 SUPPORT HARDWARE

.1 Use 10mm (3/8") threaded rod for suspended unistrut and conduit.

.2 Unless otherwise specified, use 41mm x 41mm (1-5/8" x 1-5/8") galvanized steel unistrut for conduit support systems.

Part 3 Execution

3.1 RACEWAYS

.1 Install raceways as follows:

.1 Rigidly supported.
.2 Workmanlike manner.
.3 Maintain maximum headroom.
.4 Concealed in finished area.
.5 Surface-mounted in open area.
.6 Do not pass conduits through structural members except as indicated.
.7 Parallel to or at right angles to the building lines.
.8 Thoroughly ream all conduits at ends and terminate with appropriate locknuts and bushings.
.9 Cause minimum interference in spaces through which they pass.
.10 Plug or cap conduit during construction to protect from dust, dirt or water.
.11 Unless specifically indicated on drawings or with the permission of the NRC Departmental Representative, do not cast conduits in concrete.
.12 Dry conduits out before installing wire.
.13 Mechanically bend steel conduit larger than 22 mm (3/4") diameter. Bend conduit cold.
.14 Do not cut or modify prefabricated bends.
.15 PVC conduit as indicated.
.16 Function and appearance to be to the NRC Departmental Representative's approval.
.17 Seal conduit and cable openings in fire- rated walls and floors with an approved fire stop material.
.18 Seal conduit and cable openings in exterior walls with a weatherproof silicone sealant.
.19 Paint exposed conduits and boxes to match existing wall / ceiling except the colored EMT specified in 260500.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 00 10 00.

.2 Submit stamped engineered drawings for structures supporting transformers on walls or other structures other than the floor.

.3 Prior to any installation of circuit breakers in either a new or existing installation, Contractor must submit three (3) copies of a certificate of origin, from the manufacturer, duly signed by the factory and the local manufacturer's representative, certifying that all circuit breakers come from this manufacturer, they are new and they meet standards and regulations. These certificates must be submitted to the Departmental Representative for approval.

.1 The above applies to all breakers rated above 240V.

.2 The above applied to all breakers rated up to 240V and 100A or more.

.4 A delay in the production of the certificate of origin won't justify any extension of the contract and additional compensation.

.5 Any work of manufacturing, assembly or installation should begin only after acceptance of the certificate of origin by Departmental Representative. Unless complying with this requirement, Departmental Representative reserves the right to mandate the manufacturer listed on circuit breakers to authenticate all new circuit breakers under the contract at the Contractor's expense.

.6 In general, the certificate of origin must contain:

.1 The name and address of the manufacturer and the person responsible for authentication. The responsible person must sign and date the certificate;

.2 The name and address of the licensed dealer and the person of the distributor responsible for the Contractor's account.

.3 The name and address of the Contractor and the person responsible for the project.

.4 The name and address of the local manufacturer's representative. The local representative must sign and date the certificate.

.5 The name and address of the building where circuit breakers will be installed:

.1 Project title.

.2 End user's reference number.

.3 The list of circuit breakers.

1.2 IDENTIFICATION

.1 Identification as per Section 26 05 00.

Part 2 Products

2.1 DISCONNECT SWITCHES, FUSED AND NON-FUSED

.1 Fusible and non-fusible disconnect switches in EEMAC Enclosure as indicated.

.2 Provision for padlocking in "OFF" switch position.

.3 Mechanical voidable door interlock in "ON" position.

.4 Fuses: size and type as indicated.

.5 Fuseholders in each switch to be suitable without adaptors, for type and size of fuse indicated.

.6 Quick-make, quick-break action.

.7 "ON-OFF" switch position indication on switch enclosure cover.

.8 Standard of acceptance: Square D, Cutler-Hammer, Siemens, ABB.

2.2 GROUNDING

.1 Insulated grounding conductors in accordance with Section 26 05 00.

.2 Compression connectors for grounding to equipment provided with lugs.

2.3 MOULDED CASE CIRCUIT BREAKER

.1 Thermal-magnetic moulded case circuit breakers, quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.

.2 Common-trip breakers with single handle for multiple applications.

.3 All new 120V to 600V circuit breakers installed on this project are to include the handle accessory, "Handle Padlock Attachment", which locks breakers on or off.

.4 Magnetic instantaneous trip elements in circuit breakers, to operate only when the value of current reaches 10 times their setting.

.5 Circuit breaker and panel to be of same manufacturer.

Circuit breakers minimum rating: 10K for 120/240V and 25K for 600/347V or greater if indicated.

.6 Electronic trip unit as indicated by drawing.

LI: long time and instantaneous

LSI: long time, short time and instantaneous

LSIG: long time, short time , instantaneous and grounding

A: with Ammeter

E: with energy meter

.7 Trip units setting keypad or dials should be accessible, apply short filler only.

.8 Standard of acceptance: Square D or approved equal.

Part 3 Execution

3.1 DISCONNECT SWITCHES

.1 Install disconnect switches complete with fuses as indicated.

3.2 GROUNDING

.1 Install complete permanent, continuous, system and circuit, equipment, grounding systems including, conductors, compression connectors, accessories, as indicated, to conform to requirements of Engineer, and local authority having jurisdiction over installation. Where EMT is used, run ground wire in conduit.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Soldered joints not permitted.

3.3 MOULDED CASE CIRCUIT BREAKERS

.1 Install circuit breakers as indicated.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 Motors and controls to Sections 26 22 19, 26 29 03 & 26 29 10.

1.2 MATERIALS

.1 Provide only new equipment and materials, without blemish or defect, bearing Canadian Standards Association or Authorized Electrical Inspection Department labels, and subject to the approval of the NRC Departmental Representative.

.2 After a contract is awarded, utilize alternative methods and/or materials only after receiving the NRC Departmental Representative's approval.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 00 10 00.

1.4 IDENTIFICATION

.1 Identification as per Section 26 05 00.

Part 2 Products

2.1 WIRING DEVICES

.1 Receptacles:

.1 Duplex type, CSA type 5-15R, 125 volt, 15A, U ground, specification grade with the following features:

.1 Flush type with parallel blade slots.

.2 Double-wiping contacts.

.3 Double-grounding terminals.

.4 Break-off feature for separate feeds.

.5 One piece body, colour white unless otherwise indicated.

.2 Special receptacles with ampacity and voltage as indicated.

.3 Receptacles of one manufacturer throughout the project.

.2 Cover Plates:

.1 Cover plates for wiring devices.

.2 Smooth white plastic for wiring devices mounted in flush-mounted outlet box.

.3 Sheet metal cover plates for wiring devices mounted in surface-mounted outlet box.

.4 Weatherproof covers to be die case aluminum. Standard of acceptance: Hubbell WPFS26.

Part 3 Execution

3.1 LOCATION OF OUTLETS

.1 The number and general location of outlets for lighting, power, telephones, etc., are to be as shown on the drawings. Install all outlets accurately and uniformly with respect to building details. When centering outlets, make allowance for overhead pipes, ducts, etc. and for variations in wall or ceiling finish, window trim, etc. Reinstall incorrectly installed outlets at no cost to the Owner. Make field power and control connections as indicated.

.2 The location of all outlets as shown on the plans are approximate and are subject to change, up to 3m (10') without extra cost or credit provided the information is given prior to the installation of the outlet.

.3 Unless otherwise specified, locate light switches on latch side of doors. Determine the direction of all door swings from the architectural drawings or on site, not from the electrical drawings.

3.2 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not indicated verify before proceeding with installation.

.3 Generally, locate outlets as follows: (except those otherwise shown on the drawings):

.1 Local switches 1.2m (3'-11") to centreline.
.2 Wall receptacles 400mm (1'-4") to centreline.
.3 Clock receptacles 2.4m (8'-0") to centreline.
.4 Lighting panels 1.8m (6'-0") to top.
.5 Telephone and data communications outlet 400mm (1'-4") to centreline.
.6 Fan coil speed control switch 1.2m (3'-11") to centreline.

3.3 WIRING DEVICES

.1 Install wiring devices as follows:

.1 Where more than one local device is shown at one location, they are to be set under one cover plate.
.2 Install single throw switches with handle in "up" position when switch closed.
.3 Devices in gang type outlet box when more than one device is required in one location.
.4 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
.5 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
.6 Install metal barriers where required.

.7 Remove insulation carefully from ends of conductors and connect wiring as required.

.8 Bond and ground as required.

3.4 SPLITTERS AND DEVICES

.1 Installation of splitters, junction boxes, pull boxes & cabinets as follows:

.1 Mount plumb, true and square to the building lines.

.2 Install in inconspicuous but accessible locations.

.3 Install pull boxes so as not to exceed 30 m (100') of conduit run between boxes or as indicated.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Common Work Results - Electrical Section 26 05 00

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 00 10 00.

.2 Include schematic, wiring, interconnection diagrams.

.3 Indicate:

.1 Mounting method and dimensions.
.2 Starter size and type.
.3 Layout of identified internal and front panel components.
.4 Enclosure types.
.5 Wiring diagram for each type of starter.
.6 Interconnection diagrams.

.4 Motors specified and supplied with mechanical equipment. Refer to Division 23.

1.3 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 00 10 00.

.2 Include operation and maintenance data for each type and style of starter.

Part 2 Products

2.1 MATERIALS

.1 Starters:

.1 IEC rated starters not acceptable.

2.2 MANUAL MOTOR STARTERS

.1 Single and three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:

.1 Switching mechanism, quick make and break.
.2 One and three overload heaters as indicated, manual reset, trip indicating handle.

.2 Accessories:

.1 Toggle switch, key switch or pushbutton as specified.
.2 Indicating light: type and colour as indicated.

.3 Locking tab to permit padlocking in "ON" or "OFF" position.

.3 Standard of acceptance: Square D, Class 2510 or approved equal.

2.3 FULL VOLTAGE MAGNETIC STARTERS

.1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:

.1 Contactor solenoid operated, rapid action type.

.2 Motor overload protective device in each phase, manually reset from outside enclosure.

.3 Power and control terminals.

.4 Wiring and schematic diagram inside starter enclosure in visible location.

.5 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.2 Accessories:

.1 Pushbuttons and selector switches: type and labelled as indicated.

.2 Indicating lights: type and color as indicated.

.3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

.3 Standard of acceptance: Square D, Class 8539 or approved equal.

2.4 FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 00.

2.5 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 260500.

Part 3 Execution

3.1 INSTALLATION

.1 Install starters, connect power and control as indicated.

.2 Install control devices and relay panels and interconnect as indicated.

.3 Install correct fuses and overload device elements.

.4 Megger all motors. Dry out motor if dampness is present in accordance with manufacturer's recommendations.

.5 For installation of motor with mechanical equipment refer to Division 23.

.6 Make connection to motor as indicated. Use liquid-tight PVC jacketted flexible conduit between rigid conduit and motor.

.7 Make flexible conduit long enough to permit movement of motor.

3.2 TESTS

.1 Perform tests in accordance with Section 26 05 00 and Manufacturer's instructions.

.2 Operate switches, contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Common Work Results - Electrical Section 26 05 00

1.2 DESCRIPTION

.1 This specification is to cover a complete Variable Frequency motor Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor.

.2 The drive manufacturer shall supply the drive and all necessary controls as herein specified. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of twenty years. All VFDs installed on this project shall be from the same manufacturer.

1.3 QUALITY ASSURANCE

.1 Referenced Standards:

1. Institute of Electrical and Electronic Engineers (IEEE)
   - .1 Standard 519-1992, IEEE Guide for Harmonic Content and Control.

.2 Underwriters laboratories
   - .1 UL508C

.3 National Electrical Manufacturer's Association (NEMA)
   - .1 ICS 7.0, AC Adjustable Speed Drives

.4 IEC 16800 Parts 1 and 2

.5 CSA 22.2

.2 Qualifications:

.1 VFDs and options shall be UL listed and CSA approved as a complete assembly. VFDs that require the customer to supply external fuses for the VFD to be UL listed are not acceptable. VFDs requiring additional branch circuit protection are not acceptable. The base VFD shall be UL listed for 100 KAIC without the need for input fusing.

1.4 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 00 10 00.

.2 Include schematic, wiring, interconnection diagrams.

.3 Indicate:

.1 Outline dimensions, conduit entry locations and weight.

.2 Customer connection and power wiring diagrams.

.3 Complete technical product description include a complete list of options provided. **Any portions of the specifications not complied with must be**

clearly indicated or the supplier and contractor shall be liable to provide all components required to meet the specification.

.4 Compliance to IEEE 519 – harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD).

.1 The VFD manufacturer shall provide calculations; specific to the installation, showing total harmonic voltage distortion is less than 5%. Input filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with the IEEE electrical system standard 519. All VFDs shall include a minimum of 5% equivalent impedance reactors, **no exceptions**.

.4 Motors specified and supplied with mechanical equipment. Refer to Division 23.

1.5 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 00 10 00.

.2 Include operation and maintenance data for each type and style of starter.

.3 On completion of the installation, the supplier shall provide the following:

.1 Full commissioning report documenting all programmable settings, AC input voltage, DC Bus voltage, current draw at maximum speed, and a description of ambient conditions.

.2 One operator’s manual for each VFD installed.

.3 One 8.5" x 11" wiring diagram for each VFD installed.

1.6 GENERAL DESIGN CHARACTERISTICS

.1 The VFD shall be of the Pulse Width Modulated (PWM) type.

.2 The VFD shall be rated for variable torque applications, with an overload rating of 110% for 60 seconds.

.3 All VFD’s shall be factory UL/cUL Listed.

.4 All packaged drive systems shall be CSA Listed.

.5 The VFD shall have the capability of operating multiple motors. The minimum VFD continuous current rating shall be the sum of the full load current ratings of the connected motors.

.6 The VFD shall have a minimum displacement power factor of 0.96 or higher at all output frequencies.

.7 The VFD manufacturer shall have a minimum of ten years experience in the Canadian Market.

Part 2 Products

2.1 VARIABLE FREQUENCY DRIVES

.1 The VFD package as specified herein shall be enclosed in a NEMA rated enclosure, completely assembled and tested by the manufacturer in an ISO9001 facility. The VFD tolerated voltage window shall allow the VFD to operate from a line of +30% nominal, and -35% nominal voltage as a minimum.

.1 Environmental operating conditions: $0 – 40^0$ C continuous. Altitude 0 to 3300 feet above sea level, up to 95% humidity, non-condensing. All circuit boards shall have conformal coating.

.2 The VFD shall operate within the following rated values.

.1 Output Frequency Range: 0.1 to 400 Hz.

.2 Overload Rating: VT – 110% for 60 seconds

.3 Input Voltage: 3 phase + ground , 600V +10% / -20%

.4 Input Frequency: 48-62 Hz

.3 The VFD shall be designed to include the following protective functions and display for maintainability:

.1 *Instantaneous Over Current Protection*: The VFD output shall be turned off if the operating current exceeds the specified level.

.2 *Motor Overload Protection*: cUL/CSA approved electronic thermal overload protection.

.3 *External Trip Input*: Programmable for either N/O or N/C operation.

.4 *Over Voltage Protection*: The VFD output shall turned off if the DC Bus voltage exceeds the specified level.

.5 *Ground Fault Protection*: The VFD output shall turned off in the event of a ground fault.

.6 *Line or Load Phase Loss Protection*: Programmable for enable - disable

.7 *Software Lock*: The VFD shall include a software function that prevents changes to the user-defined settings.

.8 *CPU or EEPROM Error*: The VFD output shall turned off in the event of an error in the CPU or EEPROM.

.4

.2 All VFDs shall have the following features:

.1 All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.

.2 The keypad shall include Hand-Off-Auto selections and manual speed control. There shall be fault reset and “Help” buttons on the keypad. The Help button shall include “on-line” assistance for programming and troubleshooting.

.3 There shall be a built-in time clock in the VFD keypad. The clock shall have a battery back up with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. If the battery fails, the VFD shall automatically revert to hours of operation since initial

power up. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter sets and output relays. The VFD shall have a digital input that allows an override to the time clock (when in the off mode) for a programmable time frame. There shall be four (4) separate, independent timer functions that have both weekday and weekend settings. Capacitor backup is not acceptable.

.4 The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to setpoint without safety tripping or component damage (flying start).

.5 The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430-150 for 4-pole motors.

.6 The VFD shall have 5% equivalent impedance internal reactors to reduce the harmonics to the power line and to add protection from AC line transients. The 5% equivalent impedance may be from dual (positive and negative DC bus) reactors, or 5% AC line reactors. VFDs with only one DC reactor shall add an AC line reactor.

.7 The VFD shall include a coordinated AC transient protection system consisting of 4-120 joule rated MOV's (phase to phase and phase to ground), a capacitor clamp, and 5% equivalent impedance internal reactors.

.8 The VFD shall provide a programmable proof of flow Form-C relay output (broken belt / broken coupling). The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay outputs shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false underload condition.

.3 All VFDs to have the following adjustments:

.1 Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.

.2 Two (2) PID Setpoint controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed loop control. The VFD shall have 250 ma of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. There shall be two parameter sets for the first PID that allow the sets to be switched via a digital input, serial communications or from the keypad for night setback, summer/winter setpoints, etc. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain setpoint of an independent process (ie. valves, dampers, etc.). All setpoints, process variables, etc. to be accessible from the serial communication network.

.3 Two (2) programmable analog inputs shall accept current or voltage signals.

.4 Two (2) programmable analog outputs (0-20ma or 4-20 ma). The outputs may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, and other data.

.5 Six (6) programmable digital inputs.

.6 Three (3) programmable digital Form-C relay outputs. The relays shall include programmable on and off delay times and adjustable hysteresis. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating 2 amps RMS. Outputs shall be true Form-C type contacts; open collector outputs are not acceptable.

.7 Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close.

.8 Two independently adjustable accel and decel ramps with 1 – 1800 seconds adjustable time ramps.

.9 The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and audible motor noise.

.10 The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows higher carrier frequency without derating the VFD or operating at high carrier frequency only at low speeds.

.11 The VFD shall include password protection against parameter changes.

.4 The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (LED and alpha-numeric codes are not acceptable). All VFD faults shall be displayed in English words.

.5 All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):

.1 Output Frequency
.2 Motor Speed (RPM, %, or Engineering units)
.3 Motor Current
.4 Drive Temperature
.5 DC Bus Voltage
.6 Output Voltage

.6 The VFD shall include a fireman's override input. Upon receipt of a contact closure from the fireman's control station, the VFD shall operate in one of two modes: 1) Operate at a programmed predetermined fixed speed or operate in a specific fireman's override PID algorithm that automatically adjusts motor speed based on override set point and feedback. The mode shall override all other inputs (analog/digital, serial communication, and all keypad commands), except customer defined safety run interlock, and force the motor to run in one of the two modes above. "Override Mode" shall be displayed on the keypad. Upon removal of the override signal, the VFD shall resume normal operation.

.7 Serial Communications

.1 The VFD shall have an RS-485 port as standard. The standard protocols shall be Modbus, BACnet, Johnson Controls N2 bus, and Siemens Building Technologies FLN. Each individual drive shall have the protocol in the base VFD. The use of

third party gateways and multiplexers is not acceptable. All protocols shall be "certified" by the governing authority (i.e. BTL Listing for BACnet). Use of non-certified protocols is not allowed.

.2 The BACnet connection shall be an RS485, MS/TP interface operating at 9.6, 19.2, 38.4, or 76.8 Kbps. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:

.1 Data Sharing – Read Property – B.

.2 Data Sharing – Write Property – B.

.3 Device Management – Dynamic Device Binding (Who-Is; I-AM).

.4 Device Management – Dynamic Object Binding (Who-Has; I-Have).

.5 Device Management – Communication Control – B.

.3 Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The DDC shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible.

.8 EMI / RFI filters. All VFDs shall include EMI/RFI filters. The VFD shall comply with standard EN 61800-3 for the First Environment, restricted level with up to 100' of motor cables. No Exceptions. Certified test lab test reports shall be provided with the submittals.

.9 All VFDs through 60HP shall be protected from input and output power mis-wiring. The VFD shall sense this condition and display an alarm on the keypad. The VFD shall not be damaged by this condition.

.10 OPTIONAL FEATURES – Optional features to be furnished and mounted by the drive manufacturer. All optional features shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label. The bypass enclosure door and VFD enclosure must be interlocked such that input power is turned off before either enclosure can be opened. The VFD and Bypass as a package shall have a UL listed short circuit rating of 100,000 amps and shall be indicated on the data label.

.1 A complete factory wired and tested bypass system consisting of an output contactor and bypass contactor, service (isolation) switch and VFD input fuses are required. Bypass designs, which have no VFD only fuses, or that incorporate fuses common to both the VFD and the bypass will not be accepted

.2 Door interlocked padlockable disconnect switch that will disconnect all input power from the drive and all internally mounted options.

.11 The following operators shall be provided:

Bypass Hand-Off-Auto

Drive mode selector and light
Bypass mode selector and light
Bypass fault reset
Bypass LDC display, 2 lines, for programming and status / fault / warning indications

.1 Motor protection from single phase power conditions - The Bypass system must be able to detect a single phase input power condition while running in bypass, disengage the motor in a controlled fashion, and give a single phase input power indication. Bypass systems not incorporating single phase protection in Bypass mode are not acceptable.

.2 The systems (VFD and Bypass) tolerated voltage window shall allow the system to operate from a line of +30%, -35% nominal voltage as a minimum. The system shall incorporate circuitry that will allow the drive or bypass contactor to remain "sealed in" over this voltage tolerance at a minimum.

.3 The Bypass system shall NOT depend on the VFD for bypass operation. The bypass shall be completely functional in both Hand and Automatic modes even if the VFD has been removed from the enclosure for repair / replacement.

.4 Serial communications – the bypass and VFD shall be capable of being monitored and or controlled via serial communications. Provide communications protocols for ModBus; Johnson Controls N2; Siemens Building Technologies FLN (P1) and BACnet in the bypass controller.

.5 Run permissive circuit - there shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, time-clock control, or serial communications) the VFD and bypass shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a VFD system input and allows motor operation. Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close.

.6 The bypass control shall monitor the status of the VFD and bypass contactors and indicate when there is a welded contactor contact or open contactor coil. This failed contactor operation shall be indicated on the Bypass LCD display as well as over the serial communications protocol.

.7 The bypass control shall include a programmable time delay for bypass start and keypad indication that this time delay is in process. This will allow VAV boxes to be driven open before the motor operates at full speed in the bypass mode. The time delay shall be field programmable from 0 – 120 seconds.

.8 The bypass control shall be programmable for manual or automatic transfer to bypass. The user shall be able to select via keypad programming which drive faults will generate an automatic transfer to bypass and which faults require a manual transfer to bypass.

.9 There shall be an adjustable motor current sensing circuit for the bypass and VFD mode to provide proof of flow indication. The condition shall be indicated on the keypad display, transmitted over the building automation protocol and on a relay output contact closure.

.10 The bypass controller shall have six programmable digital inputs, and five programmable Form-C relay outputs.

.11 The relay outputs from the bypass shall be programmable for any of the following indications.

.1 System started
.2 System running
.3 Bypass override enabled
.4 Drive fault
.5 Bypass fault
.6 Bypass H-O-A position
.7 Motor proof of flow (broken belt)
.8 Overload
.9 Bypass selected
.10 Bypass run
.11 System started (damper opening)
.12 Bypass alarm
.13 Over temperature

.12 The digital inputs for the system shall accept 24VAC or 24VDC. The bypass shall incorporate internally sourced power supply and not require an external control power source. The bypass power board shall supply 250 ma of 24 VDC for use by others to power external devices.

.13 Customer Interlock Terminal Strip – provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in VFD or Bypass mode. The remote start/stop contact shall operate in VFD and bypass modes. The terminal strip shall allow for independent connection of up to four (4) unique safety inputs.

.14 The user shall be able to select the text to be displayed on the keypad when the safety opens. Example text display indications include “Firestat”, “Freezestat”, “Over pressure” and “Low pressure”. The user shall also be able to determine which of the four (4) safety contacts is open over the serial communications connection.

.15 Class 10, 20, or 30 (selectable) electronic motor overload protection shall be included.

.16 Standard of acceptance:

.1 ABB ACH Series or equivalent approved by NRC departmental representative. **Approval does not relieve supplier of specification requirements.**

Part 3 Execution

3.1 INSTALLATION

.1 Installation shall be the responsibility of the electrical contractor. The contractor shall install the drive in accordance with the requirements of the VFD manufacturer’s installation manual.

.2 The contractor is to verify that the jobsite conditions for installation meet the factory recommendations and code required conditions for the VFD installation prior to installation. These shall include as a minimum:

.1 Clearance spacing.

.2 Compliance with environmental ratings of the VFD system.

.3 Separate conduit installation of the input wiring, the motor wiring, and control wiring. At no time does any of this wiring run in parallel with each other.

.4 All power and control wiring is complete.

.3 The VFD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The VFD system shall not be operated while the unit is covered.

3.2 ON-SITE STARTUP

.1 The manufacturer shall provide start-up and commissioning of the variable frequency drive and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. The commissioning personnel shall be the same personnel that will provide the factory service and warranty repairs at the customer site. Sales personnel and other agents who are not factory certified technicians for drive repair shall not be acceptable as commissioning agents.

.2 Start-up services shall include checking for verification of proper operation and installation of the VFD, its options and its interface wiring to the building automation system. Included in this service shall be as a minimum:

.1 Verification of contractor wire terminations and conduit runs to and from the VFD.

.2 Up to four hours of customer operator training on the operation and service diagnostics at the time of commissioning. On-site training is to be provided by the same factory trained application engineering and service personnel to demonstrate full programming and operating features and procedures. Date and time for this training is to be coordinated with the NRC Departmental Representative.

.3 Measurement for verification of proper operation of the following:

.1 Motor voltage and frequency. Verification of proper motor operation.

.2 Control input for proper building automation system interface and control calibration.

.3 Calibration check for the following set-points:

.1 minimum speed

.2 maximum speed

.3 acceleration and deceleration rates.

.3 Commissioning agent to verify the programming of the VFD and to provide a written copy of the settings to the engineer.

.4 Commissioning agent to lock out critical frequencies throughout the operating curve of the equipment as identified and required by the engineer. The agent shall record amperages at six (minimum) different frequencies from minimum to maximum speed.

3.3 PRODUCT SUPPORT

.1 Factory trained application engineering and service personnel that are thoroughly familiar with the VFD products offered shall be locally available at both the specifying and installation locations. A toll free 24/365 technical support line shall be available.

.2 A computer based training CD or 8-hour professionally generated video (VCR format) shall be provided to the owner at the time of project closeout. The training shall include installation, programming and operation of the VFD, bypass and serial communication.

3.4 WARRANTY

.1 Warranty shall be 24 months from the date of certified start-up. The warranty shall include all parts, labor, travel time and expenses

END OF SECTION

TP1 Amount Payable – General

1.1 Subject to any other provisions of the contract, Her Majesty shall pay the Contractor, at the times and in the manner hereinafter set out, the amount by which

1.1.1 the aggregate of the amounts described in TP2 exceeds

1.1.2 the aggregate of the amounts described in TP3

and the Contractor shall accept that amount as payment in full satisfaction for everything furnished and done by him in respect of the work to which the payment relates.

TP2 Amounts Payable to the Contractor

2.1 The amounts referred to in TP1.1.1 are the aggregate of

2.1.1 the amounts referred to in the Articles of Agreement, and

2.1.2 the amounts, if any, that are payable to the Contractor pursuant to the General Conditions.

TP3 Amounts Payable to Her Majesty

3.1 The amounts referred to in TP1.1.2 are the aggregate of the amounts, in any, that the Contractor is liable to pay Her Majesty pursuant to the contract.

3.2 When making any payments to the Contractor, the failure of Her Majesty to deduct an amount referred to in TP3.1 from an amount referred to in TP2 shall not be constitute a waiver of the right to do so, or an admission of lack of entitlement to do so in any subsequent payment to the Contractor.

TP4 Time of Payment

4.1 In these Terms of Payment

4.1.1 The "payment period" means a period of 30 consecutive days or such other longer period as is agreed between the Contractor and the Departmental Representative.

4.1.2 An amount is "due and payable" when it is due and payable by Her Majesty to the Contractor according to TP4.4, TP4.7 or TP4.10.

4.1.3 An amount is overdue when it is unpaid on the first day following the day upon which it is due and payable.

4.1.4 The "date of payment" means the date of the negotiable instrument of an amount due and payable by the Receiver General for Canada and given for payment.

4.1.5 The "Bank Rate" means the discount rate of interest set by the Bank of Canada in effect at the opening of business on the date of payment.

4.2 The Contractor shall, on the expiration of a payment period, deliver to the Departmental Representative in respect of that payment period a written progress claim that fully describes any part of the work that has been completed, and any material that was delivered to the work site but not incorporated into the work during that payment period.

4.3 The Departmental Representative shall, not later than ten days after receipt by him of a progress claim referred to in TP4.2,

4.3.1 inspect the part of the work and the material described in the progress claim; and

4.3.2 issue a progress report, a copy of which the Departmental Representative will give to the Contractor, that indicates the value of the part of the work and the material described in the progress claim that, in the opinion of the Departmental Representative,

4.3.2.1 is in accordance with the contract, and

4.3.2.2 was not included in any other progress report relating to the contract.

4.4 Subject to TP1 and TP4.5 Her Majesty shall, not later than 30 days after receipt by the Departmental Representative of a progress claim referred to in TP4.2, pay the Contractor

4.4.1 an amount that is equal to 95% of the value that is indicated in the progress report referred to in TP4.3.2 if a labour and material payment bond has been furnished by the Contractor, or

4.4.2 an amount that is equal to 90% of the value that is indicated in the progress report referred to in TP4.3.2 if a labour and material payment bond has not been furnished by the Contractor.

4.5 It is a condition precedent to Her Majesty's obligation under TP4.4 that the Contractor has made and delivered to the Departmental Representative,

4.5.1 a statutory declaration described in TP4.6 in respect of a progress claim referred to in TP4.2,

4.5.2 in the case of the Contractor's first progress claim, a construction schedule in accordance with the relevant sections of the Specifications, and

4.5.3 if the requirement for a schedule is specified, an update of the said schedule at the times identified in the relevant sections of the Specifications.

4.6 A statutory declaration referred to in TP4.5 shall contain a deposition by the Contractor that

4.6.1 up to the date of the Contractor's progress claim, the Contractor has complied with all his lawful obligations with respect to the Labour Conditions; and

4.6.2 up to the date of the Contractor's immediately preceding progress claim, all lawful obligations of the Contractor to subcontractors and suppliers of material in respect of the

work under the contract have been fully discharged.

4.7 Subject to TP1 and TP4.8, Her Majesty shall, not later than 30 days after the date of issue of an Interim Certificate of Completion referred to in GC44.2, pay the Contractor the amount referred to in TP1 less the aggregate of

4.7.1 the sum of all payments that were made pursuant to TP4.4;

4.7.2 an amount that is equal to the Departmental Representative's estimate of the cost to Her Majesty or rectifying defects described in the Interim Certificate of Completion; and

4.7.3 an amount that is equal to the Departmental Representative's estimate of the cost to Her Majesty of completing the parts of the work described in the Interim Certificate of Completion other than the defects referred to in TP4.7.2.

4.8 It is a condition precedent to Her Majesty's obligation under TP4.7 that the Contractor has made and delivered to the Departmental Representative,

4.8.1 a statutory declaration described in TP4.9 in respect of an Interim Certificate of Completion referred to in GC44.2, and

4.8.2 if so specified in the relevant sections of the Specifications, and update of the construction schedule referred to in TP4.5.2 and the updated schedule shall, in addition to the specified requirements, clearly show a detailed timetable that is acceptable to the Departmental Representative for the completion of any unfinished work and the correction of all defects.

4.9 A statutory declaration referred to in TP4.8 shall contain a deposition by the contractor that up to the date of the Interim Certificate of Completion the Contractor has

4.9.1 complied with all of the Contractor's lawful obligations with respect to the Labour Conditions;

4.9.2 discharged all of the Contractor's lawful obligations to the subcontractors and suppliers of material in respect of the work under the contract; and

4.9.3 discharged the Contractor's lawful obligations referred to in GC14.6.

4.10 Subject to TP1 and TP4.11, Her Majesty shall, not later than 60 days after the date of issue of a Final Certificate of Completion referred to in GC44.1, pay the Contractor the amount referred to in TP1 less the aggregate of

4.10.1 the sum of all payments that were made pursuant to TP4.4; and

4.10.2 the sum of all payments that were made pursuant to TP4.7.

4.11 It is a condition precedent to Her Majesty's obligation under TP4.10 that the Contractor has made and delivered a statutory declaration described in TP4.12 to the Departmental Representative.

4.12 A statutory declaration referred to in TP4.11 shall, in addition to the depositions described in TP4.9, contain a deposition by the Contractor that all of the Contractor's lawful obligations and any lawful claims against the Contractor that arose out of the performance of the contract have been discharged and satisfied.

TP5 Progress Report and Payment Thereunder Not Binding on Her Majesty

5.1 Neither a progress report referred to in TP4.3 nor any payment made by Her Majesty pursuant to these Terms of Payment shall be construed as an admission by Her Majesty that the work, material or any part thereof is complete, is satisfactory or is in accordance with the contract.

TP6 Delay in Making Payment

6.1 Nothwithstanding GC7 any delay by Her Majesty in making any payment when it is due pursuant to these Terms of Payment shall not be a breach of the contract by Her Majesty.

6.2 Her Majesty shall pay, without demand from the Contractor, simple interest at the Bank Rate plus 1 -1/4 per centum on any amount which is overdue pursuant to TP4.1.3, and the interest shall apply from and include the day such amount became overdue until the day prior to the date of payment except that

6.2.1 interest shall not be payable or paid unless the amount referred to in TP6.2 has been overdue for more that 15 days following

6.2.1.1 the date the said amount became due and payable, or

6.2.1.2 the receipt by the Departmental Representative of the Statutory Declaration referred to in TP4.5, TP4.8 or TP4.11,

whichever is the later, and

6.6.2 interest shall not be payable or paid on overdue advance payments if any.

TP7 Right of Set-off

7.1 Without limiting any right of set-off or deduction given or implied by law or elsewhere in the contract, Her Majesty may set off any amount payable to Her Majesty by the Contractor under this contract or under any current contract against any amount payable to the Contractor under this contract.

7.2 For the purposes of TP7.1, "current contract" means a contract between Her Majesty and the Contractor

7.2.1 under which the Contractor has an undischarged obligation to perform or supply work, labour or material, or

7.2.2 in respect of which Her Majesty has, since the date of which the Articles of Agreement were made, exercised any right to take the work that is the subject of the contract out of the Contractor's hands.

TP8 Payment in Event of Termination

8.1 If the contract is terminated pursuant to GC41, Her Majesty shall pay the Contractor any amount that is lawfully due and payable to the Contractor as soon as is practicable under the circumstances.

TP9 Interest on Settled Claims

9.1 Her Majesty shall pay to the Contractor simple interest on the amount of a settled claim at an average Bank Rate plus 1 ¼ per centum from the date the settled claim was outstanding until the day prior to the date of payment.

9.2 For the purposes of TP9.1,

9.2.1 a claim is deemed to have been settled when an agreement in writing is signed by the Departmental Representative and the Contractor setting out the amount of the claim to be paid by Her Majesty and the items or work for which the said amount is to be paid.

9.2.2 an "average Bank Rate" means the discount rate of interest set by the Bank of Canada in effect at the end of each calendar month averaged over the period the settled claim was outstanding.

9.2.3 a settled claim is deemed to be outstanding from the day immediately following the date the said claim would have been due and payable under the contract had it not been disputed.

9.3 For the purposes of TP9 a claim means a disputed amount subject to negotiation between Her Majesty and the Contractor under the contract.

GC1 Interpretation

1.1 In the contract

1.1.1 where reference is made to a part of the contract by means of numbers preceded by letters, the reference shall be construed to be a reference to the particular part of the contract that is identified by that combination of letters and numbers and to any other part of the contract referred to therein;

1.1.2 "contract" means the contract document referred to in the Articles of Agreement;

1.1.3 "contract security" means any security given by the Contractor to Her Majesty in accordance with the contract;

1.1.4 "Departmental Representative" means the officer or employee or Her Majesty who is designated pursuant to the Articles of Agreement and includes a person specially authorized by him to perform, on his behalf, any of his functions under the contract and is so designated in writing to the Contractor;

1.1.5 "material" includes all commodities, articles and things required to be furnished by or for the Contractor under the contract for incorporation into the work;

1.1.6 "Minister" includes a person acting for, or if the office is vacant, in place of the Minister and his successors in the office, and his or their lawful deputy and any of his or their representatives appointed for the purposes of the contract;

1.1.7 "person" includes, unless the context otherwise requires, a partnership, proprietorship, firm, joint venture, consortium and a corporation;

1.1.8 "plant" includes all animals, tools, implements, machinery, vehicles, buildings, structures, equipment and commodities, articles and things other than material, that are necessary for the due performance of the contract;

1.1.9 "subcontractor' means a person to whom the Contractor has, subject to GC4, subcontracted the whole or any part of the work;

1.1.10 "superintendant" means the employee of the Contractor who is designated by the Contractor to act pursuant to GC19;

1.1.11 "work includes, subject only to any express stipulation in the contract to the contrary, everything that is necessary to be done, furnished or delivered by the Contractor to perform the contract.

1.2 The headings in the contract documents, other than in the Plans and Specifications, form no part of the contract but are inserted for convenience of reference only.

1.3 In interpreting the contract, in the event of discrepancies or conflicts between anything in the Plans and Specifications and the General Conditions, the General Conditions govern.

1.4 In interpreting the Plans and Specifications, in the event of discrepancies or conflicts between

1.4.1 the Plans and Specifications, the Specifications govern;

1.4.2 the Plans, the Plans drawn with the largest scale govern; and

1.4.3 figured dimensions and scaled dimensions, the figured dimensions govern.

GC2 Successors and Assigns

2.1 The contract shall inure to the benefit of and be binding upon the parties hereto and their lawful heirs, executors, administrators, successors and assigns.

GC3 Assignment of Contract

3.1 The contract may not be assigned by the Contractor, either in whole or in part, without the written consent of the Minister.

GC4 Subcontracting by Contractor

4.1 Subject to this General Condition, the Contractor may subcontract any part of the work.

4.2 The Contractor shall notify the Departmental Representative in writing of his intention to subcontract.

4.3 A notification referred to in GC4.2 shall identify the part of the work, and the subcontractor with whom it is intended to subcontract.

4.4 The Departmental Representative may object to the intended subcontracting by notifying the Contractor in writing within six days of receipt by the Departmental Representative of a notification referred to in GC4.2.

4.5 If the Departmental Representative objects to a subcontracting pursuant to GC4.4, the Contractor shall not enter into the intended subcontract.

4.6 The contractor shall not, without the written consent of the Departmental Representative, change a subcontractor who has been engaged by him in accordance with this General Condition.

4.7 Every subcontract entered into by the Contractor shall adopt all of the terms and conditions of ths contract that are of general application.

4.8 Neither a subcontracting nor the Departmental Representative's consent to a subcontracting by the Contractor shall be construed to relieve the Contractor from any obligation under the contract or to impose any liability upon Her Majesty.

GC5 Amendments

5.1 No amendment or change in any of the provisions of the contract shall have any force or effect until it is reduced to writing.

GC6 No Implied Obligations

6.1 No implied terms or obligations of any kind by or on behalf of Her Majesty shall arise from anything in the contract and the express covenants and agreements therein contained and made by Her Majesty are the only covenants and agreements upon which any rights against Her Majesty are to be founded.

6.2 The contract supersedes all communications, negotiations and agreements, either written or oral, relating to the work that were made prior to the date of the contract.

GC7 Time of Essence

7.1 Time is of the essence of the contract.

GC8 Indemnification by Contractor

8.1 The Contractor shall indemnify and save Her Majesty harmless from and against all claims, demand, losses, costs, damages, actions, suits, or proceedings by whomever made, brought or prosecuted and in any manner based upon, arising out of, related to, occasioned by or attributable to the activities of the Contractor, his servants, agents, subcontractors and sub-subcontractors in performing the work including an infringement or an alleged infringement of a patent of invention or any other kind of intellectual property.

8.2 For the purpose of GC8.1, "activities" includes any act improperly carried out, any omission to carry out an act and any delay in carrying out an act.

GC9 Indemnification by Her Majesty

9.1 Her Majesty shall, subject to the Crown Liability Act, the Patent Act, and any other law that affects Her Majesty's rights, powers, privileges or obligations, indemnify and save the Contractor harmless from and against all claims, demands, losses, costs, damage, actions, suits or proceedings arising out of his activities under the contract that are directly attributable to

9.1.1 lack of or a defect in Her Majesty's title to the work site whether real or alleged; or

9.1.2 an infringement or an alleged infringement by the Contractor of any patent of invention or any other kind of intellectual property occurring while the Contractor was performing any act for the purposes of the contract employing a model, plan or design or any other thing related to the work that was supplied by Her Majesty to the Contractor.

GC10 Members of House of Commons Not to Benefit

10.1 As required by the Parliament of Canada Act, it is an express condition of the contract that no member of the House of Commons shall be admitted to any share of part of the contract or to any benefit arising therefrom.

GC11 Notices

11.1 Any notice, consent, order, decision, direction or other communication, other than a notice referred to in GC11.4, that may be given to the Contractor pursuant to the contract may be given in any manner.

11.2 Any notice, consent, order, decision, direction or other communication required to be given in writing, to any party pursuant to the contract shall, subject to GC11.4, be deemed to have been effectively given

11.2.1 to the Contractor, if delivered personally to the Contractor or the Contractor's superintendent, or forwarded by mail, telex or facsimile to the Contractor at the address set out in A4.1, or

11.2.2 to Her Majesty, if delivered personally to the Departmental Representative, or forwarded by mail, telex or facsimile to the Departmental Representative at the address set out in A1.2.1.

11.3 Any such notice, consent, order, decision, direction or other communication given in accordance with GC11.2 shall be deemed to have been received by either party

11.3.1 if delivered personally, on the day that it was delivered,

11.3.2 if forwarded by mail, on the earlier of the day it was received and the sixth day after it was mailed, and

11.3.3 if forwarded by telex or facsimile, 24 hours after it was transmitted.

11.4 A notice given under GC38.1.1, GC40 and GC41, if delivered personally, shall be delivered to the Contractor if the Contractor is doing business as sole proprietor or, if the Contractor is a partnership or corporation, to an officer thereof.

GC12 Material, Plant and Real Property Supplied by Her Majesty

12.1 Subject to GC12.2, the Contractor is liable to Her Majesty for any loss of or damage to material, plant or real property that is supplied or placed in the care, custody and control of the Contractor by Her Majesty for use in connection with the contract, whether or not that loss or damage is attributable to causes beyond the Contractor's control.

12.2 The Contractor is not liable to Her Majesty for any loss or damage to material, plant or real property referred to in GC12.1 if that loss or damage results from and is directly attributable to reasonable wear and tear.

12.3 The Contractor shall not use any material, plant or real property referred to in GC12.1 except for

the purpose of performing this contract.

12.4 When the Contractor fails to make good any loss or damage for which he is liable under GC12.1 within a reasonable time after being required to do so by the Departmental Representative, the Departmental Representative may cause the loss or damage to be made good at the Contractor's expense, and the Contractor shall thereupon be liable to Her Majesty for the cost thereof and shall, on demand, pay to Her Majesty an amount equal to that cost.

12.5 The Contractor shall keep such records of all material, plant and real property referred to in GC12.1 as the Departmental Representative from time to time requires and shall satisfy the Departmental Representative, when requested, that such material, plant and real property are at the place and in the condition which they ought to be.

GC13 Material, Plant and Real Property Become Property of Her Majesty

13.1 Subject to GC14.7 all material and plant and the interest of the Contractor in all real property, licenses, powers and privileges purchased, used or consumed by the Contractor for the contract shall, after the time of their purchase, use or consumption be the property of Her Majesty for the purposes of the work and they shall continue to be the property of Her Majesty.

13.1.1 in the case of material, until the Departmental Representative indicates that he is satisfied that it will not be required for the work, and

13.1.2 in the case of plant, real property, licenses, powers and privileges, until the Departmental Representative indicates that he is satisfied that the interest vested in Her Majesty therein is no longer required for the purposes of the work.

13.2 Material or plant that is the property of Her Majesty by virtue of GC13.1 shall not be taken away from the work site or used or disposed of except for the purposes of the work without the written consent of the Departmental Representative.

13.3 Her Majesty is not liable for loss of or damage from any cause to the material or plant referred to in GC13.1 and the Contractor is liable for such loss or damage notwithstanding that the material or plant is the property of Her Majesty.

GC14 Permits and Taxes Payable

14.1 The Contractor shall, within 30 days after the date of the contract, tender to a municipal authority an amount equal to all fees and charges that would be lawfully payable to that municipal authority in respect of building permits as if the work were being performed for a person other than Her Majesty.

14.2 Within 10 days of making a tender pursuant to GC14.1, the Contractor shall notify the Departmental Representative of his action and of the amount tendered and whether or not the municipal authority has accepted that amount.

14.3 If the municipal authority does not accept the amount tendered pursuant to GC14.1 the Contractor shall pay that amount to Her Majesty within 6 days after the time stipulated in GC14.2.

14.4 For the purposes of GC14.1 to GC14.3 "municipal authority" means any authority that would have jurisdiction respecting permission to perform the work if the owner were not Her Majesty.

14.5 Notwithstanding the residency of the Contractor, the Contractor shall pay any applicable tax arising from or related to the performance of the work under the contract.

14.6 In accordance with the Statutory Declaration referred to in TP4.9, a Contractor who has neither residence nor place of business in the province in which work under the contract is being performed shall provide Her Majesty with proof of registration with the provincial sales tax authorities in the said province.

14.7 For the purpose of the payment of any applicable tax or the furnishing of security for the payment of any applicable tax arising from or related to the performance of the work under the contract, the Contractor shall, notwithstanding the fact that all material, plant and interest of the Contractor in all real property, licenses, powers and privileges, have become the property of Her Majesty after the time of purchase, be liable, as a user or consumer, for the payment or for the furnishing of security for the payment of any applicable tax payable, at the time of the use or consumption of that material, plant or interest of the Contractor in accordance with the relevant legislation.

GC15 Performance of Work under Direction of Departmental Representative

15.1 The Contractor shall

15.1.1 permit the Departmental Representative to have access to the work and its site at all times during the performance of the contract;

15.1.2 furnish the Departmental Representative with such information respecting the performance of the contract as he may require; and

15.1.3 give the Departmental Representative every possible assistance to enable the Departmental Representative to carry out his duty to see that the work is performed in accordance with the contract and to carry out any other duties and exercise any powers specially imposed or conferred on the Departmental Representative under the contract.

CG16 Cooperation with Other Contractors

16.1 Where, in the opinion of the Departmental Representative, it is necessary that other contractors or workers with or without plant and material, be sent onto the work or its site, the Contractor shall, to the satisfaction of the Departmental Representative, allow them access and cooperate with them in the carrying out of their duties and obligation.

16.2 If

16.2.1 the sending onto the work or its site of other contractors or workers pursuant to GC16.1 could not have been reasonably foreseen or anticipated by the Contractor when entering into the contract, and

16.2.2 the Contractor incurs, in the opinion of the Departmental Representative, extra expense in complying with GC16.1, and

16.2.3 The Contractor has given the Departmental Representative written notice of his claim for the extra expense referred to in GC16.2.2 within 30 days of the date that the other contractors or workers were sent onto the work or its site,

Her Majesty shall pay the Contractor the cost, calculated in accordance with GC48 to GC50, of the extra labour, plant and material that was necessarily incurred.

GC17 Examination of Work

17.1 If, at any time after the commencement of the work but prior to the expiry of the warranty or guarantee period, the Departmental Representative has reason to believe that the work or any part thereof has not been performed in accordance with the contract, the Departmental Representative may have that work examined by an expert of his choice.

17.2 If, as a result of an examination of the work referred to in GC17.1, it is established that the work was not performed in accordance with the contract, then, in addition to and without limiting or otherwise affecting any of Her Majesty's rights and remedies under the contract either at law or in equity, the Contractor shall pay Her Majesty, on demand, all reasonable costs and expenses that were incurred by Her Majesty in having that examination performed.

GC18 Clearing of Site

18.1 The Contractor shall maintain the work and its site in a tidy condition and free from the accumulation of waste material and debris, in accordance with any directions of the Departmental Representative.

18.2 Before the issue of an interim certificate referred to in GC44.2, the Contractor shall remove all the plant and material not required for the performance of the remaining work, and all waste material and other debris, and shall cause the work and its site to be clean and suitable for occupancy by Her Majesty's servants, unless otherwise stipulated in the contract.

18.3 Before the issue of a final certificate referred to in GC44.1, the Contractor, shall remove from the work and its site all of the surplus plant and material and any waste material and other debris.

18.4 The Contractor's obligations described in GC18.1 to GC18.3 do not extend to waste material and other debris caused by Her Majesty's servants or contractors and workers referred to in GC16.1.

GC19 Contractor's Superintendent

19.1 The Contractor shall, forthwith upon the award of the contract, designate a superintendent.

19.2 The Contractor shall forthwith notify the Departmental Representative of the name, address and telephone number of a superintendent designate pursuant to GC19.1.

19.3 A superintendent designated pursuant to GC19.1 shall be in full charge of the operations of the Contractor in the performance of the work and is authorized to accept any notice, consent, order, direction, decision or other communication on behalf of the Contractor that may be given to the superintendent under the contract.

19.4 The Contractor shall, until the work has been completed, keep a competent superintendent at the work site during working hours.

19.5 The Contractor shall, upon the request of the Departmental Representative, remove any superintendent who, in the opinion of the Departmental Representative, is incompetent or has been conducting himself improperly and shall forthwith designate another superintendent who is acceptable to the Departmental Representative.

19.6 Subject to GC19.5, the Contractor shall not substitute a superintendent without the written consent of the Departmental Representative.

19.7 A breach by the Contractor of GC19.6 entitles the Departmental Representative to refuse to issue any certificate referred to in GC44 until the superintendent has returned to the work site or another superintendent who is acceptable to the Departmental Representative has been substituted.

GC20 National Security

20.1 If the Minister is of the opinion that the work is of a class or kind that involves the national security, he may order the Contractor

20.1.1 to provide him with any information concerning persons employed or to be employed by him for purposes of the contract; and

20.1.2 to remove any person from the work and its site if, in the opinion of the Minister, that person may be a risk to the national security.

20.2 The Contractor shall, in all contracts with persons who are to be employed in the performance of the contract, make provision for his performance of any obligation that may be imposed upon him under GC19 to GC21.

20.3 The Contractor shall comply with an order of the Minister under GC20.1

GC21 Unsuitable Workers

21.1 The Contractor shall, upon the request of the Departmental Representative, remove any person employed by him for purposes of the contract who, in the opinion of the Departmental Representative, is incompetent or has conducted himself improperly, and the Contractor shall not permit a person who has been removed to return to the work site.

GC22 Increased or Decreased Costs

22.1 The amount set out in the Articles of Agreement shall not be increased or decreased by reason of any increase or decrease in the cost of the work that is brought about by an increase or decrease in the cost of labour, plant or material or any wage adjustment arising pursuant to the Labour Conditions.

22.2 Notwithstanding GC22.1 and GC35, an amount set out in the Articles of Agreement shall be adjusted in the manner provided in GC22.3, if any change in a tax imposed under the Excise Act, the Excise Tax Act, the Old Age Security Act, the Customs Act, the Customs Tariff or any provincial sales tax legislation imposing a retail sales tax on the purchase of tangible personal property incorporated into Real Property

22.2.1 occurs after the date of the submission by the Contractor of his tender for the contract,

22.2.2 applies to material, and

22.2.3 affects the cost to the Contractor of that material.

22.3 If a change referred to in GC22.2 occurs, the appropriate amount set out in the Articles of Agreement shall be increased or decreased by an amount equal to the amount that is established by an examination of the relevant records of the Contractor referred to in GC51 to be the increase or decrease in the cost incurred that is directly attributable to that change.

22.4 For the purpose of GC22.2, where a tax is changed after the date of submission of the tender but public notice of the change has been given by the Minister of Finance before that date, the change shall be deemed to have occurred before the date of submission of the tender.

GC23 Canadian Labour and Material

23.1 The Contractor shall use Canadian labour and material in the performance of the work to the full extent to which they are procurable, consistent with proper economy and expeditious carrying out of the work.

23.2 Subject to GC23.1, the Contractor shall, in the performance of the work, employ labour from the locality where the work is being performed to the extent to which it is available, and shall use the offices of the Canada Employment Centres for the recruitment of workers wherever practicable.

23.3 Subject to GC23.1 and GC23.2, the Contractor shall, in the performance of the work, employ a reasonable proportion of persons who have been on active service with the armed forces of Canada and have been honourably discharged therefrom.

GC24 Protection of Work and Documents

24.1 The Contractor shall guard or otherwise protect the work and its site, and protect the contract, specifications, plans, drawings, information, material, plant and real property, whether or not they are supplied by Her Majesty to the Contractor, against loss or damage from any cause, and he shall not use, issue, disclose or dispose of them without the written consent of the Minister, except as may be essential for the performance of the work.

24.2 If any document or information given or disclosed to the Contractor is assigned a security rating by the person who gave or disclosed it, the Contractor shall take all measures directed by the Departmental Representative to be taken to ensure the maintenance of the degree of security that is ascribed to that rating.

24.3 The Contractor shall provide all facilities necessary for the purpose of maintaining security, and shall assist any person authorized by the Minister to inspect or to take security measures in respect of the work and its site.

24.4 The Departmental Representative may direct the Contractor to do such things and to perform such additional work as the Departmental Representative considers reasonable and necessary to ensure compliance with or to remedy a breach of GC24.1 to GC24.3.

GC25 Public Ceremonies and Signs

25.1 The Contractor shall not permit any public ceremony in connection with the work without the prior consent of the Minister.

25.2 The Contractor shall not erect or permit the erection of any sign or advertising on the work or its site without the prior consent of the Departmental Representative.

GC26 Precautions against Damage, Infringement of Rights, Fire, and Other Hazards

26.1 The Contractor shall, at his own expense, do whatever is necessary to ensure that

26.1.1 no person, property, right, easement or privilege is injured, damaged or infringed by reasons of the Contractor's activities in performing the contract;

26.1.2 pedestrian and other traffic on any public or private road or waterway is not unduly impeded, interrupted or endangered by the performance or existence of the work or plant;

26.1.3 fire hazards in or about the work or its site are eliminated and, subject to any direction that may be given by the Departmental Representative, any fire is promptly extinguished;

26.1.4 the health and safety of all persons employed in the performance of the work is not endangered by the method or means of its performance;

26.1.5 adequate medical services are available to all persons employed on the work or its site at all times during the performance of the work;

26.1.6 adequate sanitation measures are taken in respect of the work and its site; and

26.1.7 all stakes, buoys and marks placed on the work or its site by or under the authority of the Departmental Representative are protected and are not removed, defaced, altered or destroyed.

26.2 The Departmental Representative may direct the Contractor to do such things and to perform such additional work as the Departmental Representative considers reasonable and necessary to ensure

compliance with or to remedy a breach of GC26.1.

26.3 The Contractor shall, at his own expense, comply with a direction of the Departmental Representative made under GC26.2.

GC27 Insurance

27.1 The Contractor shall, at his own expense, obtain and maintain insurance contracts in respect of the work and shall provide evidence thereof to the Departmental Representative in accordance with the requirements of the Insurance Conditions "E".

27.2 The insurance contracts referred to in GC27.1 shall

27.2.1 be in a form, of the nature, in the amounts, for the periods and containing the terms and conditions specified in Insurance Conditions "E", and

27.2.2 provide for the payment of claims under such insurance contracts in accordance with GC28.

GC28 Insurance Proceeds

28.1 In the case of a claim payable under a Builders Risk/Installation (All Risks) insurance contract maintained by the Contractor pursuant to GC27, the proceeds of the claim shall be paid directly to Her Majesty, and

28.1.1 the monies so paid shall be held by Her Majesty for the purposes of the contract, or

28.1.2 if Her Majesty elects, shall be retained by Her Majesty, in which event they vest in Her Majesty absolutely.

28.2 In the case of a claim payable under a General Liability insurance contract maintained by the Contractor pursuant to GC27, the proceeds of the claim shall be paid by the insurer directly to the claimant.

28.3 If an election is made pursuant to GC28.1, the Minister may cause an audit to be made of the accounts of the Contractor and of Her Majesty in respect of the part of the work that was lost, damaged or destroyed for the purpose of establishing the difference, if any, between

28.3.1 the aggregate of the amount of the loss or damage suffered or sustained by Her Majesty, including any cost incurred in respect of the clearing and cleaning of the work and its site and any other amount that is payable by the Contractor to Her Majesty under the contract, minus any monies retained pursuant to GC28.12, and

28.3.2 the aggregate of the amounts payable by Her Majesty to the Contractor pursuant to the contract up to the date of the loss or damage.

28.4 A difference that is established pursuant to GC28.3 shall be paid forthwith by the party who is determined by the audit to be the debtor to the party who is determined by the audit to be the

creditor.

28.5 When payment of a deficiency has been made pursuant to GC28.4, all rights and obligations of Her Majesty and the Contractor under the contract shall, with respect only to the part of the work that was the subject of the audit referred to in GC28.3, be deemed to have been expended and discharged.

28.6 If an election is not made pursuant to GC28.1.2 the Contractor shall, subject to GC28.7, clear and clean the work and its site and restore and replace the part of the work that was lost, damaged or destroyed at his own expense as if that part of the work had not yet been performed.

28.7 When the Contractor clears and cleans the work and its site and restores and replaces the work referred to in GC 28.6, Her Majesty shall pay him out of the monies referred to in GC28.1 so far as they will thereunto extend.

28.8 Subject to GC28.7, payment by Her Majesty pursuant to GC28.7 shall be made in accordance with the contract but the amount of each payment shall be 100% of the amount claimed notwithstanding TP4.4.1 and TP4.4.2.

GC29 Contract Security

29.1 The Contractor shall obtain and deliver contract security to the Departmental Representative in accordance with the provisions of the Contract Security Conditions.

29.2 If the whole or a part of the contract security referred to in GC29.1 is in the form of a security deposit, it shall be held and disposed of in accordance with GC43 and GC45.

29.3 If a part of the contract security referred to in GC29.1 is in the form of a labour and material payment bond, the Contractor shall post a copy of that bond on the work site.

GC30 Changes in the Work

30.1 Subject o GC5, the Departmental Representative may, at any time before he issues his Final Certificate of Completion,

30.1.1 order work or material in addition to that provided for in the Plans and Specifications; and

30.1.2 delete or change the dimensions, character, quantity, quality, description, location or position of the whole or any part of the work or material proved for in the Plans and Specifications or in any order made pursuant to GC30.1.1,

if that additional work or material, deletion, or change is, in his opinion, consistent with the general intent of the original contract.

30.2 The Contractor shall perform the work in accordance with such orders, deletions and changes that are made by the Departmental Representative pursuant to GC30.1 from time to time as if they had appeared in and been part of the Plans and Specifications.

30.3 The Departmental Representative shall determine whether or not anything done or omitted by the Contractor pursuant to an order, deletion or change referred to in GC30.1 increased or decreased the cost of the work to the Contractor.

30.4 If the Departmental Representative determines pursuant to GC30.3 that the cost of the work to the Contractor has been increased, Her Majesty shall pay the Contractor the increased cost that the Contractor necessarily incurred for the additional work calculated in accordance with GC49 or GC50.

30.5 If the Departmental Representative determines pursuant to GC303.3 that the cost of the work to the Contractor has been decreased, Her Majesty shall reduce the amount payable to the Contractor under the contract by an amount equal to the decrease in the cost caused by the deletion or change referred to in GC30.1.2 and calculated in accordance with GC49.

30.6 GC30.3 to GC30.5 are applicable only to a contract or a portion of a contract for which a Fixed Price Arrangement is stipulated in the contract.

30.7 An order, deletion or change referred to in GC30.1 shall be in writing, signed by the Departmental Representative and given to the Contractor in accordance with GC11.

GC31 Interpretation of Contract by Departmental Representative

31.1 If, ar any time before the Departmental Representative has issued a Final Certificate of Completion referred to in GC44.1, any question arises between the parties about whether anything has been done as required by the contract or about what the Contractor is required by the contract to do, and, in particular but without limiting the generality of the foregoing, about

31.1.1 the meaning of anything in the Plans and Specification,

31.1.2 the meaning to be given to the Plans and Specifications in case of any error therein, omission therefrom, or obscurity or discrepancy in their working or intention,

31.1.3 whether or not the quality or quantity of any material or workmanship supplied or proposed to be supplied by the Contractor meets the requirements of the contract,

31.1.4 whether or not the labour, plant or material provided by the Contractor for performing the work and carrying out the contract are adequate to ensure that the work will be performed in accordance with the contract and that the contract will be carried out in accordance with its terms,

31.1.5 what quantity of any kind of work has been completed by the Contractor, or

31.1.6 the timing and scheduling of the various phases of the performance of the work,

the question shall be decided by the Departmental Representative whose decision shall be final and conclusive in respect of the work.

31.2 The Contractor shall perform the work in accordance with any decisions of the Departmental

Representative that are made under GC31.1 and in accordance with any consequential directions given by the Departmental Representative.

GC32 Warranty and Rectification of Defects in Work

32.1 Without restricting any warranty or guarantee implied or imposed by law or contained in the contract documents, the Contractor shall, at his own expense,

32.1.1 rectify and make good any defect or fault that appears in the work or comes to the attention of the Minister with respect to those parts of the work accepted in connection with the Interim Certificate of Completion referred to GC44.2 within 12 months from the date of the Interim Certificate of Completion;

32.1.2 rectify and make good any defect or fault that appears in or comes to the attention of the Minister in connection with those parts of the work described in the Interim Certificate of Completion referred to in GC44.2 within 12 months from the date of the Final Certificate of Completion referred to in GC44.1.

32.2 The Departmental Representative may direct the Contractor to rectify and make good any defect or fault referred to in GC32.1 or covered by any other expressed or implied warranty or guarantee.

32.3 A direction referred to in GC32.2 shall be in writing, may include a stipulation in respect of the time within which a defect or fault is required to be rectified and made good by the Contractor, and shall be given to the Contractor in accordance with GC11.

32.4 The Contractor shall rectify and make good any defect or fault described in a direction given pursuant to GC32.2 within the time stipulated therein.

GC33 Non-Compliance by Contractor

33.1 If the Contractor fails to comply with any decision or direction given by the Departmental Representative pursuant to GC18, GC24, GC26, GC31 or GC32, the Departmental Representative may employ such methods as he deems advisable to do that which the Contractor failed to do.

33.2 The Contractor shall, on demand, pay Her Majesty an amount that is equal to the aggregate of all cost, expenses and damage incurred or sustained by Her Majesty by reason of the Contractor's failure to comply with any decision or direction referred to in GC33.1, including the cost of any methods employed by the Departmental Representative pursuant to GC33.1.

GC34 Protesting Departmental Representative's Decisions

34.1 The Contractor may, within ten days after the communication to him of any decision or direction referred to in GC30.3 or GC33.1, protest that decision or direction.

34.2 A protest referred to in GC34.1 shall be in writing, contain full reasons for the protest, be signed

by the Contractor and be given to Her Majesty by delivery to the Departmental Representative.

34.3 If the Contractor gives a protest pursuant to GC34.2, any compliance by the Contractor with the decision or direction that was protested shall not be construed as an admission by the Contractor of the correctness of that decision or direction, or prevent the Contractor from taking whatever action he considers appropriate in the circumstances.

34.4 The giving of a protest by the Contractor pursuant to GC34.2 shall not relieve him from complying with the decision or direction that is the subject of the protest.

34.5 Subject to GC34.6, the Contractor shall take any action referred to in GC34.3 within three months after the date that a Final Certificate of Completion is issued under GC44.1 and not afterwards.

34.6 The Contractor shall take any action referred to in GC34.3 resulting from a direction under GC32 within three months after the expiry of a warranty or guarantee period and not afterwards.

34.7 Subject to GC34.8, if Her Majesty determines that the Contractor's protest is justified, Her Majesty shall pay the Contractor the cost of the additional labour, plant and material necessarily incurred by the Contractor in carrying out the protested decision or direction.

34.8 Costs referred to in GC34.7 shall be calculated in accordance with GC48 to GC50.

GC35 Changes in Soil Conditions and Neglect or Delay by Her Majesty

35.1 Subject to GC35.2 no payment, other than a payment that is expressly stipulated in the contract, shall be made by Her Majesty to the Contractor for any extra expense or any loss or damage incurred or sustained by the Contractor.

35.2 If the Contractor incurs or sustains any extra expense or any loss or damage that is directly attributable to

35.2.1 a substantial difference between the information relating to soil conditions at the work site that is contained in the Plans and Specifications or other documents supplied to the Contractor for his use in preparing his tender or a reasonable assumption of fact based thereon made by the Contractor, and the actual soil conditions encountered by the Contractor at the work site during the performance of the contract, or

35.2.2 any neglect or delay that occurs after the date of the contract on the part of Her Majesty in providing any information or in doing any act that the contract either expressly requires Her Majesty to do or that would ordinarily be done by an owner in accordance with the usage of the trade,

he shall, within ten days of the date the actual soil conditions described in GC35.2.1 were encountered or the neglect or delay described in GC35.2.2 occurred, give the Departmental Representative written notice of his intention to claim for that extra expense or that loss or damage.

35.3 When the Contractor has given a notice referred to in GC35.2, he shall give the Departmental Representative a written claim for extra expense or loss or damage within 30 days of the date that

a Final Certificate of Completion referred to in GC44.1 is issued and not afterwards.

35.4 A written claim referred to in GC35.3 shall contain a sufficient description of the facts and circumstances of the occurrence that is the subject of the claim to enable the Departmental Representative to determine whether or not the claim is justified and the Contractor shall supply such further and other information for that purpose as the Departmental Representative requires from time to time.

35.5 If the Departmental Representative determines that a claim referred to in GC35.3 is justified, Her Majesty shall make an extra payment to the Contractor in an amount that is calculated in accordance with GC47 to GC50.

35.6 If, in the opinion of the Departmental Representative, an occurrence described in GC35.2.1 results in a savings of expenditure by the Contractor in performing the contract, the amount set out in the Articles of Agreement shall, subject to GC35.7, be reduced by an amount that is equal to the saving.

35.7 The amount of the saving referred to in GC35.6 shall be determined in accordance with GC47 to GC49.

35.8 If the Contractor fails to give a notice referred to in GC35.2 and a claim referred to in GC35.3 within the times stipulated, an extra payment shall not be made to him in respect of the occurrence.

GC36 Extension of Time

36.1 Subject to GC36.2, the Departmental Representative may, on the application of the Contractor made before the day fixed by the Articles of Agreement for completion of the work or before any other date previously fixed under this General Condition, extend the time for its completion by fixing a new date if, in the opinion of the Departmental Representative, causes beyond the control of the Contractor have delayed its completion.

36.2 An application referred to in GC36.1 shall be accompanied by the written consent of the bonding company whose bond forms part of the contract security.

GC37 Assessments and Damages for Late Completion

37.1 For the purposes of this General Condition

37.1.1 the work shall be deemed to be completed on the date that an Interim Certificate of Completion referred to in GC44.2 is issued, and

37.1.2 "period of delay" means the number of days commencing on the day fixed by the Articles of Agreement for completion of the work and ending on the day immediately preceding the day on which the work is completed but does not include any day within a period of extension granted pursuant to GC36.1, and any other day on which, in the opinion of the Departmental Representative, completion of the work was delayed for reasons beyond the control of the Contractor.

37.2 If the Contractor does not complete the work by the day fixed for its completion by the Articles of Agreement but completes it thereafter, the Contractor shall pay Her Majesty an amount equal to the aggregate of

37.2.1 all salaries, wages and travelling expenses incurred by Her Majesty in respect of persons overseeing the performance of the work during the period of delay;

37.2.2 the cost incurred by Her Majesty as a result of the inability to use the completed work for the period of delay; and

37.2.3 all other expenses and damages incurred or sustained by Her Majesty during the period of delay as a result of the work not being completed by the day fixed for its completion.

37.3 The Minister may waive the right of Her Majesty to the whole or any part of the amount payable by the Contractor pursuant to GC37.2 I , in the opinion of the Minister, it is in the public interest to do so.

GC38 Taking the Work Out of the Contractor's Hands

38.1 The Minister may, at his sole discretion, by giving a notice in writing to the Contractor in accordance with GC11, take all or any part of the work out of the Contractor's hands, and may employ such means as he sees fit to have the work completed if the Contractor

38.1.1 Has not, within six days of the Minister or the Departmental Representative giving notice to the Contractor in writing in accordance with GC11, remedied any delay in the commencement or any default in the diligent performance of the work to the satisfaction of the Departmental Representative;

38.1.2 has defaulted in the completion of any part of the work within the time fixed for its completion by the contract;

38.1.3 has become insolvent;

38.1.4 has committed an act of bankruptcy;

38.1.5 has abandoned the work;

38.1.6 has made an assignment of the contract without the consent required by GC3.1; or

38.1.7 has otherwise failed to observe or perform any of the provisions of the contract.

38.2 If the whole or any part of the work is taken out of the Contractor's hands pursuant to GC38.1,

38.2.1 the Contractor's right to any further payment that is due or accruing due under the contract is, subject only to GC38.4, extinguished, and

38.2.2 the Contractor is liable to pay Her Majesty, upon demand, an amount that is equal to the amount of all loss and damage incurred or sustained by Her Majesty in respect of the

Contractor's failure to complete the work.

38.3 If the whole or any part of the work that is taken out of the Contractor's hands pursuant to GC38.1 is completed by Her Majesty, the Departmental Representative shall determine the amount, if any, of the holdback or a progress claim that had accrued and was due prior to the date on which the work was taken out of the Contractor's hands and that is not required for the purposes of having the work performed or of compensating Her Majesty for any other loss or damage incurred or sustained by reason of the Contractor's default.

38.4 Her Majesty may pay the Contractor the amount determined not to be required pursuant to GC38.3.

GC39 Effect of Taking the Work Out of the Contractor's Hands

39.1 The taking of the work or any part thereof out of the Contractor's hands pursuant to GC38 does not operate so as to relieve or discharge him from any obligation under the contract or imposed upon him by law except the obligation to complete the performance of that part of the work that was taken out of his hands.

39.2 If the work or any part thereof is taken out of the Contractor's hands pursuant to GC38, all plant and material and the interest of the Contractor is all real property, licenses, powers and privileges acquired, used or provided by the Contractor under the contract shall continue to be the property of Her Majesty without compensation to the Contractor.

39.3 When the Departmental Representative certifies that any plant, material, or any interest of the Contractor referred to in GC39.2 is no longer required for the purposes of the work, or that it is not in the interest of Her Majesty to retain that plant, material or interest, it shall revert to the Contractor.

G40 Suspension of Work by Minister

40.1 The Minister may, when in his opinion it is in the public interest to do so, require the Contractor to suspend performance of the work either for a specified or an unspecified period by giving a notice of suspension in wiring to the Contractor in accordance with GC11.

40.2 When a notice referred to in GC40.1 is received by the Contractor in accordance with GC11, he shall suspend all operations in respect of the work except those that, in the opinion of the Departmental Representative, are necessary for the care and preservation of the work, plant and material.

40.3 The Contractor shall not, during a period of suspension, remove any part of the work, plant or material from its site without the consent of the Departmental Representative.

40.4 If a period of suspension is 30 days or less, the Contractor shall, upon the expiration of that period, resume the performance of the work and he is entitled to be paid the extra cost, calculated in accordance with GC48 to GC50, of any labour, plant and material necessarily incurred by him as a result of the suspension.

40.5 If, upon the expiration of a period of suspension of more than 30 days, the Minister and the Contractor agree that the performance of the work will be continued by the Contractor, the Contractor shall resume performance of the work subject to any terms and conditions agreed upon by the Minister and the Contractor.

40.6 If, upon the expiration of a period of suspension of more than 30 days, the Minister and the Contractor do not agree that performance of the work will be continued by the Contractor or upon the terms and conditions under which the Contractor will continue the work, the notice of suspension shall be deemed to be a notice of termination pursuant to GC41.

GC41 Termination of Contract

41.1 The Minister may terminate the contract at any time by giving a notice of termination in writing to the Contractor in accordance with GC11.

41.2 When a notice referred to in GC41.1 is received by the Contractor in accordance with GC11, he shall, subject to any conditions stipulated in the notice, forthwith cease all operations in performance of the contract.

41.3 If the contract is terminated pursuant to GC41.1, Her Majesty shall pay the Contractor, subject to GC41.4, an amount equal to

41.3.1 the cost to the contractor of all labour, plant and material supplied by him under the contract up to the date of termination in respect of a contract or part thereof for which a Unit Price Arrangement is stipulated in the contract, or

41.3.2 the lesser of

41.3.2.1 an amount, calculated in accordance with the Terms and Payment, that would have been payable to the Contractor had he completed the work, and

41.3.2.2 an amount that is determined to be due to the Contractor pursuant to GC49 in respect of a contract or part thereof for which a Fixed Price Arrangement is stipulated in the contract

less the aggregate of all amounts that were paid to the Contractor by Her Majesty and all amounts that are due to Her Majesty from the Contractor pursuant to the contract.

41.4 If Her Majesty and the Contractor are unable to agree about an amount referred to in GC41.3 that amount shall be determined by the method referred to in GC50.

GC42 Claims Against and Obligations of the Contractor or Subcontractor

42.1 Her Majesty may, in order to discharge lawful obligations of and satisfy claims against the Contractor or a subcontractor arising out of the performance of the contract, pay any amount that is due and payable to the Contractor pursuant to the contract directly to the obligees of and the claimants against the Contractor or the subcontractor but such amount if any, as is paid by Her Majesty, shall not exceed that amount which the Contractor would have been obliged to pay to

such claimant had the provisions of the Provincial or Territorial lien legislation, or, in the Province of Quebec, the law relating to privileges, been applicable to the work. Any such claimant need not comply with the provisions of such legislation setting out the steps by way of notice, registration or otherwise as might have been necessary to preserve or perfect any claim for lien or privilege which claimant might have had;

42.2 Her Majesty will not make any payment as described in GC42.1 unless and until that claimant shall have delivered to Her Majesty:

42.2.1 a binding and enforceable Judgment or Order of a court of competent jurisdiction setting forth such amount as would have been payable by the Contractor to the claimant pursuant to the provisions of the applicable Provincial or Territorial lien legislation, or, in the Province of Quebec, the law relating to privileges, had such legislation been applicable to the work; or

42.2.2 a final and enforceable award of an arbitrator setting forth such amount as would have been payable by the Contractor to the claimant pursuant to the provisions of the applicable Provincial or Territorial lien legislation, or, in the Province of Quebec, the law relating to privileges, had such legislation been applicable to the work; or

42.2.3 the consent of the Contractor authorizing a payment.

For the purposes of determining the entitlement of a claimant pursuant to GC42.2.1 and GC42.2.2, the notice required by GC42.8 shall be deemed to replace the registration or provision of notice after the performance of work as required by any applicable legislation and no claim shall be deemed to have expired, become void or unenforceable by reason of the claimant not commencing any action within the time prescribed by any applicable legislation.

42.3 The Contractor shall, by the execution of his contract, be deemed to have consented to submit to binding arbitration at the request of any claimant those questions that need be answered to establish the entitlement of the claimant to payment pursuant to the provisions of GC42.1 and such arbitration shall have as parties to it any subcontractor to whom the claimant supplied material, performed work or rented equipment should such subcontractor wish to be adjoined and the Crown shall not be a party to such arbitration and, subject to any agreement between the Contractor and the claimant to the contrary, the arbitration shall be conducted in accordance with the Provincial or Territorial legislation governing arbitration applicable in the Province or Territory in which the work is located.

42.4 A payment made pursuant to GC42.1 is, to the extent of the payment, a discharge of Her Majesty's liability to the Contractor under the contract and may be deducted from any amount payable to the Contractor under the contract.

42.5 To the extent that the circumstances of the work being performed for Her Majesty permit, the Contractor shall comply with all laws in force in the Province or Territory where the work is being performed relating to payment period, mandatory holdbacks, and creation and enforcement of mechanics' liens, builders' liens or similar legislation or in the Province of Quebec, the law relating to privileges.

42.6 The Contractor shall discharge all his lawful obligations and shall satisfy all lawful claims against him arising out of the performance of the work at least as often as the contract requires Her

Majesty to pay the Contractor.

42.7 The Contractor shall, whenever requested to do so by the Departmental Representative, make a statutory declaration deposing to the existence and condition of any obligations and claims referred to in GC42.6.

42.8 GC42.1 shall only apply to claims and obligations

42.8.1 the notification of which has been received by the Departmental Representative in writing before payment is made to the Contractor pursuant to TP4.10 and within 120 days of the date on which the claimant

42.8.1.1 should have been paid in full under the claimant's contract with the Contractor or subcontractor where the claim is for money that was lawfully required to be held back from the claimant; or

42.8.1.2 performed the last of the services, work or labour, or furnished the last of the material pursuant to the claimant's contract with the Contractor or subcontractor where the claim is not for money referred to in GC42.8.1.1, and

42.8.2 the proceedings to determine the right to payment of which, pursuant to GC42.2. shall have commenced within one year from the date that the notice referred to in GC42.8.1 was received by the Departmental Representative, and

the notification required by GC42.8.1 shall set forth the amount claimed to be owing and the person who by contract is primarily liable.

42.9 Her Majesty may, upon receipt of a notice of claim under GC42.8.1, withhold from any amount that is due and payable to the Contractor pursuant to the contract the full amount of the claim or any portion thereof.

42.10 The Departmental Representative shall notify the Contractor in writing of receipt of any claim referred to in GC42.8.1 and of the intention of Her Majesty to withhold funds pursuant to GC42.9 and the Contractor may, at any time thereafter and until payment is made to the claimant, be entitled to post, with Her Majesty, security in a form acceptable to Her Majesty in an amount equal to the value of the claim, the notice of which is received by the Departmental Representative and upon receipt of such security Her Majesty shall release to the Contractor any funds which would be otherwise payable to the Contractor, that were withheld pursuant to the provisions of GC42.9 in respect of the claim of any claimant for whom the security stands.

GC43 Security Deposit – Forfeiture or Return

43.1 If

43.1.1 the work is taken out of the Contractor's hands pursuant to GC38,

43.1.2 the contract is terminated pursuant to GC41, or

43.1.3 the Contractor is in breach of or in default under the contract,

Her Majesty may convert the security deposit, if any, to Her own use.

43.2 If Her Majesty converts the contract security pursuant to GC43.1, the amount realized shall be deemed to be an amount due from Her Majesty to the Contractor under the contract.

43.3 Any balance of an amount referred to in GC43.2 that remains after payment of all losses, damage and claims of Her Majesty and others shall be paid by Her Majesty to the Contractor if, in the opinion of the Departmental Representative, it is not required for the purposes of the contract.

GC44 Departmental Representative's Certificates

44.1 On the date that

44.1.1 the work has been completed, and

44.1.2 the Contractor has complied with the contract and all orders and directions made pursuant thereto,

both to the satisfaction of the Departmental Representative, the Departmental Representative shall issue a Final Certificate of Completion to the Contractor.

44.2 If the Departmental Representative is satisfied that the work is substantially complete he shall, at any time before he issues a certificate referred to in GC44.1, issue an Interim Certificate of Completion to the Contractor, and

44.2.1 for the purposes of GC44.2 the work will be considered to be substantially complete,

44.2.1.1 when the work under the contract or a substantial part thereof is, in the opinion of the Departmental Representative, ready for use by Her Majesty or is being used for the purpose intended; and

44.2.1.2 when the work remaining to be done under the contract is, in the opinion of the Departmental Representative, capable of completion or correction at accost of not more that

44.2.1.2.1 -3% of the first $500,000, and

44.2.1.2.2 -2% of the next $500,000, and

44.2.1.2.3 -1% of the balance

of the value of the contract at the time this cost is calculated.

44.3 For the sole purpose of GC44.2.1.2, where the work or a substantial part thereof is ready for use or is being used for the purposes intended and the remainder of the work or a part thereof cannot be completed by the time specified in A2.1, or as amended pursuant to GC36, for reasons beyond the control of the Contractor or where the Departmental Representative and the Contractor agree not to complete a part of the work within the specified time, the cost of that part of the work

which was either beyond the control of the Contractor to complete or the Departmental Representative and the Contractor have agreed not to complete by the time specified shall be deducted from the value of the contract referred to GC44.2.1.2 and the said cost shall not form part of the cost of the work remaining to be done in determining substantial completion.

44.4 An Interim Certificate of Completion referred to in GC44.2 shall describe the parts of the work not completed to the satisfaction of the Departmental Representative and all things that must be done by the Contractor

44.4.1 before a Final Certificate of Completion referred to in GC44.1 will be issued, and

44.4.2 before the 12-month period referred to in GC32.1.2 shall commence for the said parts and all the said things.

44.5 The Departmental Representative may, in addition to the parts of the work described in an Interim Certificate of Completion referred to in GC44.2, require the Contractor to rectify any other parts of the work not completed to his satisfaction and to do any other things that are necessary for the satisfactory completion of the work.

44.6 If the contract or a part thereof is subject to a Unit Price Arrangement, the Departmental Representative shall measure and record the quantities of labour, plant and material, performed, used and supplied by the Contractor in performing the work and shall, at the request of the Contractor, inform him of those measurements.

44.7 The Contractor shall assist and co-operate with the Departmental Representative in the performance of his duties referred to in GC44.6 and shall be entitled to inspect any record made by the Departmental Representative pursuant to GC44.6.

44.8 After the Departmental Representative has issued a Final Certificate of Completion referred to in GC44.1, he shall, if GC44.6 applies, issue a Final Certificate of Measurement.

44.9 A Final Certificate of Measurement referred to in GC44.8 shall

44.9.1 contain the aggregate of all measurements of quantities referred to in GC44.6, and

44.9.2 be binding upon and conclusive between Her Majesty and the Contractor as to the quantities referred to therein.

GC45 Return of Security Deposit

45.1 After an Interim Certificate of Completion referred to in GC44.2 has been issued, Her Majesty shall, if the Contractor is not in breach of or in default under the contract, return to the Contractor all or any part of the security deposit that, in the opinion of the Departmental Representative, is not required for the purposes of the contract.

45.2 After a Final Certificate of Completion referred to in GC44.1 has been issued, Her Majesty shall return to the Contractor the remainder of any security deposit unless the contract stipulates otherwise.

45.3 If the security deposit was paid into the Consolidated Revenue Fund of Canada, Her Majesty shall pay interest thereon to the Contractor at a rate established from time to time pursuant to section 21(2) of the Financial Administration Act.

GC46 Clarification of Terms in GC47 to GC50

46.1 For the purposes of GC47 to GC50,

46.1.1 "Unit Price Table" means the table set out in the Articles of Agreement, and

46.1.2 "plant" does not include tools customarily provided by a tradesman in practicing his trade.

GC47 Additions or Amendments to Unit Price Table

47.1 Where a Unit Price Arrangement applies to the contract or a part thereof the Departmental Representative and the Contractor may, by an agreement in writing,

47.1.1 add classes of labour or material, and units of measurement, prices per unit and estimated quantities to the Unit Price Table if any labour, plant or material that is to be included in the Final Certificate of Measurement referred to in GC44.8 is not included in any class of labour, plant or material set out in the Unit Price Table; or

47.1.2 subject to GC47.2 and GC47.3, amend a price set out in the Unit Price Table for any class of labour, plant or material included therein if the Final Certificate of Measurement referred to in GC44.8 shows or is expected to show that the total quantity of that class of labour, plant or material actually performed, used or supplied by the Contractor in performing the work is

47.1.2.1 less than 85% of that estimated total quantity, or

47.1.2.2 in excess of 115% of that estimated total quantity.

47.2 In no event shall the total cost of an item set out in the Unit Price Table that has been amended pursuant to GC47.1.2.1 exceed the amount that would have been payable to the Contractor had the estimated total quantity actually been performed, used or supplied.

47.3 An amendment that is made necessary by GC47.1.2.2 shall apply only to the quantities that are in excess of 115%.

47.4 If the Departmental Representative and the Contractor do not agree as contemplated in GC47.1, the Departmental Representative shall determine the class and the unit of measurement of the labour, plant or material and, subject to GC47.2 and GC47.3, the price per unit therefore shall be determined in accordance with GC50.

GC48 Determination of Cost – Unit Price Table

48.1 Whenever, for the purposes of the contract, it is necessary to determine the cost of labour, plant or material, it shall be determined by multiplying the quantity of that labour, plant or material expressed in the unit set out in column 3 of the Unit Price Table by the price of that unit set out in column 5 of the Unit Price Table.

GC49 Determination of Cost – Negotiation

49.1 If the method described in GC48 cannot be used because the labour, plant or material is of a kind or class that is not set out in the Unit Price Table, the cost of that labour, plant or material for the purposes of the contract shall be the amount agreed upon from time to time by the Contractor and the Departmental Representative.

49.2 For the purposes of GC49.1, the Contractor shall submit to the Departmental Representative any necessary cost information requested by the Departmental Representative in respect of the labour, plant and material referred to in GC49.1

GC50 Determination of Cost – Failing Negotiation

50.1 If the methods described in GC47, GC48 or GC49 fail for any reason to achieve a determination of the cost of labour, plant and material for the purposes referred to therein, that cost shall be equal to the aggregate of

50.1.1 all reasonable and proper amounts actually expended or legally payable by the Contractor in respect of the labour, plant and material that falls within one of the classes of expenditure described in GC50.2 that are directly attributable to the performance of the contract,

50.1.2 an allowance for profit and all other expenditures or costs, including overhead, general administration cost, financing and interest charges, and every other cost, charge and expenses, but not including those referred to in GC50.1.1 or GC50.1.3 or a class referred to in GC50.2, in an amount that is equal to 10% of the sum of the expenses referred to in GC50.1.1, and

50.1.3 interest on the cost determined under GC50.1.1 and GC50.1.2, which interest shall be calculated in accordance with TP9,

provide that the total cost of an item set out n the Unit Price Table that is subject to the provisions of GC47.1.2.1 does not exceed the amount that would have been payable to the Contractor had the estimated total quantity of the said item actually be performed, used or supplied.

50.2 For purposes of GC50.1.1 the classes of expenditure that may be taken into account in determining the cost of labour, plant and material are,

50.2.1 payments to subcontractors;

50.2.2 wages, salaries and travelling expenses of employees of the Contractor while they are actually and properly engaged on the work, other than wages, salaries, bonuses, living

and travelling expenses of personnel of the Contractor generally employed at the head office or at a general office of the Contractor unless they are engaged at the work site with the approval of the Departmental Representative,

50.2.3 assessments payable under any statutory authority relating to workmen's compensation, unemployment insurance, pension plan or holidays with pay;

50.2.4 rent that is paid for plant or an amount equivalent of the said rent if the plant is owned by the Contractor that is necessary for and used in the performance of the work, if the rent of the equivalent amount is reasonable and use of that plant has been approved by the Departmental Representative;

50.2.5 payments for maintaining and operating plant necessary for and used in the performance of the work, and payments for effecting such repairs thereto as, in the opinion of the Departmental Representative, are necessary to the proper performance of the contract other than payments for any repairs to the plant arising out of defects existing before its allocation to the work;

50.2.6 payments for material that is necessary for and incorporated in the work, or that is necessary for and consumed in the performance of the contract;

50.2.7 payments for preparation, delivery, handling, erection, installation, inspection protection and removal of the plant and material necessary for and used in the performance of the contract; and

50.2.8 any other payments made by the Contractor with the approval of the Departmental Representative that are necessary for the performance of the contract.

GC51 Records to be kept by Contractor

51.1 The Contractor shall

51.1.1 maintain full records of his estimated and actual cost of the work together with all tender calls, quotations, contracts, correspondence, invoices, receipts and vouchers relating thereto.

51.1.2 make all records and material referred to in GC5.1.1 available to audit and inspection by the Minister and the Deputy Receiver General for Canada or by persons acting on behalf of either of both of them, when requested;

51.1.3 allow any of the person referred to in GC51.1.2 to make copies of and to take extracts from any of the records and material referred to in GC51.1.1; and

51.1.4 furnish any person referred to in GC51.1.2 with any information he may require from time to time in connection with such records and material.

51.2 The records maintained by the Contractor pursuant to GC51.1.1 shall be kept intact by the Contractor until the expiration of two years after the date that a Final Certificate of Completion referred to in GC44.1 was issued or until the expiration of such other period of time as the

Minister may direct.

51.3 The Contractor shall cause all subcontractors and all other persons directly or indirectly controlled by or affiliated with the Contractor and all persons directly or indirectly having control of the Contractor to comply with GC51.1 and GC51.2 as if they were the Contractor.

GC52 Conflict of Interest

52.1 It is a term of this contract that no former public office holder who is not in compliance with the Conflict of Interest and Post-Employment Code for Public Office Holders shall derive a direct benefit from this contract.

GC53 Contractor Status

53.1 The Contractor shall be engaged under the contract as an independent contractor.

53.2 The Contractor and any employee of the said Contractor is not engaged by the contract as an employee, servant or agent of Her Majesty.

53.3 For the purposes of GC53.1 and GC53.2 the Contractor shall be solely responsible for any and all payments and deductions required to be made by law including those required for Canada or Quebec Pension Plans, Unemployment Insurance, Worker's Compensation or Income Tax.

GENERAL CONDITONS

IC 1 Proof of Insurance
IC 2 Risk Management
IC 3 Payment of Deductible
IC 4 Insurance Coverage

GENERAL INSUANCE COVERAGES

GCI 1 Insured
GIC 2 Period of Insurance
GIC 3 Proof of Insurance
GIC 4 Notification

COMMERCIAL GENERAL LIABILITY

CGL 1 Scope of Policy
CGL 2 Coverages/Provisions
CGL 3 Additional Exposures
CGL 4 Insurance Proceeds
CGL 5 Deductible

BUILDER'S RISK – INSTALLATION FLOATER – ALL RISKS

BR 1 Scope of Policy
BR 2 Property Insured
BR 3 Insurance Proceeds
BR 4 Amount of Insurance
BR 5 Deductible
BR 6 Subrogation
BR 7 Exclusion Qualifications

INSURER'S CERTIFICATE OF INSURANCE

General Conditions

IC 1 Proof of Insurance
(02/12/03)

Within thirty (30) days after acceptance of the Contractor's tender, the Contractor shall, unless otherwise directed in writing by the Contracting Officer, deposit with the Contracting Officer an Insurer's Certificate of Insurance in the form displayed in this document and, if requested by the Contracting Officer, the originals or certified true copies of all contracts of insurance maintained by the Contractor pursuant to the Insurance Coverage Requirements shown hereunder.

IC 2 Risk Management
(01/10/94)

The provisions of the Insurance Coverage Requirements contained hereunder are not intended to cover all of the Contractor's obligations under GC8 of the General Conditions "C" of the contract. Any additional risk management measures or additional insurance coverages the Contractor may deem necessary to fulfill its obligations under GC8 shall be at its own discretion and expense.

IC 3 Payment of Deductible
(01/10/94)

The payment of monies up to the deductible amount made in satisfaction of a claim shall be borne by the Contactor.

IC 4 Insurance Coverage
(02/12/03)

The Contractor has represented that it has in place and effect the appropriate and usual liability insurance coverage as required by these Insurance Conditions and the Contractor has warranted that it shall obtain, in a timely manner and prior to commencement of the Work, the appropriate and usual property insurance coverage as required by these Insurance Conditions and, further, that it shall maintain all required insurance policies in place and effect as required by these Insurance Conditions.

INSURANCE COVERAGE REQUIREMENTS

PART I
GENERAL INSUANCE COVERAGES (GIC)

GCI 1 Insured
(02/12/03)

Each insurance policy shall insure the Contractor, and shall include, as an Additional Named Insured, Her Majesty the Queen in right of Canada, represented by the National Research Council Canada.

GIC 2 Period of Insurance
(02/12/03)

Unless otherwise directed in writing by the Contracting Officer or otherwise stipulated elsewhere in these Insurance Conditions, the policies required hereunder shall be in force and be maintained from the date of the contract award until the day of issue of the Departmental Representative's Final Certificate of Completion.

GIC 3 Proof of Insurance
(01/10/94)

Within twenty five (25) days after acceptance of the Contractor's tender, the Insurer shall, unless otherwise directed by the Contractor, deposit with the Contractor an Insurer's Certificate of Insurance in the form displayed in the document and, if requested, the originals or certified true copies of all contracts of insurance maintained by the Contractor pursuant to the requirements of these Insurance Coverages.

GIC 4 Notification
(01/10/94)

Each Insurance policy shall contain a provision that (30) days prior written notice shall be given by the Insurer to Her Majesty in the event of any material change in or cancellation of coverage. Any such notice received by the Contractor shall be transmitted forthwith to Her Majesty.

PART II
COMMERCIAL GENERAL LIABILITY

CGL 1 Scope of Policy
(01/10/94)

The policy shall be written on a form similar to that known and referred to in the insurance industry as IBC 2100 – Commercial General Liability policy (Occurrence form) and shall provide for limit of liability of not less than $2,000,000 inclusive for Bodily Injury and Property Damage for any one occurrence or series of occurrences arising out of one cause. Legal or defence cost incurred in respect of a claim or claims shall not operate to decrease the limit of liability.

CGL 2 Coverages/Provisions
(01/10/94)

The policy shall include but not necessarily be limited to the following coverages/provisions.

2.1 Liability arising out of or resulting from the ownership, existence, maintenance or use of premises by the Contractor and operations necessary or incidental to the performance of this contract.

2.2 "Broad Form" Property Damage including the loss of use of property.

2.3 Removal or weakening of support of any building or land whether such support be natural or otherwise.

2.4 Elevator liability (including escalators, hoists and similar devices).

2.5 Contractor's Protective Liability

2.6 Contractual and Assumed Liabilities un this contact.

2.7 Completed Operations Liability – The insurance, including all aspects of this Part II of these Insurance Conditions shall continue for a period of at least one (1) year beyond the date of the Departmental Representative's Final Certificate of Completion for the Completed Operations.

2.8 Cross Liability – The Clause shall be written as follows:

Cross Liability – The insurance as is afforded by this policy shall apply in respect to any claim or action brought against any one Insured by any other Insured. The coverage shall apply in the same manner and to the same extent as though a separate policy had been issued to each Insured. The inclusion herein of more than one Insured shall not increase the limit of the Insurer's liability.

2.9 Severability of Interests – The Clause shall be written as follows:

Severability of Interests – This policy, subject to the limits of liability stated herein, shall apply separately to each Insured in the same manner and to the same extent as if a separate policy had been issued to each. The inclusion herein of more than one insured shall not increase the limit of the Insurer's liability.

CGL 3 Additional Exposures
(02/12/03)

The policy shall either include or be endorsed to include the following exposures of hazards if the Work is subject thereto:

3.1 Blasting

3.2 Pile driving and calsson work

3.3 Underpinning

3.4 Risks associated with the activities of the Contractor on an active airport

3.5 Radioactive contamination resulting from the use of commercial isotopes

3.6 Damage to the portion of an existing building beyond that directly associated with an addition, renovation or installation contract.

3.7 Marine risks associated with the contraction of piers, wharves and docks.

CGL 4 Insurance Proceeds
(01/10/94)

Insurance Proceeds from this policy are usually payable directly to a Claimant/Third Party.

CGL 5 Deductible
(02/12/03)

This policy shall be issued with a deductible amount of not more than $10,000 per occurrence applying to Property Damage claims only.

PART III
BUILDER'S RISK – INSTALLATION FLOATER – ALL RISKS

BR 1 Scope of Policy
(01/10/94)

The policy shall be written on an "All Risks" basis granting coverages similar to those provided by the forms known and referred to in the insurance industry as "Builder's Risk Comprehensive Form" or "Installation Floater – All Risks".

BR 2 Property Insured
(01/10/94)

The property insured shall include:

2.1 The Work and all property, equipment and materials intended to become part of the finished Work at the site of the project while awaiting, during and after installation, erection or construction including testing.

2.2 Expenses incurred in the removal from the construction site of debris of the property insured, including demolition of damaged property, de-icing and dewatering, occasioned by loss, destruction or damage to such property and in respect of which insurance is provided by this policy.

BR 3 Insurance Proceeds
(01/10/94)

3.1 Insurance proceeds from this policy are payable in accordance with GC28 of the General Conditions "C" of the contract.

3.2 This policy shall provide that the proceeds thereof are payable to Her Majesty or as the Minister may direct.

3.3 The Contractor shall do such things and execute such documents as are necessary to effect payment of the proceeds.

BR 4 Amount of Insurance
(01/10/94)

The amount of insurance shall not be less than the sum of the contract value plus the declared value (if any) set forth in the contract documents of all material and equipment supplied by Her Majesty at the site of the project to be incorporated into and form part of the finished Work.

BR 5 Deductible
(02/12/03)

The Policy shall be issued with a deductible amount of not more than $10,000.

BR 6 Subrogation
(01/10/94)

The following Clause shall be included in the policy:

"All rights of subrogation or transfer of rights are hereby waived against any corporation, firm, individual or other interest, with respect to which, insurance is provided by this policy".

BR 7 Exclusion Qualifications
(01/10/94)

The policy may be subject to the standard exclusions but the following qualifications shall apply:

7.1 Faulty materials, workmanship or design may be excluded only to the extent of the cost of making good thereof and shall not apply to loss or damage resulting therefrom.

7.2 Loss or damage caused by contamination by radioactive material may be excluded except for loss or damage resulting from commercial isotopes used for industrial measurements, inspection, quality control radiographic or photographic use.

7.3 Use and occupancy of the project or any part of section thereof shall be permitted where such use and occupancy is for the purpose for which the project is intended upon completion.

INSURER'S CERTIFICATE OF INSURANCE

(TO BE COMPLETED BY INSURER (NOT BOKER) AND DELIVERD TO NATIONAL RESEARCH COUNCIL CANADA WITH 30 DAYS FOLLOWING ACCEPTANCE OF TENDER)

CONTRACT

DESCRIPTION OF WORK	CONTRACT NUMBER	AWARD DATE
LOCATION		

INSURER

NAME
ADDRESS

BROKER

NAME
ADDRESS

INSURED

NAME OF CONTRACTOR
ADDRESS

ADDITIONAL INSURED

HER MAJESTY THE QUEEN IN RIGHT OF CANADA AS REPRESENTED BY THE NATIONAL RESEARCH COUNCIL CANADA

THIS DOCUENT CERTIFIES THAT THE FOLLOWING POLICES OF INSURANCE ARE AT PRESENT IN FORCE COVERING ALL OPERATIONS OF THE INSURE IN CONNECTION WITH THE CONTRACT MADE BETWEEN THE NAMED INSURED AND THE NATIONAL RESEARCH COUNCIL CANADA AND IN ACCORDANCE WITH THE INSURANCE CONDITIONS "E"

POLICY					
TYPE	NUMBER	INCEPTION DATE	EXPIRY DATE	LIMITS OF LIABILITY	DEDUCTIBLE
COMMERCIAL GENERAL LIABILITY					
BUILDERS RISK "AL RISKS"					
INSTALLATION FLOATER "ALL RISKS"					

THE INSURER AGREES TO NOTIFY THE NATIONAL RESEARCH COUNCIL CANADA IN WRITING 30 DAYS PRIOR TO ANY MATERIAL CHANGE IN OR CANCELLATION OF ANY POLICY OR COVERAGE SPECIFICALLY RELATED TO THE CONTRACT

NAME OF INSURER'S OFFICER OR AUTHORIZED EMPLOYEE	SIGNATURE	DATE:
		TELEPHONE NUMBER:

ISSUANCE OF THIS CERTIFIATE SHALL NOT LIMIT OR RESTRICT THE RIGHT OF THE NATIONAL RESEARCH COUNCIL CANADA TO REQUEST AT ANY TIME DUPLICATE COPIES OF SAID INSURANCE POLICIES

CS1 Obligation to provide Contract Security

1.1 The Contractor shall, at the Contractor's own expense, provide one or more of the forms of contract security prescribed in CS2.

1.2 The Contractor shall deliver to the Departmental Representative the contract security referred to in CS1.1 within 14 days after the date that the Contractor receives notice that the Contractor's tender or offer was accepted by Her Majesty.

CS2 Prescribed Types and Amounts of Contract Security

2.1 The Contractor shall deliver to the Departmental Representative pursuant to CS1

2.1.1 a performance bond and a labour and material payment bond each in an amount that is equal to not less than 50% of the contract amount referred to in the Articles of Agreement, or

2.1.2 a labour and material payment bond in an amount that is equal to not less than 50% of the contract amount referred to in the Articles of Agreement, and a security deposit in an amount that is equal to

2.1.2.1 not less than 10% of the contract amount referred to in the Articles of Agreement where that amount does not exceed $250,000, or

2.1.2.2 $25,000 plus 5% of the part of the contract amount referred to in the Articles of Agreement that exceeds $250,000, or

2.1.3 a security deposit in an amount prescribed by CS2.12 plus an additional amount that is equal to 10% of the contract amount referred to in the Articles of Agreement.

2.2 A performance bond and a labour and material payment bond referred to in CS2.1 shall be in a form and be issued by a bonding or surety company that is approved by Her Majesty.

2.3 The amount of a security deposit referred to in CS2.1.2 shall not exceed $250,000 regardless of the contract amount referred to in the Articles of Agreement.

2.4 A security deposit referred to in CS2.1.2 and CS2.1.3 shall be in the form of

2.4.1 a bill of exchange made payable to the Receiver General of Canada and certified by an approved financial institution or drawn by an approved financial institution on itself, or

2.4.2 bonds of or unconditionally guaranteed as to principal and interest by the Government of Canada.

2.5 For the purposes of CS2.4

2.5.1 a bill of exchange is an unconditional order in writing signed by the Contractor and addressed to an approved financial institution, requiring the said institution to pay, on demand, at a fixed or determinable future time a sum certain of money to, or to the order

of, the Receiver General for Canada, and

2.5.2 If a bill of exchange is certified by a financial institution other than a chartered bank then it must be accompanied by a letter or stamped certification confirming that the financial institution is in a t least one of the categories referred to in CS2.5.3

2.5.3 an approved financial institution is

2.5.3.1 any corporation or institution that is a member of the Canadian Payments Association,

2.5.3.2 a corporation that accepts deposits that are insured by the Canada Deposit Insurance Corporation or the Régie de l'assurance-dépôts du Québec to the maximum permitted by law,

2.5.3.3 a credit union as defined in paragraph 137(6)(b) of the *Income Tax Act*,

2.5.3.4 a corporation that accepts deposits from the public, if repayment of the deposit is guaranteed by Her Majesty in right of a province, or

2.5.3.5 The Canada Post Corporation.

2.5.4 the bonds referred to in CS2.4.2 shall be

2.5.4.1 made payable to bearer, or

2.5.4.2 accompanied by a duly executed instrument of transfer of the bonds to the Receiver General for Canada in the form prescribed by the Domestic Bonds of Canada Regulations, or

2.5.4.3 registered, as to principal or as to principal and interest in the name of the Receiver General for Canada pursuant to the Domestic Bonds of Canada Regulations, and

2.5.4.4 provided on the basis of their market value current at the date of the contract.

Government of Canada / Gouvernement du Canada

Contract Number / Numéro du contrat	
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
National Research Council	ASPM
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
Retrofit the M50 IPF wing fume exhaust and make-up air systems

5. a) Will the supplier require access to Controlled Goods? Le fournisseur aura-t-il accès à des marchandises contrôlées?	☒ No Non	☐ Yes Oui
5. b) Will the supplier require access to unclassified military technical data subject to the provisions of the Technical Data Control Regulations? Le fournisseur aura-t-il accès à des données techniques militaires non classifiées qui sont assujetties aux dispositions du Règlement sur le contrôle des données techniques?	☒ No Non	☐ Yes Oui
6. Indicate the type of access required / Indiquer le type d'accès requis		
6. a) Will the supplier and its employees require access to PROTECTED and/or CLASSIFIED information or assets? Le fournisseur ainsi que les employés auront-ils accès à des renseignements ou à des biens PROTÉGÉS et/ou CLASSIFIÉS? (Specify the level of access using the chart in Question 7. c) (Préciser le niveau d'accès en utilisant le tableau qui se trouve à la question 7. c)	☒ No Non	☐ Yes Oui
6. b) Will the supplier and its employees (e.g. cleaners, maintenance personnel) require access to restricted access areas? No access to PROTECTED and/or CLASSIFIED information or assets is permitted. Le fournisseur et ses employés (p. ex. nettoyeurs, personnel d'entretien) auront-ils accès à des zones d'accès restreintes? L'accès à des renseignements ou à des biens PROTÉGÉS et/ou CLASSIFIÉS n'est pas autorisé.	☐ No Non	☒ Yes Oui
6. c) Is this a commercial courier or delivery requirement with **no** overnight storage? S'agit-il d'un contrat de messagerie ou de livraison commerciale **sans** entreposage de nuit?	☒ No Non	☐ Yes Oui

7. a) Indicate the type of information that the supplier will be required to access / Indiquer le type d'information auquel le fournisseur devra avoir accès

Canada ☒	NATO / OTAN ☐	Foreign / Étranger ☐

7. b) Release restrictions / Restrictions relatives à la diffusion

No release restrictions / Aucune restriction relative à la diffusion ☒	All NATO countries / Tous les pays de l'OTAN ☐	No release restrictions / Aucune restriction relative à la diffusion ☐
Not releasable / À ne pas diffuser ☐		
Restricted to: / Limité à : Specify country(ies): / Préciser le(s) pays : ☐	Restricted to: / Limité à : Specify country(ies): / Préciser le(s) pays : ☐	Restricted to: / Limité à : Specify country(ies): / Préciser le(s) pays : ☐

7. c) Level of information / Niveau d'information

PROTECTED A / PROTÉGÉ A ☐	NATO UNCLASSIFIED / NATO NON CLASSIFIÉ ☐	PROTECTED A / PROTÉGÉ A ☐
PROTECTED B / PROTÉGÉ B ☐	NATO RESTRICTED / NATO DIFFUSION RESTREINTE ☐	PROTECTED B / PROTÉGÉ B ☐
PROTECTED C / PROTÉGÉ C ☐	NATO CONFIDENTIAL / NATO CONFIDENTIEL ☐	PROTECTED C / PROTÉGÉ C ☐
CONFIDENTIAL / CONFIDENTIEL ☐	NATO SECRET / NATO SECRET ☐	CONFIDENTIAL / CONFIDENTIEL ☐
SECRET / SECRET ☐	COSMIC TOP SECRET / COSMIC TRÈS SECRET ☐	SECRET / SECRET ☐
TOP SECRET / TRÈS SECRET ☐		TOP SECRET / TRÈS SECRET ☐
TOP SECRET (SIGINT) / TRÈS SECRET (SIGINT) ☐		TOP SECRET (SIGINT) / TRÈS SECRET (SIGINT) ☐

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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?
Le fournisseur aura-t-il accès à des renseignements ou à des biens COMSEC désignés PROTÉGÉS et/ou CLASSIFIÉS?
If Yes, indicate the level of sensitivity:
Dans l'affirmative, indiquer le niveau de sensibilité : ☒ No / Non ☐ Yes / Oui

9. Will the supplier require access to extremely sensitive INFOSEC information or assets?
Le fournisseur aura-t-il accès à des renseignements ou à des biens INFOSEC de nature extrêmement délicate? ☒ No / Non ☐ Yes / 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

☒ RELIABILITY STATUS / COTE DE FIABILITÉ	☐ CONFIDENTIAL / CONFIDENTIEL	☐ SECRET / SECRET	☐ TOP SECRET / TRÈS SECRET
☐ TOP SECRET– SIGINT / TRÈS SECRET – SIGINT	☐ NATO CONFIDENTIAL / NATO CONFIDENTIEL	☐ NATO SECRET / NATO SECRET	☐ COSMIC TOP SECRET / COSMIC TRÈS SECRET
☐ SITE ACCESS / ACCÈS AUX EMPLACEMENTS			

Special comments:
Commentaires spéciaux : _____

NOTE: If multiple levels of screening are identified, a Security Classification Guide must be provided.
REMARQUE : Si plusieurs niveaux de contrôle de sécurité sont requis, un guide de classification de la sécurité doit être fourni.

10. b) May unscreened personnel be used for portions of the work?
Du personnel sans autorisation sécuritaire peut-il se voir confier des parties du travail? ☒ No / Non ☐ Yes / Oui
If Yes, will unscreened personnel be escorted?
Dans l'affirmative, le personnel en question sera-t-il escorté? ☐ No / Non ☐ Yes / 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?
Le fournisseur sera-t-il tenu de recevoir et d'entreposer sur place des renseignements ou des biens PROTÉGÉS et/ou CLASSIFIÉS? ☒ No / Non ☐ Yes / Oui

11. b) Will the supplier be required to safeguard COMSEC information or assets?
Le fournisseur sera-t-il tenu de protéger des renseignements ou des biens COMSEC? ☒ No / Non ☐ Yes / 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?
Les installations du fournisseur serviront-elles à la production (fabrication et/ou réparation et/ou modification) de matériel PROTÉGÉ et/ou CLASSIFIÉ? ☒ No / Non ☐ Yes / 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?
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? ☒ No / Non ☐ Yes / Oui

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

Government of Canada / Gouvernement du Canada

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PART C - *(continued)* / PARTIE C - *(suite)*

For users completing the form **manually** use the summary chart below to indicate the category(ies) and level(s) of safeguarding required at the supplier's site(s) or premises.
Les utilisateurs qui remplissent le formulaire **manuellement** doivent utiliser le tableau récapitulatif ci-dessous pour indiquer, pour chaque catégorie, les niveaux de sauvegarde requis aux installations du fournisseur.

For users completing the form **online** (via the Internet), the summary chart is automatically populated by your responses to previous questions.
Dans le cas des utilisateurs qui remplissent le formulaire **en ligne** (par Internet), les réponses aux questions précédentes sont automatiquement saisies dans le tableau récapitulatif.

SUMMARY CHART / TABLEAU RÉCAPITULATIF

Category / Catégorie	PROTECTED / PROTÉGÉ			CLASSIFIED / CLASSIFIÉ			NATO				COMSEC					
	A	B	C	CONFIDENTIAL / CONFIDENTIEL	SECRET	TOP SECRET / TRÈS SECRET	NATO RESTRICTED / NATO DIFFUSION RESTREINTE	NATO CONFIDENTIAL / NATO CONFIDENTIEL	NATO SECRET	COSMIC TOP SECRET / COSMIC TRÈS SECRET	PROTECTED / PROTÉGÉ A	PROTECTED / PROTÉGÉ B	PROTECTED / PROTÉGÉ C	CONFIDENTIAL / CONFIDENTIEL	SECRET	TOP SECRET / TRES SECRET
Information / Assets / Renseignements / Biens	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Production	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
IT Media / Support TI	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
IT Link / Lien électronique	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

12. a) Is the description of the work contained within this SRCL PROTECTED and/or CLASSIFIED?
La description du travail visé par la présente LVERS est-elle de nature PROTÉGÉE et/ou CLASSIFIÉE?

☒ No / Non ☐ Yes / Oui

If Yes, classify this form by annotating the top and bottom in the area entitled "Security Classification".
Dans l'affirmative, classifier le présent formulaire en indiquant le niveau de sécurité dans la case intitulée « Classification de sécurité » au haut et au bas du formulaire.

12. b) Will the documentation attached to this SRCL be PROTECTED and/or CLASSIFIED?
La documentation associée à la présente LVERS sera-t-elle PROTÉGÉE et/ou CLASSIFIÉE?

☒ No / Non ☐ Yes / Oui

If Yes, classify this form by annotating the top and bottom in the area entitled "Security Classification" and indicate with attachments (e.g. SECRET with Attachments).
Dans l'affirmative, classifier le présent formulaire en indiquant le niveau de sécurité dans la case intitulée « Classification de sécurité » au haut et au bas du formulaire et indiquer qu'il y a des pièces jointes (p. ex. SECRET avec des pièces jointes).

Government of Canada / Gouvernement du Canada

Contract Number / Numéro du contrat	
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	
Robin Craig	Construction Project Manager		
Telephone No. - N° de téléphone	**Facsimile No. - N° de télécopieur**	**E-mail address - Adresse courriel**	**Date**
613-993-6869	613-957-9828	Robin.Craig@nrc-cnrc.gc.ca	2016-10-17

14. Organization Security Authority / Responsable de la sécurité de l'organisme

Name (print) - Nom (en lettres moulées)	Title – Titre	Signature	
Charlotte Carrier	Controlled Goods and Contracts Security Coordinator		
Telephone No. - N° de téléphone	**Facsimile No. - N° de télécopieur**	**E-mail address - Adresse courriel**	**Date**
601-993-8956	613-990-0946	Charlotte.Carrier@nrc-cnrc.gc.ca	2016-10-17

15. Are there additional instructions (e.g. Security Guide, Security Classification Guide) attached?
Des instructions supplémentaires (p. ex. Guide de sécurité, Guide de classification de la sécurité) sont-elles jointes?

☒ No / Non ☐ Yes / Oui

16. Procurement Officer / Agent d'approvisionnement

Name (print) - Nom (en lettres moulées)	Title – Titre	Signature	
Alain Leroux	Senior Proc. Officer	A L	
Telephone No. - N° de téléphone	**Facsimile No. - N° de télécopieur**	**E-mail address - Adresse courriel**	**Date**
613 991-9890		alain.leroux@nrc-cnrc.gc.ca	19-10-16

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**