

SPECIFICATION

FOR

AHU-8 and AHU-18 Replacement

Queen Elizabeth Hospital

Charlottetown, Queens County, PEI

Project 2665-22058

Prepared by:

PEI Department of Transportation and Infrastructure

August, 2023

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1. GENERAL

- a) All bidders submitting tenders for this work shall first examine the site and all conditions thereon and/or therein. All tenders shall take into consideration all such conditions as may affect the work under this contract, no claims for extras resulting from conditions existing at the time of tender will be accepted by the Owner.

2. SITE VISIT

- a) **There will be a recommended site visit held, Thursday, August 17, 2023, at 10:00 AM. Contractors are asked to meet outside the main entrance of the building.**

END

DTI Public Works and Planning is moving forward with our capital building repair and construction program and will be issuing tenders as follows:

Tenders will continue to be advertised and posted to the PEI Government tender site:

<https://www.princeedwardisland.ca/en/tenders>

Tender submissions will be received in clearly mark, sealed envelopes at the Security Desk at the main entrance of Jones Building, 11 Kent Street, Charlottetown, PEI, C1A 7N8 until **2:00 PM, Local Time, on Thursday, August 24, 2023. Tender closes at 2:00:00PM, Local Time.**

QEH – AHU-8 and AHU-18 Replacement Charlottetown, Queens County, PE

Scope of Work:

Replacement of existing AHU-8 & AHU-18 including associated exhaust fans, modification to existing ductwork, steam humidification system, chilled water system and automatic controls system as indicated on the drawings and herein including but not limited to:

- .1 Provision of new AHU-8 & AHU-18.
- .2 Provision of new intake louvres and all cutting and patching of exterior penthouse walls.
- .3 Provision of new piping and accessories for AHU-8 & 18 supply and return chilled water systems.
- .4 Provision of new piping and accessories for heating steam, condensate and humidification steam and condensate for AHU-8 & 18.
- .5 Provision of new control systems (Johnson Controls) including fire and smoke controls.
- .6 Provision of new electrical connections, re-feeding, disconnections of temporary unit, and disconnection of existing for demolition. Includes: FS-08, FR-08, FE-08, FS-18, FR-18, FE-18, AHU-8 lights, AHU-18 lights, 120V control power to panels and motorized dampers.
- .7 Provision of all demo services to remove existing piping and accessories as indicated and including existing pneumatics to be decommissioned by Lowther Refrigeration under this contract. Confirm with owner which equipment shall be turned over prior to disposal.
- .8 Provision of temporary ductwork connections for AHU-8 & AHU-18.
- .9 Provision of commissioning and reports.
- .10 Provision of all general cutting and patching.
- .11 Provision of all roofing services associated with relocation of temporary AHU and replacement of mechanical discharges in penthouse roofs.
- .12 Provision of crane services for relocation of temporary AHU.
- .13 Provision of crane services for demolition of existing AHU-8, AHU-18, and accessories.
- .14 Provision of crane services for installation of new AHUs and accessories.

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- .15 Provision of staff training on new AHU operation.
 - .16 Provision of insulation/jacketing on chilled water, steam, and condensate piping and AHU-8/AHU-18 supply, exhaust and outside air intake ductwork and exterior temporary ductwork as indicated.
 - .17 Repair cracking and seal/paint concrete floor of mechanical room where accessible.
 - .18 Fire alarm - provision of new duct-mounted smoke detectors and connect to building fire alarm system.
 - .19 Provision of balancing existing systems as they are presently and balancing of new systems after new AHUs and fans are installed.
 - .20 Provision of new duct work as indicated on drawings.
 - .21 Provision of duct cleaning of complete AHU-8, AHU-18, EF-8 & EF-18 duct systems.
 - .22 ALL WORK TO BE CARRIED OUT WITH PROPER INFECTION CONTROL PROCEDURES IN PLACE, AND IN ACCORDANCE WITH CSA Z317.13. CONTRACTOR MUST SUBMIT INFECTION CONTROL PLAN TO STAFF FOR REVIEW PRIOR TO COMENCING WORK.

Hard copies (paper copies) of tender documents will **not** be made available to bidders at this time. All tender documentation will only be available electronically. Electronic documents will be posted electronically to the Government tender page:

<https://www.princeedwardisland.ca/en/tenders>

Electronic documents will be issued to Construction Association of PEI (CAPEI) as well as to NB and NS Construction Associations. Addenda will only be posted to the Government tender site and issued to the Construction Associations. **It is the Contractor's responsibility to ensure that they have incorporated all addenda into their bid submission.**

- Tender envelopes must be clearly marked with the project Name.
- Tender documents will need to be received prior to 2PM on the date specified in the tender.
- No submissions will be accepted after that time.
- The tender opening will be opened to the public.
- Tender envelopes will be opened immediately after the tender closing.

Refer to Instructions to Bidders for Bid Security and Contract Security requirements.

Lowest or any Tender will not necessarily be accepted.

Any additional information can be obtained by contacting **Tyler Gallant, at 902-620-3647 or fax 902-569-0590.**

END

1. GENERAL

- a) The Tender Documents including General Conditions of Contract, the Instructions to bidders, Specifications, Tender Form and Drawings are all complementary and shall be read together.
- b) Each Tenderer shall examine the Tender Documents as soon as possible after receipt thereof and should he or she discover any errors or omissions therein, he or she shall notify the Department as soon as possible and at least seven (7) days prior to the date set for receiving tenders so that further instructions and/or drawings may be issued to all Tenderers before the date set for receiving tenders.

2. ADDENDA

- a) Tenders may, during the tendering period, be advised by addenda of required additions to, deletions from, or alterations to the requirements of the tender documents. All such changes shall become an integral part of the Tender Documents and shall be allowed for in arriving at the fixed sum tender figure. Addenda will only be posted to the Government tender site and issued to the Construction Associations. **It is the Contractor's responsibility to ensure that they have incorporated all addenda into their bid submission.**

3. BID AND CONTRACT SECURITY

BID SECURITY

- a) Each Tender submitted shall be accompanied by the following security:

- .1 General Contract Tender less than or equal to Three Million (\$3,000,000.00) Dollars, including mechanical and electrical subcontract values:

A Bid Bond equal to at least ten percent (10%) of the Tender amount and a Letter of Surety from a bonding company guaranteeing to supply a Performance Bond in the amount of fifty percent (50%) of the total contract amount.

OR

A Security Deposit equal to at least ten percent (10%) of the Tender amount.

- .2 General Contract Tender more than Three Million (\$3,000,000.00) Dollars, including mechanical and electrical subcontract values:

A Bid Bond equal to at least ten percent (10%) of the Tender amount and a Letter of Surety from a bonding company guaranteeing to supply a Performance Bond in the amount of fifty

percent (50%) of the total contract amount and a Labour and Material Payment Bond in the amount of fifty percent (50%) of the total contract amount.

- b) .1 All Bonds and Letter of Surety, provided by General Contractors, made payable to the Owner.
- .2 Bonds and Letters of Surety supplied by the General Contractor to the Owner shall be from a recognized surety company, satisfactory to, and approved by the Owner.
- c) .1 Security Deposits, provided by General Contractors, must be in the form of a Certified Cheque or Bank Draft drawn on a Bank to which the Bank Act applies or a Credit Union, payable to “**Minister of Finance, Province of Prince Edward Island**”.

OR

- .2 Bond of the Government of Canada, unconditionally guaranteed, as to the principal and interest by the Government of Canada if such Bonds are:
 - (a) Payable to the bearer, or
 - (b) Accompanied by a duly executed instrument of transfer to the Owner, in the form prescribed by the Domestic Bonds of Canada Regulations, or
 - (c) Negotiated as to principal or as to principal and interest in the name of the Owner, pursuant to the Domestic Bonds of Canada Regulations.
- d) Security deposits submitted through the Bid Depository shall be accompanied by the Bid Security. The subcontractors shall advise General Contractors what form of bid security is being used and what form of contract security will be used.

CONTRACT SECURITY

- a) Upon award of a contract the Contractor is to provide the following contract security:
 - .1 General Contract Tender less than or equal to Three Million (\$3,000,000.00) Dollars, including mechanical and electrical subcontract values:

A Performance Bond in the amount of fifty percent (50%) of the contract amount.

OR

A Security Deposit in an amount equal to at least ten percent (10%) of the contract amount.

.2 General Contract Tender more than Three Million (\$3,000,000.00) Dollars, including mechanical and electrical subcontract values:

A Performance Bond and a Labour and Materials Payment Bond, each in the amount of fifty percent (50%) of the contract amount.

- b) .1 All bonds, provided by General Contractors, are to be made payable to the Owner.
- .2 Bonds shall be from a recognized surety company, satisfactory, and approved by the Owner.
- .3 If a Performance Bond is utilized, it shall be maintained in force for a period of not less than twelve (12) months after the issuance of the total Performance Certificate.
- c) .1 Security Deposits, provided by General Contractors, must be in the form of a Certified Cheque or Bank Draft drawn on a Bank to which the Bank Act applies or a Credit Union, payable to “**Minister of Finance, Province of Prince Edward Island**”.

OR

- .2 Bonds of the Government of Canada, unconditionally guaranteed, as to the principal and interest by the Government of Canada if such Bonds are:
 - (a) Payable to the bearer, or
 - (b) Accompanied by a duly executed instrument of transfer to the Owner, in the form prescribed by the Domestic Bonds of Canada Regulations, or
 - (c) Negotiated as to principal or as to principal and interest in the name of the Owner pursuant to the Domestic Bonds of Canada Regulations.
 - (d) Contract security shall be provided at the expense of the Contractor, bonds shall be provided by an established surety company satisfactory to, and approved by the Owner. Certified Cheques or Bank Drafts shall be drawn on an account with a recognized financial institution.
 - (e) Contract security submitted by subcontractors, to General Contractors, shall be in a form satisfactory to the General Contractor.

4. CONSTRUCTION SCHEDULE

- a) Work is to begin immediately following contract award unless indicated otherwise.

- b) The completion date for this project shall be **September 30, 2024**.
- c) Contractor to provide a construction schedule, safety policy, proof of insurance and signed contract documents prior to starting work.

5. MATERIALS AND EQUALS

- a) Materials, plant and equipment are described and named specifically in the Specifications ONLY to describe types and qualities of materials, plant and equipment required.
- b) Suppliers or manufacturers wishing to have their material, plant or equipment approved as an equal shall submit complete technical information to the Consultant seven (7) days prior to the receipt of tenders. The Consultant shall review the material submitted and notify all prospective bidders of any materials, plant or equipment that have been accepted as equal.
- c) All bidders submitting a tender shall include in their tender amount only materials, plant or equipment as specified or that have been approved as an equal.

6. ALTERNATE PRODUCTS

- a) Approval may be given by the Consultant after the award of the Contract, on application in writing from the Contractor, for the substitution of a similar material, item or plant or equipment bearing another brand name or of other manufacture, subject to the following:
 - .1 Any top quality material or item of plant and equipment proposed as a substitute by the Contractor and considered by the Engineer to be of equal quality, value and price to that specified and suitable for the purpose intended, may be accepted as a substitute.
 - .2 Materials and items of plant and equipment which the Contractor proposes as substitutes and which are considered by the Engineer to be suitable for the purpose intended, but which are in their opinion of lesser value, quality and price than those specified will only be accepted as substitutes if reasonable credits are allowed for their use.
 - .3 Requests for alternates must be made by the Contractor well in advance of the time the item is to be ordered. The request shall be accompanied by sufficient information in the form of manufacturers literature, samples, and other data to permit proper investigation of the substitutes proposed.
- b) Bidders are requested to include information on alternates as an appendix to this tender. The information should indicate the proposed credit or extra, to the tender amount, and include sufficient data to allow the Consultant to evaluate the item proposed as an alternate.

7. SUPERVISION AND COORDINATION

- a) The Contractor shall be responsible for supervising and coordinating all aspects of the work.
- b) The Contractor shall include in their quotation all cost relative to supervising sub-Contractors, including those submitting tenders directly to the Owner, which form a portion of the complete project and shall be assigned to the successful General Contractor.

8. RESPONSIBILITY

- a) The Contractor shall be responsible to be fully familiar with the complete documents and shall include in their tender those items which are named, implied, or traditionally a part of the general contract work.

9. DEFINITIONS

In this specification the following terms shall have the definitions noted below:

OWNER: **Government of Prince Edward Island as represented by the Minister of
Transportation and Infrastructure**
CONSULTANT: MCA Consultants Inc.

10. SITE INSPECTOR

- a) There will be an Inspector representing the Department of Transportation and Infrastructure, Province of PEI. No work is to be covered without having received approval from the Inspector. The Inspector will have the authority to cause any part of the work to cease, should, in their opinion, there be a cause to do so.

This work shall be examined by the Department and approval granted to resume when a satisfactory solution has been found.

- b) The inspector does not have authority to authorize changes to work. He or she shall confer with the Consultant or Engineer who, if necessary, will authorize any change.
- c) The fact that the inspector does not reject any work shall not remove the responsibility for completing all work as specified; from the Contractor.

11. OWNERS RIGHT TO TERMINATE CONTRACT

- a) The Owner reserves the right to remove the Contractor from the site if the work is not completed as specified in Paragraph 4. If the Contractor is removed, the Owner shall have the work completed and deduct the cost of this work from the amount owing the Contractor and their bid deposit.

12. SUB-CONTRACTORS

- a) Bidders shall include with their tender, in the space in **Section E – Contract Tender**, Appendix A, the name of each Subcontractor and/or Supplier, as designated, whose price has been included in their tender and who will perform the trade work. Substitution for another Subcontractor in the event that the listed Subcontractor is unable to do the work shall be subject to the approval of the Owner and contingent on evidence satisfactory to the Owner that the original Subcontractor's price was legitimately carried in the Tender, and that the original Subcontractor is now incapable of carrying out the work required under the subcontract, or that he refuses to carry out the work and provides documented reasons for such incapability or refusal.
- b) The term "Own Forces," as a subcontractor, may be used by a Bidder where the Bidder is equipped to and in fact normally carries out the trade work using employees in the direct employment of the Contractor or a wholly owned subsidiary company. Other designations such as "Own Estimate" are unacceptable and may be cause for rejection of the tender by the Owner. **Carrying Subcontractor options next to identified work will not be acceptable.**
- c) When a Bidder indicates "Own Forces" as a subcontractor, the Bidder may be required to demonstrate to the Owner that he has the resources, experience and employees necessary, available and qualified to perform the trade work in a manner and quality satisfactory to fulfill the obligations of the Contract Documents and that the trade work is a normal and continual part of his business.
- d) A Bidder, whose tender is accepted, that included "Own Forces" for a subcontract will if requested, provide the Owner with payroll records verifying that the employees carrying out the "Own Forces" subcontract work are direct employees of the Contractor or of a wholly owned subsidiary company of the Contractor.
- e) All Sub-Contractors are advised to become familiar with all Specifications and Drawings. The General Contractor shall ensure that all sub-trades understand their entire responsibilities in order to complete the project. Sub-trade work may appear in various sections of Specifications and on various drawings.

13. GUARANTEES

- a) The Contractor shall be required to guarantee the work of this Contract for a period of twelve (12) months after the Owner's acceptance of the work, against improper or defective materials and workmanship, and shall repair and make good at their own expense any damage to the building and contents through any of the above causes during this period. Any contract omissions and/or deficiencies reported to the Contractor within twelve (12) months after acceptance of the work shall be made good by the Contractor at their own expense.
- b) Notwithstanding the above, the bidder's attention is directed to the fact that certain individual items on this project may be required to be guaranteed by the manufacturer for periods in excess of twelve (12) months. These specific requirements are to be found in various sections of the Specifications for this project.

14. OFFER ACCEPTANCE/ REJECTION

- a) Duration of Offer:
 - a. Bids to remain open to acceptance, and irrevocable for 30 days after Bid closing date.
- b) Bid Evaluation:

The Consultant and Owner will evaluate Bids submitted for this project. The criteria considered in evaluating the Bids and awarding the Contract will include a combination of:

 - a. Bid amount;
 - b. Scheduling;
 - c. Compliance;
 - d. Expertise and experience;
 - e. Past performance of the Bidder on projects for the Owner, including:
 - a. Quality of work
 - b. Ability to complete project on schedule
 - c. Ability to organize work activities and subcontractors;
 - f. The Bidder's qualifications to perform the Work, the Bidder's financial capacity to do the Work and the competency of the Bidder;
 - g. Qualifications of the Bidder and named Subcontractors/Suppliers (see paragraph 12. Subcontractors); and
 - h. Any other conditions as may be determined by the Owner to be in the best interests of the Owner. A decision on acceptance of a Bid will be made by the Owner based on the results of the Consultant and Owner's evaluation.

c) Acceptance of Offer:

- a. Owner reserves right to accept or reject any or all offers.
- b. The lowest or any Bid will not necessarily be accepted.
- c. Bids submitted which indicate “Own Forces” for subcontract work, that in the opinion of the Owner cannot be successfully completed by the Bidder’s employees will not be accepted.
- d. Bids not submitted on the required form will be rejected.
- e. Bids which are incomplete or qualified will be rejected.
- f. This Bid creates no obligation on the part of the Owner to award the contract or to reimburse proponents for the proposal preparation expenses. The Owner reserves the right to accept or reject any and all proposals, in whole or in part, received as a result of this request, and to negotiate in any manner necessary to best serve the interest of the Owner.
- g. All Bidders acknowledge that they have no claim against, or entitlement to damages from the Owner of the Consultant by reason of the Owner’s rejection of their individual Bids or all Bids.
- h. Following acceptance of the Bid by the Owner, the Consultant will issue a written notice of acceptance to the successful Bidder.
- i. Following acceptance of a Bid, the Owner will return Bid Security Deposits that were submitted with Bids which were not accepted.

15. CONSULTANT’S INTERPRETATION

- a) The Consultant’s interpretation of plans and specifications shall be final. Should the Contractor have any doubt as to interpretation, he or she shall refer to the Consultant for clarification before submitting their tender. No allowances or extras will be made for misinterpretation of plans and specifications by the Contractor.

16. PERMITS, REGULATIONS AND TAXES

- a) All permits and fees required for the proper completion and inspection of the work herein specified will be paid for by the Contractor. Except the building permit which will be paid for by the Owner. All applicable taxes shall be included in the tender price, excluding the Harmonized Sales Tax. The Contractor, as per current Provincial Regulations, shall include on all invoices the Harmonized Sales Tax as an additional line item. This would be in addition to the tender amount which does not include HST.

- b) The work shall be completed to the satisfaction of the Consultant and local inspecting authorities.
- c) In the absence of any provisions contained herein, the applicable Provincial Codes or the National Building Code shall govern in that order.
- d) The latest edition of the Canadian Electrical Code shall govern all Electrical work, whether prewired and/or assembled remote from the site or not.
- e) All equipment supplied or installed shall be CSA approved for the intended use.
- f) All materials, components and equipment as well as construction methods shall comply with the latest edition of the National Building Code and all other applicable codes or regulations.
- g) The latest edition of the PEI Occupational Health and Safety Act and Regulations shall govern safe construction practices.

17. EXISTING CONDITIONS

- a) Bidders will be held to have examined the Tender Documents, to have visited the site and to have informed themselves as to existing conditions and limitations.
- b) If in the performance of the contract, subsurface or latent conditions at the site are found to be materially different from those indicated by the drawings and specifications, or unknown conditions not usually inherent in work of the character shown and specified, the attention of the Consultant shall be called immediately in writing to such conditions before they are disturbed. Upon such notice, or upon their own observation of such conditions, the Consultant shall promptly make such changes in the drawings and specifications as he or she finds necessary to conform to the different conditions and any increase or decrease in the cost shall be adjusted as provided under "Changes in the Work".

18. RECEIPT AND OPENING OF TENDERS

- a) Tenders will be opened at the time and place stated in the tender call. The officer whose duty it is to open them will decide when the specified time has arrived. No responsibility will attach to any officer for the premature opening of a bid not properly addressed and identified.

19. AWARD OF CONTRACT

- a) If the tender is accepted the Contract will be awarded as promptly after the opening of bids as is possible. The selection of the tender that is accepted shall be at the sole discretion of the Owner.

- b) Each bidder shall be prepared, if so requested by the Owner, prior to the award of the Contract to present evidence of their experience, qualifications and financial ability to carry out the terms of the Contract.

20. TENDER SUBMISSION

- a) Tenders must be submitted on the form included with this specification. This form must be completely filled out in ink or be typewritten with the signature in longhand. The completed forms shall be without interlineations, alteration or erasures.
- b) The tender, together with the Tender Security described in this section must be addressed and delivered in a sealed envelope marked “Tender” and bearing the name of the Contractor submitting the tender, together with identification indicating the name of the project.
- c) Tenders will be received at the place and time indicated in the tender call. Late tenders will not be accepted and will be returned unopened to the tenderer.
- d) Amendments to the submitted offer will be permitted if received in writing prior to tender closing and if endorsed by the same party or parties who signed and sealed the offer. Amendments submitted by fax will be accepted, if received prior to tender closing. (Fax (902) 569-0590).
- e) The receipt of addenda for the project shall be acknowledged by filling in the addendum number and date of issue for each addendum on the appropriate line in the tender form. These lines shall be initialed by the person signing the tender after they have been filled in.
- f) Any appendices to the tender form requesting information on suppliers, sub-contractors or alternate prices shall be filled in for the tender to be considered complete.

21. TAXES

- a) All tenders submitted shall EXCLUDE the Harmonized Sales Tax.

22. CONFIDENTIALITY AND FREEDOM OF INFORMATION (Effective November 1, 2002)

- a) By submitting your bid, you agree to disclosure of the information supplied, subject to the provisions of the Freedom of Information and Protection of Privacy (FOIPP) Act.
- b) Anything submitted in your bid that you consider to be “confidential information” because of its proprietary nature should be marked as “CONFIDENTIAL” and will be subject to appropriate consideration under the Freedom of Information and Protection of Privacy Act.

- c) During the delivery and installation of goods and/or services, you may have access to confidential or personal information. Should this occur, you must ensure that such information is not released to any third party or unauthorized individual.
- d) Any information provided on this contract may be subject to release under the Freedom of Information and Protection of Privacy Act. You will be consulted prior to the release of any information.

23. HEALTH AND SAFETY COMPLIANCE REQUIREMENTS – POLICIES AND PROTOCOLS

- a) Contractor to follow all Government Health and Safety policies and protocols as required by the project's facility or property onto which the work must occur. Such policies and protocols must be reviewed and discussed prior to the start of the work on the site.

24. INFECTION CONTROL IN AN ACTIVE HEALTH CARE FACILITY

- a) **Queen Elizabeth Hospital** is an active **Class A** Health Care Facility, requiring Infection Control measures throughout the duration of construction, as outlined in CSA Z317.13. The contractor must provide an Infection Control Plan for review by DTI, Health PEI, and Facility staff, a minimum of 2 weeks prior to the commencement of any onsite work.
- b) The contractor may not commence any onsite work without proper infection control measures in place, unless the scope of work does not require infection control measures and has been approved by all parties.
- c) During construction, if infection control measures are not maintained, the contractor must stop all activities until the infection control measures are corrected.
- d) DTI will arrange for third party monitoring of infection control measures as required throughout the duration of the contract.

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1. DEFINITIONS

- a) The Contract Documents shall include instructions to Tenderers, General Conditions, Supplementary General Conditions, Specifications, Drawings, Tender Form and the signed agreement.
- b) The Owner, the Contractor and the Consultant are those names as such in the Agreement and Specifications.
- c) The term 'Subcontractor' includes only a person, firm or corporation having a contract for the execution of a part or parts of the work included in the Contract, and a person, firm or corporation furnishing material called for in the Contract and worked to a special design according to the Drawings or Specifications, but does not include one who merely furnishes material not so worked.
- d) The term 'work' includes all labour, materials and services required, as shown or described in the contract, documents, supplied and installed or erected complete at the place of building.
- e) The term 'Other Contractor' means any person, firm or corporation employed by or having a contract directly or indirectly with the Owner otherwise than through the Contractor.
- f) The place of building is the designated site or location of the completed work.
- g) The law of the place of building shall govern the work.
- h) For the purpose of contract signing authority, the Director is the Director of the Public Works and Planning Division of the PEI Department of Transportation and Infrastructure.

2. DOCUMENTS

- a) The Contract Documents shall be signed in duplicate by the Owner and Contractor. The Contract Documents are complementary and what is called for by any one shall be as binding as if call for by all. The intention of the documents is to include all labour and materials reasonably necessary for the proper execution of the work. It is not intended however, that materials or work not covered by or properly inferable from any heading, section or trade in the specifications shall be supplied unless shown on the drawings. Descriptions of materials or work in words which so applied have well known technical or trade meanings shall be held to refer to such recognized standards. Should the specification conflict with the drawings, the specifications shall govern. In the case of discrepancies between drawings, those of larger scale, or if the scales are the same, those of later date shall govern.

All drawings and specifications shall be interpreted in conformity with the agreement and these General Conditions which shall govern.

3. DETAIL DRAWINGS & INSTRUCTIONS

- a) The Consultant shall furnish as necessary for the execution of the work, additional instructions, by means of drawings or otherwise. All such additional instructions shall be consistent with the Contract Documents. The work shall be executed in conformity therewith and the Contractor shall do no work without such additional instructions. In giving such additional instructions, the Consultant shall have authority to make minor changes in the work, not inconsistent with the Contract.

If either the Contractor or the Consultant so request, they shall jointly prepare a schedule, subject to change from time to time in accordance with the progress of the work fixing the dates at which the various detail drawings will be required and the Consultant shall furnish them in accordance with this schedule, and on like request, a schedule shall be prepared, fixing the dates for the submission of shop drawings, for the beginning of manufacture and installation of materials and for the completion of the various parts of the work.

4. COPIES FURNISHED

- a) The Consultant shall furnish to the Contractor, without charge, as many copies of all Drawings and Specifications as are reasonably necessary for the proper execution of the work.

5. SHOP DRAWINGS

- a) The Contractor shall furnish to the Consultant, at proper times, all shop and setting drawings or diagrams which the Consultant may deem necessary in order to clarify the details of the work. The Contractor shall make any changes in such drawings or diagrams which the Consultant may require consistent with the Contract, and shall submit sufficient copies of the revised prints to the Consultant for approval – all but one of which shall be returned to the Contractor if approved by the Consultant. When submitting such shop and setting drawings, the Contractor shall notify the Consultant in writing of changes made therein from the Consultant's Drawings or Specification. The Consultant's approval of such drawings or of the revised drawings shall not relieve the Contractor from responsibility for errors made by the Contractor therein or for changes made from the Consultant's Drawings or Specifications not covered by the Contractor's written notification to the Consultant.

6. DRAWINGS AND SPECIFICATIONS ON THE WORK

- a) The Contractor shall keep one copy of all Drawings, Specifications and approved shop drawing on the work, in good order, available to the Consultant and to his or her representatives.

7. OWNERSHIP OF DRAWINGS AND MODELS

- a) All drawings, specifications and copies thereof and all models furnished by the Consultant are property of the Owner. They are not to be used on other work and, with the exception of the signed contract set of the Drawings and Specifications, are to be returned to him or her on request on the completion of the work. Any models furnished by the Contractor or the Owner are the property of the Owner.

8. SAMPLES

- a) The Contractor shall furnish for the Consultant's approval such samples as he or she may reasonably require. The work shall be in accordance with approved samples.

9. MATERIAL TESTS AND MIX DESIGNS

- a) The Contractor shall furnish for the Consultant's approval such material tests and mix designs as he or she may reasonable require. The cost of providing the foregoing beyond the extent called for in the specification shall be charged to the Owner. The work shall be in accordance with approved material tests and mix designs.

10. CONSULTANT AND CONTRACTOR

- a) The Consultant is, in the first instance, the interpreter of the Contract and the judge of its performance; he or she shall use his or her powers under the Contract to enforce its faithful performance by both parties hereto. The Contractor shall, however, have complete control, subject to Article 12, of his or her organization. In case of the termination of the employment of the Consultant, the Owner shall appoint any Consultant whose status under the Contract shall be that of the former Consultant.

11. THE CONSULTANT'S DECISION

- a) The Consultant shall decide on questions arising under the Contract Documents, whether as to the performance of the work or the interpretation of the Specifications and drawings, but should the Contractor hold such decisions to be at variance with the Contract Documents or to involve changes in the work already built, fixed, ordered or in hand in excess of the contract, or to be given in error, he or she shall notify the Consultant before proceeding to carry them out. In the event of the Consultant and the Contractor failing to agree as to such excess or error and the Consultant deciding to carry out such disputed work, the Contractor shall act according to such decision. Any question of excess of cost due to the aforesaid cause may be decided in the manner hereinafter provided in Article 43.

12. SUPERINTENDENCE

- a) The Contractor shall keep on the work, during its progress, a competent superintendent and any necessary assistants, all satisfactory to the Consultant. The superintendent shall not be changed except with the consent of the Consultant, unless the superintendent proves to be unsatisfactory to the Contractor or ceases to be in his or her employ. The superintendent shall represent the Contractor in his or her absence and directions on minor matters given to him or her shall be held to be given to the Contractor. Important directions shall be given in writing to the Contractor. The Contractor shall give efficient supervision to the work using his or her best skill and attention.

13. MATERIALS, APPLIANCES, EMPLOYEES

- a) Unless otherwise stipulated, the Contractor shall provide and pay for all materials, labour, water, tools, equipment, light and power necessary for the execution of the work. Unless otherwise specified all materials shall be new. Both workmanship and materials shall be of the quality specified. The Contractor shall not employ on the work any unfit person or anyone not skilled in the work assigned to him or her.

14. INSPECTION OF WORK

- a) The Owner, or the Consultant on his or her behalf, and their representatives shall at all times have access to the work wherever it is in preparation or progress and the Contractor shall provide proper facilities for such access and for inspection. If the specifications, the Consultant's instructions, the laws, or the ordinances of any public authority require any work to be specially tested or approved, the Contractor shall give the Consultant timely notice of its readiness for inspection, and if the inspection is by an authority other than the Consultant, of the date and time fixed for such inspection. Inspections by the Consultant shall be promptly made. If any such work should be covered up without approval or consent of the Consultant, it must, if required by the Consultant, be uncovered for examination and made good at the Contractor's expense. Re-examination of questioned work may be ordered by the Consultant. If such work be found in accordance with the Contract, the Owner shall pay the cost of re-examination and replacement. If such work be found not in accordance with the contract, through the fault of the Contractor, the Contractor shall pay such cost.

15. REJECTED WORK

- a) The Contractor shall promptly remove from the premises any defective work, whether the result of poor workmanship, use of defective materials, damage through carelessness or other act of the Contractor, which has been condemned by the Consultant as failing to conform to the Contract Documents, whether incorporated in the work or not. The Contractor shall

promptly replace and re-execute his or her own work in accordance with the contract and without expense to the Owner and shall bear the expense of making good all work of other Contractors destroyed or damaged by such removal or replacement. If the Contractor does not remove such condemned material or work within the time fixed by written notice, the Owner may remove them and may store such materials at the expense of the Contractor. If the Contractor does not pay the expense of such removal within Five (5) days thereafter, the Owner may, upon Ten (10) day's written notice, sell such materials at auction or at private sale and shall account for the net proceeds thereof, after deducting all the costs and expenses that should have been borne by the Contractor.

16. DEDUCTIONS FOR UNCORRECTED WORK

- a) If, in the opinion of the Consultant, it is not expedient to correct defective work or work not done in accordance with the Contract Documents, the Owner may deduct from the contract price the difference in value between the work as done and that called for by the contract, the amount of which shall be determined in the final instance by the Consultant.

17. CORRECTION AFTER COMPLETION

- a) Subject to any special provisions in the Contract Documents, the Contractor shall remedy any defects due to faulty materials or workmanship appearing within a period of one year from the date of substantial completion of the work and shall pay for any damage to other work resulting therefrom which appears within such period and neither the final certificate nor payment thereunder shall relieve the Contractor from responsibility hereunder. The Owner shall give notice of observed defects promptly. Questions arising under this Article may be decided as provided in Article 43.

18. EMERGENCIES

- a) The Consultant has authority in an emergency to stop the progress of the work whenever, in his or her opinion, such stoppage may be necessary to ensure the safety of life, or of the structure, or neighbouring property. This includes authority to make such changes and to order, access and award the cost of such work extra to the Contract or otherwise as may in his or her opinion be necessary.

19. PROTECTION OF WORK AND PROPERTY

- a) The Contractor shall maintain continuously adequate protection of all his or her work from damage and shall take reasonable precautions to protect the Owner's property from all injury arising in connection with this Contract. He or she shall make good any damage or injury to his or her work and shall make good any damage or injury to the property of the Owner resulting from the lack of reasonable protective precautions. He or she shall not be responsible,

however, for any damage or injury to his or her work and to the property of the Owner which may be directly due to errors in the Contract Documents or caused by the Owner, his or her agents, or employees, or from any work or risk which the Owner has agreed to insure, provided the Contractor has taken reasonable protective precautions. He or she shall adequately protect adjacent property as required by law and the Contract Documents.

20. CONTRACTORS' INSURANCE

a) INDEMNITY/HOLD HARMLESS

- .1 The Contractor shall be liable for all injuries to persons and for damage to property caused by his or her operations, and those of his or her sub-contractors, and his or her and their employees, engaged on all operations in connection with the contract both on and off the site, and he or she shall indemnify and save harmless the Owner from all suits, claims, expenses, costs, demands, losses, and damages to which the Owner may be put by reason of injury, including death, to persons, and damage to property of the Owner and others, resulting from; negligence, carelessness and any other cause whatsoever in the performance of the work.
- .2 The Contractor shall, until the date of issue of the final Certificate of Approval of the work by the Consultant, Indemnify and Save Harmless the Owner, and protect his or her own interests against:
 - (a) Theft, burglary or robbery of, and loss or damage to, all materials and equipment brought to the site for use in the work, whether or not such materials and equipment are incorporated in the work at the time that any such theft, burglary, robbery, loss or damage occurs.
 - (b) Theft or burglary of, and loss or damage to, any of his or her own plant and equipment being used on the Project and/or stored on the site.

b) BUILDERS RISK, ALL RISK PROPERTY INSURANCE

- .1 The Contractor shall, without limiting its obligations or liabilities herein and at its own expense, provide and maintain the following insurances with Insurers and in forms and amounts acceptable to Government:
 - (a) The Contractor shall have Commercial General Liability coverage in an amount not less than Two Million (\$2,000,000.00) dollars inclusive per occurrence against bodily injury and property damage. **The Government of Prince Edward Island is to be added as an additional insured under this policy.** Such insurance shall include, but not be limited to:

- i) Blanket Written Contractual Liability;
- ii) Personal Injury Liability;
- iii) Non-owned Automobile Liability;
- iv) Cross Liability;
- v) Operation of Attached Machinery

Commercial General Liability insurance shall be endorsed to provide the Owner with thirty (30) day advance written notice of cancellation or material change and fifteen (15) days notice in the event of non-payment.

- (b) Automotive liability coverage (Standard Automobile Policy) on all vehicles, the subject of this Agreement, owned, leased, operated or licensed in the name of the Contractor, in an amount not less than Two Million (\$2,000,000.00) dollars
- (c) If the work involves new construction or reconstruction of a property being repaired or maintained, the Contractor shall provide and maintain All Risk Course of Construction (Builder's Risk) to the full value of the work in the amount of the Contract Price. The policy will permit partial or complete use or occupancy by the Owner during the term of this insurance.

All the foregoing insurance shall be primary and not require the sharing of any loss by any insurer of the Government nor by any other form of recovery available such as the Provincial Self Insurance and Risk management Fund.

.2 Proof of Insurance

A Certificate(s) of Insurance and any renewals thereof, shall be furnished to the Government prior to commencement of work by the Contractor and must be updated as required during the Term.

The policies required by this Agreement shall be in a form and with insurers satisfactory to the Government. Default of deliver or receipt by the government shall not be construed as acknowledgement or concurrence that there has been compliance with the terms of this Agreement.

.3 Indemnification

The Contractor shall indemnify and hold harmless the Government of Prince Edward Island, its agents, representatives and employees from and against all claims, demands, losses, costs, damages, actions, suits or proceedings of every nature and kind whatsoever arising out of or resulting from the performance of work (herein called the "claims"), provided that any such claim is caused in whole or in part of any act, error or omission, including but not

limited to those of negligence of the Contractor, or anyone directly or indirectly employed by the Contractor anyone for whom the Contractor may be liable.

21. PERFORMANCE BOND

- a) The Owner shall have the right to require the Contractor to furnish a bond covering the faithful performance of the Contract – including the corrections after completion provided for in Article 17 – and the payment of all obligations arising under the contract, in such form as the Consultant may prescribe and with such sureties as he or she may approve. If such bond is required by written instructions given previous to the receipt of bids, the premium shall be paid by the Contractor, if subsequent thereto, it shall be paid by the Owner.

22. CASH ALLOWANCES

- a) The Contractor shall include in the contract sum all cash allowances mentioned in the Specifications, which allowances shall be expended in whole or in part as the Consultant shall direct and the amount of the contract sum being adjusted in conformity therewith. The Contract sum includes such sums for expenses and profit on account of such cash allowances as the Contractor requires except those allowances included for contingency purposes.

23. SUBSURFACE CONDITIONS

- a) In the event that during the execution of the work, subsurface conditions at the site are found to differ materially from those indicated in the Contract Documents and soil reports, or otherwise represented by the Owner or Consultant to the Contractor, then the Contractor shall promptly notify the Consultant in writing of such conditions, the Consultant shall promptly investigate such conditions and if he or she finds that they differ materially and will result in an increase or decrease in the cost of, or time required for performance of this Contract, an equitable adjustment shall be made between the parties and the contract modified in writing accordingly. If the parties fail to agree upon the adjustment to be made, the dispute may be determined as provided for in Article 43.

24. CHANGES IN THE WORK

- a) The Owner or the Consultant, without invalidating the contract, may make changes by altering, adding to, or deducting from the work, the contracts sum being adjusted accordingly. All such work shall be executed under the conditions of the Contract except that any claim for extension or reduction of time caused thereby shall be adjusted at the time of ordering such change. Except as provided in Article 18, no change shall be made unless in pursuance of a written order from the Consultant and no claim for an addition to or deduction from the contract sum shall be valid unless so ordered and at the same time valued, or agreed to be valued, as provided in Article 25.

25. VALUATION OF CHANGES

- a) Change Orders calling for normal changes or additions to the work will be priced in detail giving actual material trade prices (not list prices) and actual labour costs (including Employment Insurance, Worker's Compensation, holiday pay) and actual equipment rental. To these prices the Contractor will add:
- .1 For work less than \$2,500 involving the General Contractor only, the General Contractor adds 20% to his or her costs.
 - .2 For work over \$2,500 involving the General Contractor only, the General Contractor adds 15% to his or her costs.
 - .3 For work less than \$2,500 involving a Sub-Contractor only, the Sub-Contractor adds 20% to his or her costs, submits this price to the General Contractor who adds 10%.
 - .4 For work over \$2,500 involving a Sub-Contractor only, the Sub-Contractor adds 15% to his or her cost, submits this price to the General Contractor who adds 5%.
 - .5
 - (a) For work less than \$2,500 involving the General Contractor and Sub-Contractor, the Sub-Contractor adds 20% to his or her costs, submits his or her price to the General Contractor who adds 10%; to this amount the General Contractor adds the cost of his or her own work plus 20% of the cost of his or her own work only.
 - (b) The General Contractor does not add a further 10% to the cost of his or her own work.
 - .6
 - (a) For work over \$2,500 involving the General Contractor and a Sub-Contractor, the Sub-Contractor adds 15% to his or her cost, submits this price to the General Contractor who adds 5%; to this amount the General Contractor adds the cost of his or her own work plus 15% of the cost of his or her own work only.
 - (b) The General Contractor does not add a further 5% to the cost of his or her own work.
 - .7 Deletions to Contract: A mark-up shall **not** be charged nor credited on a credit portion of a Change Order.
 - .8 Supervision related to Change Orders shall be considered as included in the allowable mark-up and shall **not** be included in the labour charges for a Change Order.

26. APPLICATION FOR PAYMENTS

- a) The Contractor shall – before the first application for payment – submit to the Consultant a schedule of values of the various parts of the work aggregating to the total sum of the contract, divided so as to facilitate payments, made out in such form, and supported by such evidence as to its correctness as the Consultant may direct. This schedule, when approved by the Consultant, shall be used as a basis for applications of payment, unless it can be found to be in error.
- b) The Contractor, as per current Provincial regulation, shall include on all invoices the Harmonized Sales Tax as an additional line item. This amount would be in addition to the tender amount which does not include HST. See article 28 of this Section.

27. CERTIFICATES AND PAYMENTS

- a) Partial payments will be made monthly and within thirty (30) days after approval by the Owner and on the basis of a duly certified and approved estimate of work performed during the preceding period. In preparing estimates, the material delivered on the site and preparatory work done shall be taken into consideration.
- b) In making such partial payments, there shall be retained a hold back in the amount of fifteen percent (15%) of the estimated amount on each partial payment estimate, less any holdback release which may have been made to specific sub-contractors under any progressive release of holdback provisions in Provincial Legislation.
- c) All materials and work covered by partial payments made shall thereupon become the sole property of the Owner, but this shall not be construed as relieving the Contractor from the sole responsibility for the safety and preservation of all materials and work upon which payments have been made and restoration of any damaged work or as a waiver of the right of the Owner to require the fulfillment of all the terms of the contract. Nor shall Consultant's Certification of Partial Payment for any work be construed as his or her final or irrevocable acceptance of that work.
- d) Document of Completion: Upon completion and acceptance of all work whatsoever required and the release of all claims against the Owner as specified, the Consultant shall file a written document with the Owner and with the Contractor as to the entire amount of work performed and compensation earned by the Contractor – including the extra work and compensation therefore.
- e) Final Payment: Within sixty (60) days after the filing of such document of completion and minimum one (1_ day after the lien period, and upon receipt from the General Contractor of declarations signed by each of his sub-contractors that the sub-contractor has been paid up to,

and including the past previous partial payment, the Owner will pay the Contractor the amount stated therein less all deductions authorized by the terms of this contract and previous payments and advances whatsoever to or for the account of the Contractor. All previous estimates and payments, including those relating to extra work, shall be subject to correction at the time of this payment which is, throughout this contract, called Final Payment. Final Payment shall be subject to inspection and acceptance by the Owner or duly authorized representatives of the Owner and by representatives of all agencies having direct interest in the project.

Submittals to include:

- Certificate or letter of clearance from the Provincial Worker's Compensation Board
- f) With the second and all subsequent applications for payment, the Contractor shall include a statutory declaration form CCDC 9B, or other similar acceptable form to the Owner, declaring that all labour and materials entering into the work, including Sub-Contractors, covered by the previous application, have been paid. With application for release of lien holdback, the Contractor shall include a statutory declaration form CCDC 9A, or other similar form acceptable to the Owner.
- g) With application for release of lien holdback, the Contractor shall include certificates issued by the Worker's Compensation Board, indicating that Worker's Compensation premiums in relation to the project have been paid in full.

28. TAXES

- a) Unless otherwise provided herein, the Contractor shall pay all government sales or excise taxes in force at the date of the Agreement, provided that any increase or decrease in such taxes shall increase or decrease the contract sum accordingly.

29. PERMITS, NOTICES, LAWS AND RULES

- a) The Contractor shall apply and pay for all necessary permits or licenses required for the execution of the work (but this shall not include the obtaining of the Building Permit or permanent easement or right of servitude). The Contractor shall give all necessary notices and pay all fees required by law and comply with all laws, ordinances, rules and regulations relating to the work and to the preservation of the public's health. The Contractor shall be responsible for the safety of all workmen and equipment on the project in accordance with all applicable safety legislation passed by federal, provincial and local authorities governing construction safety.

If the Contract Documents are at variance therewith, any resulting additional expense incurred by the Contractor shall constitute an addition to the contract price.

30. PATENT FEES

- a) The Contractor shall pay all royalties and license fees and shall save the Owner harmless from loss on account of suits or claims for infringement of patents in the doing of the work.

31. USE OF PREMISES

- a) The Contractor shall confine his or her apparatus, the storage of materials and the operations of his or her workmen to limits indicated by laws, ordinances, permits or by direction of the Consultant and shall not unreasonably encumber the premises with his or her materials. The Contractor shall not load – or permit to be loaded – any part of the work with a weight that will endanger its safety. The Contractor shall enforce the Consultant’s instructions regarding signs, advertisements, fires and smoking.

32. CLEANING UP

- a) The Contractor shall at all times keep the premises free from accumulations of waste material or rubbish caused by his or her employees or work and, at the completion of the work, he or she shall remove all his or her rubbish and all tools, equipment and surplus materials from and about the work and shall leave the work “broom clean” or its equivalent, unless more exactly specified. In case of dispute, the Owner may remove the rubbish and charge the cost as the Consultant shall determine to be just.

33. CUTTING, PATCHING AND DIGGING

- a) The Contractor shall do all cutting, fitting or patching of his or her work that may be required to make its several parts come together properly and fit it to receive or be received by work of Other Contractors shown upon, or reasonably implied by, the Contract Documents.

Any cost caused by ill-times work shall be borne by the party responsible therefore.

The Contractor shall not endanger any existing work by cutting, digging or otherwise and shall not cut or alter the work of any other Contractor save with the consent of the Consultant.

34. DELAYS

- a) If the Contractor is delayed in the completion of the work by any act or neglect of the Owner, Consultant or any Other Contractor or any employee of any one of them or by changes ordered

in the work, then the time of completion shall be extended for such reasonable time as the Consultant may decide.

- b) If the Contractor is delayed in the performance of the Work by:
- .1 labor disputes, strikes, lock-outs (including lock-outs decreed or recommended for its members by a recognized contractors' association, of which the Contractor is a member or to which the Contractor is otherwise bound),
 - .2 fire, unusual delay by common carriers or unavoidable casualties,
 - .3 abnormally adverse weather conditions, or any cause beyond the Contractor's control other than one resulting from a default or breach of Contract by the Contractor the Contractor will make reasonable efforts to counter the circumstances giving rise to the delay or to otherwise remedy its inability to perform its obligations by utilizing all resources reasonably required in the circumstances, including obtaining supplies or services from other sources if the same are reasonably available (including seeking injunctive relief or other judicial, quasi-judicial or law enforcement remedy, provided that the Contractor will not be required to settle or resolve any labor disturbance, strike, lock-out, or work slowdown (collectively "Employment Matters") but excluding any Employment Matters involving persons retained, employed or hired by the Contractor to supply materials or services to meet the Contractor's obligations under this Contract; or any Employment Matter caused by, or attributable to, any act (including any pricing or other practice or method of operation) or omission of the Contractor. Only after the Contractor has made such reasonable efforts the Contract Time shall be extended for such reasonable time as the Consultant may recommend in consultation with the Contractor. The extension of time shall not be less than the time lost as the result of the event causing the delay, unless the Contractor agrees to a shorter extension. The Contractor shall not be entitled to payment for costs incurred by such reasonable efforts or delays unless such reasonable efforts or delays were required as a result of actions by the Owner, Consultant or anyone employed or engaged by them directly or shall be necessary.

No such extension shall be made for delay unless written notice of claim is given to the Consultant within seven (7) days of its commencement provided, however, that in the case of a continuing cause of delay only one claim shall be necessary.

If no schedule is made under Article 3, no claim for delay shall be allowed on account of failure to furnish drawings until two (2) weeks after demand for such drawings and not then unless such claim be reasonable.

The Consultant shall not, except by written notice to the Contractor, or as provided in Article 18, stop or delay any part of the work pending decisions or proposed changes either by him or herself or by the Owner.

35. OWNER'S RIGHT TO DO WORK

- a) If the Contractor should neglect to execute the work properly or fail to perform any provision of this Contract, the Owner, after five (5) days written notice to the Contractor, may without prejudice to any other right or remedy he or she may have, make good such deficiencies and may deduct the cost thereof from the payment then or thereafter due the Contractor; provided however, that the Consultant shall approve both such actions and the amount charged to the Contractor.

36. OWNER'S RIGHT TO TERMINATE CONTRACT

- a) If the Contractor should be adjusted as bankrupt, or if he or she should make a general assignment for the benefit of his or her creditors, or if a receiver should be appointed on account of his or her insolvency or if he or she should – except in case of recited in Article 35 – refuse or fail to supply enough properly skilled workmen or proper materials after having received seven (7) days notice in writing from the Consultant to supply additional workmen or materials, or if he or she should fail to make prompt payment to Sub-Contractors or for material or labour, or persistently disregard laws, ordinances or the instruction of the Consultant, or otherwise be guilty of a substantial violation of the provisions of the Contract, then the Owner, upon the certificate of the Consultant that sufficient cause exists to justify such action, may, without prejudice to any right or remedy he or she may have, by giving the Contractor written notice, terminate the employment of the Contractor and take possession of the premises and of all materials, tools and appliances thereon and finish the work by whatever method he or she may deem expedient, but without undue delay or expense. In such case, the Contractor shall not be entitled to receive the expense of finishing the work, including compensation to the Consultant for his or her additional services; such excess shall be paid to the Contractor. If such expense shall exceed such unpaid balance, the Contractor shall pay the difference to the Owner. The expense incurred by the Owner as herein provided, shall be certified by the Consultant.

37. CONTRACTOR'S RIGHT TO SUSPEND WORK OR TERMINATE CONTRACT

- a) If the work should be stopped under an order of any court or other public authority through no act or fault of the Contractor or of anyone employed by him or her, or if the Consultant fails to issue a certificate in accordance with Article 27, or if the Owner should fail to pay to the Contractor within seven (7) days of its maturing and presentation, any sum certified by the Consultant or awarded by arbitrators, then the Contractor may, upon five (5) days written notice to the Owner and the Consultant, stop work and/or terminate this Contract without

prejudice to any other right or remedy he or she may have and recover from the Owner payment for all work executed and any loss sustained upon the plant or material with reasonable profit and damages.

38. DAMAGES AND MUTUAL RESPONSIBILITY

- a) If either party to this Contract should suffer damage in any manner because of any wrongful act or neglect of the other party or of anyone employed by him or her then he or she shall be reimbursed by the other party for such damage. Claims under this paragraph shall be made in writing to the party liable within a reasonable time after the first observance of such damage and not later than the time of final certificate, except as expressly stipulated otherwise in the case of faulty work or materials, and may be adjusted by agreement or in the manner set out in Article 43 and the party reimbursing the other party as aforesaid shall thereupon be subrogated to the rights of the other party in respect of such wrongful act or neglect if it be that of a third party. Should the Contractor cause damage to any other Contractor on the work the Contractor agrees – upon due notice – to settle with such other Contractor by agreement or arbitration, if he or she will so settle. If such other Contractor sues the Owner on account of any damage alleged to have been so sustained, the Owner shall notify the Contractor who shall defend such proceedings at the Owner's expense and if any final order or judgment against the Owner arises therefrom the Contractor shall pay or satisfy it and pay all costs incurred by the Owner provided that if the Contractor becomes liable to pay or satisfy any final order or judgment against the Owner, then the Contractor shall have the right upon undertaking to indemnify the Owner against any and all liability for costs to appeal, in the name of the Owner, such final order or judgment to any and all courts or competent jurisdiction.

39. SEPARATE CONTRACTS WITH OTHER CONTRACTORS

- a) The Owner reserves the right to let separate contracts in connection with the undertaking of which the work is a part and the Contractor shall connect properly and coordinate this work with that of other Contractors. If any part of the Contractor's work depends – for its proper execution or results – upon the work of any other Contractor, the Contractor shall inspect the work prior to proceeding with his or her work as required by the Contract. Should the Contractor fail so to inspect and report, he or she shall have no claim against the Owner by reason of the defective or unfinished work of any other Contractor except as to latent defects not reasonably noticeable at the time of the commencement of the Contractor's work. In letting separate contracts, the Owner shall be responsible for the coordination of fire and other insurance coverages and shall take all precautions reasonable possible to avoid possible occurrence of a labour dispute or disputes on the work.

40. ASSIGNMENT

- a) Neither party to the Contract shall assign the Contract without the written consent of the other.

41. SUB-CONTRACTS

- a) The Contractor agrees that the list of names of sub-contractors supplied prior to the signing of the Contract is the list of Sub-Contractors proposed to be used to carry out those parts of the work noted thereon and he or she shall not employ any to whom the Consultant may reasonable object.

If the change of any name on such list is required by the Consultant and the work has to be awarded to a higher bidder, the contract price shall be increased by the difference between the two bids.

The Consultant shall, on request, furnish to any Sub-Contractor wherever practicable, evidence of the amounts certified to on his or her account.

The Contractor shall be held as fully responsible to the Owner for the acts and omissions of his or her sub-contractors and of persons directly or indirectly employed by them, as for the acts and omissions of persons directly employed by him or her. In view of this responsibility, the Contractor shall not be obliged to employ as a sub-contractor or supplier any person or firm to whom he or she may reasonable object.

42. RELATIONS OF CONTRACTOR AND SUB-CONTRACTOR

- a) The Contractor agrees to bind every sub-contractor by the terms of the Contract Documents, as far as applicable to his or her work.

43. ARBITRATION

- a) In the case of any dispute arising between the Owner (or the Consultant acting on his or her behalf) and the Contractor as to their respective rights and obligations under the Contract, either party hereto shall be entitled to give to the other notice of such dispute and to request arbitration thereof; and the parties may, with respect to the particular matters then in dispute, agree to submit the same to arbitration in accordance with the applicable law of the place of building.

Arbitration proceedings shall not take place until after the completion or alleged completion of the work except (a) on a question of certificate for payment, or (b) in a case where either party can show that the matter in dispute is of such nature as to require immediate consideration while evidence is available.

44. OWNER SIGNING AUTHORITY

- a) Mr. Adam Clark, P. Eng. is designated as the Director for the purposes of this agreement, the Director shall represent Government in all matters pertaining to the construction project being

provided pursuant to this agreement, and will administer said agreement, and shall complete necessary approvals of all plans and specifications provided for under this agreement on behalf of Government, provided however, that the Director shall not be authorized to amend the terms of the Agreement.

Government may replace the Director by providing written notice, in accordance with the notice requirements of this Agreement.

45. CONFLICT OF INTEREST

- a) The Contractor warrants that as at the date of this Agreement, no conflict of interest, or any circumstance that might interfere with independent and objective exercise of judgment, exists or is likely to arise in relation to execution of this Agreement or its subject matter. The Contractor shall immediately notify Government, in writing, if any such actual or potential conflict of interest should arise at any time during the Term. In the event Government discovers or is notified by the Contractor of an actual or potential conflict of interest, Government, in its sole discretion, may either:
 - i) allow the Contractor to resolve the actual or potential conflict to the satisfaction of Government; or
 - ii) terminate the Agreement in accordance with the Termination section of this Agreement.

END

PROJECT: QEH AHU-8 and AHU-18 Replacement

1. GENERAL

- a) The undersigned tenderer (hereinafter called the “Contractor”) hereby offers to the Minister of Transportation and Infrastructure (hereinafter called the “Owner”) to furnish all necessary tools, plant, services, materials and labour to execute and complete in a careful and workmanlike manner the work set out under the **Project # 2665-22058** herein, which is more particularly described in the Plans and Specifications titled **QEH – AHU-8 and AHU-18 Replacement** and dated **August, 2023** for the lump sum as set out in Clause 3.

The Contractor agrees:

- .1 To complete the work by the date indicated on the Instructions to Bidders.
- .2 That this Form of Agreement supersedes and cancels all communication, negotiations and agreements relating to the work other than contained in the completed tender.
- .3 To use all suppliers and sub-contractors indicated on his or her tender unless prior approval is received from the Engineer to make a change.

2. ADDENDA

- a) The following addenda are included in this contract:

3. CONTRACT PRICE

- a) The Contract Price (*the lump sum referred to in Clause 1:*) which excludes value added taxes is:

- b) Value added (HST)(of _____%) payable by the Owner to the Contractor are:

c) Total amount payable by the Owner to the Contractor for the construction of the work is:

4. CORRESPONDENCE

a) The Owner, Consultant, and Contractor may be contacted in writing at the addresses below:

Owner & Consultant

PEI Department of Transportation and Infrastructure
PO Box 2000
Charlottetown, PE
C1A 7N8

Contractor

5. CONTRACTOR'S ACCEPTANCE

a) Accepted and executed on behalf of the Contractor this ____ day of _____, 20____,
in the presence of _____.

Witness

Signature & Corporate Seal

6. OWNER'S ACCEPTANCE

a) Accepted and executed on behalf of the Owner this ____ day of _____, 20____, in
the presence of _____.

Witness

Signature & Seal

END

1. GENERAL

1.1. TENDER

.1 SUBMITTED BY:

(Name) _____
(Address) _____
(Contact) _____
(Phone) _____ (Fax) _____
(Date) _____

FOR: QEH – AHU-8 and AHU-18 Replacement
60 Riverside Dr.
Charlottetown, PE C1A 8T5

TO: Minister of Transportation and Infrastructure
11 Kent Street
PO Box 2000
Charlottetown, PE
C1A 7N8

HAVING examined the drawings and specifications for this project as well as any addenda issued, we hereby offer to furnish all materials, plant and labour necessary for the full and proper completion of:

“QEH – AHU-8 and AHU-18 Replacement”

INCLUDING all prime cost allowances, or other taxes in force at this date and **excluding HST**; but not including any additional or deductible allowance or taxes which may be applicable subsequent to this date, and which shall be payable by or to the Owner, in accordance with the above mentioned documents, for the sum of:

_____ Dollars (\$ _____)
in lawful money of Canada.

In submitting this tender we recognize the necessity to complete the information requested on any appendices, as well as the right of the Owner to accept any tender at the price submitted or to reject all tenders, it being understood, and this tender is submitted on the condition that revised tenders will not be called for if minor changes are contemplated.

In the event of this tender being accepted within thirty (30) days of the time stated for the closing of tenders, and our failing or declining to enter into a contract, then our bid deposit shall be forfeited to the Owner in lieu of any damages which he or she may suffer by reason of our failure or refusal to enter into such contract.

In the event of our tender not being accepted within thirty (30) days of the time stated for the closing of tenders, the bid deposit will be returned to us forthwith unless a satisfactory arrangement is made with us covering its retention for a further stated period.

1.2. ACKNOWLEDGEMENT OF RECEIPT OF ADDENDA

.1 Addendum # _____ Issued _____ Initial _____
Addendum # _____ Issued _____ Initial _____
Addendum # _____ Issued _____ Initial _____
Addendum # _____ Issued _____ Initial _____
Addendum # _____ Issued _____ Initial _____

1.3. SUB-CONTRACTORS AND SUPPLIERS

.1 Our tender includes the following sub-contractors and suppliers, (own forces may be used, as per Section B item 12). The following work will be performed (or provided) by following Sub-contractors and supplies coordinated by us in our role as General Contractor.

| | |
|----------------------------|-------|
| Mechanical (HVAC) | _____ |
| Mechanical (Plumbing) | _____ |
| Electrical | _____ |
| Painting | _____ |
| Insulation | _____ |
| Automatic Controls | _____ |
| Air Balancing | _____ |
| Duct Cleaning | _____ |
| Infection Control Measures | _____ |
| Air Handling Units | _____ |
| Humidifiers | _____ |

1.4. ACCEPTANCE OF AGREEMENT

- .1 If we are notified of the acceptance of this tender within the above specified time we will:
 - .1 Enter into a formal contract agreement with the Owners.
 - .2 Furnish a general analysis of the contract sum, the total aggregating the amount of our tender.
 - .3 Provide a Construction Schedule and complete the entire work on or before the dates stated.

1.5. LABOUR RATES

- .1 Prior to signing the Contract related to this Bid, the successful Bidder will provide the Owner with labor rates covering labor provided by the Bidder and major Subcontractors, for extra work carried out in relation to Change Order and Change Directive work. These labor rates are to be substantiated by actual labor costs and wage levies; the labor rates must be reasonable, in comparison to local industry standards, and acceptable to the Owner.

1.6. CONTRACTOR'S SIGNATURE

The undersigned bidder declares that this tender is made without connection with any other person or persons submitting tenders for the same work, and is in all respect, fair & without collusion or fraud.

- .1 Signed, sealed and submitted for and on behalf of:

Submitted by (Company Name)

Authorized Name and Title (Print)

Authorized Signature

Date

END

1. REFERENCES

- a) Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations.
- b) Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- c) Province of Prince Edward Island
 - .1 Occupational Health and Safety Act, R.S.P.E.I.1988 (including any amendments to and regulations)
- d) CSA C22.1-18 – Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.
- e) CSA C22.3 No. 7-94 (R2005) - Underground Systems
- f) COSH, Canada Occupational Health and Safety Regulations (SOR/86-304)
- g) Fire Protection Standards issued by Fire Protection Services of Human Resources Development Canada as follows:
 - .1 FCC No. 301 – June 1982 Standard for Construction Operations. (or latest edition)
 - .2 FCC No. 302 – June 1982 Standard for Welding and Cutting. (or latest edition)

2. COMPLIANCE REQUIREMENTS

- a) Comply with Occupational Health and Safety Act, Occupational Health and Safety Act Regulations PEI (including any amendments to and regulations).
- b) Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.
- c) Perform lockouts in compliance with:
 - .1 Canadian Electrical Code
 - .2 Federal and Provincial Occupational Health and Safety Acts and Regulations.
 - .3 Regulations and code of practice as applicable to mechanical equipment or other machinery being de-energized.

- d) In event of conflict between any provisions of above Authorities, the most stringent provision will apply. Should a dispute arise in determining the most stringent requirement, the Consultant will advise on the course of action to be followed.

3. CONSTRUCTION SAFETY MEASURES

- a) Observe and enforce construction safety measures required by latest National Building Code, Part 8, Provincial Government, Worker's Compensation Board and municipal statues and authorities.
- b) Provide and maintain first aid equipment appropriate to the work and its location in accordance with the First Aid Regulations. Implement recommendations from Occupational Health and Safety Division specific to the project work site.

4. HEALTH AND SAFETY COORDINATOR

- a) Employ and assign to work, competent and authorized representative as Health and Safety Coordinator. Health and Safety Coordinator must:
 - .1 Have minimum 2 years site-related working experience specific to activities associated with Construction.
 - .2 Having working knowledge of occupational health and safety regulations.
 - .3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform work.
 - .4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.

5. SAFETY ASSESSMENT

- a) Perform site specific hazard assessment related to project.
- b) Perform on-going hazard assessments during the progress of Work identifying new or potential health risks and safety hazards not previously known. As a minimum, hazard assessments shall be carried out when:
 - .1 New subtrade work, new subcontractor(s) or new workers arrive at the site to commence another portion of work.

- .2 The scope of work has been changed by Change Order.
- .3 Potential hazard or weakness in current health and safety practices are identified by Consultant or by an authorized safety representative.
- c) Each hazard assessment to be made in writing. Keep copies of all assessments on site for duration of Work. Upon request, make available to Consultant for inspection.

6. SUBMITTALS

- a) Upon request, submit within seven (7) days to the Consultant, one copy electronically and one hard copy of the site-specific Health and Safety Plan.
- b) Upon request, submit within seven (7) days to the Consultant, one copy electronically and one hard copy of the Contractor's authorized representative's worksite health and safety inspection reports.
- c) Upon request, submit within seven (7) days to the Consultant, one copy electronically and one hard copy of the construction safety toolbox meetings and formal contractor safety meetings.
- d) In the event of an incident/accident, immediately submit to the Consultant one copy electronically and one hard copy of the incident/accident report.

7. SITE CONTROL AND ACCESS

- a) Control worksite and entry points. Grant and allow entry to only workers and other persons so authorized. Immediately stop non-authorized persons from circulating within construction areas and remove from site.
- b) Prior to gaining access to the site, all contractors, subcontractors and suppliers shall file with the General Contractor their proof of Workers Compensation coverage, proof of required Insurance and proof of contract. Upon request, proof of these documents will be provided to the Owner and Consultant.
- c) Delineate and isolate construction areas from other areas of site by use of appropriate means. Erect barricades, fences, hoarding and temporary lighting as required.
- d) Erect signage at entry points and at other strategic locations around site, clearly identifying construction areas(s) as being "off limits" to non-authorized persons. Signage must be professionally made.

- e) Ensure persons granted access is fitted and wear appropriate personal protective equipment (PPE).

8. PROTECTION

- a) Provide temporary facilities for protection and safe passage of building occupants, public pedestrian and vehicular traffic around and adjacent to work site.
- b) Provide safety barricades, lights and signage within work site as required to provide a safe working environment for workers.

9. MEETINGS

- a) Prior to commencement of work hold a Health and Safety meeting. Have Contractor's Site Superintendent in attendance.
- b) Provide site safety orientation session to all workers and all workers new to the site and other authorized persons prior to granting them access to work site. Brief persons on site conditions and on the site safety rules in force at site.
- c) Conduct site specific occupational health and safety meetings during the entire work as follows and submit minutes as requested.
 - .1 Formal meetings on a minimum monthly basis.
 - .2 Informal toolbox meetings on a regular basis from a predetermined schedule.
- d) Attend Health and Safety meetings as directed by the Contractor.

10. HAZARDOUS MATERIALS

- a) Should material resembling hazardous materials (other than those identified within the Contract Documents) be encountered in the course of work, stop work immediately. Do not proceed until written instructions have been received from the Consultant.
- b) Any material which contains asbestos, lead paint or PCB's that is disturbed or removed during construction work shall be removed in accordance with the regulations set out by the Occupational Health and Safety Act.

11. WHIMIS

- a) Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) Regulations regarding use, handling, storage, and disposal of hazardous materials; and regarding labeling and provision of Safety Data Sheets.
- b) Have a copy of WHMIS Safety Data Sheets available at the workplace on delivery of hazardous products.

12. SITE CLEANING

- a) Except where special permission is obtained, maintain clean access on public sidewalks and roads.
- b) Maintain walks and roads clear of construction materials and debris, including excavated material. Clean walks and roads as frequently as required to ensure that they are cleared of materials, debris and excavated material.
- c) Remove snow and ice from areas as required to execute the work.

13. FIRE SAFETY REQUIREMENTS

- a) Comply with requirements of latest standard for Building Construction Operations issued by the Fire Commissioner of Canada and Fire Safety Regulations of Local Authority. (latest editions)
- b) Implement and follow fire safety measures during Work. Comply with following:
 - .1 National Fire Code, (latest edition)
 - .2 Fire Protection Standards FCC 301 and FCC 302, (latest edition).
 - .3 Federal and Provincial Occupational Health and Safety Acts and Regulations.
- c) In event of conflict between any provisions of above authorities the most stringent provision will apply. Should a dispute arise in determining the most stringent requirements, Consultant will advise on the course of action.
- d) Hot Work will not be permitted on or within the facility except as outlined herein. Prior to conducting hot work, a hot work permit (see attached Appendix B) shall be prepared and submitted. A new permit shall be obtained at the start of each work shift during which hot work will be conducted.

14. EMERGENCY MANAGEMENT PLAN

- a) Must include response for medical and fire emergencies.
- b) Know the location of the nearest fire alarm box and telephone (if no cell phone available), including the emergency phone number.
- c) Know where the “Civic Address” of worksite is posted to report to emergency personnel.
- d) Report immediately all fire incidents to the fire department as follows:
 - .1 Activate nearest fire alarm box
 - .2 Telephone 911
 - .3 Where fire alarm box is exterior to building, the person activating the fire alarm box shall remain at the box to direct Fire Department to scene of the fire.
 - .4 When reporting a fire by telephone, give location of fire, name or number of building and be prepared to verify the location.
- e) Notify the Owner of any emergency.

15. POSTING OF DOCUMENTS

- a) Ensure applicable items, articles, notices and orders are posted on site in accordance with Acts and Regulations of Province having jurisdiction, and in consultation with Consultant.

16. CORRECTION OF NON-COMPLIANCE

- a) Immediately address health and safety non-compliance issues identified by Authority having Jurisdiction or by Consultant.
- b) Provide Consultant with written report of action taken to correct non-compliance of health and safety issues identified.

17. OPEN EXCAVATIONS

- a) If open foundations or demolition areas are to be left at the end of a workday, a protective barrier must be placed around the entire perimeter of the open excavation or demolition areas to limit access by others. Barrier to be approved by the requirements established in the OH&S Regulations.

END

1. GENERAL

- a) The General Contractor is to provide each item and properly execute all work as specified herein, indicated by drawings, specifications, addenda, or change orders issued with respect to this Project.
- b) The General Contractor shall co-ordinate, administer and supervise all work and material acquisition unless noted otherwise in either the Specifications or Drawings. Faulty work by any Section which could have been avoided by proper co-ordination and/or supervision by the General Contractor will not be accepted.
- c) Unless specified otherwise, the provisions of this Section shall apply to all Sections of the specifications.
- d) Study all Contract documents to determine additional work required by your section on which the work of other sections depends.
- e) Establish rates of wages and conditions of work in accordance with the Employee Standards Act of the Province of Prince Edward Island. Wherever possible give preference to local labour.
- f) Workmanship shall be of highest quality in accordance with best standard practice for this type of work, except where specified more precisely.

2. SPECIFICATION FORMAT

- a) These specifications are not intended as a detailed description of installation methods but serve to indicate requirements in the completed work.
- b) Conform to the latest edition of the National Building Code, together with all its related supplements, hereinafter referred to as the “Code” or “code”. Where Drawings and Specifications exceed code requirements provide such additional requirements.
- c) Where a material is designated on Drawings or in the Specifications for a certain application, unless otherwise specified, that material shall conform to standards designated in the latest edition of the National Building Code and any other Code, Act or Bylaw of Provincial or Local Application provided that in the case of conflict or discrepancy the more stringent requirement shall apply. Similarly, unless otherwise specified, installation methods and standards of workmanship shall also conform to standards invoked by the aforementioned code. Where no particular material is specified for a certain use, the bidder shall select from the choice offered in the code in each case.

- d) References to codes, and standards, including manufacturer's direction for installation shall be the latest edition thereof.
- e) Provide a copy of all certificates of acceptance issued by Provincial or Local authorities.
- f) Parts of the specification are written in short form, therefore it is understood that where a component of the work is stated in a heading followed by a material or operation, the words "Shall be", "Shall consist of" or similar words or phrases are implied which denote complete supply and installation of such materials of operations for the component of work designated by the heading.
- g) Where the aforementioned Code or this specification does not provide all information necessary for complete installation of any item, then the manufacturer's instructions for first quality workmanship shall be strictly complied with.
- h) Where words in the Contract Documents occur in the singular number, they shall be taken as plural where applicable in accordance with the quantities required to satisfy the requirements of the Contract.

3. STANDARDS AND DEFINITIONS

- a) Where a reference is made to specification standards produced by various organizations, conform to latest edition of standards, as amended and revised to date of Contract.
- b) Have a copy of each specified standard which relates to your work available on the Site to be produced immediately on the Consultant's request.

4. CO-OPERATION

- a) Co-operate with and co-ordinate with other trades as required for the satisfactory and expeditious completion of the work. Take field dimensions relative to this work. Fabricate and erect work to suit field dimensions and field conditions. Provide all forms, templates, anchors, sleeves, inserts and accessories required to be fixed to or inserted in the work and set in place or instruct the related trades as to their location. Pay the cost of extra work caused by and make up time lost as the result of failure to provide the necessary co-operation, information or items to be fixed to or built in, in adequate time.
- b) This Section shall provide other Sections with and be responsible for levels and dimensions which other sections require for establishing proper locations for their work.

5. MATERIAL STORAGE AND HANDLING

- a) Store packaged materials in original, undamaged condition with manufacturers' labels and seals intact. Handle and store materials in accordance with manufacturers' and suppliers' recommendations and in a manner to prevent damage to materials during storage and handling.

6. SITE VISIT

- a) All bidders submitting tenders for this work shall first examine the site and all conditions therein. All tenders shall take into consideration all such conditions as may affect the work under this contract, no claims for extras resulting from conditions existing at the time of tender will be accepted by the Owner.

7. EXAMINATION

- a) All trades shall examine the existing conditions upon which their work depends. Report to the General Contractor with a copy to the Consultant in writing defects in such work. The application of their work or any part of it shall be deemed acceptance of the work upon which their work or that part of it which has been applied depends.
- b) Drawings are, in part, diagrammatic and are intended to convey scope of work and indicate general and approximate location, arrangement and sizes of building components.

8. CONSTRUCTION SAFETY

- a) Observe construction safety measures of the latest edition of the National Building Code Part 8, Provincial Government Workers/Workers Compensation Board and municipal authority provided in any case of conflict or discrepancy more stringent requirements shall apply.
- b) Comply with requirements of FCC no. 301.
- c) Ensure no part of Work is subjected to loading that will endanger its safety or will cause permanent deformation.
- d) Design and construct falsework in accordance with CSA S269.2.
- e) Operate such equipment only by qualified hoist or crane operators, and maintain current inspection certificate.
- f) Design and construct scaffolding in accordance with CSA S269.2.

- g) Comply with the requirements of the Fall Protection & Scaffolding Regulations, Province of Prince Edward Island.
- h) Each user of equipment or tools shall be appropriately trained and be responsible to examine for sufficiency before use. Make equipment and tools safe if necessary, or notify the Contractor in writing that user will not commence work with such tools until it is made safe.
- i) Comply with the requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and comply regarding labeling and provision of material safety data sheets.

.1 Have a copy of WHMIS data sheets available at the workplace on delivery of materials.

9. PROTECTION

- a) Take reasonable and required measures, including those required by authorities having jurisdiction to protect the public and those employed on work from body harm and to protect adjacent public and private property from damage. Make full restitution for such harm and damage resulting from failure to take adequate protective measures. Make good damage to work from whatever cause.
- b) Take all necessary precautions to guard site, premises, materials and the public at time other than when supervised work is in progress.
- c) Provide and maintain in working order, suitable Underwriters' labeled fire extinguishers and locate in prominent position to approval of authorities having jurisdiction.
- d) Provide all signs, ramps, barricades, and hoarding and protective measures necessary to the safe execution of the work and protection of the public.
- e) Protect, relocate and maintain existing, active services wherever they are encountered. Wherever inactive services are encountered, cap them off and remove the unwanted portion, with the approval of the authorities having jurisdiction or the public utility concerned, in the manner approved by them.
- f) All trades shall protect previously installed work while carrying out their own work.
- g) Damaged work shall be made good by appropriate trades but at the expense of those causing damage.

- h) Attach and fasten fixtures and fittings in place, in a safe, sturdy, secure manner so that they cannot work loose or fall or shift out of position during the occupancy of building as a result of vibration or other causes in normal use.
- i) Protect existing buildings, landscaping, curbs, roads and lanes and utilities. If, during work, any buildings, landscaping, curbs, roads and lanes are damaged, repair or replace them at no extra expense to the Owner.
- j) Provide safety helmets for Consultants, Owner's representatives and any other authorized visitors to site if required.

10. FASTENINGS

- a) Supply all fastenings, anchors and accessories and adhesives required for fabrication and erection of the work.
- b) Exposed metal fastenings and accessories shall be of same texture, colour and finish as base metal on which they occur.
- c) Exterior anchors for windows and roofing sheet metal and anchors occurring on or in an exterior wall shall be noncorrosive or hot dip galvanized steel.
- d) Anchoring and fastening devices or adhesive shall be of appropriate type and shall be used in sufficient quantity in such a manner as to provide positive permanent anchorage of the unit to be anchored in position. Install anchors at spacing to provide for required load carrying capacity.
- e) Keep exposed fastenings to a minimum, evenly spaced and neatly laid out.
- f) Supply adequate instructions and templates and, if necessary, supervise installation where fastenings or accessories are required to be built into work of other trades.
- g) Fastenings shall be of permanent type. Wood plugs are not permitted.
- h) Fastenings which cause spalling or cracking of material to which anchorage is being made are not permitted.
- i) Do not use powder actuated fastening devices, which are stressed in withdrawal on any part of this work without written approval from the Consultant. Take particular stringent safety precautions when using powder actuated fastenings. Only low velocity plunger-type are permitted.

11. CUTTING, FITTING, AND PATCHING

- a) All cutting and patching shall be the responsibility of the General Contractor.
- b) All excavation backfilling and concrete work required to complete the work of Section 15 and or Section 16 shall be the responsibility of the General Contractor.
- c) Where new work connects with existing and where existing work is altered, cut and patch and make good to match existing work.
- d) Make cuts with clean, true, smooth edges. Make patches inconspicuous in final assembly.

12. EXISTING SERVICES

- a) Where work involves breaking into or connecting to existing services, submit work schedule sufficiently in advance to allow coordination of possible interruption with the Owner. Confirm each interruption 24 hours immediately prior to scheduled date of implementation.

13. ENVIRONMENTAL PROTECTION

- a) Ensure that pollution and environmental control of construction activities are exercised during the work to requirements of the federal and provincial environmental acts; including, but not limited to, the Prince Edward Island Environmental Protection Act.

14. HAZARDOUS MATERIAL

- a) Should material resembling hazardous materials (other than those identified within the Contract Documents), including, but not limited to spray or trowel applied asbestos, be encountered in course of work; stop work immediately. Do not proceed until written instructions have been received from Consultant.
- b) Any material which contains asbestos that is disturbed or removed during construction work (see Asbestos Content Report (where applicable)), shall be removed in accordance with the regulations set out by the Occupational Health & Safety Act. All costs for proper cutting, removal and disposal of all asbestos on this contract shall be included in Tender. Refer also to Section 2C (as applicable).
- c) Where work entails use, storage, or disposal of toxic or hazardous materials, chemicals and or explosives, or otherwise creates a hazard to life, safety, health, or the environment; work shall be in accordance with the Jurisdictional Authority.

15. CLEANING

- a) All rubbish and construction debris must be removed from the entire site on a regular basis, so that the site is maintained in a clean, safe condition. Materials removed are to be disposed of in a manner acceptable to the Provincial Department of Communities, Land & Environment.
- b) Vacuum clean all areas prior to painting and close all areas after completion of painting to restrict access to authorized persons.
- c) On completion of work, by other trades, mop clean all resilient flooring strip using wet method to remove all layers of new or existing finish. Reseal with one coat sealer and two coats wax (wax to contain a minimum of 22% solids). Vacuum clean all carpets. All cleaning to be carried out by competent cleaners.
- d) Dust and clean all surfaces including glass (interior and exterior), doors and hardware.
- e) Arrange and pay for replacement of heating, ventilation and air conditioning filters if operated during construction.

16. FIRES

- a) Do not light fires of any sort to burn rubbish resulting from the work.

17. ACCESS TO SITE

- a) Access to site shall be directed by the Consultant.

18. SITE LIMITS

- a) The limits of the site are shown on the drawings and all activity relating to the contract shall be confined within these limits.

19. MAINTENANCE MANUALS

Prior to the issuance of the final certificate the following items shall be assembled and incorporated into a three ring binder complete with table of contents:

- a) All warranties and guarantees submitted by manufacturers.
- b) The printed or typewritten copies of recommended maintenance procedures for all items requiring regular maintenance.

- c) A copy of all approved Shop Drawings.

20. PERMITS

- a) Obtain and pay for all required permits, licenses, and inspections; required by applicable laws and regulations. Except the building permit which will be paid for by the Owner.

21. TOBACCO PRODUCT USAGE BAN

The use of Tobacco products is not permitted within the building or property.

- a) Property – Includes all lands and buildings under the control of the Government of PEI.
- b) Tobacco Products – Includes cigarettes, e-cigarettes, cigars, pipes, chewing tobacco, snuff, and any other products containing or reasonably resembling tobacco or tobacco products except approved cessation products used in approved cessation programs.
- c) Tobacco Usage Ban – Includes smoking, vaping, chewing, dipping or any other form of use of tobacco products.

END

1. CUTTING AND PATCHING

- a) Cut, patch and make good to leave work in a finished condition where new work connects with existing.
- b) Sections responsible for various categories of cutting and patching are as follows:
 - .1 All cutting and patching shall be the responsibility of the General Contractor.
 - .2 All excavation, backfilling and concrete work required to complete the work of Section 15 and/or Section 16 shall be the responsibility of the General Contractor.
- c) Carry out cutting and patching in the following manner:
 - .1 Regardless of which Subcontractor or Section of the specifications is responsible for any portion of cutting and patching work, in each case tradesmen qualified in the work being cut and patched shall be employed to carry out or supervise this work to ensure that it is correctly done.
 - .2 Where new work connects with existing and where existing work is altered, cut and patch and make good to match existing work.
 - .3 Do not cut, drill or sleeve load-bearing members without first obtaining the Consultant's written authority for each condition.
 - .4 Drill work carefully, leaving a clean hole not larger than required. This applies to both new and existing work.
 - .5 Cut holes after they are located by trades requiring them.
 - .6 Bulkheads to be constructed with steel studs, furring and seam filled gyproc.
 - .7 Make cuts with clean, true, smooth edges. Make patches inconspicuous in final assembly.
 - .8 Co-ordinate work of your Section with work of other Sections, taking into account existing installations to assure best arrangement of components in available space. For critical locations consult with Consultant before commencing work.
 - .9 At penetrations of fire rated ceilings, walls, and floor/roof assemblies, completely seal voids with fire rated material, fill thickness of constructed element.

END

1. GENERAL

- a) This section shall install and maintain the items required to prevent environmental damage.
- b) Ensure that pollution and environmental control of construction activities are exercised during the Work to requirements of the federal and provincial environmental acts; including, but not limited to, the Prince Edward Island Environmental Protections Act.

2. DISPOSAL OF WASTE

- a) Do not bury rubbish or waste material on site.
- b) Provide containers or otherwise prevent material from being wind-blown around the site and on to adjoining properties.
- c) Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm or sanitary sewers.
- d) All rubbish and construction debris must be removed from all the site on a regular basis, so that the site is maintained in a clean, safe condition. Materials removed are to be disposed of in a manner acceptable to the Provincial Department of Environment, Labour & Justice.

3. DRAINAGE

- a) Provide temporary drainage and pumping as necessary to keep excavations and site free from water.
- b) Do not pump water containing suspended materials into waterways, sewer or drainage systems.
- c) Control disposal of runoff of water containing suspended materials or other harmful substances in accordance with local Authorities.

END

1. GENERAL

- a) This section shall be responsible for the demolition and removal of items indicated on the drawings and those which must be demolished to allow for the new air handling unit, including mechanical & electrical components, site material, structural components, which will be demolished under the supervision of the section sub-contractor. These materials include, but are not limited to: **steel AHU frame & foundation, electrical and mechanical components as required to complete work as per the specifications & drawings.**

2. PROTECTION

- a) Prevent movement, settlement or damage of structures and parts of existing building to remain, provide bracing, shoring and underpinning as required. Make good damage caused by demolition.
- b) Take precautions to support affected structures and, if safety of building services appears to be endangered, cease operations and notify Consultant.
- c) If during the demolition work a situation should develop or a condition be exposed which has the potential to endanger the safety of the occupants or users of the buildings or structure in which demolition work is being carried out, or occupants or users of adjoining buildings or structures, the Contractor will cease operations, take whatever emergency actions, in the Contractor's opinion, is required to ensure the immediate safety of the occupants or users of these buildings or structures, and notify the Architect before continuing with the work.

3. DESCRIPTION OF WORK

- a) Perform all demolition removal and restitution as indicated, implied and required to properly complete the work of this contract.
- b) Refer closely to drawings and specifications to determine extent of demolition requirement.
- c) Demolition drawings serve only as a guide to demolition requirements. Location of new components and finishes where components exist implies removal of such components prior to new construction.
- d) Demolition of existing components, required to facilitate construction of new work is required.

4. EXECUTION

- a) Dispose of demolished materials in accordance with authorities having jurisdiction.

- b) Do not disrupt active or energized utilities and services.
- c) At the end of each day's work leave the site in a safe condition, with no danger of any component toppling or falling.
- d) Remove existing equipment, services, and obstacles where required for refinishing or making good of existing surfaces, and replace as work progresses.
- e) Do not sell or burn materials on site.
- f) Remove contaminated or dangerous materials, as defined by authorities having jurisdiction relating to environmental protection, from site and dispose of in safe manner to minimize danger at site or during disposal.
- g) All demolished materials become the property of the Contractor, unless indicated otherwise, and are to be removed from the site and disposed of in a manner and in a location acceptable to Provincial Authority governing such disposal.

END

1. GENERAL

- 1.1. This section shall supply all the necessary material, labour, equipment and supervision required to install the preformed metal siding accessories as specified below and detailed on the drawings.

2. MATERIALS

2.1. Sheet Steel

- 2.1.1. Preformed Grade A
2.1.2. Galvanized to ASTM A525 (G90) or ASTM 525M (Z275) coating
2.1.3. Factory precoated in coil form to a 5000 series paint finish on exposed surfaces.
2.1.4. Thickness: 0.61mm base steel nominal
2.1.5. Color:
2.1.6. Profile:

2.2. Flashing

- 2.2.1. Shall be formed from single or multiple sections of prefinished flat steel sheets that have been brake formed to required profile and length to allow for expansion and contraction.
2.2.2. Thickness: 0.46mm base steel nominal
2.2.3. Color: same as sheet steel

2.3. Soffit

- 2.3.1. Shall be formed from single or multiple sections of prefinished flat steel sheets that have been brake formed to required profile and length to allow for expansion and contraction.
2.3.2. Thickness: 0.46mm base steel nominal
2.3.3. Color: same as sheet steel
2.3.4. Profile: channel wall

2.4. Girts

- 2.4.1. Shall be preformed from galvanized metal
2.4.2. Meeting CAN-3-S136-M84
2.4.3. Depth: 100mm

2.5. Insulation

- 2.5.1. Shall be 1220mm wide fiberglass steel building insulation with WMP 30 facing.
- 2.5.2. R-Value = 13.6 min

2.6. Fasteners

- 2.6.1. Shall be screw type fasteners with neoprene exposed heads
- 2.6.2. Color: to match prefinished siding
- 2.6.3. In accordance to siding manufacturers recommendations for the specified siding

2.7. Sealants

- 2.7.1. Shall be of thermoplastic rubber base as recommended by manufacturer for specified application
- 2.7.2. Color: to match prefinished siding

2.8. Air Barrier Material

- 2.8.1. Shall be reinforced non-perforated polyolefin sheathing membrane
- 2.8.2. To meet requirements of NBC section 5.4.1.2 and Appendix A-9.25.3.2, Air Barrier System Properties.
 - 2.8.2.1. Air barrier accessories to include sheathing tape and sealants (do not use silicone based sealants) compatible with sheathing membrane.

3. WORKMANSHIP

- 3.1. Carefully install flashing and trim as required to cover top and sides of metal siding and provide waterproof joints.
- 3.2. Install metal siding with allowance for thermal expansion and contraction.
- 3.3. Fasten flashing with concealed fasteners, where possible.
- 3.4. Caulk joints between dissimilar materials and where required to provide waterproof joints.
- 3.5. Provide metal or neoprene closures, sealed to stop weather penetration at all locations indicated and as recommended by the siding manufacturer.

- 3.6. Air barrier to be installed in accordance to manufacturer's instructions.
 - 3.6.1. Sheathing membrane must be lapped a minimum of 100mm and taped.
 - 3.6.2. Sheathing membrane is to be placed over flashings and taped to properly drain cavity behind metal siding.
- 3.7. Install insulation vertically, with facing on warm side; joints on facing between adjacent sheets are to be folded and stapled. Make slits in fiberglass without penetrating facing, allowing girts to be fastened through the facing to hold it in place. Reset fiberglass around girt to provide tight joint.
- 3.8. Fasten girts, on 1220mm centers, to concrete block wall, through facing of insulation.

END

1. GENERAL

1.1. This section shall provide all labour and materials to paint all walls, existing ceilings, window trims, existing doors, and frames within the renovation area.

1.2. References:

1.2.1. Canadian Painting Contractors' Architectural (CPCA) Painting Specifications Manual, latest edition.

1.2.2. Canadian General Standards Board (CGSB) latest edition for specified paints.

1.2.3. National Fire Code of Canada 1995.

1.3. Quality Assurance:

1.3.1. Walls: No defects visible from a distance of 1000 mm at 90 degrees to surface.

1.3.2. Ceilings: No defects visible from floor at 45 degrees to surface when viewed using final lighting source.

1.3.3. Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

1.4. Environmental Requirements:

1.4.1. Apply paint finishes only when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.

1.4.2. Apply paint finish only in areas where dust is no longer being generated by related construction operations such that airborne particles will not affect the quality of the finished surface.

1.4.3. Apply paint only when surface to be painted is dry, properly cured and adequately prepared.

1.5. Extra Materials:

- 1.5.1. Submit one - 2 litre can of each type and colour of finish coating. Identify colour and paint type in relation to established colour schedule and finish formula.

2. MATERIALS

- 2.1. Qualified Products: Paint finishes shall be selected by the Consultant from any of the following brand paint materials for interior paint application on this project:

- 2.1.1. Olympic
- 2.1.2. Behr
- 2.1.3. Benjamin Moore
- 2.1.4. Para
- 2.1.5. Pittsburgh
- 2.1.6. Pratt & Lambert

- 2.2. Maintenance grade paint will not be acceptable.

- 2.3. Paint materials for each coating formula to be products of a single manufacturer.

- 2.4. Paint materials to CGSB Standards listed in Finishing formula.

- 2.5. Colours:

- 2.5.1. The Consultant will provide colour schedule after contract award.
- 2.5.2. Interior colour schedule will be based upon the selection of no more than three base colours and two trim colours.
- 2.5.3. Selection of colours will be from manufacturer's full range of colours.
- 2.5.4. Perform all colour tinting operations prior to delivery of paint to site.

- 2.6. Interior Finishes:

- 2.6.1. For repaired plaster and new gypsum board walls and window trim in finished areas apply:
 - 2.6.1.1. One coat primer/sealer.
 - 2.6.1.2. Two coats scrubbable latex base paint, satin finish.

2.6.2. For existing painted plaster wall apply:

- 2.6.2.1. One coat of superstick primer.
- 2.6.2.2. Two coats scrubbable latex base paint, satin finish.

2.6.3. For existing painted concrete block masonry walls apply:

- 2.6.3.1. Two coats scrubbable latex base paint, satin finish.

2.6.4. For existing unpainted masonry wall repairs apply:

- 2.6.4.1. One coat primer/sealer.
- 2.6.4.2. One coat block filler.
- 2.6.4.3. Two coats scrubbable acrylic latex base, satin finish.

2.6.5. For new gypsum board ceiling apply:

- 2.6.5.1. One coat primer/sealer.
- 2.6.5.2. Two coats scrubbable latex base paint, flat finish.

2.6.6. For existing ceilings apply:

- 2.6.6.1. One coat of superstick primer.
- 2.6.6.2. Two coats scrubbable latex base paint, flat finish.

2.6.7. For existing wood doors and trim to remain apply:

- 2.6.7.1. Sand doors fully.
- 2.6.7.2. One coat alkyd primer/sealer.
- 2.6.7.3. Two coats melamine (alkyd polyurethane) enamel. Paint all six sides of the door.

2.6.8. For primed ferrous metal surfaces apply:

- 2.6.8.1. One coat primer/sealer.
- 2.6.8.2. Two coats scrubbable latex base paint, semi-gloss finish.

3. INSTALLATION

- 3.1. Perform all painting operations in accordance with CAN/CGSB-85.100 except where specified otherwise.

3.2. Perform all painting operations in accordance with CPCA Paint Specifications Manual except where specified otherwise.

3.3. Preparation:

3.3.1. Remove electrical cover plates, light fixtures, surface hardware on doors, door stops and all other surface mounted fittings and fastenings prior to undertaking any painting operations. Store for re-installation after painting is completed.

3.3.2. As painting operations progress, place “WET PAINT” signs in occupied areas to approval of the Consultant.

3.4. Protection:

3.4.1. Protect existing building surfaces not to be painted from paint spatters, markings and other damage. If damaged, clean and restore such surfaces as directed by the Consultant.

3.4.2. Cover or mask floors, windows and other ornamental hardware adjacent to areas being painted to prevent damage and to protect from paint drops and splatters. Use non-staining coverings.

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

3.4.4. Protect factory finished products and equipment.

3.4.5. Protect passing pedestrians and the general public in and about the building.

3.5. Cleaning:

3.5.1. Clean all surfaces to be painted as follows:

3.5.1.1. Remove all dust, dirt, and other surface debris by vacuuming, wiping with dry, clean cloths or compressed air.

3.5.1.2. Wash existing surfaces with solution of T.S.P. bleach and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.

3.5.1.3. Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.

3.5.1.4. Allow surfaces to drain completely and allow to dry thoroughly.

3.6. Surface Preparation:

3.6.1. Prepare new wood surfaces to CGSB 85-GP-1M.

3.6.1.1. Apply vinyl sealer to CAN/CGSB-1.126 over knots, pitch, sap and resinous areas.

3.6.1.2. Apply wood filler to nail holes and cracks.

3.6.2. Where possible, prime all surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.

3.6.3. Prepare plaster and wallboard surfaces to CGSB 85-GP-33M.

3.7. Application:

3.7.1. Apply paint by brush, roller or air sprayer. Conform to manufacturer's application instructions unless specified otherwise.

3.7.2. Sand and dust between each coat to remove visible defects.

3.8. Mechanical/Electrical Equipment:

3.8.1. Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.

3.8.2. Do not paint over name plates.

END

PART ONE - GENERAL

1.01 General

- .1 The Executed Agreement including General Conditions and Supplementary Conditions, applicable Sections of Division 0 and Division 1, applicable drawings and amendments are part of and are to be read in conjunction with all Mechanical and Electrical Specification Sections.
- .2 Work in the Specifications is divided into descriptive Sections which are not intended to delegate functions or work to any specific Subcontractor or identify absolute contractual limits between Subcontractor, nor between the Contractor and his Subcontractor. The requirements of any one Section apply to all other Sections, for example: the motor service factor requirement. Refer to plans by each discipline, Divisions 1-16 to ensure a completed operational product and fully coordinated standard of work.
- .3 The direction to 'provide' equipment, materials, products, labour and services shall be interpreted to 'supply, install and test' the Division 15 work indicated on the Drawings and specified in the Specifications.
- .4 Provide and include in the Contract Price Division 15 work including mechanical components and normal system accessories not shown on the Drawings or stipulated in the Specifications, and required to ensure completed operational systems and a fully coordinated standard of Work acceptable to the Consultant and all authorities having jurisdiction.
- .5 Do complete installation in accordance with all Provincial and Municipality Regulations in force at time of tender.

1.02 Scope of Work

- .1 The work included in this contract shall include the furnishing of labour, materials, equipment, plant, tools, and services, necessary for or incidental to the supply, installation and completion of the Mechanical Systems to the full intent of the drawings and as hereinafter specified.
- .2 Any work or equipment herein specified but not shown on the plans, or vice versa, or any work, material or equipment necessary for the proper completion of the job, shall be furnished and installed as though both shown on the plans and specifications.

- .3 The work shall generally include, but not be limited to the following:
 - .1 Provision of plumbing and mechanical systems as indicated or specified herein.
 - .2 Provision of automatic controls systems as indicated or specified herein.
 - .3 Provision of insulation for mechanical systems as indicated or specified herein.
 - .4 Demolition of mechanical systems and or equipment as indicated, identified, or specified.

1.03 **Intent**

- .1 Mention in the Specifications or the indication on the Drawings of equipment, materials, operation and methods, requires provision of the quality noted, the quantity required, and the systems complete in every respect.
- .2 Consider the Specifications as an integral part of the accompanying Drawings. Any item or subject omitted from one or the other, but which is either mentioned or reasonably implied, shall be considered as properly and sufficiently specified.
- .3 Be completely responsible for the acceptable condition and operation of all systems, equipment and components forming part of the installation or directly associated with it. Promptly replace defective materials, equipment and parts of equipment and repair related damages.

1.04 **Schedule**

- .1 Work on site is to begin immediately after award of contract and all work, including testing, and commissioning is to be completed by date indicated in Instructions to Bidders.
- .2 The Contractor is to clean and remove all construction dirt prior to completion of the daily work.
- .3 The Contractor is to prepare a Construction Schedule within 5 days of award of contract.
- .4 The Contractor is to provide a purchasing list, within 5 days of award of contract, showing that all major items have been purchased. The list is to include suppliers name, purchase order, date ordered, and delivery date.

1.05 Metric Practice

- .1 Conform to Canadian Metric Practice Guide CSA CAN3-Z234.1-89.
- .2 Provide adapters between metric and Imperial installations.
- .3 Metric descriptions in this Division are nominal equivalents of Imperial values.

1.06 Drawings and Specifications

- .1 Drawings show general design and arrangement of mechanical system installation, and are diagrammatic. Obtain further clarification of Drawings or Specifications from Consultant prior to installation.
- .2 Drawings do not indicate exact Architectural, Civil Structural or Electrical features. Examine Drawings prior to laying out.
- .3 Do not scale Drawings to order materials. Take field measurements before ordering and fabricating materials.
- .4 Clarify 'roughing-in' requirements of equipment which is not part of Division 15 work before proceeding.
- .5 Leave areas clear where space is indicated as reserved for future equipment and where space is required to maintain equipment. Maintenance clearances in addition to providing for servicing of equipment, shall allow for removal and reinstallation of replaceable items such as motors, coils and filters.
- .6 The Contractor shall check the content of the drawings, specifications and dimensions, and before proceeding, report to the Consultant any error or omission between mechanical or electrical and architectural plans.
- .7 These specifications are to be considered as an integral part of the drawings which accompany them, neither the drawings nor the specifications shall be used alone. Any item which is omitted in one but which is reasonably implied in the other, shall be considered properly and sufficiently specified and must, therefore, be provided under the Contract. The decision of the Consultant shall be final, if interpretation is required.
- .8 Misinterpretation of drawings and specifications shall not relieve the Contractor of responsibility.

- .9 All contractors shall make themselves familiar with the overall intended operation of the mechanical systems prior to installation so that all necessary accessories such as dampers, vents, valves, controls, etc., can be installed during the normal progress of the work. Failure to do so will result in the contractor being responsible for providing such devices, at his expense, when the need for such devices becomes apparent during start-up.

1.07 Site Visits

- .1 Before commencing work, visit site and verify that requirements of Plans and Specifications are consistent with site conditions.
- .2 Advise Consultant, in writing, of any discrepancies or conflicts.
- .3 No allowance shall be made for failure to include items which a thorough investigation would have shown to be required.
- .4 Bidders should note that this project is a renovation of an existing building. No attempt has been made to show all existing conditions. Each bidder is responsible to determine the extent of work involved in tying into existing systems or re-routing his work around obstructions.

1.08 Guarantees

- .1 The contractor shall guarantee all his work free from defects for a period of one (1) year (unless specifically noted otherwise) from the date of Substantial Performance of the Work as determined by the Consultant and shall make good all defects other than normal wear and tear during the life of the guarantee. The contractor shall guarantee all work and equipment supplied by him to work quietly and satisfactorily and to accomplish the work for which it was installed during the life of the above guarantee. At any time during this period, he shall make any necessary changes and adjustments, or replacements, to accomplish this at his own expense.

1.09 Permits and Regulations

- .1 All contractors shall comply with all regulations of Authorities having jurisdiction, where applicable, including but not limited to the following:
- Provincial Department of Labour
 - Provincial Fire Marshal

- Local Fire Authority
 - Provincial Plumbing Inspector
 - Provincial Department of Health
 - Provincial Department of the Environment
- .2 Contractor shall obtain and pay for any permits required by Local Codes and Regulations and arrange for inspections.
- .3 Any additional materials or labour required to conform to any of these rules and regulations shall be furnished under the contract with no additional cost to the owner.

1.10 Reference Standards

- .1 Provide new materials and equipment of proven design and quality. Provide current models of equipment manufactured in Canada or the United States, unless specified otherwise, with published ratings certified by recognized North American testing and standards agencies.
- .2 Select Canadian made materials and equipment and other equipment to maximize the Canadian content of the Work.
- .3 Workmanship and installation methods shall conform to the best modern practice. Employ skilled tradesmen to perform work under the direct supervision of fully qualified personnel.
- .4 Install equipment in strict accordance with manufacturers written recommendations.
- .5 Meet ASHRAE and other industry standards in the selection and provision of equipment, materials, pipe and duct components and systems.
- .6 Meet ASHRAE/IES 90.1, 2004 Standards for the supply and installation of all equipment.
- .7 Meet the additional selection, sizing and performance criteria specified in this specification.
- .8 In general, and as applicable, the physical and chemical properties, the characteristics and the performance of Division 15 work shall meet the requirements of recognized agencies and standards including those listed herein, latest edition:

| | |
|---|---|
| AABC | Associated Air Balance Council |
| AMCA | Air Moving and Conditioning Association |
| ARI | Air Conditioning and Refrigeration Institute |
| ASHRAE | American Society of Heating, Refrigeration and Air Conditioning Engineers |
| ASME | American Society of Mechanical Engineers |
| ASTM | American Society for Testing and Materials |
| AWS | American Welding Society |
| AWWA | American Water Works Association |
| CBMA | Canadian Boiler Manufacturers Association |
| CEMA | Canadian Electrical Manufacturers Association |
| CFUA | Canadian Fire Underwriters' Association |
| CGA | Canadian Gas Association |
| CSA | Canadian Standards Association |
| CUA | Canadian Underwriters' Association |
| HRA | Heating, Refrigeration and Air Conditioning Institute of Canada |
| IIAR | International Institute of Ammonia Refrigeration |
| NBFU | National Board of Fire Underwriters' |
| NBS | National Bureau of Standards |
| NECB | National Energy Code of Canada For Buildings |
| NFPA | National Fire Protection Association |
| SBI | Steel Boilers Institute |
| SMACNA | Sheet Metal and Air Conditioning Contractors National Association Inc. |
| UL | Underwriters' Laboratories |
| ULC | Underwriters' Laboratories of Canada |
| CGSB | Canadian Government Standards Board |
| Local Bylaws | As applicable |
| CSA Propane | Installation Code |
| Provincial Occupational Health & Safety Act | and Regulations |
| Provincial Boiler and Pressure Vessel Act | and Regulations |
| CAN/CSA B52 | Mechanical Refrigeration Code |
| CAN/CSA B51 | Boiler, Pressure Vessel, and Pressure Piping Code |
| NBC | National Building Code of Canada (2010) |
| CPC | National Plumbing Code of Canada (2010) |
| NFC | National Fire Code of Canada (2010) |
| ASHRAE | Standard 62.1 Ventilation for Acceptable Indoor Air Quality |
| ASHRAE | Standard 90.1 Energy Efficient Design of New Buildings |
| NFPA 10 | Code for Safety to Life from Fire in Buildings and Structures |
| Insurers Advisory Organization | Requirements |

ASHRAE Guideline 1.1-2007 The HVAC&R Technical Requirements for
the Commissioning Process

ASHRAE Guideline 0-2005 The Commissioning Process

1.11 Co-ordination

- .1 Contractors are **CAUTIONED** that space is limited and close co-ordination of the work of all trades is required. Before fabrication or installation begins the contractor must do the following:
 - .1 Become fully familiar with all architectural and structural details that affect his work.
 - .2 Exchange information with other mechanical and electrical trades to identify potential areas of conflict.
 - .3 Arrange for and attend meetings as required to resolve conflicts.
 - .4 Prepare detailed co-ordination drawings showing actual location of pipes, ducts or conduits in relation to architectural and structural components and the work of other trades. Such locations are to be as agreed upon with other trades and shall be complementary to similar drawings by other trades.
 - .5 Dimension proposed location of Division 15 work with respect to building elevations and established grid lines.
 - .6 Prepare fully dimensioned detail drawings of all shafts, duct spaces and pipe spaces. Show sleeving, recessed and formed holes required in concrete for Division 15 work. Include information pertaining to access, clearances, tappings, housekeeping pads, drains and electrical connections.
 - .7 Base information used to prepare drawings on reviewed Shop Drawings.
 - .8 Provide field drawings with position of various services when required by Consultant.
 - .9 Submit a list of access doors and panels showing proposed type, size and location. Coordinate drawings with Architectural detail drawings and reflected ceiling plans prior to submission.
- .2 The order of precedence in congested areas shall be:
 - .1 Drainage piping.
 - .2 Trunk ducts.
 - .3 Sprinkler mains.
 - .4 Heating mains.
 - .5 Main conduits.
 - .6 Water piping mains.
 - .7 Branch ducts, pipes and conduits.

- .3 Location of outlets shall be in accordance with the architect's reflected ceiling plan. If an outlet is not shown thereon or is in conflict with work of another trade, obtain direction from the consultant before proceeding.
- .4 Relocation of branch ducts, pipes or outlets within 3m of location shown on drawings to facilitate coordination with other trades shall not be considered extra work.

1.12 Changes to Contract Work

- .1 Do not proceed with any changes to the Work without written authority from the Owner.
- .2 Follow procedures outlined in Tendering and Contract Requirements for administration and execution of Contract revisions.
- .3 Valuation of Changes:
 - .1 See General Conditions section 01 00 00.
 - .2 Labour man hour quantities for changes to work shall be based on:
 - .1 Published industry labour calculators accepted by the Consultant.

Example: Mechanical labour estimates published in the latest edition of The National Plumbing, Heating, Cooling Contractors.
 - .2 Methods directed by the Consultant.

1.13 Acceptable Products

- .1 Acceptable Products will be listed in the Specification or Addendum.
- .2 Should the contractor desire to have a product listed as an Acceptable Product, he shall apply in writing for such permission at least five (5) working days before the closing date of Mechanical Trade Tenders.
- .3 The contractor is cautioned that all layouts on the mechanical drawings are based on the specified equipment. Any changes necessary, using Acceptable Products, will be done at the contractor's expense. Furthermore, if it is found that the provisions made regarding space

conditions are not met, the right is reserved by the Consultant to require installation of the equipment used on the layout.

- .4 Contractors are cautioned that it is the responsibility of the Contractor and their suppliers of Acceptable Products to select products that meet the specifications of the specified products in all significant respects. Contractors are to satisfy themselves that Acceptable Products offered meet the specifications and fit in the available space as no extra charge will be considered if they are later found to be unsuitable.

1.14 Shop Drawings

- .1 Refer to Section 01 33 00 and CCDC 2 (3.10).
- .2 The contractor shall prepare a minimum of six (6) copies of shop drawings of the equipment called for hereinafter and also for all equipment or materials which he wishes to substitute for specified items, provided such alternative equipment has had prior approval.
- .3 All such drawings shall be submitted to the Architect for review and the work shall not commence until such approval has been obtained.
- .4 The Engineer's review of these drawings is general. It is not intended to release the contractor from the necessity of furnishing materials and performing the work as required by the plans and specifications.
- .5 All shop drawings must be checked against the requirements of the plans and specifications by the contractor prior to forwarding them to the Architect. Drawings not checked and stamped will be returned without approval.
- .6 All shop drawings must be first quality reproductions with all details, lettering, etc. distinct and legible. **Drawings sent by FAX are not acceptable and will not be reviewed except by prior arrangement.**
- .7 Where drawings and specifications are in metric or in both imperial and metric, all design, data capacities, sizes and dimensions specifically called for on the drawing or in the specifications shall be submitted in like terms on the shop drawings.

1.15 Access and Access Doors

- .1 All equipment and system components requiring servicing, inspection or adjusting must be easily accessible. Where equipment may be required to be removed for repair or servicing adequate access must be provided.
- .2 Where equipment or system components are concealed in furred ceilings or in walls or partitions access doors will be supplied by the Mechanical Contractor for installation by the general contractor.
- .3 All openings shall be sufficient size for both removal and maintenance of the concealed equipment, and shall be a minimum size of 450mm(18") x 450mm(18").
- .4 Access doors are not required where there is a removable acoustic tile ceiling.
- .5 The contractor shall arrange with the appropriate package Contractor to install any panels found necessary during the course of construction.
- .6 Doors shall open 180 degrees, have rounded safety corners, concealed hinges, anchor straps and allen head cam locks.
- .7 Provide stainless steel access doors for tile, marble or terrazzo surfaces.
- .8 Doors in block walls or in tile shall be sized to suit the wall module.

1.16 Package Equipment

- .1 The contractor shall note that whenever package equipment is specified it is intended that this equipment shall be a complete package with all necessary accessories to allow for fail safe automatic operation.
- .2 These accessories shall include all necessary starters, disconnects, relays, transformers, pressure switches, sensors, timers, etc. Where subject to the weather, the device shall be enclosed in a "weatherproof" enclosure.
- .3 The contractor shall be responsible for checking with the supplier of the equipment to ensure that the package equipment is complete with all necessary accessories. He shall also determine which accessories are factory mounted and which ones are shipped loose with the equipment. The contractor shall include in his tender an amount for all necessary wiring and piping, etc. required to incorporate loose pieces of equipment into the job at no additional cost to the owner.
- .4 The contractor shall note that the above refers to all package equipment

including boilers, chillers, heat reclaim units, pump sets, condensing units, humidifiers, etc. It shall be his responsibility to co-ordinate this with the supplier of the equipment to ensure the supply and installation of any accessories necessary for the operation of this equipment.

1.17 Electrical Connections, Motors and Starters

- .1 Electrical equipment shall bear CSA Label. Obtain special inspection labels required by Provincial Authority having jurisdiction.
- .2 Use 3 phase, 575 volts for motors 3/4 h.p. and larger. Use single phase 115 volts for motors less than 3/4 h.p.
- .3 Use 1750 rpm, open drip-proof, ball bearing motors manufactured to CEMA standards for 40 degrees C temperature rise and designed for continuous service and vibration free, quiet operation.
- .4 All motors 1 h.p. and larger shall be of the high efficiency type with a guaranteed minimum efficiency by the manufacturer as outlined in the following Table. Quoted efficiency shall be those as tested by IEEE-112 Method B.

| <u>Motor Size</u> <u>(HP/kw)</u> | <u>Minimum</u> <u>Efficiency</u> |
|---|---|
| 1.0 | 82.4 |
| 1.5 | 82.8 |
| 2.0 | 83.8 |
| 3.0 | 86.1 |
| 5.0 | 86.9 |
| 7.5 | 88.4 |
| 10.0 | 89.4 |
| 15.0 | 90.1 |
| 20.0 | 90.9 |
| 25.0 | 91.1 |
| 30.0 | 91.5 |
| 40.0 | 92.0 |
| 50.0 | 92.5 |

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

- .6 Where motors may be subject to high moisture levels such as in the boiler room and in the air stream after cooling coils or in areas subject to washdown, such motors shall be splash-proof or totally enclosed fan cooled.
- .7 Conform to requirements of Canadian Electrical Code, Local and Municipal and Provincial Authorities, and specified standards.
- .8 All equipment shall be supplied complete with a disconnect switch. Where exposed to the weather, "weatherproof" disconnects shall be provided. Disconnect switches serving explosion proof motors shall be explosion proof type.

1.18 Sleeves and Escutcheons

- .1 Sleeves:
 - .1 This trade shall provide stainless steel sleeves extending 19mm(3/4") above the finished floor level for any openings required for the mechanical systems.
 - .2 Unless otherwise indicated, insulated pipes shall be carried through walls in galvanized or stainless steel sleeves.
 - .3 Unless otherwise specified, construct sleeves of minimum 18 gauge material with lock seam joints. Sleeves through footings shall be minimum 16 gauge stainless steel.
- .2 Sizes:
 - .1 Provide approximately 12mm(1/2") clearance, all around, between sleeve and pipes or between sleeve and insulation.
 - .2 Through footings use sleeves large enough to accommodate hub of CI soil pipe.
 - .3 Where piping passes below footings, provide minimum all round clearance of 50mm(2") between piping and sleeves. Backfill up to underside of footing with concrete of same strength as footing.
 - .4 Unless otherwise specified, terminate sleeves flush with walls.
 - .5 Sleeves shall be sized to accommodate the insulated pipe diameter.
- .3 Unless otherwise indicated for pipes passing through roofs, use Thaler Industries Model MEF-34 or MEF-44 aluminium mechanical flashings, height 300mm(12"). Anchor flashings in roof construction; install in accordance with manufacturer's instructions; make watertight durable joint.
- .4 Caulking:

- .1 Firestop all penetrations through fire rated walls and floors in accordance with firestop manufacturer's UL or ULC listed detail..
 - .2 Caulk sleeves in foundation walls with oakum and non-shrink pipe sealing mastic sleeve and pipe or manufactured seals equal to "Link-Seal".
 - .3 Where sleeves pass through below grade floors or on grade slab and slab floors, caulk space between insulation and sleeve or between pipe and sleeve with dry oakum. Seal space at each end of sleeve with non-shrink pipe sealing mastic.
 - .4 Ensure no contact between copper tube or pipe and ferrous sleeve.
 - .5 Insulation to be continuous through walls and floors.
 - .6 Ensure no contact between copper tube or pipe and ferrous sleeve.
- .5 Escutcheons and Plates:
- .1 Provide on pipes passing through finished walls, partition floors and ceilings.
 - .2 Use chrome or nickel plated brass, with set screws for ceiling or wall mounted. For equipment room use cast-iron type. Where split escutcheons are used they shall be installed to provide continuous appearance.
 - .3 Inside diameter shall fit around pipe insulation or uninsulated pipe. Outside diameter shall cover sleeve.
 - .4 Where sleeve extends above finished floor, escutcheons or plates shall clear sleeve extension.
 - .5 Secure to pipe or sleeve but not to insulation.

1.19 Penetration of Fire Separations

- .1 Where pipes or ducts pass through walls or floors which provide fire separations, Div. 15 shall seal around openings with ULC classified fire stop material in accordance with ULC listing installation details. Material shall provide a fire rating equal to that of the separation which has been penetrated.
- .2 Submit material shop drawings and all ULC listed installation details for all penetrations applicable to project.
- .3 Acceptable Products:
Dow Corning Fire Stop System
3M Fire Barrier Penetration
Sealing System
Bio-Fire Biotherm or Bio-K10 (Supplied by Wormald)
Hilti

1.20 Bases and Supports

- .1 Unless otherwise noted, concrete bases are required under all floor mounted equipment including equipment with attached skid and bases. All such bases shall be 100mm(4") deep and shall be 100mm(4") larger in all directions than the equipment being supported.
- .2 Where equipment is raised above the floor it shall be supported by means of angle iron, I beams or pipe. All such supports shall be anchored to the floor and shall have a metal base to spread the load. These supports shall be cross-braced with diagonal members. Fabricated stands/supports require engineered stamped drawings by a professional engineer registered to practice in the province of installation.
- .3 Where equipment is suspended from the structure provide appropriately sized hanger rods, channel iron or angle iron hangers. Distribute the weight of the units uniformly across the structure, consistent with the design loading for the structure and as approved by the Consultant.
- .4 Where structure has not been designed to support equipment, this contractor shall provide pipe stands or angle iron supports to support the equipment from the floor.
- .5 Concrete bases shall be the responsibility of this Contractor. This Contractor to supervise and coordinate final layout and sizes of all concrete bases.
- .6 Unless specifically noted otherwise, provide spring isolators under all floor mounted vibrating, rotating or oscillating equipment designed to eliminate 90% of the vibration from being transmitted to the structure. For similar suspended equipment, provide spring hangers.
- .7 All exterior supports shall be stainless steel or hot dipped galvanized.
- .8 Supports for piping and equipment on roof shall be manufactured mechanical roof supports designed for equipment load and suitable for roofing system.
 - .1 Acceptable Product: Thaler Metal Industries Inc.

1.21 Di-Electric Unions

- .1 All connections between steel and copper for pipe 50mm(2") and smaller shall be made with di-electric unions. On pipe 63mm(2 1/2") and larger use

flanged connections with non-metallic gasket and plastic sleeves for bolts.

1.22 Special Tools and Spare Parts

- .1 Furnish spare parts as follows:
 - .1 One set of V-belts for each piece of machinery.
 - .2 One glass for each gauge glass installed.
 - .3 One set of packing or seals for each pump.
- .2 Identify spare parts containers as to contents and replacement parts number.
- .3 Provide one set of all tools required to service equipment as recommended by manufacturers.

1.23 Quality Assurance and Tests

- .1 Notice of Tests: Give written notice in ample time of date when tests will be made.
- .2 Prior Tests: Concealed or insulated work shall remain uncovered until completely tested and approved but if construction schedule requires arrange for prior tests on parts of system as approved.
- .3 Acceptance Tests: Conduct in presence of the Consultant or representative of Agencies having jurisdiction.
- .4 Costs: Bear all costs in connection with all tests.
- .5 It is the Contractor's responsibility to verify that all required examinations and testing have been completed and to inspect the piping to extent necessary to be satisfied that it conforms to all applicable examination requirements of the Codes and the Local Authority having jurisdiction.
- .6 The Owner's Representative shall have access to any place where work concerned with the mechanical installation is being performed. They shall have the right to audit any examination, to inspect the work using any examination method specified by the engineering design, and to review all certifications and records necessary to satisfy the Owner's requirements.
- .7 Certificates: Obtain acceptance certificates from Agencies having jurisdiction. Work is not considered complete until certificates have been

delivered to Consultant. Contractor shall furnish test certificates for all tests signed and dated by Contractor and signed by witness (either Owner's representative or Authority having Jurisdiction).

.8 Piping Systems Required Tests:

- .1 Test plumbing and piping systems as required by National Building Code and Provincial Regulations.
- .2 Sanitary, storm and vent piping shall be tested by the water test as described in the National Plumbing Code by sealing outlets and filling the system to the highest point with water. The water level shall remain constant for a minimum of two (2) hours. Alternatively an air test in accordance with the NPC will be considered subject to prior approval by the Engineer and AHJ.
- .3 Potable Water: Fill with water and hydraulically test at 1½ times system operating pressure or at 100 psig whichever is greatest. Maintain pressure without loss for a two (2) hour period. Alternatively an air test in accordance with the NPC will be considered subject to prior approval by the Engineer and AHJ.
- .4 Hydronic/Glycol heat transfer systems, Steam and Condensate, thermal fluids, Process piping : Perform hydrostatic pressure test at 100 psig or 1 ½ times maximum allowable working pressure, whichever is the greater.

.9 Pipe Pressure Testing:

- .1 Pressure tests shall be made in accordance with the applicable piping codes and standards including but not limited to the ANSI B31.1 and B31.3 Codes.
- .2 Contractor shall furnish all labor, tools and equipment required for pressure testing piping systems.
- .3 Drains and vents shall be tested watertight. There shall be no allowable leakage, and defects shall be corrected.
- .4 Contractor shall furnish all temporary test equipment, blank flange plates, pipe plugs, caps, valves, hookup piping and hoses, pressure gauges, gaskets, portable water pumps, air compressors and desiccant filters as required to accomplish the testing.
- .5 Lines containing check valves shall have the source of testing pressure on the upstream side.
- .6 Strainer elements shall be removed prior to testing.

- .7 Control valves and soft seat block valves shall be removed prior to testing. The valves shall be replaced with pipe spools or the ends of the pipe shall be blinded.
 - .8 Locally mounted pressure indicating gauges, where the test pressure would exceed their scale range, shall be removed prior to testing.
 - .9 Tests shall be made after erection and before the application of insulation or being covered in the case of underground piping, unless directed otherwise by the Owners Representative.
 - .10 Equipment such as tanks and pumps and the like shall be isolated during testing of the piping systems.
 - .11 All air shall be vented from the system prior to the application of the test pressure.
 - .12 Test fluid fill lines shall be equipped with temporary strainers.
 - .13 Test gauges shall be calibrated just prior to the test and the calibration records submitted to the Owner's Representative. Test gauges shall be installed as near as practicable to the lowest point in the piping system.
 - .14 All tests shall be witnessed and approved by the Owner's Representative. The test results shall be recorded and a copy shall be provided to the Owner's Representative.
 - .15 Contractor shall repair and make leak-tight all joints (welded, threaded, flanged, or other) found to leak as a result of the test procedure. All joints, which were opened to permit testing, shall be closed and tightened by Contractor at conclusion of testing.
 - .16 Backwelding of threaded joints, or over-tightened of flange bolts, as methods of leak removal shall not be permitted. Poor threading practice damaged flange faces, damaged gaskets, loose flange bolts, incompletely welded joints, etc. shall be removed and replaced by Contractor to the full satisfaction of the Owner.
- .10 Piping Hydrostatic Testing
- .1 For all piping, the test medium shall be clean, fresh, potable water. Following testing, the water shall be drained immediately and, if necessary, the system dried by blowing with air.
 - .2 Unless otherwise indicated, the test pressure shall be 100 psig or 1 ½ times maximum allowable working pressure, whichever is the greater. Unless otherwise indicated, test pressure shall be held for a minimum total time of 2 hour with no noticeable loss in pressure while all joints are visually inspected for leaks. Water temperature shall not exceed 100 degrees F. After pressure is applied, the pressurizing device must be disconnected during the inspection period.
 - .3 Where new piping connects to existing piping, Contractor shall

flush, test and clean the sections of existing piping sections which include the new tie-ins.

1.24 Piping Systems Cleaning and Water Treatment

- .1 Shop Drawing Submittals: Submit manufacturers product shop drawings, WHMIS data sheets, and application specific cleaning and treatment procedures for review prior to execution.
- .2 Reports:
 - .1 Reports shall be signed and dated by technician executing work and signed by Owner's representative.
 - .2 Contractor shall furnish flushing and cleaning record reports for all systems.
 - .3 Contractor shall furnish water treatment record reports for all steam boilers and hydronic circulating systems.
- .3 Water Treatment Specialist:
 - .1 Contractor shall engage Owner's supplier specializing in commercial and industrial water treatment systems for supply of chemicals, equipment, training, and service.
 - .2 Water treatment Services shall include:
 - .1 Reinstate existing systems.
 - .2 System Start-up assistance.
- .4 Cleaning and Treatment Chemicals:
 - .1 All cleaning and treatment chemicals shall be by a single manufacturer. Chemicals to be compatible with system and materials of construction.
 - .2 Acceptable Chemical Manufacturers: GE Betz, Dearborn
- .5 Flushing and Cleaning
 - .1 Contractor shall clean all piping before assembly to remove dirt, loose slag, etc.
 - .2 After pressure tests are completed and approved, prior to start-up and placing into operation, flush and clean out all piping systems.

- .4 Notice: Give written notice in ample time of date when flushing and cleaning will be conducted.
- .5 Witness: Final flushing of systems shall be conducted in the presence of the Owner's representative.
- .6 Contractor shall provide necessary anchored and braced temporary header connections, portable pump, strainers, filters, portable air compressors, air dryers, materials and temporary piping for "flushing", "blowing-out", draining and otherwise cleaning out the piping system. The temporary piping shall be installed to direct the discharge in accordance with environmental regulations and such that it will not injure personnel or damage property.
- .7 Block off or isolate all systems that may be adversely affected by the accumulations of dirt, weld or other foreign matter. Isolate and bypass any equipment that may be damaged during the flushing and cleaning procedure.
- .8 Contractor shall provide all labour as required to clean all strainers prior to start-up. During flushing and cleaning, line each strainer basket with a fine mesh nylon screen, and replace the screens at the end of each day's circulation until each system is thoroughly cleaned.
- .9 Specific Systems
 - .1 Water and Glycol Circulating Systems:
 - .1 A neutral pH preoperational ambient temperature cleaner formulated for HVAC systems and compatible with the materials of construction shall be utilized to clean the piping system in accordance with the chemical manufacturers recommended procedure.
 - .2 Introduce the chemical solution into the system by means of a bypass feeder across the circulating pump headers.
 - .3 Flush and drain systems until free of dirt, sludge, oil, grease and other foreign material. Clean strainers.
 - .4 Refill water system with clean water.

- .5 Before any new system is connected to a cleaned and treated system, the new system shall be separately cleaned by the specified method, inspected and certified, and chemically treated to the specified level before allowing the systems to mix. The mixing of clean and unclean systems will result in the entire system requiring recleaning. Ensure that treatment programs are compatible before connection to existing piping.
- .2 Utility and instrument compressed air, nitrogen piping systems shall be blown clean with clean, dry, oil-free nitrogen or air supplied with a portable compressor and desiccant dryer followed by a filter for removal of oil and dirt.
- .3 Steam, steam condensate and water piping shall be cleaned with steam blowdown, unless directed otherwise by Owner Representative.

1.25 Duct Cleaning

- .1 Clean ductwork in accordance with Section 23 73 10 requirements.

1.26 Balancing

- .1 Scope of Work
 - .1 The contractor will contract with an independent testing, adjusting, and balancing (TAB) agency to test, adjust, and balance the systems. Original airflows and balancing reports will be provided to the successful bidder upon request.
 - .2 The work included in this section consists of furnishing labor, instruments, and tools required in testing, adjusting and balancing the systems, as described in these specifications or shown on accompanying drawings. Services shall include checking equipment performance, taking the specified measurements, and recording and reporting the results.
 - .3 The items requiring testing, adjusting, and balancing include the following:
 - .1 Complete ventilation systems before and after installation of new AHU-8, AHU-18, EF-8, EF-18.

.2 Cooling coil flow rates.

.2 Definitions, References, Standards

All work shall be in accordance with the latest edition of the AABC National Standards. If these contract documents set forth more stringent requirements than the AABC National Standards, these contract documents shall prevail.

.3 Submittals

Qualifications: The TAB agency shall submit a company resume listing personnel and project experience in air and hydronic system balancing and a copy of the agency's test and balance engineer (TBE) certificate.

.4 TAB preparation and coordination

.1 Shop drawings, submittal data, up-to-date revisions, change orders, and other data required for planning, preparation, and execution of the TAB work shall be provided to the TAB agency no later than 30 days prior to the start of TAB work.

.2 System installation and equipment startup shall be complete prior to the TAB agency's being notified to begin.

.3 The building control system shall be complete and operational. The Building Control System contractor shall install all necessary computers and computer programs, and make these operational. Assistance shall be provided as required for reprogramming, coordination, and problem resolution.

.4 All test points, balancing devices, identification tags, etc. shall be accessible and clear of insulation and other obstructions that would impede TAB procedures.

.5 Qualified installation or startup personnel shall be readily available for the operation and adjustment of the systems. Assistance shall be provided as required for coordination and problem resolution.

.5 Reports

Final TAB Report - The TAB agency shall submit the final TAB report for review by the engineer. All outlets, devices, HVAC equipment, etc., shall be identified, along with a numbering system corresponding to report unit identification. The TAB agency shall submit an a certificate assuring that the project systems were tested, adjusted and balanced in accordance with the project specifications and AABC National Standards. Submit three (3) copies of the Final TAB Report.

.6 Deficiencies

- .1 Any deficiencies in the installation or performance of a system or component observed by the TAB agency shall be brought to the attention of the Consultant.
- .2 The work necessary to correct items on the deficiency listing shall be performed and verified by the affected contractor before the TAB agency returns to retest. Unresolved deficiencies shall be noted in the final report.

.7 Instrumentation

- .1 All instruments used for measurements shall be accurate and calibrated. Calibration and maintenance of all instruments shall be in accordance with the requirements of AABC National Standards.
- .2 Contractor shall provide any instrumentation devices as required to complete the balancing. For pipelines without calibrated flow measuring devices, contractor shall use strap-on ultrasonic flow meter or equivalent.

.8 Air Distribution Systems

- .1 The balancing sub-contractor will completely familiarize himself with the air distribution systems at the time of tender and will report to the Sheet Metal Contractor any and all areas where he feels additional dampers or other control devices are necessary for him to do a complete and thorough job so that the Sheet Metal Contractor can include in his Tender price.
- .2 Test and balance all air supply, return, and exhaust systems. Balancing must be performed by trained personnel who shall keep records on each trial balance.
- .3 Variable air volume devices including fans, supply/exhaust valves, VAV boxes, fume hoods, etc. shall be balanced and recorded at the minimum and maximum settings specified.
- .4 Spaces utilizing volumetric airflow offset control (including labs) shall be balanced and recorded over full airflow operating range to verify specified volumetric offset in maintained.
- .5 Balancing shall be accomplished by means of Pitot tube traverse on all main and branch ducts. Fan speeds and dampers shall be adjusted until proper air quantities are obtained. Individual dampers behind registers and diffusers shall only be used for fine tuning.
- .6 Each outlet shall be adjusted by a "flow hood", anemometer or velometer readings to provide air quantities specified. Each supply outlet shall be adjusted to provide proper throw and distribution in

- accordance with requirements.
- .7 All necessary equipment including gauges, pitot tubes, anemometers velometers, etc., required for the testing and air balance shall be furnished and shall be of quality and capacity to ensure proper accuracy.
 - .8 Upon completion of the balancing, supply the Architect with four (4) complete records which shall include air quantities at each outlet, provide if requested, a spot check on the system with the Owner's representative and Architect. If actual quantities do not agree with the balance report, this sub-contractor may be called upon to completely rebalance the systems until satisfactory to the Architect.
 - .9 Adjust airflows as follows:
 - .1 Balancing Contractor is cautioned that for systems that employ pressure independent constant and variable volume airflow control valves, balancing shall be co-ordinated with flow control valve manufacturer's recommendations and automatic controls Contractor.
 - .2 Balancing Contractor is cautioned that for VRF Air source heat pump systems, balancing shall be co-ordinated with air source heat pump system manufacturer's recommendations and air source heat pump system start-up technician. Balancing adjustments shall include indoor unit fan speed adjustments per the manufacturers instructions to ensure fan motors are not overloaded and are operating per the manufacturer's requirements.
 - .3 Adjust and balance supply, return and exhaust fans speed as required to meet air flow requirements. Balancer is cautioned that air flow control valves may require a minimum static pressure as indicated in the manufacturer's literature to operate properly.
 - .4 Where room pressurization indicated, adjust air volume as required to obtain room pressure differentials as indicated or required by Owner. Balancer shall adjust air flows if necessary from indicated settings to maintain specified pressure differentials. Confirm with Engineer prior to adjusting flows from design values but generally for rooms with positive design offset, adjust return/exhaust airflows to meet pressurization requirements. For rooms with negative design offset, adjust supply airflow to meet pressurization requirements.
 - .5 Adjust grilles and diffuser to adjust airflow distribution downstream of flow control valves to meet specifications and pressurization required.

- .6 Adjustment of constant volume flow control valves are required and shall be performed by balancing Contractor in accordance with equipment manufacturer's recommendations.
- .7 Closely coordinate final setting with Engineer to meet performance, airflow, and pressure differentials required.
- .10 Provide the following information as part of the balancing report:
- System No.
System Location
Area System Serves
- Specified CFM
Actual CFM
- Specified Suction SP
Actual Suction SP
- Specified Discharge SP
Actual Discharge SP
- Specified Total SP
Actual Total SP
- Type of Sheave and Location (Motor or Fan)
Position of Sheave (ie) Maximum or Minimum RPM)
Motor KW
Fan Rated KW
- Amp Draw on Each Phase
Measured Voltage
Motor RPM
- Fan RPM Specified
Fan RPM Actual
- Fan curves for each fan showing plotted design and field conditions, static pressure readings across filter banks, coils banks of each air handling system, showing design and actual readings. Detailed summary of velocity traverses and calculated air quantities for each fan and branch ductwork. Schematic diagrams for all systems with all outlet numbered.
- .11 All openings shall be closed using removable gasketed plugs.

- .9 Hydronic Systems
 - .1 The balancing sub-contractor will completely familiarize himself with the hydronic systems at the time of tender and will report to the Mechanical Contractor any and all areas where he feels additional balancing valves or other control devices are necessary for him to do a complete and thorough job so that the mechanical contractor can include in his Tender price.
 - .2 The TAB agency shall, as applicable, confirm that all hydronic equipment, piping, and coils have been filled and purged; that strainers have been cleaned; and that all balancing valves (except bypass valves) are set full open. The TAB agency shall perform the following testing and balancing functions in accordance with the AABC National Standards:
 - .3 Pumps
 - .1 Test and adjust hydronic circulators, and condenser water pumps to achieve maximum or design GPM. Check pumps for proper operation. Pumps shall be free of vibration and cavitation. Record appropriate gauge readings for final TDH and Block-Off/Dead head calculations.
 - .2 Current and Voltage - Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure pump motor is not in or above the service factor.
 - .3 Mains & Branches
 - .1 Adjust water flow in pipes to achieve maximum or design GPM.
- .10 Report Verification
 - .1 At the time of final inspection, the TAB agency may be required to recheck, in the presence of the owner's representative, specific or random selections of data recorded in the certified report. Points and areas for recheck shall be selected by the owner's representative. Measurements and test procedures shall be the same as approved for the initial work for the certified report. Selections for recheck, specific plus random, will not exceed 10% of the total number tabulated in the report.

1.27 Identification

- .1 Manufacturers Nameplates:
 - .1 Provide on each piece of equipment a metal nameplate, mechanically fastened with raised or recessed letters.

- .2 Include registration plates (e.g. Pressure vessel, Underwriters' Laboratories and CSA approval) as required by respective agency and as specified. Indicate size, equipment model, manufacturer's name, serial number, voltage cycle, phase and power of motors, all factory supplied.
 - .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 150mm x 75mm x 3mm thickness (6" x 3" x 1/8") nominal thickness, engraved with 100mm (4") high lettering. Use 25mm (1") lettering for major equipment.
 - .2 Fasten nameplates securely in conspicuous place. Where nameplates can not be mounted on cool surface, provide standoffs.
 - .3 Identify equipment type and number and service or areas or zone of building served.
- .3 Pipe Identification:
- .1 Identify piping with markers by background color, legend and directional flow arrows. Include temperature and pressure where relevant. To ASME A13.1 2007 except where specified otherwise.
 - .2 Piping systems governed by codes shall be identified in accordance with governing code as follows:
 - .1 Propane Gas: to CSA/CGA B149.1
 - .2 Sprinklers: to NFPA 13
 - .3 Standpipe and Hose Systems: to NFPA 14
 - .4 Breathing Air: to CSA Z180.1
 - .5 Ammonia Refrigeration Systems: ASME A13.1 2007 and IIAR Bulletin #114.
 - .3 Legend:
 - .1 Block capitals to sizes and colors listed in ASME A13.1 2007.
 - .4 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75mm (3"): 100mm (4") long x 50mm(2") high.
 - .2 Outside diameter of pipe or insulation 75mm(3") and greater: 150mm(6") long x 50mm(2") high.
 - .3 Use double-headed arrows where flow is reversible.
 - .5 Extent of background color marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate full length of legend and arrows.
 - .6 Materials for background color marking, legend, arrows:

- .1 Pipes and tubing 20mm(3/4”) and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
- .2 Other pipes: pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C (302 degrees F) and intermittent temperature of 200 degrees C (392 degrees F).
- .7 Colors and Legends:
 - .1 Where not listed, obtain direction from Engineer.
 - .2 Colors for legends, arrows: to following table:

| <u>Background Color:</u> | <u>Legend, arrows:</u> |
|--------------------------|------------------------|
| Yellow | BLACK |
| Green | WHITE |
| White | BLACK |
| Grey | WHITE |
| Black | WHITE |
| Blue | WHITE |
| Orange | BLACK |
| Brown | WHITE |
| Purple | WHITE |
| Red | WHITE |
 - .3 Background color marking and legends for piping systems:

NOTE: CONFIRM REQUIREMENT OF EXISTING SYSTEMS, OTHERWISE USE SCHEDULE BELOW:

| <u>Contents</u> | <u>Background Color</u> | <u>Legend</u> |
|------------------------------|-------------------------|---------------------------|
| Condensate High Press.(HCO) | Green | HIGH PRESS. CONDENSATE |
| Condensate Low Press. (LCO) | Green | LOW PRESS. CONDENSATE |
| Cooling Water Supply (CWS) | Green | COOLING WATER SUPPLY |
| Cooling Water Return (CWR) | Green | COOLING WATER RETURN |
| Potable Cold Water (CW) | Green | POTABLE COLD WATER |
| Steam High. Press.(HST) | Green | HIGH PRESS. STEAM |
| Steam Low Press. (LST) | Green | LOW PRESS. STEAM |

- .4 Duct Identification
 - .1 Use 2" high black stencilled letters, i.e. "Supply", "Fresh", "Return", "Sanitary Exhaust", "Kitchen Exhaust", with directional flow arrow.
 - .2 Stencil over final finish only.
- .5 Location of Identification on Piping and Ductwork Systems:
 - .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 20ft intervals.
 - .2 Adjacent to each change in direction.
 - .3 At least once in each small room through which piping or ductwork passes.
 - .4 On both sides of visual obstruction or where run is difficult to follow.
 - .5 On both sides of separations such as walls, floors, partitions.
 - .6 Where system is installed in pipe chase, ceiling spaces, galleries, confined spaces, at entry to exit points, and at access openings.
 - .7 At beginning and end points of each run and at each piece of equipment in run.
 - .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
 - .9 Identification easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust or dirt.
- .6 Valves and Equipment:
 - .1 Provide brass or lamacoid tags with ½" stamped code lettering and numbers filled with black paint Secure with non-ferrous chains or "S" hooks. Use for all valves, operating controllers, instruments and equipment.
 - .2 Provide Architect with six (6) identification flow diagrams of approved size for each system. Include tag schedule, designating number, service, function, and location of each tagged item and normal operating position of valve.
 - .3 Mount where directed one copy of flow diagram and schedule each mounted in a glazed frame. Provide one copy in each maintenance instruction manual.

- .4 Consecutively number valves in system.

1.28 Operating Instruction & Maintenance Manual

- .1 Refer to requirements of Div 01.
- .2 Provide factory trained personnel to instruct operating staff on maintenance, adjustment and operation of mechanical equipment. Instruct staff on changes or modification in equipment made under terms of guarantee.
- .3 Provide instruction during regular work hours prior to acceptance and turn-over to operating staff for regular operation.
- .4 Prepare a maintenance schedule which will advise the Owner's staff what maintenance must be done and the suggested intervals at which it should be done.
- .5 Submit one copy for review at least two weeks before instruction to Owner are commenced.
- .6 Submit three (3) copies of final manuals to the Architect.
- .7 Ensure that the terminology used in various sections of the manual is consistent.
- .8 Each manual shall contain the following information:
 - .1 Description of each system with description of each major component of system.
 - .2 Complete sets of page size equipment Shop Drawings
 - .3 Equipment manufacturer's installation, startup and operation manuals.
 - .4 Equipment manufacturer's recommended spare parts lists
 - .5 Equipment wiring diagrams
 - .6 Lubrication schedule for all equipment
 - .7 Equipment identification list with serial numbers
 - .8 Page size valve tag schedule and flow diagrams
 - .9 Final balancing reports
 - .10 Water treatment procedure and tests
 - .11 Control drawings, sequences of operation
 - .12 Extended warranty documentation if applicable.
- .9 Manuals are to be completed and approved in time to be used during instruction of operating staff.

1.29 Completion

- .1 Nothing herein contained can be construed to relieve the trade from making good and perfect work in all usual details of construction and in accordance with best standard practice and in strict compliance with the provisions of any and all laws and ordinances, and the rules and regulations of any duly constituted public body having jurisdiction over this work.
- .2 This trade shall be held responsible to provide and furnish all necessary labour and to bear all expenses incidental to the satisfactory completion of the work.
- .3 Remove all debris from inside Division 15 systems and equipment.
- .4 Rectify deficiencies and complete work before submitting request for Substantial Performance inspection.
- .5 Follow manufacturer's written instructions regarding bearing lubrication. Remove grease from pillowblock type bearings and install new grease before equipment is put into operation.
- .6 Check and align all drives to manufacturer's acceptable tolerances.
- .7 Adjust belts for proper tension.
- .8 Check and align all pumps to manufacturer's acceptable tolerances.
- .9 Remove all temporary protection and covers.
- .10 Remove oil and grease from equipment and bases.
- .11 Clean all fixtures and equipment. Polish all plated surfaces.
- .12 Vacuum clean the inside of all air handling systems, including fans, ducts, coils and terminal units to ensure that they are free from debris and dust.
- .13 Change air and water filters.
- .14 Remove, clean and reinstall pipeline strainer screens.
- .15 Leave Division 15 work in as new working order.

1.30 Project Record Drawings

- .1 Refer to requirements of Div 01.
- .2 Nothing herein contained can be construed to relieve the trade from making good and perfect work in all usual details of construction and in accordance with best standard practice and in strict compliance with the provisions of any and all laws and ordinances, and the rules and regulations of any duly constituted public body having jurisdiction over this work.
- .3 One (1) set of white prints, and an electronic disk will be provided for record drawing purposes. Maintain project "as-built" record drawings and accurately record significant deviations from the Contract Documents, caused by site condition or Contract change. Mark changes on white prints in "Red". At the completion of the project, and prior to final inspection, transfer "as-built" information and notations to reproducible transparencies and submit both sets to the Architect for review.

1.31 Installation and Commissioning of Equipment

- .1 Manufacturer's instructions shall be made available to both the installing tradesmen and the on-site inspector prior to installation of equipment. These instructions are to be read, understood and closely followed. Failure to abide by this requirement will provide justification for the engineer to require removal and re-installation.
- .2 Ensure that all safety devices and other significant accessories are in place and operable before starting major pieces of equipment. As part of the commissioning process accessories are to be checked, calibrated and adjusted as necessary to ensure safe operation.
- .3 Follow manufacturer's instructions in detail in establishing start-up and commissioning procedure.
- .4 Provide start-up reports on all equipment installed under this Contract.

1.32 Demonstration of Complete Systems

- .1 At the conclusion of the job, the contractor shall review and demonstrate to the owner all equipment and their respective functions and operation. Such demonstration shall be provided for such reasonable periods of time as the complexity of the job warrants, and as approved by the Consultant.

Such review and demonstration shall be made by an authorized representative of the contractor, fully knowledgeable of the project, its installation and operation.

- .2 The length of time required for training for each specific piece of equipment and each specific system will be approved by the Consultant prior to the training period.
- .3 Provide the Consultant with a schedule of system demonstration at least two (2) weeks prior to demonstration.

1.33 Mechanical Substantial Completion

- .1 Prior to Substantial Performance Review by the Consultant, Substantial Performance of this Contract, and occupancy by the Owner, the Contractor will inspect the project, provide a mechanical deficiency list, provide confirmation that all items on the list have been corrected and complete the following:
 - .1 All Quality Assurance Testing completed and Certificates provided.
 - .2 Cleaning and Water Treatment of all systems is completed and reports provided.
 - .3 Balancing is completed on all systems and the Report submitted.
 - .4 Identification of all systems is completed.
 - .5 All Operating Instruction & Maintenance Manuals have been submitted.
 - .6 Complete all items listed in Section 21 05 01 paragraph titled "Completion".
 - .7 All Record drawings provided.
 - .8 Demonstrations of all systems completed.
 - .9 Spare Tools and Spare Parts provided as specified.
 - .10 Signed Letters of Guarantee provided.
 - .11 Submit Start-Up reports on all equipment. Contractor shall provide confirmation that all equipment has been properly commissioned.

Automatic Controls

- .1 All automatic control systems have been completed, commissioned, tested and debugged.
- .2 The training of the automatic control systems has been completed with the Owner's representatives.
- .3 All controls must be permanent controls. No temporary automatic

- controls will be permitted.
- .4 Commissioning report has been submitted.
- .2 The Consultant shall review the work upon completion of the above. The Contractor shall correct all defects and deficiencies noted, sign off and date when each item is corrected. Upon completion of corrective action provide written confirmation and request for final review. If it is determined that any of the items signed off as being complete remain deficient, the cost of all follow up reviews shall be the responsibility of the Contractor.

PART ONE - GENERAL

1.01 General Conditions

- .1 All conditions included in Section 21 05 01 form part of this specification and shall apply as if repeated here. This contractor is to become familiar with those requirements and to conform to all provisions affecting his work.
- .2 The plumbing systems are to be installed in accordance with the latest edition of the National Building Code, and the National Plumbing Code.

1.02 Scope

- .1 The intent of this Section of the specifications is to complement the drawings in describing all of the plumbing work required for the completion of this project.
- .2 This shall include but is not necessarily confined to the following:
 - .1 All drains as shown on the drawings or specified herein.
 - .2 A complete condensate drainage piping system from AHU to drain.
 - .3 Domestic water to humidifier drain water coolers.

1.03 Shop Drawings

- .1 This contractor shall submit shop drawings for review in accordance with Section 01 33 00 and 21 05 01 for the following equipment:
 - .1 Plumbing Specialties

PART TWO - PRODUCTS

2.01 Piping and Fittings

- .1 Above Ground Sanitary Drainage & Vent Piping
 - .1 50mm (2") and Smaller:
 - .1 Pipe: DWV copper conforming to ASTM B306
 - .2 Fittings: Wrought copper or cast brass.
 - .3 Joints: 50/50 soldered, screwed at fixtures.
 - .2 Water Piping - Above Ground
 - .1 Pipe: Type "L" copper conforming to ASTM B88
 - .2 Fittings: Wrought copper or cast brass.
 - .3 Joints: 95/5 lead-free solder. Unions at fixtures.

2.02 Hangers

- .1 Myatt, Grinnell or approved equal and equal to the following Myatt Cat. No.'s:
 - .1 Copper pipe:
Myatt Fig. 151CT Copper plated clevis hanger.
 - .2 Hangers on insulated piping are to be sized to accommodate the insulation thickness. Provide Myatt Fig. 251S insulation shields for all hangers on insulated piping.

2.03 Plumbing Specialties

- .1 General:
 - .1 Plumbing specialties shall be Zurn, Smith, or Watts unless otherwise noted.
 - .2 All parts of specialties (other than gaskets) shall be metallic.

2.04 Di-Electric Unions

- .1 Provide di-electric unions equal to Watts 3001A Series where required.

PART THREE - EXECUTION

3.01 Piping Installation

- .1 Install in accordance with Canadian Plumbing Code (CPC) and authorities having jurisdiction.
- .2 Conform to requirements of ANSI B31 Code for Pressure Piping.
- .3 Conform to requirements of CSA B149.1 and CSA B149.2 for propane and natural gas piping.
- .4 Install straight, parallel and close to walls and ceilings, with specified pitch. Use standard fittings for direction changes.
- .5 Install groups of piping parallel to each other, spaced to permit application of insulation, identification, and service access or trapeze hangers.
- .6 Install eccentric reducers in horizontal piping to permit drainage and eliminate air pockets.
- .7 Where pipe sizes differ from connection sizes of equipment, install reducing fittings close to equipment. Reducing bushings are not permitted.
- .8 Brass and copper pipe and tubing shall be free from surface damage. Replace damaged pipe or tubing.
- .9 Ream ends of pipes and tubes before being made up.
- .10 Lay copper tubing so that it is not in contact with dissimilar metal and will not be kinked or collapsed.
- .11 Use non-corrosive lubricant or teflon tape applied to male thread.
- .12 Grooved pipe ends: cut square, seating surface clean and free from indent and score marks.
- .13 Install di-electric couplings wherever piping of dissimilar metals are joined.
- .14 Install swing or swivel joints to connect risers to mains.
- .15 All piping shall be run concealed in pipe spaces, chases and ceiling spaces where possible. Piping that is run exposed in finished areas shall be located in corners and boxed in. Where exposed piping is not boxed in, it is to be chrome plated.

- .16 Right angle connections in drain pipes shall be made with Y branches and 1/8 bends, the use of 90 Degree tees and elbows being avoided.
- .17 Each fixture shall be provided with back vent connections and individual trap.
- .18 All pipes passing under or through walls or underground shall be protected from breakage. All pipes below grade shall be carefully supported and every precaution taken against injury to pipe and joints.
- .19 An easily accessible cleanout shall be provided at each alternate change in direction in main soil or waste pipe and at the base of each stack. All cleanouts shall be of the same nominal size as the pipes up to 100mm (4") and not less than 100mm (4") for larger pipes. The distance between cleanouts in horizontal soil and waste lines shall not exceed 15m (50ft) in pipe 100mm (4") and smaller and 25m (80ft) in pipe 150mm (6") and larger.
- .20 Each main, all branch mains and runouts to a fixture group shall be valved.
- .21 Stacks less than 75mm (3") where carried through the roof, shall be increased to at least 100mm (4") before passing through the roof. Stacks 100mm (4") and larger shall be carried through the roof full size.
- .22 It shall be the responsibility of this contractor to space all pipes so that they may be completely and separately insulated. Where possible, hot water pipes shall not run below parallel cold water pipes.
- .23 Pipe all relief valves to the floor. In other than Mechanical Rooms, pipe relief valves to floor drains or service sink.

3.02 Hangers

- .1 All piping shall be securely hung from the building structure using approved hangers.
- .2 Maximum horizontal spacing shall be as follows:

| <u>Copper</u> | <u>Maximum Spacing</u> |
|----------------------|-------------------------------|
| Up to 25mm (1") | 2.5m (8.2ft) |
| Over 25mm (1") | 3m (10ft) |

Cast Iron

All sizes

Maximum Spacing

3m (9.84ft)

PVC or ABS

All sizes

Maximum Spacing

1.2m (3.94ft)

- .3 Vertical pipes shall be supported at each floor by means of iron hooks or straps placed directly below hub or fittings. Vertical drops to fixture shall be supported at top of riser to prevent strain on fixture connection.

3.03 Cleanouts

- .1 Every cleanout shall be easily accessible and it shall be the responsibility of the Mechanical Contractor to see that access panels are provided for this purpose.

3.04 Di-electric Unions and Flanges

- .1 Install between any iron or steel and copper piping or equipment up to and including 50mm (2"). Flanged connections with rubber gaskets and plastic bolt sleeves are to be used above 50mm (2").

3.05 Special Equipment

- .1 The contractor shall provide all necessary piping and make all connections to all special equipment such as heating equipment, ventilation equipment etc. All air handling units shall be provided with drains and piped indirectly to the sewer. A drain shall be provided at all fresh air intake and exhaust openings and shall be piped indirectly to the sewer. Traps or drains shall have unequal legs to compensate for the fan static pressure.

PART ONE - GENERAL

1.01 General Conditions

- .1 All conditions included in Section 21 05 01 form part of this specification and shall apply as if repeated here. This contractor is to become familiar with those requirements and to conform to all provisions affecting his work.

1.02 Scope of Work

- .1 The work included in this Contract shall include the furnishing of all labour, materials, equipment, plant tools, and services, necessary for or incidental to the supply, installation and completion of a heating system to the full intent of the drawings and as hereinafter specified.
- .2 Any piping, fixtures, work or equipment herein specified but not shown on the plans, or vice versa, or any work, material or equipment necessary for the proper completion of the job, shall be furnished and installed as though both shown on the plans and specifications.
- .3 The work shall include, but is not necessarily limited to the following:
 - .1 Provision of steam and condensate to AHU-8 & AHU-18 heating coil and humidifier.
 - .2 Provision of the chilled water cooling system serving AHU-8 & AHU-18.
 - .3 Installation of control valves, sensors, etc. supplied by others.
 - .4 Piping of all coils and units supplied under Section 23 05 00.
 - .5 Humidification piping, valves, and equipment serving AHUs.

1.03 Shop Drawings

- .1 This contractor shall submit shop drawings for review in accordance with Section 01 33 00 and 21 05 01 for the following equipment:
 - .1 Thermometers
 - .2 Pressure Gauges
 - .3 Valves
 - .4 Balancing Valves

PART TWO - PRODUCTS

2.01 Pipe and Fittings

- .1 Low pressure steam and condensate, chilled water cooling, shall be as follows:

PIPE

50mm (2") & smaller - Blk steel T&G, ASTM-A-53 Sched. 40 continuous weld.

65mm (2 1/2") & larger- Blk steel P.E., ASTM-A-53 Sched. 40.

JOINTS

50mm (2") & smaller - Screwed

65mm (2 1/2") & larger- Welded, flanged or valves at equipment.

FITTINGS

50mm (2") & smaller - Standard malleable iron, screwed.

65mm (2 1/2") & larger- Sch. 40 steel butt welding ASTM-A-234 Grade A, Weld-O-Lets or equal.

FLANGES

All - Class 150 steel slip-on or weld neck type, raised face, ASTM-A-181.

BOLTS

- Stud bolts, carbon steel, heavy hex nuts.

UNIONS

65mm (2 1/2") & smaller

- Class 150 malleable iron, brass to iron seats.

GASKETS

All - 2.3mm (1/8") thick Cranite or approved equal.

- .2 Victaulic Roll grooved piping system including fittings, valves and couplings are considered acceptable on 63mm (2 1/2") and larger chilled water piping.

- .1 Joints - Standard rigid couplings to CSA B242. Victaulic #107 Quick Vic couplings. Flexible couplings to CSA B242 to be used where noted Victaulic #77 or #177 flexible couplings.

2.02 Hangers and Inserts

- .1 Pipe hangers to be Myatt or Grinnell and equal to the following Myatt Cat. No.'s.
Steel Piping and PVC Piping - 124L

2.03 Valves

- .1 All valves shall be by one manufacturer and shall have the manufacturer's name and pressure rating clearly marked on the outside of the body.
- .2 The metal bodies, bonnets, yokes and discs of all bronze valves shall conform to ASTM-B-62. In iron body valves the cast iron shall conform to ASTM-A-126, Class B.
- .3 All valves shall be complete with 50mm (2") diameter metal tag attached with a chain identifying its function.
- .4 Valves shall be Jenkins, Milwaukee, Red & White/Toyo, Newman Hattersley, Nibco, Kitz, Crane or Victaulic and equal to the following Fig. No.'s.

Up to 75mm (3")

- | | | |
|-------------|---|-----------------------------|
| Ball Valve | - | Jenkins Fig 201J or 202J |
| Check Valve | - | Jenkins Fig 4092J or 9093 |
| Globe Valve | - | Jenkins Fig 106BP or 106BPJ |

100mm (4") and Larger

- | | | |
|-----------------|---|--|
| Gate Valve | - | Jenkins Fig 454J |
| Globe Valve | - | Jenkins Fig 2342J |
| Check Valve | - | Jenkins Fig 588J, Victaulic #712 check valve |
| Butterfly Valve | - | Jenkins Series 100, Victaulic Vic 300 |

2.04 Air Vents

- .1 Float type automatic air eliminators are required at all high points in the piping system.
- .2 Acceptable Products: Armstrong AV-11, Watts, Flair.

2.05 Drains

- .1 On all mains and risers provide Dahl #50.430 ball valve with cap and chain.

2.06 Thermometers

- .1 Adjustable type, 225mm (9") case, calibrated in Degrees F and Degrees C with range so that the normal operating temperature of the fluid is at the approximate mid-point.
- .2 Acceptable Products: Winters Vari-angle, Terrice BX, or Taylor-Weiss.

2.07 Pressure Gauges

- .1 110mm (4 ½") diameter, equal to Ashcroft No. 1010.
- .2 All gauges to be complete with a gauge cock.
- .3 Provide a syphon on all steam services, snubber for pulsating operation, diaphragm for corrosive service.
- .4 Acceptable Products: Ashcroft, Marsh, Taylor, Terrice.

2.08 Safety and Relief Valves

- .1 Safety valves of the correct rating for equipment to be protected.
- .2 Acceptable Products: Consolidated, Watts, Kunkle.

2.09 Strainers

- .1 "Y" pattern, full size of pipe, 50mm and smaller, screwed; 65mm and larger, flanged. Strainers shall have monel perforated screens and equal to the following Erwel Cat. No.'s
 - Up to 50mm (2") - Type YS, Class 125
 - 65mm (2 ½") and up - Type D, Class 125
- .2 Acceptable Products: Erwel, Crane, Dunham, Spirax/Sarco, Sureflow.

2.10 **Balancing Valves**

- .1 Provide balancing valves where indicated equal to B & G Series CB.
- .2 Acceptable Products: Armstrong, Tour and Anderson, Victaulic

PART THREE - EXECUTION

3.01 Installation and Commissioning of Equipment

- .1 Install in strict accordance with manufacturer's instructions, and Provincial Regulations.
- .2 Clearances: Provide clearance around units for service and maintenance.
- .3 Manufacturer's instructions shall be made available to the installing tradesmen and commissioning agent (where applicable) prior to installation of equipment. These instructions are to be read, understood and closely followed. Failure to abide by this requirement will provide justification for the engineer to require removal and re-installation.
- .4 Ensure that all safety devices and other significant accessories are in place and operable before starting major pieces of equipment. As part of the commissioning process accessories are to be checked, calibrated and adjusted as necessary to ensure safe operation.
- .5 Follow manufacturer's instructions in detail in establishing start-up and commissioning procedure.

3.02 Piping and Installation

- .1 Arrange and install piping approximately as indicated, straight, plumb, and as direct as possible. Pipe shall be at right angles or parallel lines to building walls.
- .2 Locate groups of pipe parallel to each other, spaced at a distance to permit applying full insulation and access for servicing valves.
- .3 Grade forced water piping 1.5mm per meter (1/8" per foot) so that when the system is filled, the air in the mains and risers shall be carried to vents at high point. Install sediment faucets to drain low points.
- .4 Where horizontal water piping is reduced in size, provide eccentric reducing coupling with top of pipe level.
- .5 All downfed heating units to have sediment faucets on return piping for proper drainage of heating systems.

- .6 Forced water return and supply piping shall be taken off main at 45 Degree angle from each main or branch main. All runouts to be made with four (4) joints to permit expansion and avoid strain on equipment.
- .7 Unions shall be provided where indicated and at the following locations; in by-passes around equipment, at heaters, tanks, pumps or other equipment requiring disconnection for repairs or replacement. Locate between shut-off and equipment. Do not conceal unions in walls, partitions, or ceilings.
- .8 Provide shut-off valves where indicated or specified and in the following locations: in risers and main branches at point of take-off from the supply or return main, at individual equipment unit inlets and outlets to permit unit removal for repairs without interfering with remainder of system.
- .9 Keep piping free from scale and dirt. Protect open end of pipe wherever work is suspended during construction. To prevent foreign bodies entering or lodging use temporary plugs, burlap or other approved materials for protection.

3.03 Expansion Joints Anchors and Guides

- .1 Provide for expansion of mains and risers by use of loops, bends, offsets and expansion joints. Provide guides and anchors where indicated or as required to allow expansion of pipe without binding.
- .2 Install expansion joints in strict conformity with manufacturer's instructions.
- .3 All main expansion loops or bends shall be half cold sprung. Branch connections shall have strain on when cold, off when hot.
- .4 Where not otherwise indicated provide two (2) sets of alignment guides on each side of expansion joint spaced to manufacturer's requirement.

3.04 Hangers and Supports

- .1 Provide all hangers required for the proper support of piping in this division.
- .2 In concrete construction, each Sub-Contractor shall set inserts at proper centers, securely attached to forms before concrete is poured. Inserts shall be Grinnell No. 281. Where concrete has been poured, a suitable

fastening device shall be used.

- .3 Beam clamps shall be used when hanging from any structural steel members. No drilling or welding of these members shall be permitted unless approved by the Architect.
- .4 Hang all piping to and from any circulating pumps 2 h.p. and larger within mechanical room with spring hangers.
- .5 Supporting bolts shall be maximum size usable with the specified hanger, with adjustable and locking stop units.
- .6 Space hangers for horizontal piping as follows:
 - .1 Steel Piping
Up to & including 25mm (1") - 2m (7ft) intervals.
32mm (1 1/4") and over - 3m (10ft) intervals.
 - .2 Copper Piping
Up to & including 25mm (1") - 2m (7ft) intervals.
32mm (1 1/4") and over - 3m (10ft) intervals.
- .7 On uninsulated copper piping, use plastic coated hangers, or other approved separation between copper and ferrous hanger.
- .8 Pipe hanger and structural attachments shall be installed in such a manner that the rod is vertical when the piping is hot.

3.05 Air Vents

- .1 At every high point in piping mains, the contractor shall supply and install automatic air eliminators in order to avoid air pockets in the system. Air vents are to be installed at an accessible place with the aid of necessary piping in order to facilitate maintenance.
- .2 Supply and install a pet-cock on pipe between main and air vent for shut-off and servicing of vent.
- .3 Provide manual type air vents on all upfed radiation. Extension shall be provided to enable operation of the vent without removing the enclosure.

3.06 Drains

- .1 Provide drain valves with hose ends at the low points of all piping, and at the bottom of each downfeed heating riser.

- .2 All small drains from each piece of equipment shall be brought over to a hopper drain and shall terminate 50mm (2") above the funnel. These shall include small surface drains from cooling system main drain outlets, etc., and shall run in galvanized steel piping to nearest floor drain or hopper. No drip drain or over-flow line shall be left so that liquid or vapour will spill on equipment or floors.

- .3 On all mains and risers provide a ball valve between mains and sediment faucets.

3.07 Thermometers

- .1 Thermometers to be installed for easy reading. Thermometers shall be provided where shown on the drawings.

3.08 Gauges

- .1 Pressure gauges shall be supplied and installed where shown on the drawings.

PART ONE - GENERAL

1.01 General

- .1 All conditions included in Section 21 05 01 form part of this specification and shall apply as if repeated here. This contractor is to become familiar with those requirements and to conform to all provisions affecting his work.

1.02 Scope of Work

- .1 The work included in this Contract shall include the furnishing of all labour, materials, equipment, plant, tools and services necessary for, and incidental to the supply, installation and completion of insulation to the full intent of the Drawings and as hereinafter specified.
- .2 Work shall include, but is not necessarily limited to insulation of the following:
 - .1 Chilled Water Piping
 - .2 Steam and Condensate Piping
 - .3 Outdoor air ducts from intake louvers to AHU-8 & AHU-18 including plenum.
 - .4 HVAC supply ductwork from AHU-8 & AHU-18.
 - .5 Temporary outdoor ductwork from temporary AHU to AHU-8 & AHU-18 distribution system.
 - .6 Exhaust ductwork on AHU-8, AHU-18 and FE-18 replacement.
 - .7 Air intake plenum drain pipe to drain.
 - .8 Domestic water piping

1.03 Reference Standards

- .1 Conform to CHVAC-1975, CSA B54.1-1972 and ASTM 4-11-1967.

1.04 Submittals

- .1 Submit for approval if requested, manufacturer's catalogue literature related to installation, fabrication for pipe, fittings, valves and jointing recommendations.

1.05 Definitions

- .1 Unless otherwise specified, terms "exposed pipe" or "exposed ductwork" as used in this section shall refer to pipe or ductwork in finished spaces and shall include all areas except; furred spaces, pipe and duct shafts, spaces above furred ceilings, spaces over excavated areas, and crawl spaces. These latter areas will be referred to as "concealed spaces". Working chases or cores shall be considered as finished spaces.

PART TWO - PRODUCTS

2.01 Pipe Insulation

- .1 Non-Flammable Hot/Cold Liquids (Chilled Water Supply and Return, Steam and Condensate, AHU Drains and Plenum Drains:
 - .1 Pipe and fittings insulation shall be preformed glass fiber having a nominal density of 88 kg/m³(5lbs/ft³).
 - .2 Jacketing on pipe insulation shall be as follows:
 - .1 Glass fiber reinforced kraft foil laminate.
 - .2 Maximum vapour transmission rate of 0.02 perms.
 - .3 50mm (2") longitudinal overlap joints.
 - .4 Fire retardant having a maximum flame spread rating of 25 and a maximum smoke developed rating of 25.
 - .5 50mm (2") overlap butt joints.
 - .6 Insulation covers for fittings shall be premolded to match jacket type.
 - .7 Protective Jacketing (see equipment location):
 - .1 Self sealing PVC (sized to pipe).
 - .2 Steam and Condensate only:
 - .1 Utility Rooms - embossed aluminum.
 - .8 Exterior insulation shall be made weatherproof.

2.02 Rigid Duct Insulation

- .1 Rigid rectangular duct insulation shall be, rigid fibre glass board, having a minimum density of 96 kg/m³ (6lb/ft³). Vapour jacket shall be factory applied foil-scrim-kraft facing consisting of aluminum foil reinforced with fibre glass yarn mesh and laminated to 2.7 kg (6lb). chemically treated fire resistant kraft.

- .2 Rigid round duct insulation shall be semi-rigid fibrous glass board material designed for application to curved surfaces 10" diameter or larger. Semi-rigid fibre glass board shall have a minimum compressive strength at 10% deformation of 125lb/sq.ft.. Vapour jacket shall be factory applied laminated kraft-aluminum foil ASJ facing.
 - .1 Standard of acceptance: Owens Corning Fiberglass Pipe and Tank Insulation.
- .3 Maximum flame spread rating 25. Maximum smoke developed rating 50.
- .4 Protective Jacketing:
 - .1 Interior: Interior Self Adhering waterproof Membrane
 - .2 Exterior: Exterior Self Adhering waterproof Membrane
- .5 Exterior insulation shall be made weatherproof.

2.03 Flexible Duct Insulation

- .1 Flexible duct insulation shall be fibre glass, formed into a flexible blanket, having a nominal density of 12 kg/m³(0.75lb/ft³).
- .2 The insulation shall be furnished with a factory applied foil-scrim-kraft facing consisting of aluminum foil reinforced with fibre glass yarn mesh and laminated to chemically treated fire resistant kraft.

2.04 Protective Jacketing

- .1 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type and sheet to CGSB 51-GP-53M with pre-formed shapes as required.
 - .2 Colors: Prefinished white.
 - .3 Minimum service temperatures: -20°C.
 - .4 Maximum service temperature: 65°C.
 - .5 Moisture vapour transmission: 0.02 perm.
 - .6 Thickness: 0.56 mm.
 - .7 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.

- .3 Pressure sensitive vinyl tape of matching colour.
- .8 Special requirements:
 - .1 Indoor: flame spread rating 25. Smoke developed 50.
 - .2 Outdoor: UV rated material at least 0.5 mm thick.
- .9 Covering adhesive: Compatible with insulation.

- .2 Canvas:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
 - .2 Lagging adhesive: Compatible with insulation.
 - .3 Provide adequate lagging adhesive to provide a smooth finish to the satisfaction of the Engineer.

- .3 Aluminum:
 - .1 To ASTM B209.
 - .2 Thickness: 0.50 mm sheet.
 - .3 Finish: Stucco embossed or corrugated.
 - .4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.

 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

- .4 Stainless steel:
 - .1 Type: 304 or 316.
 - .2 Thickness: 0.25 mm.
 - .3 Finish: Smooth, corrugated or stucco embossed.
 - .4 Joining: Longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.50 mm thick die-shaped fitting covers with factory-attached protective liner.

 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

- .5 Fiberglass:
 - .1 Provide fiberglass jacket system over applied insulation to provide continuous vapour barrier equal to Fiberane jacket as manufactured by

- .6 Exterior Self Adhering Waterproof Membrane:
 - .1 Provide weather proof composite membrane consisting of a multiply embossed UV-resistant aluminum foil/polymer laminate, rubberized asphalt layer, low temperature (10F) acrylic adhesive layer.
 - .2 Application: Peel and Stick
 - .3 Properties:
 - .1 Product Thickness (w/o liner): 35-38 mils
 - .2 Product Weight: 0.2 lbs/sf
 - .3 Water Vapor Transmission (grains/hr-ft²): 0 .00
 - .4 Permeance (US Perms) : 0 .00
 - .5 Peel Adhesion (to primed steel): >16 lbs/in
 - .6 Elongation at Break : 164%
 - .7 Tensile Strength: 50 lb/in
 - .8 Puncture Resistance (Film Only): 150 PSI
 - .9 Mold Resistance ASTM C1338 : Pass
 - .10 Upper Temperature Limit :150°F
 - .11 Emissivity: .030
 - .4 Pipe Fittings: Preformed 0.5 mm thick die-shaped aluminum fitting covers with factory attached protective liner. Fitting covers shall have adequate extension to ensure adequate overlap.
 - .5 Acceptable Product:
Cold Glycol - Alumaguard
Ductwork and all other fluids - Alumaguard All-Weather.

- .7 Interior Self Adhering Waterproof Membrane:
 - .1 Provide 5 ply composite membrane consisting of UV-resistant aluminum foil/polyester laminate, low temperature acrylic adhesive, and kraft liner.
 - .2 Application: Peel and Stick
 - .3 Properties:
 - .1 Product Thickness (w/o liner): 5 mils
 - .2 Water Vapor Transmission (grains/hr-ft²): 0 .00
 - .3 Permeance (US Perms) : 0 .00
 - .4 Peel Adhesion (to primed steel): 62.4oz/in

- .5 Breaking Strength : 80.9 lbs
 - .6 Tensile Strength (film only): 5000psi
 - .7 Puncture Resistance (Film Only): 48.7 PSI
 - .8 Mold Resistance ASTM C1338 : Pass
 - .9 Upper Temperature Limit :150°F
 - .10 Flame/Smoke Ratings: Meets 25/50
 - .11 Emissivity: .030
 - .12 Color: White
- .4 Pipe Fittings: Preformed PVC fitting covers.Fitting covers shall have adequate extension to ensure adequate overlap.
- .5 Acceptable Product: Alumaguard Lite White

2.05 Removeable Insulation Covers

- .1 General:
- .1 All Covers shall be sewn, stapled or” hog-ringed” covers shall not be acceptable.
 - .2 Covers shall conform to the configuration of the items being insulated.
 - .3 Covers shall include openings for all protrusions such as pipes, packing glands on valves and expansion joints, hangers, supports, instrument lines, and other appurtenances.
 - .4 Covers shall be designed so that no force bending or folding of the cover is necessary for installation.
 - .5 Minimum 50mm wide flaps at terminal ends are to be provided to overlap adjacent covers to ensure a good heat seal.
 - .6 Parting seems shall be at the installed low points (gravitational bottom) of the cover to allow drainage without the use of weep tubes or grommets.
 - .7 Valve bonnets are to be covered, but packing glands shall remain exposed.
 - .8 Valve covers are to be designed such that the bonnet section is sewn to the body section. For larger valves, the cover may be fabricated in two sections, each section containing one half of the valve body and bonnet.
 - .9 Covers shall incorporate integral vapor barrier.
- .2 Insulation Core:

- .1 The insulation core shall be fabricated in one piece, wherever possible.
 - .2 To prevent insulation settlement, the insulation core shall be secured within the jacket through the weather barrier (outer jacketing), the insulation, and the liner (inner jacketing).
 - .3 Insulating cores with more than one piece shall have staggered joints to prevent hot spots and heat loss. The joint edges shall be butted together and extra securement provided at those edges.
 - .4 Insulation core shall be comprised of 50mm thick fiberglass insulation of non-combustible wool with resilient inorganic glass fibers bonded with a thermosetting resin. Insulation density to be 38 Kg/m³. Insulation thermal conductivity to be 0.044W/m.°C at a mean temperature of 100°C.
- .3 Jacket
- .1 The jacket shall be fabricated in one piece, wherever possible.
 - .2 Gusset walls shall be required for covers with core insulation thickness in excess of 25mm.
 - .3 All seams, except the final closing seam, shall be inside seams. The jackets are to be sewn inside out, then turned correct side out before inserting the insulation core. The final closing seam shall be sewn on the exterior of the jacket. Seams shall be sewn with Teflon® coated fiberglass thread or Kevlar® coated stainless steel thread.
 - .4 Machine stitching shall be used for all sewing. Sewing shall be 6-8 stitches per centimeter.
 - .5 Draw cords are to be placed along the outer edge of the flap and the outer edge of the flap then rolled back inside and double stitched.
 - .6 Draw cords are to be of sufficient length to allow 150mm of cord to protrude from each side of the flap.
 - .7 The inner and outer jacket shall be comprised of a fiberglass fabric impregnated with silicone rubber. The silicone rubber shall be flame retardant and suitable for high temperature usage. Outer jacket density shall be 595 gms/m².
- .3 Securement Devices:
- .1 The securement belts and D-ring belts shall be of the same material as the weather barrier (exterior jacket).
 - .2 The belts shall be placed 50mm back from the parting seams and on 150mm centers.

- .3 Fire retardant Velcro® shall be used to fasten the securement belt to the weather barrier after the belt passed through the Stainless Steel D-rings.
- .4 Warranty:
 - .1 Provide a 5-year product Warranty
- .5 Acceptable manufacturers:
 - .1 Advanced Industrial Systems Inc., Thermo Help Canada Inc., Advanced Thermal Corp.

2.06 Accessories

- .1 Stainless steel wire, 18 gauge, Type 304, dead soft annealed.
- .2 Galvanized wire, 15 gauge, annealed.
- .3 Stainless steel mesh, hexagonal mesh, 20 gauge, Type 204.
- .4 Galvanized Mesh, hexagonal mesh, 15 gauge, galvanized annealed.
- .5 Aluminum straps, shall be 13mm (1/2") x 26 gauge.
- .6 Stainless steel straps, shall be 13mm (1/2") x 26 gauge. Type 304, dead soft.
- .7 Lagging adhesive, shall be Childers Chil-Lag CP-52 or Sealfast 30.36.
- .8 Vapour barrier mastic, shall be Childers Chil-Perm CP-10 weather barrier coating.
- .9 Weatherproof coating shall be Childers Chil-Perm CP-32 or Flintkote 230-04.
- .10 Reinforcing membrane under weatherproof coating shall be Childers Chil-Glas #5.

2.07 Acceptable Products

- .1 Products of the following manufacturers are acceptable.

Fibreglass Canada
Canadian Johns Manville

Knauf Fibre Glass
Bakor
Dow

PART THREE - EXECUTION

3.01 General

- .1 Install insulation in accordance with the Thermal Insulation Association of Canada (TIAC) Best Practices Guide. Unless specific insulation details indicated on drawings submit proposed insulation details to Engineer for review prior to installation. Installation details shall be in accordance with applicable TIAC standard insulation details.
- .2 All insulation applied to cold piping, ductwork, and equipment shall have continuous insulation and vapour barrier with no condensation (surface or interior) permitted.

3.02 Pipe Insulation

- .1 Pipe Insulation Thickness Requirements:

| Insulation Type | Pipe Size | | | | |
|---|---------------------------|----------------|----------------|------------------|----------------|
| | Runouts* ≤50mm (2") | ≤ 25mm (1") | ≤ 50mm (2") | ≤ 100mm (4") | ≥125mm (5") |
| Domestic Cold Water | 25mm (1") | 25mm (1") | 25mm (1") | 25mm (1") | 38mm (1 ½") |
| Heating Systems (LP Steam & Condensate Fluids ≤ 121C) | 38mm (1 ½ ") | 63mm (2 ½") | 63mm (2 ½") | 75mm (3") | 75mm (3") |
| Heating Systems (HP Steam, Fluids ≤ 177C) | 38mm (1 ½") | 75mm (3") | 100mm (4") | 113mm (4 ½ ") | 113mm (3") |
| Chilled Water (Fluids ≥ 4C) | 25mm (1") | 25mm (1") | 25mm (1") | 25mm (1") | 25mm (1") |

* Runouts refers to individual terminal units not exceeding 3.7m (12ft) in length.

- .2 Insulation shall not be applied until all the required tests have been completed.
- .3 Pipe surfaces must be clean and dry prior to application of insulation.
- .4 Pipe insulation must be kept clean and dry.

- .5 Pipe insulation shall be continuous at all hangers. The hangers shall be sized for the insulation thickness and be complete with insulation shields.
- .6 Unless specifically noted otherwise on the drawings, insulation shall be carried through walls and floors in 18 gauge galvanized iron pipe sleeves. Pipe sleeves shall be 25mm (1") larger in diameter than the insulated pipe and the resulting void is to be packed with firestop material. Piping passing through fire separations shall be installed in accordance with fire stop manufacturer's UL or ULC listed detail.
- .7 Both longitudinal and butt joints may be made with factory applied pressure sensitive vapour proof adhesive or by using a vapour proof mastic extending at least 25mm (1") on either side of the joint.
- .8 Valve bodies shall have removable insulation with pre-moulded covers on exposed piping.
- .9 Gouge out insulation for proper fit where there is interface between weld bead and insulation. Insulation shall be bevelled away from studs and nuts to permit their removal without damage to insulation, and shall be closely and neatly trimmed around extending parts of pipe saddles, supports, hangers, and clamp guides and sealed with insulating cement.
- .10 In exposed areas apply pipe jacketing system on specified.
- .11 Pipe jacketing shall be made waterproof by placing seams on bottom and using a clear waterproof sealant where required.
- .12 Install hangers c/w insulation shield on outside of insulation on systems subject to temperatures below ambient. Provide high density insulation under shield.
- .13 Install cellular glass insulation and foam insulation in accordance with manufacturer's instructions for temperature/service expected.
- .14 Install interior and exterior Self Adhering Waterproof Membrane jacketing systems in strict accordance with manufacturers recommended installation practices. Ensure vapor barrier and waterproofing is continuous throughout.

3.03 Duct Insulation

- .1 Schedule of required insulation:

Ducts to be insulated

Thickness

- | | | |
|----|--|-----------|
| .1 | Outdoor air ducts from intakes to air handling units | 50mm (2") |
| .2 | HVAC supply ductwork. | 25mm (1") |
| .3 | Exhaust ducts 3m back from MD, BDD or louver | 25mm (1") |
| .4 | Exterior Ductwork | 75mm (3") |

.2 Rigid Duct Insulation:

- .1 Rigid duct insulation shall be used on exposed ducts.
- .2 Insulation shall be applied with edges tightly butted and sealed with a 75mm (3") wide strip of the vapour barrier material, applied with a compatible adhesive.
- .3 The insulation shall be impaled on stick clips or pins welded to the duct, and secured with speed washers. Maximum spacing of pins shall be 1 pin per square foot.
- .4 Penetrations of the vapour barrier shall be patched with a strip of vapour barrier material.
- .5 Duct insulation and vapour barrier, where applicable, shall be continuous through walls and floor openings, except at fire dampers.
- .6 Where more than one thickness of insulation is required, stagger both longitudinal and horizontal joints.
- .7 In exposed areas apply jacketing system on specified.
- .8 Gouge out insulation for proper fit where there is interference between weld bead and insulation. Insulation shall be bevelled away from studs and nuts to permit their removal without damage to insulation and shall be closely and neatly trimmed around extending parts of pipe saddles, supports, hangers, and clamp guides and sealed with insulating cement.
- .9 Exterior duct jacketing shall be made waterproof by placing seams on bottom and using a clear waterproof sealant under overlapping metal or PVC jacket seams and where required.
- .10 Install interior and exterior Self Adhering Waterproof Membrane jacketing systems in strict accordance with manufacturers recommended installation practices. Ensure vapor barrier and waterproofing is continuous throughout.
- .11 Install hangers c/w insulation shield on outside of insulation on systems subject to temperatures below ambient. Provide high density insulation under shield.

3.04 Flexible Duct Insulation

- .1 Flexible duct insulation, 25mm (1") thick, may be used on all concealed ducts.

- .2 Cut insulation slightly longer than the circumference of the duct to ensure full thickness at corners.
- .3 On ducts 450mm (18") and wider the insulation shall be secured to the bottom of the ducts by means of welded pins and speed clips. Cut pins flush after the clip has been applied.
- .4 Seal all joints and penetrations of the vapour barrier, including locations where it is penetrated by securing pins, with 75mm (3") pressure sensitive aluminum foil tape.

3.05 Removable Insulation Covers

- .1 Installation to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.
- .2 Removable insulation covers shall be provided for the following:
 - .1 Balancing , Control and Regulating Valves.
 - .2 Strainers.
 - .3 Manual Valves NPS 2½ and larger .
 - .4 Flex connections, expansion joints.
 - .5 Air separators.

3.06 Workmanship

- .1 Install insulation in first class manner with smooth and even surfaces. Outline of pipe and round duct insulation shall be true circular and concentric shape. Outline of fitting insulation shall be shaped to blend with adjacent covering. Do not use scrap pieces of insulation where full length section will fit.

PART ONE - GENERAL

1.01 General

- .1 All conditions included in Section 21 05 01, Division 1 and General Conditions form part of this specification and the contractor shall comply with all clauses included in these sections.

1.02 Scope

- .1 The work included in this Contract shall include the furnishing of all labour, materials, equipment, plant, tools and services necessary for or incidental to the supply, installation and completion of air handling systems to the full intent of the drawings and as hereinafter specified.
- .2 Any ductwork, fixtures, work or equipment herein specified but not shown on the plans, or vice versa, or any work, material or equipment necessary for the proper completion of the job shall be furnished and installed as though both shown on the plans and called for in the specification.
- .3 The work covered by this section includes, but is not necessarily confined to the supply and installation of the following:
 - .1 Provision of complete exhaust systems, including fans, etc. as indicated, and specified herein.
 - .2 Provision of complete air handling systems as indicated and specified herein.
 - .3 Provision of temporary ventilation as indicated and specified herein.
 - .4 Provision of re-routing ductwork as indicated and specified herein.
 - .5 Provision of modification to existing ductwork system.
 - .6 Provision of new distribution branches as indicated.
 - .7 Provision of air balancing and duct cleaning as specified herein.

1.03 Shop Drawings

- .1 This contractor shall submit shop drawings for review in accordance with Section 01 33 00 and 21 05 01 for the following equipment:
 - .1 Fans
 - .2 Air Handling Units
 - .3 Louvres
 - .4 Dampers
 - .5 Grilles & Diffusers
 - .6 Humidifiers

PART TWO - PRODUCTS

2.01 Ductwork

.1 General

- .1 All ductwork and hangers shall be constructed of ASTM A924/A653 G90 galvanized steel. Construction shall meet SMACNA Low Pressure Duct Construction Standards unless otherwise indicated or specified under Special Duct Construction.
- .2 The following duct construction is based on a maximum of 0.5 kPa (2" W.C) static pressure in the ducts.
- .3 Alternate construction and reinforcing may be used provided it meets the same rigidity class that the following specification complies with.

.2 Rectangular Ductwork

- .1 Rectangular duct shall be galvanized steel. Ducts shall be fabricated according to the schedule in Appendix 15800A at the end of Part 3 of this section.
- .2 Reinforcing must be attached to the duct within 50mm (2") of the corners and elsewhere at 1.2m (4 ft) centers maximum. Attachment may be spot welds, rivets or screws.
- .3 Hangers for rectangular duct shall be as follows:

| Longest Side | Trapeze Shelf Angle | Hanger Rods | Hanger Spacing |
|----------------------------|----------------------------|--------------------|-----------------------|
| Up to 750mm (30") | 25 x 25 x 3 | 6mm (1/4") | 2.5m (8ft) |
| 775 (31") to 1050mm (42") | 38 x 38 x 3 | 6mm (1/4") | 2.5m (8ft) |
| 1075 (43") to 1500mm (60") | 38 x 38 x 3 | 9mm (3/8") | 2.5m (8ft) |
| 1525 (61") to 2100mm (84") | 50 x 50 x 3 | 9mm (3/8") | 1.5m (5ft) |
| 2125 (85") and up | 60 x 50 x 6 | 9mm (3/8") | 1.5m (5ft) |

- .4 Hanger rods must be attached to the shelf angle within 50mm (2") of the duct on both sides.
- .5 For ducts 200mm (8") and smaller, 25mm (1") wide strap hangers extending down two sides of the duct and a minimum of 25mm (1") under the bottom of the duct may be used instead of trapeze hangers.
- .6 Strap hangers must be attached to the duct a maximum of 50mm (2") from the corner and at a maximum of 1200mm (48") centers.
- .7 Longitudinal joints shall be Pittsburgh lock or Button punch snap lock and shall meet SMACNA Low Pressure Duct Construction

- Standards.
- .8 Ducts 300mm (12") wide and larger shall be cross broken or beaded. Beading shall be provided a maximum of 150mm (6") from joints and at a maximum spacing of 300mm (12").
 - .9 On ducts which will be under negative pressure ducts will be cross broken for inward deflection.
 - .10 Hangers shall be the same material as the duct.
- .3 Round Duct
- .1 Round ductwork shall be galvanized steel of the following U.S. Standard gauges.

| Duct Diameter | Spiral Duct Gauge | Plain Duct Gauge |
|----------------------------|-------------------|------------------|
| 75mm (3") - 200mm (8") | 28 | 24 |
| 225mm (9") - 350mm (14") | 26 | 24 |
| 375mm (15") - 650mm (28") | 24 | 22 |
| 675mm (29") - 900mm (36") | 22 | 20 |
| 925mm (37") - 1250mm (50") | 20 | 18 |
 - .2 Longitudinal joints for round duct shall be butt welded, SMACNA type RL-4 or grooved seams, SMACNA type RL-5.
 - .3 Transverse joints beaded crimp joints with at least 25mm (1") lap to accommodate screws at 400mm (16") centers or a minimum of 3 per joint.

2.02 Special Duct Construction

- .1 Temporary Ventilation Duct
 - .1 Temporary ductwork is existing on site/supplied by owner. Contractor shall provide any additional fittings as required.
 - .2 Temporary ductwork on gravel roof shall be installed and secured in place by this contractor using fabricated duct restraint system and sleepers, refer to details on drawings.

2.03 Flexible Ductwork

- .1 Flexible ducts shall be:
 - .1 UL listed for Class 1 air duct material, UL-181.
 - .2 In accordance with NFPA Standard 90A.

- .3 Constructed of corrosion resistant, coated spring wire bonded to a woven fibre glass impregnated fabric or 22 mil P.V.C. cloth.
- .4 Capable of operating pressures of 2.5 kPa (10" W.C) positive and 0.5 kPa (2" W.C) negative.
- .5 Capable of operating temperatures of from -18 Degrees C (0 Degrees F) to 93 Degrees C (200 Degrees F).
- .6 Acceptable Products: Thermaflex M-KE or Atlas Type LD, insulated, for both insulated and non-insulated ducts.

2.04 Duct Sealers and Tapes

- .1 Duct sealers shall consist of woven fabric material coated with a sealant which shall be:
 - .1 Water resistant.
 - .2 Compatible with duct materials.
 - .3 Suitable for the service involved.
 - .4 Meet ULC S-102 (1975).
 - .5 Flame spread ratings of 25 and maximum smoke developed rating of 50.
 - .6 Non toxic.
- .2 Acceptable Products: Trans Continental Tough-Bond, Duro Dyne, Bakor.

2.05 Access Doors

- .1 Access doors under 600mm (24") x 600mm (24") shall have at least two heavy duty hinges in conjunction with two heavy duty type latches. Access doors 600mm (24") x 600mm (24") and over shall be installed with at least three heavy duty hinges, two heavy duty latches, and one pull.
- .2 All hardware shall be equal to Duro Dyne:

| Door Sizes | Latch Model No. |
|--|----------------------------|
| Up to 300mm (12") x 300mm (12") | SL - 1 |
| 325 (13") x 325 (13") to 600 (24") x 600 (24") | SP - 10 |
| 625 (25") x 625 (25") and Larger | SP - 20 |

2.06 Balancing Dampers

- .1 Provide balancing dampers on each supply and return branch.

- .2 Balancing dampers shall be the same materials as duct and complete with locking operator.

2.07 Flexible Connections

- .1 Flexible connections shall be as follows:
 - .1 Heavy glass fabric double coated with neoprene.
 - .2 Non-combustible.
 - .3 Weatherproof and airtight.
 - .4 Resistant to acids, grease, alkaline oil and gasoline.
 - .5 Acceptable for temperatures of up to 93 deg C (200 deg F).
- .2 The flexible connections will be pre-assembled of 24 gauge galvanized metal clinched by means of a double lock seam to each side of the fabric.
- .3 Acceptable Products: Duro Dyne Neoprene.
- .4 Acceptable product for outdoor use or temperatures to 120 deg. C (248 deg. F). Duro Dyne Duralon.

2.08 Grilles, Registers and Diffusers

- .1 Grilles, registers and diffusers shall be E.H. Price, Airvector, Titus, Kruger, Carnes, Nailor or Tuttle & Bailey.
- .2 All grilles, diffusers and registers shall be of type and size indicated on drawings and shall be complete with O.B. damper unless otherwise noted.
- .3 Grilles and diffusers located in drywall ceilings shall be supplied complete with plaster frame.
- .4 Grilles and diffusers smaller than one full tile located in T-bar ceilings shall be supplied complete with plaster frame.
- .5 Refer to grilles and diffusers schedule on drawings for sizes and capacities.

2.09 Fans General

- .1 Units shall be of the size and capacity as indicated. Motor sheave shall be adjustable and sized so that specified speed is in the mid-range of the pulley.

- .2 Provide fan curves and acoustic data as part of shop drawings.
- .3 Motors shall be sized so that they draw no more than 75% of their rated maximum amp draw at design conditions.
- .4 Suspended units shall have spring type vibration isolators minimum 12mm (1/2") deflection.

2.10 In-line Exhaust Fans

- .1 FE-18:

Provide VFD compatible, in-line exhaust fan as indicated in drawing schedule. Fan shall be hung from ceiling, belt drive c/w disconnect switch, belt guard, ceiling mounted isolators, 14 Ga. Steel housing, re-greaseable bearings.

Acceptable alternate products: Greenheck, S&P

NOTE: Exhaust fan VFDs provided by Electrical.

2.11 Louvres

- .1 Provide louvres of sizes as shown on the drawings.
- .2 Louvres shall at least meet the following construction details. All welded construction. 12 Ga frame and blades of 6063-T52 alloy, 150mm (6") deep. Fastenings, all stainless steel. 12mm (1/2") aluminum birdscreen on inside face. Factory finished after assembly with Kynar 500 coating in colour to match adjacent siding colour. Airolite K6386 is an acceptable product.
- .3 Acceptable Materials: Alumavent, Ruskin, Ventex.

2.12 Indoor Modular Air Handling Units (AHU-8 & AHU-18)

- .1 Provide packaged modular air handling units as specified herein. Johnson Controls, Engineered Air, Daikin and Trane are considered Acceptable Alternates provided all features are included.
- .2 Suppliers are CAUTIONED that the units must be equal or better in all significant respects to the units specified to be considered and must fit in the existing space constraints.
- .3 Quality Assurance
 - .1 Air-handling unit assembly shall have UL 1995 certification for safety, including use with electric heat.

- .2 Products requiring electric connection shall be listed and classified by ETL and CSA as suitable for the purpose specified and indicated.
 - .3 Coil performance shall be certified in accordance with AHRI Standard 410, latest edition.
 - .4 Unit performance shall be rated in accordance with AHRI Standard 430 for Central Air Handling Units and subject to verification of rating accuracy by AHRI-sponsored, third party testing. Units shall meet NFPA 90A requirements.
- .4 General Description
- .1 Units shall ship in the number of sections necessary to meet project installation requirements. Contractor to coordinate with manufacture prior to shipping.
 - .2 Unit shall be factory-supplied, central station air handler. The air-handling unit shall consist the factory-installed components specified herein or as indicated on the equipment schedule and AHU Schematic.
 - .3 Unit shall be provided with supply airflow measuring station c/w transmitters as required to provide signal to BMS.
- .5 Casing
- .1 Construction:
 - .1 All units shall be supplied with 14-gage or heavier, G-90 galvanized steel base rails. Perimeter lifting lugs for overhead lifting shall be provided on each shipping section.
 - .2 Unit shall be thermally broken to minimize the conduction path from the inside of the casing to the outside.
 - .3 Casing panels (top, sides, and bottom) shall be constructed of:
 - .1 Exterior : Unpainted G90 Galvanized steel.
 - .2 Interior: Unpainted 304 stainless steel
 - .4 Casing panels (top, sides, and bottom) shall be one piece, double-wall construction with insulation sealed between the inner and outer panels. Panel assemblies shall not carry an R-value of less than 13.
 - .5 Casing deflection shall not exceed a 1:200 ratio when subject to an internal pressure of ± 8 -in. wg. Casing leakage rate shall be less than 1% at 8 in. wg of nominal unit airflow or 50 cfm, whichever is greater.
 - .6 Fan supports, structural members, panels, or flooring shall not be welded, unless aluminum, stainless steel, or other corrosion-resistant material is used.
 - .7 All coil sections shall be double-wall construction with insulation sealed between the inner and outer panels.

- .8 Blow-thru sections shall have a diffuser plate as an integral part of the fan section.
- .2 Provide the following accessories :
 - .1 Hinged double-wall access doors as indicated (see schedule) with removable access panel(s) on the other side.
 - .2 Factory installed Thermal pane reinforced glass viewports as indicated (see schedule)
 - .3 Factory installed Marine lights as indicated (see schedule)
- .3 Drain Pans:

Drain pans shall be insulated double-wall stainless steel construction. The pan shall be sloped toward the drain connection. Drain pan shall have 1 1/2-in. MPT connection exiting through the hand side or opposite side of the casing as required to suit the site conditions. Contractor to coordinate with manufacturer prior to AHU construction. One drain outlet shall be supplied for each cooling coil, humidifier section, and outdoor air section. Drain pan shall allow no standing water and comply with ASHRAE Standard 62.1-2010.
- .6 Fans
 - .1 General:
 - .1 Entire fan assembly shall be cleaned, primed and painted with alkyd enamel, except for an aluminum fan wheel when supplied. They shall be designed for continuous operation at the maximum rated fan speed and motor horsepower. Fans shall be VFD compatible as well as have an AMCA class rating corresponding to the static pressure at which the fan is designed to operate (Class I, II, or III). Completed fan assembly shall be dynamically balanced.
 - .2 Fan assembly vibration shall not exceed 0.248 in. per second when mounted on active isolators. Vibration shall be measured in both vertical and horizontal directions at the specified fan operating speed using specified motor. Accelerometers shall be mounted on the motor near the bearing locations.
 - .3 All fan sled components shall provide corrosion protection to pass 100-hour salt spray test per ASTM B-117.
 - .4 Fan wheels shall be keyed to the shaft and shall be designed for continuous operation at maximum rated fan speed and motor horsepower. Fan wheels and shafts shall be selected with a maximum operating speed 25% below the first critical.

- .5 Belt drive fan motor shall be mounted within the fan section casing on slide rails equipped with adjusting screws. Motor shall be premium efficiency, open drip-proof or totally enclosed fan cooled NEMA Design A or B with size and electrical characteristics as shown on the equipment schedule. All three-phase motors shall have a \pm 10% voltage utilization range and a 1.15 minimum service factor.
- .2 Performance Ratings:
Fan performance shall be rated and certified in accordance with AHRI Standard 430, latest edition.
- .3 Sound Ratings:
Manufacturer shall submit first through eighth octave sound power for fan discharge and casing radiated sound. Sound ratings shall be tested in accordance with AHRI 260.
- .4 Mounting:
Fan scroll, wheel, shaft, bearings, drives, and motor shall be mounted on a common base assembly. The base assembly is isolated from the outer casing with factory-installed isolators and rubber vibration absorbent fan discharge seal. Units shall use 2-in. deflection spring isolators.
- .5 Fan Accessories:
 - .1 Belt guards.
 - .2 Inlet screen.
 - .3 Supply airflow measuring station c/w transmitter to provide signal to BMS.
- .7 Bearings and Drives
 - .1 Bearings:
Self-aligning, grease lubricated, anti-friction with lubrication fittings extended to drive side of fan section. Provide grease fittings extended to the exterior of the casing. All bearing life calculations shall be done in accordance with ABMA 9 for ball bearings and ABMA 11 for roller bearings. Bearings shall be selected for a minimum average life (L50) of 200,000 hours.
 - .2 Shafts:
Fan shafts shall be solid steel, turned, ground, polished and coated with a rust inhibitor.
 - .3 V-Belt Drive:
Drive shall be designed for a minimum 1.5 service factor. All drives shall be factory mounted, with sheaves aligned and belts properly tensioned.
 - .4 VFDs:
Provide AHUs c/w VFD on each fan.
Acceptable manufacturers: ABB, Danfoss

- .8 Coils
 - .1 All water, steam and direct expansion (DX) refrigerant coils shall be provided to meet the scheduled performance. All coil performance shall be certified in accordance with AHRI Standard 410. All water and direct expansion coils shall be tested at 450 psig air pressure.
 - .2 General Fabrication:
 - .1 All water and refrigerant coils shall have minimum 1/2-in. OD copper tubes mechanically expanded into fins to ensure high thermal performance with lower total flow and pumping requirements. Minimum tube wall thickness shall be 0.016 inches.
 - .3 Hydronic Cooling Coils:
 - 1. Headers shall be constructed of steel with steel MPT connections. Headers shall have drain and vent connections accessible from the exterior of the unit.
 - 2. Configuration: Coils shall be drainable, with non-trapping circuits. Coils will be suitable for a design working pressure of 300 psig at 200 F.
 - .4 Face and Bypass Steam Heating Coils:
 - 1. 5/8" OD steel tube, aluminum fin, 16 ga galvanized casing
 - 2. Minimum MAWP (pressure rating): 100 psig
 - 3. Capacity: As indicated on schematic
 - 4. Inlet pressure: 10 psig
- .9 Humidifier Sections:
 - .1 Equip with drain pan, access door with viewing glass and marine light.
 - .2 Provide direct injection humidifier as per section 2.13.
- .10 Filter Sections:
 - .1 Flat filter sections shall accept either 2-in. or 4-in. filters. Sections shall include side access slide rails.
 - .2 Provide c/w Dwyer Magnehelic Gages or equal
- .11 Dampers
 - .1 Mixing boxes, filter-mixing boxes, and exhaust boxes shall have parallel or opposed blades and interconnecting outside-air and return-air dampers
 - .2 Damper blades shall be constructed of galvanized steel with a double-skin airfoil design, with blade seals and stainless steel jamb seals. Blades shall be mechanically fastened to axle rods rotating in self-lubricating synthetic bearings. Maximum leakage rate shall be 2 cfm/ft² at 1 in. wg (0.25 kPa) differential pressure.

- .12 Refer to Equipment Schedule on drawings for individual AHU requirements.

2.13 Direct Injection Humidifier (H-8)

- .1 Humidifier H-8:
Provide Dristeem Ultra-Sorb
Size: 88"W x 46"H
Absorption Distance: 6"
Load: 107 lb/hr
Steam Pressure: 10 psig
Provide c/w:
- 304 stainless steel construction
 - Air proving switch
 - Duct mounted high limit humidistat
 - Drain water cooler
 - Communications interface compatible with building EMCS.
 - High efficiency insulated tubes
 - Start-up by manufacturer's technician
- Acceptable alternate product: Neptronic

2.14 Direct Injection Humidifier (H-18)

- .1 Humidifier H-18:
Provide Dristeem Ultra-Sorb
Size: 75"W x 48"H
Absorption Distance: 10"
Load: 89.1 lb/hr
Steam Pressure: 10 psig
Provide c/w:
- 304 stainless steel construction
 - Air proving switch
 - Duct mounted high limit humidistat
 - Drain water cooler
 - Communications interface compatible with building EMCS.
 - High efficiency insulated tubes
 - Start-up by manufacturer's technician
- Acceptable alternate product: Neptronic

PART THREE - EXECUTION

3.01 Installation and Commissioning of Equipment

- .1 Install in strict accordance with manufacturer's instructions, and Provincial Regulations.
- .2 Clearances: Provide clearance around units for service and maintenance.
- .3 Manufacturer's instructions shall be made available to the installing tradesmen and commissioning agent (where applicable) prior to installation of equipment. These instructions are to be read, understood, and closely followed. Failure to abide by this requirement will provide justification for the engineer to require removal and re-installation.
- .4 Ensure that all safety devices and other significant accessories are in place and operable before starting major pieces of equipment. As part of the commissioning process accessories are to be checked, calibrated, and adjusted as necessary to ensure safe operation.
- .5 Follow manufacturer's instructions in detail in establishing start-up and commissioning procedure.
- .6 Provide start-up reports on all equipment installed under this Contract. Start-up shall be by the manufacturer's representative or factory trained technician for the following equipment including but not limited to:
 - .1 Humidifiers
 - .2 Air Handling Units
 - .3 Exhaust Fans

3.02 Ductwork

- .1 General:
 - .1 All ductwork shall be constructed, installed, and sealed in accordance with ANSI/SMACNA 006 "HVAC Duct Construction Standards – Metal and Flexible", latest edition.
 - .2 Ductwork at louvres shall be welded or made watertight. Ducts shall be sloped so that water drains to the outside or be sloped to a low point and provided with a 25mm (1") pipe to drain. On exhaust ducts this requirement shall extend to at least one metre past the damper. On

intake ducts this requirement shall extend up to the filter and be arranged so that any snow trapped and melting at the filter will be piped to a drain.

- .3 At all locations where splitter dampers are indicated on the drawings furnish splitter dampers with manufactured control and linkage devices. A 6mm (1/4") diameter steel rod shall be provided to connect the bracket and the ball joint control device for positioning the damper.
- .4 At each main branch take-off and in such other locations where required to properly balance the air distribution system, furnish and install volume dampers which shall be provided with damper regulators. Where regulators are mounted on insulated ducts the regulator shall be mounted on top of the insulation.
- .5 A balancing damper shall be installed in all branches off the main trunk duct. Additional dampers shall be installed in any short branches leading to supply or return outlets. In all cases, sufficient dampers shall be installed in the branches so that the dampers at the diffusers are used for "Fine tuning" only.
- .6 Provide access doors for access to filters, fire dampers, dampers, coils, and where shown or directed. Access doors shall be tight fitting.
- .7 Sheet Metal Contractors shall review drawings with Balancing Contractor before installation and have all required dampers, extractors, etc. included at time of installation.
- .8 Ductwork shall be free from pulsation or objectionable noises. Should these defects appear, they shall be corrected by replacing or reinforcing the work as directed by the Engineer at the site and without charge.
- .9 The dimensions of any duct must be as indicated on the drawings, except wherever any construction impediment or requirement renders such dimensions impossible, in which case it must be altered to give an effective cross sectional area equal to that which could have been obtained from the original at no cost to the Owner. Where conflicts occur with other trades, the Engineer reserves the right to make changes in site locations without extra cost. Where insulation is installed on interior of ducts, the dimensions shown on plans are clear inside dimensions.
- .10 Install duct elbows having a throat radius 1-1/2 times the diameter or fabricated with square throats and backs, fitted with duct turns. Duct turns shall be fabricated with blades of approved construction.
- .11 All vertical ducts in shafts shall be rigidly supported with steel angles supplied and installed by this Contractor. In no case shall angles be less than 38mm x 38mm x 6mm (1 1/2" x 1 1/2" x 1/4").
- .12 All duct joints shall be coated with duct sealer applied according to manufacturer's recommendations before assembling.
- .13 Where ducts are shown passing through fire separations and at the floor, there shall be provided a continuous 38mm x 38mm x 6mm (1

½" x 1 ½" x ¼") galvanized angle iron frame which shall be bolted to the construction and made airtight to the same by applying caulking compound. Sheet metal at these locations shall be bolted to the angle iron. Any excess space between duct and opening shall be packed and sealed with fire stop material.

.2 Round Ductwork:

- .1 Where space permits round ducts may be used in place of rectangular ducts sized to provide the same air carrying capacity.
- .2 Long radius elbows shall be used where space permits. Where space is limited use maximum radius possible.
- .3 90 Degree branch take-offs shall be made with conical "T"s.
- .4 30 Degree take-offs shall be used on dust collection system.
- .5 Balancing dampers shall be provided in all take-offs from mains or branch mains.

3.03 Flexible Ducts

- .1 Insulated flexible duct may be used for a distance of 2m (7ft) between the ventilation diffuser and the supply duct.
- .2 Flexible duct shall be supported at 1.5m (5ft) intervals maximum.
- .3 Insulated flexible duct may be used between return grilles and ductwork. In no case shall the flexible duct exceed 3m (10ft) in length.

3.04 Duct Sealers and Tapes

- .1 Surfaces shall be cleaned and treated in accordance with manufacturer's recommendations.
- .2 Sealer shall be spread on one side of the tape. The tape shall be wrapped around the area to be sealed (activated side to the metal) and overlapped 50mm (2"). The exposed side of the tape shall then be covered with sealer.

3.05 Duct Sealing Class and Leakage Testing

- .1 Duct Sealing:
 - .1 Seal ductwork to minimum:
SMACNA Seal Class : **A**
SMACNA Leakage Class : **6** (rectangular ductwork)

3 (round ductwork)

- .2 Test duct systems as required by National Building Code and Provincial Regulations. Ensure systems are free of audible leaks
- .3 Ductwork is to be leak tested only where required per the NECB in accordance with ANSI/SMACNA 016 "HVAC Air Duct Leakage Test Manual".
- .4 Perform tests using an independent testing laboratory whose equipment, facilities and qualifications are acceptable to the Consultant.
- .5 Acceptable Leakage Rates:
 - .1 Sealed ductwork leakage is not to exceed the value in .1 above at maximum system pressure as stated in Part 2.

3.05 Access Doors

- .1 Access doors shall be provided at all fire dampers, fresh air and exhaust plenums, before filters, coils, and any device requiring maintenance or observation.
- .2 Insulated access panels shall be provided where the ducts are to be insulated.

3.06 Dampers

- .1 Control dampers shall be as called for in control section. All control dampers not part of manufactured mixing boxes shall be supplied by the Control Supplier and installed by this Section.
- .2 Opposed blade balancing dampers with locking quadrant shall be provided where shown.
- .3 All exhaust air systems, including roof and wall exhausters, shall be complete with automatic backdraft dampers supplied and installed by the Contractor.

3.07 Fire Dampers

- .1 Wherever required according to the National Building Code, the

Contractor shall supply and install fire dampers. These dampers shall be installed according to the requirements of the manufacturer for the rated assembly.

- .2 Each damper shall be provided with a suitably located access door to allow resetting of dampers. Access doors shall be supplied with removable covers.
- .3 Fire dampers shall be provided at all locations where ducts penetrate a floor and at all locations where ducts penetrate a wall required to have a fire resistance rating. Walls shall include, but not be limited to, the following areas: Exit Stairs, Boiler Room, Electrical Room, Elevator Machine Room, Janitor Rooms, and all floor separations. Refer to Architectural Drawing for all fire separations required to have fire dampers and include for all required.
- .4 Where ducts pass through FIRE PARTITIONS, (2 hours rating) steel plate fire dampers shall be installed as follows:

| | |
|--|----------------|
| Under 12550 sq. mm (20 in ²) | No fire damper |
| Up to 450mm (18") dia. or width | 16 gauge |
| 475mm (19") - 900mm (36") dia. or width | 12 gauge |
| Above 900mm (36") dia. or width | 7 gauge |

Steel louvred type fire dampers shall be installed as follows:

| | |
|----------------------------------|----------|
| Up to 900mm (36") width | 18 gauge |
| 925mm (37") - 1200mm (48") width | 16 gauge |
- .5 Where guillotine dampers are used on ducts less than 450mm (18") the blades shall be completely out of the air stream when open.
- .6 Fire dampers shall be located within the fire separation.
- .7 Fire stops shall be provided where ceilings forming part of the fire rated assembly are penetrated in steel joist construction.
- .8 In general, fire dampers are indicated on the drawings, however, this Sub-Contractor shall review the architectural drawings and provide any additional dampers that may be required in "rated" fire separations at no additional cost.

3.08 Flexible Connections

- .1 Where shown on the drawings and on the inlet and outlet connections of each fan and outlet of each unit, there shall be installed a flexible connection. Flexible connections shall be a minimum of 150mm (6") wide.
- .2 Flexible connections shall be installed with adequate slack.

3.09 Belt Guards

- .1 Belt guards shall be securely bolted to floor or apparatus, to completely enclose drive and pulleys. Provide hinged access doors not less than 150mm (6") x 150mm (6") for access to motor and fan shafts for test purposes. Provide RPM holes at ends of each equipment shaft.

3.10 V-Belt Drives

- .1 Adjust the tension and align V-belt drives.
- .2 Adjust and/or replace sheaves as required during balancing to obtain system specified airflows at the lowest fan speed achievable to reduce noise levels.

3.11 Fans

- .1 All suspended or floor mounted units shall be provided with suitably sized spring type vibration isolators as specified in Part 2.
- .2 Units suspended from the structure shall be provided with suitably sized hanger rods and channel iron shall be provided to distribute the weight of the units over an appropriate number of joists.
- .3 Roof exhausters shall be securely fastened to curbs with non-corrosive fasteners on all four sides.
- .4 Fans shall be mounted in such a manner so that maximum space is available for access to all parts requiring periodic maintenance. Coordinate with all other Trade Contractors to ensure that maximum access is maintained.

3.12 Louvres

- .1 Co-ordinate installation with other trades to ensure that louvres are properly flashed at head, sill and sides to provide a completely weather tight installation.
- .2 Ensure that blank off panels have adequate rigidity and fastening strength for area covered.
- .3 Colour to match adjacent siding colour.

3.13 Air Handling Units

- .1 Install and assemble in accordance with manufacturer's instructions.
- .2 Pipe drains to roof or nearest floor drain per manufacturer's instructions and Canadian Plumbing Code. Pipe materials shall be in accordance with section 22 05 00. Roof mounted unit drains shall utilize PVC pipe suitable for seasonal disassembly.
- .3 Pipe heating and cooling supplies to hydronic coils in AHU with steel pipe and fittings in per section 23 05 00 and accordance with Dept. Of Labour Requirements.
- .4 Do not operate units until ductwork is clean, Dept. of Labor inspections completed (where applicable), filters are in place, bearings lubricated, condensate properly trapped, piping connections verified and leak tested, belts aligned and tensioned, all shipping braces have been removed, and fan has been test run under observation.
- .5 Provide clean filters at substantial completion and one set of spare filters.
- .6 Provide start-up by manufacturer's factory trained technician and submit start up report.

3.14 Humidifiers

- .1 Install in accordance with manufacturer's instructions.
- .2 Provide start-up by manufacturer's technician and submit report to Engineer.

- .3 Div.16 shall provide power wiring to humidifier only. All control wiring and any power wiring between humidifier and distribution units or accessories shall be the responsibility of the mechanical contractor regardless of voltage. Wiring shall be in accordance with Div.16 requirements and the Canadian Electrical Code.

3.15 Duct Cleaning

NOTE: Contractor to submit a detailed duct cleaning plan including estimated timelines and infection control procedures for approval by hospital staff prior to commencing work.

- .1 All ductwork shall be installed while maintaining the highest priority on cleanliness. Ductwork shall be cleaned, handled, stored, and installed in strict accordance with the requirements of “Advanced Level Cleanliness” as described in the SMACNA Duct Cleanliness for New Construction Guidelines.
- .2 Ductwork shall remain sealed until installation, and any exposed opening of installed ductwork shall remain sealed until the completion of connections and/or construction.
- .3 Supply and return ducts shall be cleaned in accordance with CSA Z317.2-10 (Special Requirements for HVAC Systems in Health Care Facilities) and NADCA (National Air Duct Cleaners Association) General Specifications for the Cleaning of Commercial Heating, Ventilating, and Air Conditioning Systems.
- .4 Duct Cleaning shall be performed by qualified duct cleaning firms with minimum 5 years experience performing successful duct cleaning operations in Health Care Facilities per CSA Z317.2 and NADCA requirements.
- .5 Upon completion of cleaning, Verification of HVAC system cleanliness shall be provided in accordance with NADCA ACR 2006. Once the system cleanliness has been verified to meet the cleanliness requirements, Contractor shall prepare and submit the Duct Cleaning Report to the Consultant for review. Report shall include documentation and inspection reports verifying compliance with the standard. Documentation shall be well organized and can include legible written and visual records.
Note:
 - .1 If visual inspection (Method 1 in NADCA ACR 2006) is inconclusive, surface comparison testing (Method 2 in NADCA ACR 2006) shall be used.

- .2 If surface comparison testing is inconclusive, vacuum testing (Method 3 in NADCA ACR 2006) shall be used.

- .6 All cleaning must be completed and approved by the Consultant prior to TAB.

APPENDIX A

Galvanized Steel Ducts: for low pressure up to 0.50 KPA (2" WC)

| DUCT SIZE | DUCT GAUGE | TRANSVERSE JOINTS | | REINFORCING | |
|--------------------------------|---------------|-------------------|-----------------|--|---------------------------------|
| | | Short Side | Longest Side | Size | Spacing |
| Up to 300mm (12") | 26 | T1 | T6 | | None |
| 325mm - 450mm (13" - 18") | 24 | T1 | T6 | | None |
| | 26 | T1 | T6 | 20mm x 20mm (3/4" x 3/4") 20 Ga L | Each Joint Max 2.4m (8ft) |
| | 26 | T3 | T10 | | None |
| 450mm - 750mm (18" - 30") | 24 | T3 | T10 | | None |
| | | T1 | T6 | 25mm x 25mm (1" x 1") 20 Ga L | Each Joint Max 2.4m (8ft) |
| 750mm – 1200mm (30" - 48") | 22 | T3 | T10 | | None |
| | | T1 | T6 | 32mm x 32mm (1 1/4" x 1 1/4") 20 Ga L | Each Joint Max 1.5m (5ft) |
| 1200mm – 1500mm (48" - 60") | 22 | T1 | T6 | 32mm x 32mm (1 1/4" x 1 1/4") 3mm (1/8") L | Each Joint Max 1.5m (5ft) |
| | | T1 | T6 | 50mm x 50mm (2" x 2") 3mm (1/8")L | Each Joint Max 1.2m (4ft) |

Reinforcing must be maximum of 75mm (3") from the joint.

T joints may be used in place of the T10 joints.

See SMACNA manual for details of T joints.

End of Section

PART ONE - GENERAL

1.01 General Conditions

- .1 All conditions included in Section 21 05 01 form part of this specification and shall apply as if repeated here. This contractor is to become familiar with those requirements and to conform to all provisions affecting his work.

1.02 Scope of Work

- .1 The work included in this Contract shall include the furnishing of all labour, materials, etc. necessary for the completion of the Automatic Control Systems required for the operation of the mechanical system.
- .2 Provide a fully operational Direct Digital Control (DDC) microprocessor based building energy management and control system (EMCS) with full range of programmable HVAC and Energy Management capabilities resident on the controller. All new controls shall be Johnson Controls. Work shall include but not limited to the following:
 - .1 AHU-8 & AHU-18 control systems as indicated including new MCUs.
 - .2 Removal and disposal of existing controls including pneumatic tubing, control devices, etc. Coordinate with owner if any devices are to be turned over to owner.
 - .3 Field control devices.
 - .4 Software/hardware complete with full documentation.
 - .5 Complete operating and maintenance manuals.
 - .6 Training of personnel.
 - .7 Acceptance tests, technical support during commissioning, full documentation.
 - .8 Wiring interface co-ordination of equipment supplied by others.
 - .9 Miscellaneous work as indicated or specified herein.
 - .10 Submittals, data entry, pneumatic and electrical installation, programming, start up, and system warranty.
 - .11 Temporary AHU controls connections. Connection of existing temporary control wiring from temporary AHU to DDC system.
- .3 Design Requirements:
 - .1 Design and provide conduit, pneumatic tubing, and wiring linking elements of system. Pneumatic tubing shall be installed as per local codes.

- .4 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by Engineer prior to installation.
- .5 Location of controllers as reviewed by Engineer prior to installation.

1.03 References

- .1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).
 - .1 ANSI/ISA 5.5-[1985], Graphic Symbols for Process Displays.
- .2 American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).
 - .1 ANSI/IEEE 260.1-[1993], American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).
- .3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
 - .1 ASHRAE STD 135-[R2001], BACNET - Data Communication Protocol for Building Automation and Control Network.
- .4 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-Z234.1-[89(R1995)], Canadian Metric Practice Guide.
- .5 Consumer Electronics Association (CEA).
 - .1 CEA-709.1-[B-2002], Control Network Protocol Specification.

1.04 Acronyms and Abbreviations

- .1 Acronyms used in EMCS:
 - .1 AEL - Average Effectiveness Level.
 - .2 AI - Analog Input.
 - .3 AIT - Agreement on International Trade.
 - .4 AO - Analog Output.
 - .5 BACnet - Building Automation and Control Network.
 - .6 BC(s) - Building Controller(s).
 - .7 BECC - Building Environmental Control Center.
 - .8 CAD - Computer Aided Design.
 - .9 CDL - Control Description Logic.
 - .10 CDS - Control Design Schematic.
 - .11 COSV - Change of State or Value.

- .12 CPU - Central Processing Unit.
- .13 DI - Digital Input.
- .14 DO - Digital Output.
- .15 DP - Differential Pressure.
- .16 ECU - Equipment Control Unit.
- .17 EMCS - Energy Monitoring and Control System.
- .18 HVAC - Heating, Ventilation, Air Conditioning.
- .19 IDE - Interface Device Equipment.
- .20 I/O - Input/Output.
- .21 ISA - Industry Standard Architecture.
- .22 LAN - Local Area Network.
- .23 LCU - Local Control Unit.
- .24 MCU - Master Control Unit.
- .25 NAFTA - North American Free Trade Agreement.
- .26 NC - Normally Closed.
- .27 NO - Normally Open.
- .28 OS - Operating System.
- .29 O&M - Operation and Maintenance.
- .30 OWS - Operator Work Station.
- .31 PC - Personal Computer.
- .32 PCI - Peripheral Control Interface.
- .33 PCMCIA - Personal Computer Micro-Card Interface Adapter.
- .34 PID - Proportional, Integral and Derivative.
- .35 RAM - Random Access Memory.
- .36 SP - Static Pressure.
- .37 ROM - Read Only Memory.
- .38 TCU - Terminal Control Unit.
- .39 USB - Universal Serial Bus.
- .40 UPS - Uninterruptible Power Supply.
- .41 VAV - Variable Air Volume.

1.05 Definitions

- .1 Point: may be logical or physical.
 - .1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.
 - .2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.
- .2 Point Name: composed of two parts, point identifier and point expansion.

- .1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25 character field for each point identifier. "System" is system that point is located on.
 - .1 Area descriptor: building or part of building where point is located.
 - .2 System descriptor: system that point is located on.
 - .3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be shortforms or acronyms. Database must provide 25 character field for each point identifier.
- .2 Point expansion : comprised of three fields, one for each descriptor. Expanded form of shortform or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide 32 character field for each point expansion.
- .3 Bilingual systems to include additional point identifier expansion fields of equal capacity for each point name for second language.
 - .1 System to support use of numbers and readable characters including blanks, periods or underscores to enhance user readability for each of the above strings.
- .4 Point Object Type: points fall into following object types:
 - .1 AI (analog input).
 - .2 AO (analog output).
 - .3 DI (digital input).
 - .4 DO (digital output).
 - .5 Pulse inputs.
- .5 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.
 - .1 Printouts: to ANSI/IEEE 260.1.

1.06 Submittals

- .1 Submit the following for review by Engineer. All of the items are required prior to substantial completion.
 - .1 Shop drawings.
 - .1 Preliminary design document within 15 days of contract award.

- .2 Preliminary shop drawings within 30 days of contract award.
- .3 Detailed shop drawings within 60 days of contract award.
- .2 List of existing field control devices to be reused.
- .3 Operating and maintenance data.
- .4 Guarantee.
- .5 As-built documentation
- .6 Start-up, verification and commissioning final report.

1.07 Quality Control

- .1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
- .2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
- .3 Submit proof of compliance to specified standards with shop drawings and product data. Label or listing of specified organization is acceptable evidence.
- .4 In lieu of such evidence, submit certificate from testing organization, approved by Engineer, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.
- .5 For materials whose compliance with organizational standards/codes/specifications is not regulated by organization using its own listing or stating that material complies with applicable referenced standard or specification.
- .6 Permits and fees: in accordance with general conditions of contract.
- .7 Existing devices intended for re-use: submit test report.

1.08 **Quality Assurance**

- .1 Have the ability to provide trained personnel capable of providing instruction, routine maintenance and emergency service on systems.
- .2 Provide record of successful previous installations submitted tender showing experience with similar installations utilizing computer-based systems.
- .3 Have access to local supplies of essential parts and provide 7 year guarantee of availability of spare parts after obsolescence.
- .4 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.

1.09 **Existing Conditions – Control Components**

- .1 Utilize existing control wiring and piping as indicated or required.
- .2 Re-use field control devices that are usable in their original configuration provided that they conform to applicable codes, standards specifications.
 - .1 Do not modify original design of existing devices without written permission from Engineer.
 - .2 Provide for new, properly designed device where re-usability of components is uncertain.
- .3 Inspect and test existing devices intended for re-use within 30 days of award of contract, and prior to installation of new devices.
 - .1 Furnish test report within days of award of contract listing each component to be re-used and indicating whether it is in good order or requires repair to Engineer.
 - .2 Failure to produce test report will constitute acceptance of existing devices by contractor.
- .4 Non-functioning items:
 - .1 Provide with report specification sheets or written functional requirements to support findings.
 - .2 Contractor will repair or replace existing items judged defective yet deemed necessary for EMCS.
- .5 Submit written request for permission to disconnect controls and to Obtain equipment downtime before proceeding with work.

- .6 Assume responsibility for controls to be incorporated into EMCS after written receipt of approval from Engineer.
 - .1 Be responsible for items repaired or replaced by Contractor.
 - .2 Be responsible for repair costs due to negligence or abuse of equipment.
 - .3 Responsibility for existing devices terminates applicable portions of EMCS as approved by Engineer.
- .7 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

1.10 Electrical Work

- .1 Line Voltage power wiring will be provided by the Electrical Contractor (Div. 16). Source of 120V power for low voltage transformers will be provided in the main electrical panel. Actuators etc. shall be fed from that point by this contractor.
- .2 All control wiring (regardless of voltage) shall be the responsibility of this Contractor. Wiring to be installed in accordance with this Section and Div 16 Sections.
- .3 All Electrical wiring to be done in accordance with the Provincial Dept. of Labour Regulations and the Canadian Electrical Code.
- .4 All controls shall be on emergency power.

1.11 Shop Drawings

- .1 This contractor shall submit for review shop drawings for all Automatic Control Systems in accordance with General Conditions and Section 21 05 01.
- .2 Shop drawings to consist of 6 hard copies and 1 soft copy of design documents, shop drawings, product data and software.
- .3 Hard copy to be completely indexed and coordinated package to assure compliance with contract requirements and arrange in same sequence as specification and cross-referenced to specification section and paragraph number.
- .4 Soft copy to be in Autocad and Microsoft Word for easy loading and retrieval on OWS.

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

 - .6 Preliminary shop drawing review to contain the following:
 - .1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.
 - .2 Detailed system architecture showing all points associated with each controller including, signal levels, pressures where new EMCS ties into existing control equipment.
 - .3 Spare point capacity of each controller by number and type.
 - .4 Controller locations.
 - .5 Auxiliary control cabinet locations.
 - .6 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.
 - .7 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).
 - .8 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.

- .9 Flow measuring stations: complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at design flow rate, manufacturer, model and range of velocity transmitter.
- .10 Compressor schematic and sizing data.
- .7 Detailed shop drawings review to contain the following information:
 - .1 Corrected and updated versions (hard copy only) of submissions made during preliminary review.
 - .2 Wiring diagrams.
 - .3 Piping diagrams and hook-ups.
 - .4 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.
 - .5 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:
 - .1 Sensing element type and location.
 - .2 Transmitter type and range.
 - .3 Associated field wiring schematics, schedules and terminations.
 - .4 Pneumatic schematics and schedules.
 - .5 Complete Point Name Lists.
 - .6 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
 - .7 Software and programming details associated with each point.
 - .8 Manufacturer's recommended installation instructions and procedures.
 - .9 Input and output signal levels or pressures where new system ties into existing control equipment.
 - .6 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.
 - .7 Graphic system schematic displays of systems with point identifiers and textual description of system, and typical floor plans as specified.
 - .8 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.
 - .9 Listing and example of specified reports.
 - .10 Listing of time of day schedules.
 - .11 Mark up to-scale construction drawing to detail control room showing location of equipment and operator work space.

- .12 Type and size of memory with statement of spare memory capacity.
 - .13 Full description of software programs provided.
 - .14 Sample of "Operating Instructions Manual" to be used for training purposes.
 - .15 Outline of proposed start-up and verification procedures.
- .8 Control Narrative shall be a written description of actual EMCS or stand alone controls operating sequences including component and point discrete I.D. numbers, signal type, controller type/function, and interface with other control systems such as fire alarm and refrigeration systems. Each step of a system control function shall be sequentially listed including alarms and spaces shall be provided for Contractor and Owner representatives signatures on a line by line basis to be utilized during the commissioning process. All systems and each piece of equipment should have complete narrative prepared based on plans and specifications.

1.12 Operating and Maintenance Data

- .1 Provide operating and maintenance data specified in Section 21 05 01.
- .2 Custom design O & M manuals (both hard and soft copy) to contain material pertinent to this project only, and to provide full and complete coverage of subjects referred to in this section.
- .3 Provide 3 complete sets of hard and soft copies prior to system or equipment tests.
- .4 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.
- .5 Functional description to include:
 - .1 Functional description of theory of operation.
 - .2 Design philosophy.
 - .3 Specific functions of design philosophy and system.
 - .4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.
 - .5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.

- .6 Description of person-machine interactions required to supplement system description, know or established constraints on system operation, operating procedures currently implemented for implementation in automatic mode.
- .6 System operation to include:
 - .1 Complete step-by-step procedures for operation of system including required actions at each OWS.
 - .2 Operation of computer peripherals, input and output formats.
 - .3 Emergency, alarm and failure recovery.
 - .4 Step-by-step instructions for systems functions and operating modes, including key strokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.
- .7 Software to include:
 - .1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.
 - .2 Detailed descriptions of program requirements and capabilities.
 - .3 Data necessary to permit modification, relocation, reprogramming and to permit software modules to respond to changing system functional requirements without disrupting normal operation.
 - .4 Software modules, fully annotated source code listings, error free object code files ready for loading via peripheral device
 - .5 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, program execution.
 - .6 Software for each Controller and single section referencing Controller common parameters and functions.
 - .7 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including calibration, maintenance, repair of sensors, transmitters, transducers, controller and interface firmware's, plus diagnostics and repair/replacement of system hardware.
- .8 System configuration document:
 - .1 Provisions and procedures for planning, implementing and recording hardware and software modifications required during operating lifetime of system.
 - .2 Information to ensure co-ordination of hardware and software changes, data link or message format/content changes, sensor or control changes in event that system modifications are required.

- .9 Programmer control panel documentation: provide where panels are independently interfaced with BECC, including interfacing schematics, signal identification, timing diagrams, fully commented source listing of applicable driver/handler.

1.13 As-Built Documentation

- .1 Provide as-built information in accordance with General Condition and Section 21 05 01.
- .2 Provide 2 copies of detailed shop drawings and include:
 - .1 Changes to contract documents as well as addenda and contract extras.
 - .2 Changes to interface wiring.
 - .3 Routing of conduit, wiring and control air lines associated with EMCS installation.
 - .4 Locations of obscure devices to be indicated on drawings.
 - .5 Listing of alarm messages.
 - .6 Panel/circuit breaker number for sources of normal/emergency power.
 - .7 Names, addresses, telephone numbers of each sub-contractor having installed equipment, local representative for each item of equipment, each system.
 - .8 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports.
 - .9 Basic system design and full documentation on system configuration.
- .3 Submit for final review by Engineer.
- .4 Provide before acceptance 1 hard and 1 soft copy incorporating changes made during final review.

1.14 Warranty and Maintenance

- .1 Provide a written guarantee stating that the controls are guaranteed against faulty material and workmanship for a period of one (1) year from the latest of:
 - .1 Date of substantial completion;
 - .2 The date on which all systems are demonstrated to be operating

correctly. For the purpose of establishing the latter date, the contractor shall arrange to demonstrate full and complete operation to the Owner and Engineer. This demonstration to take place after all controlled items are in pace and operating.

- .2 At the end of the warranty period the DDC operating system shall be the latest version from the manufacturer.
- .3 Submit detailed preventative maintenance schedule for system components to Engineer.
- .4 Submit detailed inspection reports to Engineer.
- .5 Submit dated, maintenance task list to Engineer and include the following sensor and output point detail, as proof of system verification.
 - .1 Point name and location.
 - .2 Device type and range.
 - .3 Measured value.
 - .4 System displayed value.
 - .5 Calibration detail.
 - .6 Indication if adjustment required.
 - .7 Other action taken or recommended.
- .6 Submit network analysis report showing results with detailed recommendations to correct problems found.
- .7 Records and Logs:
 - .1 Maintain records and logs of each maintenance task on site.
 - .2 Organize cumulative records for each major component and for entire EMCS chronologically.
 - .3 Submit records to Engineer after inspection indicating that planned and systematic maintenance have been accomplished.
- .8 Revise and submit to Engineer “as-built drawings” documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.
- .9 Maintenance Service During Warranty Period:
 - .1 Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.

- .2 Emergency Service Calls:
 - .1 Initiate service calls when EMCS is not functioning correctly.
 - .2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.
 - .3 Furnish Engineer with telephone number where service personnel may be reached at any time.
 - .4 Service personnel to be on site ready to service EMCS within 4 hours after receiving request for service.
 - .5 Perform Work continuously until EMCS restored to reliable operating condition.
- .3 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.
- .4 Work requests: record each service call request, when received separately on approved form and include:
 - .1 Serial number identifying component involved.
 - .2 Location, date and time call received.
 - .3 Nature of trouble.
 - .4 Names of personnel assigned.
 - .5 Instructions of work to be done.
 - .6 Amount and nature of materials used.
 - .7 Time and date work started.
 - .8 Time and date of completion.
- .5 Provide system modifications in writing.
 - .1 No system modification, including operating parameters and control settings, to be made without prior written approval of Engineer.
- .10 Field Quality Control:
 - .1 Perform as minimum (3) three minor inspections and one major inspection (more often if required by manufacturer) per year. Provide detailed written report to Engineer as described in Submittal article.
 - .2 Perform inspections during regular working hours, 0800 to 1630 h, Monday through Friday, excluding statutory holidays.
 - .3 Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:

- .1 Perform calibrations using test equipment having traceable, certifiable accuracy at minimum 50% greater than accuracy of system displaying or logging value.
- .2 Check each field input/output device in accordance with Canada Labour Code - Part I and CSA Z204.
- .3 Provide dated, maintenance task lists, as proof of execution of complete system verification.
- .4 Minor inspections to include, but not limited to:
 - .1 Perform visual, operational checks to BC's, peripheral equipment, interface equipment and other panels.
 - .2 Check equipment cooling fans as required.
 - .3 Visually check for mechanical faults, air leaks and proper pressure settings on pneumatic components.
 - .4 Review system performance with Engineer to discuss suggested or required changes.
- .5 Major inspections to include, but not limited to:
 - .1 Minor inspection.
 - .2 Clean OWS(s) peripheral equipment, BC(s), interface and other panels, micro-processor interior and exterior surfaces.
 - .3 Check signal, voltage and system isolation of BC(s), peripherals, interface and other panels.
 - .4 Verify calibration/accuracy of each input and output device and recalibrate or replace as required.
 - .5 Provide mechanical adjustments, and necessary maintenance on printers.
 - .6 Run system software diagnostics as required.
 - .7 Install software and firmware enhancements to ensure components are operating at most current revision for maximum capability and reliability.
 - .1 Perform network analysis and provide report as described in Submittal article.
- .6 Rectify deficiencies revealed by maintenance inspections and environmental checks.
- .7 Continue system debugging and optimization.
- .8 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.
 - .1 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

1.15 BACnet Equipment Interface

Equipment specified to be supplied with a communication card and is to be connected to the BAS network and “communicate to the BAS” use the BACnet standard. The equipment shall include:

- .1 Details of what type of BACnet communication media is provided. IE – for unitary equipment (heat pumps, fan coils) BACnet communication over RS485 2-wire network and a 76,800 baud rate is acceptable. For major mechanical equipment boilers, chillers, large RTU BACnet communication over an Ethernet is acceptable.
- .2 Verify details as to what type of information must be read from the device and also what type of information must be written or defined from the BAS to meet the intended sequence of the equipment.
- .3 The equipment shop drawings are to include job specific wiring diagrams with details on interface wiring including, wire type, and detailed wire termination drawings. Details on site specific addressing requirements and confirmation there will be no conflicts with the existing system architecture.
- .4 The equipment is to be supplied complete with all configuration and programming software. Including any specific cables and proprietary software required to connect to and program the equipment. The Owner will have full access to the equipment sequence at turnover of project. Equipment sequence to be fully programmable by the technician on-site.
- .5 Details of equipment supplier/factory start-up requirements. The specification must include a “Factory Trained Technician” to be on site for start-up, commissioning and be available for technical support when required during the installation and setup.
- .6 Details of equipment supplier/factory training requirements. The specification must include a “Factory Trained Technician” to be on site for customer training and be available for technical support when required during the warranty period.

PART TWO - PRODUCTS

2.01 General

- .1 Specified control system is by Johnson Controls.
- .2 Control equipment including field devices shall be the product of Johnson Controls unless otherwise specified.

2.02 Wiring

- .1 In accordance with Div. 16 Electrical.
- .2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.
- .3 Wiring must be continuous without joints.

2.03 Control Air Piping and Tubing

- .1 Control air high pressure mains shall be type “M hard drawn seamless copper with forged copper soldering type fittings and 95% tin/5% antimony solder joints.
- .2 Control air low pressure tubing shall be:
 - .1 seamless, hard drawn, phosphorized copper tubing with proper soldering type copper fittings 50% lead/50% tin solder joints;
 - .2 annealed soft copper with “GARLOCK” compression type fittings.

2.04 Local Area Network (LAN)

- .1 Summary:
 - .1 Section includes system requirements for Local Area Network (LAN) for Building Energy Monitoring and Control System (EMCS).

.2 References:

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

.3 System Description:

- .1 Data communication network to link Operator Workstations and Master Control Units (MCU) in accordance with CSA T529, TIA/EIA-568, CSA T530 and TIA/EIA-569-A.
 - .1 Provide reliable and secure connectivity of adequate performance between different sections (segments) of network.
 - .2 Allow for future expansion of network, with selection of networking technology and communication protocols.
- .2 Data communication network to include, but not limited to:
 - .1 EMCS-LAN.
 - .2 Modems.
 - .3 Network interface cards.
 - .4 Network management hardware and software.

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

2.05 Building Controllers

.1 Summary:

.1 Section Includes:

- .1 Materials and installation for building automation controllers including:
 - .1 Master control unit (MCU)
 - .2 Local control unit (LCU)
 - .3 Equipment control unit (ECU)
 - .4 Terminal control unit (TCU)

.2 References:

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

.3 System Description:

- .1 General: Network of controllers comprising of MCU('s), LCU('s), ECU('s) or TCU('s) to be provided as indicated or required to support building systems and associated sequence(s) of operations as detailed in these specifications.
 - .1 Provide sufficient controllers to meet intents and requirements of this section.
 - .2 Controller quantity, and point contents to be approved by Engineer at time of preliminary design review.

- .3 Major equipment including air handling units, fan coil heat pump, or VAV box shall each have a dedicated controller. Multiple pumps or exhaust fans in the same area can be grouped on a common controller.
- .2 Controllers: stand-alone intelligent Control Units.
 - .1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.
 - .2 Incorporate communication interface ports for communication to LANs to exchange information with other Controllers.
 - .3 Capable of interfacing with operator interface device.
 - .4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controller. Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).
- .4 Design Requirements:
 - .1 To include:
 - .1 Scanning of AI and DI connected inputs for detection of change of value and processing detection of alarm conditions.
 - .2 Perform On-Off digital control of connected points, including resulting required states generated through programmable logic output.
 - .3 Perform Analog control using programmable logic, (including PID) with adjustable dead bands and deviation alarms.
 - .4 Control of systems as described in sequence of operations.
 - .5 Execution of optimization routines as listed in this section.
 - .2 Total spare capacity for MCUs and LCUs: at least 25 % of each point type distributed throughout the MCUs and LCUs.
 - .3 Field Termination and Interface Devices:
 - .1 To: CSA C22.2 No.205.
 - .2 Electronically interface sensors and control devices to processor unit.
 - .3 Include, but not be limited to, following:
 - .1 Programmed firmware or logic circuits to meet functional and technical requirements.

- .2 Power supplies for operation of logics devices and associated field equipment.
 - .3 Lockable wall cabinet.
 - .4 Required communications equipment and wiring (if remote units).
 - .5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.
 - .6 Input Output interface to accept as minimum AI, AO, DI, DO functions as specified.
 - .7 Wiring terminations: use conveniently located screw type or spade lug terminals.
- .4 AI interface equipment to:
- .1 Convert analog signals to digital format with 12 bit analog-to-digital resolution.
 - .2 Provide for following input signal types and ranges:
 - .1 4 - 20 mA;
 - .2 0 - 10 V DC;
 - .3 100/1000 ohm RTD input;
 - .3 Meet IEEE C37.90.1 surge withstand capability.
 - .4 Have common mode signal rejection greater than 60 dB to 60 Hz.
 - .5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.
- .5 AO interface equipment:
- .1 Convert digital data from controller processor to acceptable analog output signals using 12 bit digital-to-analog resolution.
 - .2 Provide for following output signal types and ranges:
 - .1 4 - 20mA.
 - .2 0 - 10 V DC.
 - .3 Meet IEEE C37.90.1 surge withstand capability.
- .6 DI interface equipment:
- .1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.
 - .2 Meet IEEE C37.90.1 surge withstand capability.
 - .3 Accept pulsed inputs up to 2 kHz.

- .7 DO interface equipment:
 - .1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 V AC.
 - .2 Switch up to 5 amps at 220 V AC using optional interface relay.
- .8 Controllers and associated hardware and software: operate in conditions of 0 degrees C to 44 degrees C and 20 % to 90 % non-condensing RH.
- .9 Controllers (MCU, LCU): mount in wall mounted cabinet with hinged, keyed-alike locked door.
 - .1 Provide for conduit entrance from top, bottom or sides of panel.
 - .2 ECUs and TCUs to be mounted in equipment enclosures or separate enclosures.
 - .3 Mounting details as approved by Engineer for ceiling mounting.
- .10 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.
- .11 Provide surge and low voltage protection for interconnecting wiring connections.
- .5 Master Control Unit (MCU):
 - .1 General: primary function of MCU is to provide co-ordination and supervision of subordinate devices in execution of optimization routines such as demand limiting or enthalpy control.
 - .2 Include high speed communication LAN Port for Peer to Peer communications with OWS(s) and other MCU level devices.
 - .1 MCU must support BACnet.
 - .3 MCU local I/O capacity as follows:
 - .1 MCU I/O points as allocated in I/O Summary Table referenced in MD13800.
 - .2 LCUs may be added to support system functions.
 - .4 Central Processing Unit (CPU).
 - .1 Processor to consist of minimum 16 bit microprocessor capable of supporting software to meet specified requirements.

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- .2 CPU idle time to be more than 30 % when system configured to maximum input and output with worst case program use.
 - .3 Minimum addressable memory to be at manufacturer's discretion but to support at least performance and technical specifications to include but not limited to:
 - .1 Non-volatile EEPROM to contain operating system, executive, application, sub-routine, other configurations definition software. Tape media not acceptable.
 - .2 Battery backed (72 hour minimum capacity) RAM (to reduce the need to reload operating data in event of power failure) to contain CDLs, application parameters, operating data or software that is required to be modifiable from operational standpoint such as schedules, setpoints, alarm limits, PID constants and CDL and hence modifiable on-line through operator panel or remote operator's interface. RAM to be downline loadable from OWS.
 - .4 Include uninterruptible clock accurate to plus or minus 5 secs/month, capable of deriving year/month/day/hour/minute/second, with rechargeable batteries for minimum 72 hour operation in event of power failure.
- .6 Local Control Unit:
- .1 Provide multiple control functions for typical built-up and package HVAC systems, hydronic systems and electrical systems.
 - .2 Minimum of 16 I/O points of which minimum be 4 AOs, 4 AIs, 4 DIs, 4 DOs.
 - .3 Points integral to one Building System to be resident on only one controller.
 - .4 Microprocessor capable of supporting necessary software and hardware to meet specified requirements as listed in previous MCU article with following additions:
 - .1 Include minimum 2 interface ports for connection of local computer terminal.
 - .2 Design so that shorts, opens or grounds on input or output will not interfere with other input or output signals.

- .3 Physically separate line voltage (70V and over) circuits from DC logic circuits to permit maintenance on either circuit with minimum hazards to technician and equipment.
 - .4 Include power supplies for operation of LCU and associated field equipment.
 - .5 In event of loss of communications with, or failure of, MCU, LCU to continue to perform control. Controllers that use defaults or fail to open or close positions not acceptable.
 - .6 Provide conveniently located screw type or spade lug terminals for field wiring.
- .7 Terminal/Equipment Control Unit (TCU/ECU):
- .1 Microprocessor capable of supporting necessary software and hardware to meet TCU/ECU functional specifications.
 - .1 TCU/ECU definition to be consistent with those defined in ASHRAE HVAC Applications Handbook section 45.
 - .2 Controller to communicate directly with EMCS through EMCS LAN and provide access from EMCS OWS for setting occupied and unoccupied space temperature setpoints, flow setpoints, and associated alarm values, permit reading of sensor values, field control values (% open) and transmit alarm conditions to EMCS OWS.
 - .3 VAV Terminal Controller.
 - .1 Microprocessor based controller with integral flow transducer, including software routines to execute PID algorithms, calculate airflow for integral flow transducer and measure temperatures as per required inputs.
 - .2 Controller to support point definition; in accordance with Part 1.
 - .3 Controller to operate independent of network in case of communication failure.
 - .4 Controller to include damper actuator and terminations for input and output sensors and devices.
- .8 Software:
- .1 General.
 - .1 Include as minimum: operating system executive, communications, application programs, operator interface, and systems sequence of operation - CDL's.

- .2 Include "firmware" or instructions which are programmed into ROM, EPROM, EEPROM or other non-volatile memory.
- .3 Include initial programming of Controllers, for entire system.
- .2 Program and data storage.
 - .1 Store executive programs and site configuration data in ROM, EEPROM or other non-volatile memory.
 - .2 Maintain CDL and operating data including setpoints, operating constants, alarm limits in battery-backed RAM or EEPROM for display and modification by operator.
- .3 Programming languages.
 - .1 Program Control Description Logic software (CDL) using English like or graphical, high level, general control language.
 - .2 Structure software in modular fashion to permit simple restructuring of program modules if future software additions or modifications are required. GO TO constructs not allowed unless approved by Engineer.
- .4 Operator Terminal interface.
 - .1 Operating and control functions include:
 - .1 Multi-level password access protection to allow user/manager to limit workstation control.
 - .2 Alarm management: processing and messages.
 - .3 Operator commands.
 - .4 Reports.
 - .5 Displays.
 - .6 Point identification.
- .5 Pseudo or calculated points.
 - .1 Software to provide access to value or status in controller or other networked controller in order to define and calculate pseudo point. When current pseudo point value is derived, normal alarm checks must be performed or value used to totalize.
 - .2 Inputs and outputs for process: include data from controllers to permit development of network-wide control strategies. Processes also to permit operator to use results of one process as input to number of other processes (e.g. cascading).

- .6 Control Description Logic (CDL):
 - .1 Capable of generating on-line project-specific CDLs which are software based, programmed into RAM or EEPROM and backed up to OWS. Owner must have access to these algorithms for modification or to be able to create new ones and to integrate these into CDLs on BC(s) from OWS.
 - .2 Write CDL in high level language that allows algorithms and interlocking programs to be written simply and clearly. Use parameters entered into system (e.g. setpoints) to determine operation of algorithm. Operator to be able to alter operating parameters on-line from OWS and BC(s) to tune control loops.
 - .3 Perform changes to CDL on-line.
 - .4 Control logic to have access to values or status of points available to controller including global or common values, allowing cascading or inter-locking control.
 - .5 Energy optimization routines including enthalpy control, supply temperature reset, to be LCU or MCU resident functions and form part of CDL.
 - .6 MCU to be able to perform following pre-tested control algorithms:
 - .1 Two position control.
 - .2 Proportional Integral and Derivative (PID) control.
 - .7 Control software to provide ability to define time between successive starts for each piece of equipment to reduce cycling of motors.
 - .8 Provide protection against excessive electrical-demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
 - .9 Power Fail Restart: upon detection of power failure system to verify availability of Emergency Power as determined by emergency power transfer switches and analyze controlled equipment to determine its appropriate status under Emergency power conditions and start or stop equipment as defined by I/O Summary. Upon resumption of normal power as determined by emergency power transfer switches, MCU to analyze status of controlled equipment, compare with normal occupancy scheduling, turn equipment on or off as necessary to resume normal operation.

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

- .1 MCUs to accumulate and store automatically run-time for binary input and output points.
 - .2 MCU to automatically sample, calculate and store consumption totals on daily, weekly or monthly basis for user-selected analog or binary pulse input-type points.
 - .3 MCU to automatically count events (number of times pump is cycled off and on) daily, weekly or monthly basis.
 - .4 Totalization routine to have sampling resolution of 1 min or less for analog inputs.
 - .5 Totalization to provide calculations and storage of accumulations up to 99,999.9 units (eg. kWh, litres, tonnes, etc.).
 - .6 Store event totalization records with minimum of 9,999,999 events before reset.
 - .7 User to be able to define warning limit and generate user-specified messages when limit reached.
- .9 Levels of Address:
- .1 Upon operator's request, EMCS to present status of any single 'point', 'system' or point group, entries 'area' or entire network on printer or OWS as selected by operator.
 - .1 Display analog values digitally to 1 place of decimals with negative sign as required.
 - .2 Update displayed analog values and status when new values received.
 - .3 Flag points in alarm by linking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm.
 - .4 Updates to be change-of-value (COV) driven or if polled not exceeding 2 second intervals.
- .10 Point Name Support:
- .1 Controllers (MCU, LCU) to support point naming convention as defined in Part 1.
- .11 Location:
- .1 Location of controllers to be approved by Engineer.
- .12 Installation:
- .1 Install controllers in secure locking enclosures.

- .2 Provide necessary power from local 120V branch circuit panel for equipment.
- .3 Install tamper locks on breakers of circuit breaker panel.
- .4 Use uninterruptible power supply (UPS) and emergency power when equipment must operate in emergency and coordinating mode.

2.06 Field Control Devices

- .1 General:
 - .1 Control devices of each category to be of same type and manufacturer.
 - .2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant assembly.
 - .3 Operating conditions: 0 - 32 degrees C with 10 - 90% RH (non-condensing) unless otherwise specified.
 - .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
 - .5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.
 - .6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
 - .7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.
 - .8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.
 - .9 Range: including temperature, humidity, pressure, as required to meet System Sequences of Operation.

- .2 Temperature Sensors:
 - .1 General: except for room sensors to be resistance type to following requirements:
 - .1 RTD's: 100 or 1000 ohm at 0 degrees C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm degrees C.
 - .2 Sensing element: hermetically sealed.
 - .3 Stem and tip construction: copper or type 304 stainless steel
 - .4 Time constant response: less than 3 seconds to temperature change of 10 degrees C.
 - .5 Immersion wells: NPS $\frac{3}{4}$ stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length 100mm or as required.
 - .6 Duct temperature sensor:
 - .1 General purpose duct type: suitable for insertion into ducts at various orientations, insertion length 460mm or as required.
 - .2 Averaging duct type: incorporates numerous sensors inside assembly which are averaged to provide one reading. Minimum insertion length 6000mm. Bend probe at field installation time to 100mm radius at point along probe without degradation of performance.
 - .7 Outdoor air temperature sensors:
 - .1 Outside air type: complete with probe length 100mm long, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13mm conduit, weatherproof construction in NEMA 4 enclosure.
 - .3 Temperature Transmitters:
 - .1 Requirements:
 - .1 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0 degrees C, platinum resistance detector type sensors.
 - .2 Power supply: 24V DC into load of 575 ohms. Power supply effect less than 0.01 degrees C per volt change.

- .3 Output signal: 4-20 mA into 500 ohm maximum load.
 - .4 Input and output short circuit and open circuit protection.
 - .5 Output variation: less than 0.2% of full scale for supply voltage variation of plus or minus 10%.
 - .6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5% of full scale output.
 - .7 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.
 - .8 Integral zero and spa adjustments.
 - .9 Temperature effects: no to exceed plus or minus 1.0% of full scale/50 degrees C.
 - .10 Long term output drift: not to exceed 0.25% of full scale/6 months.
 - .11 Transmitter ranges: select narrowest range to suit application from following:
 - .1 Minus 50 degrees C to plus 50 degrees C, plus or minus 0.5 degrees C.
 - .2 0 to 100 degrees C, plus or minus 0.5 degrees C.
 - .3 0 to 50 degrees C, plus or minus 0.25 degrees C.
 - .4 0 to 25 degrees C, plus or minus 0.11 degrees C.
 - .5 10 to 35 degrees C, plus or minus 0.25 degrees C.
- .4 Humidity Sensors:
- .1 Room and Duct Requirements:
 - .1 Range: 5 - 90 % RH minimum.
 - .2 Operating temperature range: 0 - 60 degrees C.
 - .3 Absolute accuracy:
 - .1 Duct sensors: plus or minus 2%.
 - .2 Room sensors: plus or minus 1%.
 - .4 Sheath: stainless steel with integral shroud for specified operation in air streams of up to 10 m/s.
 - .5 Maximum sensor non-linearity: plus or minus 2% RH with defined curves.
 - .6 Room sensors: locate in air stream near RA grille wall mounted.

- .7 Duct mounted sensors: locate so that sensing element is in air flow in duct.
- .2 Outdoor Humidity Requirements:
 - .1 Range: 0 - 100 % RH minimum.
 - .2 Operating temperature range: -40 - 50 degrees C.
 - .3 Absolute accuracy: plus or minus 2%.
 - .4 Temperature coefficient: plus or minus 0.03%RH/degrees C over 0 to 50 degrees C.
 - .5 Must be unaffected by condensation or 100% saturation.
 - .6 No routine maintenance or calibration is required.
- .5 Humidity Transmitters:
 - .1 Requirements:
 - .1 Input signal: from RH sensor.
 - .2 Output signal: 4 - 20 mA onto 500 ohm maximum load.
 - .3 Input and output short circuit and open circuit protection.
 - .4 Output variations: not to exceed 0.2 % of full scale output for supply voltage variations of plus or minus 10 %.
 - .5 Output linearity error: plus or minus 1.0% maximum of full scale output.
 - .6 Integral zero and span adjustment.
 - .7 Temperature effect: plus or minus 1.0 % full scale/6 months.
 - .8 Long term output drift: not to exceed 0.25 % of full scale output/6 months.
- .6 Duct Static Pressure Sensors:
 - .1 Requirements:
 - .1 Multipoint element with self-averaging manifold.
 - .1 Maximum pressure loss: 160Pa at 10 m/s. (Air stream manifold).
 - .2 Accuracy: plus or minus 1% of actual duct static pressure.

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- .7 Duct Static Pressure Transmitters:
 - .1 Requirements:
 - .1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
 - .2 Calibrated span: not to exceed 150 % of duct static pressure at maximum flow.
 - .3 Accuracy: 0.4% of span.
 - .4 Repeatability: within 0.5% of output.
 - .5 Linearity: within 1.5% of span.
 - .6 Deadband or hysteresis: 0.1% of span.
 - .7 External exposed zero and span adjustment.
 - .8 Unit to have 12.5 mm N.P.T. conduit connection.
Enclosure to be integral part of unit
 - .8 Pressure and Differential Pressure Switches:
 - .1 Requirements:
 - .1 Internal materials: suitable for continuous contact with compressed air, water, steam, etc., as applicable.
 - .2 Adjustable setpoint and differential.
 - .3 Switch: snap action type, rated at 120V, 15 amps AC or 24 V DC.
 - .4 Switch assembly: to operate automatically and reset automatically when conditions return to normal.
Over-pressure input protection to at least twice rated input pressure.
 - .5 Accuracy: within 2% repetitive switching.
 - .6 Provide switches with isolation valve and snubber, where code allows, between sensor and pressure source.
 - .7 Switches on steam and high temperature hot water service: provide pigtail syphon.
 - .9 Temperature Switches:
 - .1 Requirements:
 - .1 Operate automatically. Reset automatically, except as follows:
 - .1 Low temperature detection: manual reset
 - .2 High temperature detection: manual reset.

- .2 Adjustable setpoint and differential.
- .3 Accuracy: plus or minus 1 degrees C.
- .4 Snap action rating: 120V, 15 amps or 24V DC as required. Switch to be DPST for hardwire and EMCS connections.
- .5 Type as follows:
 - .1 Room: for wall mounting on standard electrical box with protective guard as indicated.
 - .2 Duct, general purpose: insertion length = 460 mm.
 - .3 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100mm.
 - .4 Duct, low temperature detection: continuous element with 6000 mm insertion length, duct mounting, to detect coldest temperature in any 30 mm length.

- .10 Current/Pneumatic (I/P) Transducers:
 - .1 Requirements:
 - .1 Input range: 4 to 20 mA.
 - .2 Output range: proportional 20-104 kPa or 20-186 kPa as applicable.
 - .3 Housing: dustproof or panel mounted.
 - .4 Internal materials: suitable for continuous contact with industrial standard instrument air.
 - .5 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 2 % of full scale over entire range.
 - .6 Integral zero and span adjustment.
 - .7 Temperature effect: plus or minus 2.0 % of full scale/50 degrees C or less.
 - .8 Regulated supply pressure: 206 kPa maximum.
 - .9 Air consumption: 16.5 ml/s maximum.
 - .10 Integral gauge manifold c/w gauge (0-206 kPa).

- .11 Solenoid Control Air Valves:
 - .1 Coil: 120V AC or 24V DC, as required.

 - .2 Capacity: to pass a minimum of 0.15 l/s air at 140 kPa differential.

- .12 Air Pressure Gauges:
 - .1 Diameter: 63mm minimum.
 - .2 Range: zero to two times operating pressure of measured pressure media or nearest standard range.
- .13 Electromechanical Relays:
 - .1 Requirements:
 - .1 Double voltage, DPDT, plug-in type with termination base.
 - .2 Coils: rated for 120V AC or 24V DC. Other voltage: provide transformer.
 - .3 Contacts: rated at 5 amps at 120V AC.
 - .4 Relay to have visual status indication.
- .14 Solid State Relays:
 - .1 General:
 - .1 Relays to be socket or rail mounted.
 - .2 Relays to have LED Indicator
 - .3 Input and output Barrier Strips to accept 14 to 28 AWG wire.
 - .4 Operating temperature range to be -20 degrees C to 70 degrees C.
 - .5 Relays to be CSA Certified.
 - .6 Input/output Isolation Voltage to be 4000 VAC at 25 degrees C for 1 second maximum duration.
 - .7 Operational frequency range, 45 to 65 HZ.
 - .2 Input:
 - .1 Control voltage, 3 to 32 VDC.
 - .2 Drop out voltage, 1.2 VDC.
 - .3 Maximum input current to match AO (Analog Output) board.
 - .3 Output:
 - .1 AC or DC Output Model to suit application.

-
- .15 Current Transducers:
 - .1 Requirements:
 - .2 Purpose: combined sensor/transducer, to measure line current and produce proportional signal in one of following ranges:
 - .1 4-20 mA DC.
 - .2 0-1 volt DC.
 - .3 0-10 volts DC.
 - .4 0-20 volts DC.
 - .3 Frequency insensitive from 10 - 80 hz.
 - .4 Accuracy to 0.5% full scale.
 - .5 Zero and span adjustments. Field adjustable range to suit motor applications.
 - .6 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.
 - .16 Current Sensing Relays:
 - .1 Requirements:
 - .1 Suitable to detect belt loss or motor failure.
 - .2 Trip point adjustment, output status LED.
 - .3 Split core for easy mounting.
 - .4 Induced sensor power.
 - .5 Relay contacts: capable of handling 0.5 amps at 30 VAC / DC. Output to be NO solid state.
 - .6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.
 - .7 Adjustable latch level.
 - .17 Control Dampers:
 - .1 Construction: blades, 152 mm wide, 1219mm long, maximum. Modular maximum size, 1219 mm wide x 1219 mm high. Three or more sections to be operated by jack shafts.
 - .2 Materials:
 - .1 Frame: 2.03 mm minimum thickness extruded aluminum. For outdoor air and exhaust air applications, frames to be insulated.

- .2 Blades: extruded aluminum. For outdoor air/exhaust air applications, blades to be internally insulated.
- .3 Bearings: maintenance free, synthetic type of material.
- .4 Linkage and shafts: aluminum, zinc and nickel plated steel.
- .5 Seals: synthetic type, mechanically locked into blade edges.
 - .1 Frame seals: synthetic type, mechanically locked into frame sides.
- .3 Performance: minimum damper leakage meet or exceed AMCA Standard 500-D ratings.
 - .1 21 L/s/m² maximum allowable leakage against 1000 Pa static pressure (size 1220 x 1220).
 - .2 Temperature range: minus 40 degrees C to plus 100 degrees C.
- .4 Arrangements: dampers mixing warm and cold air to be parallel blade, mounted at right angles to each other, with blades opening to mix air stream.
- .5 Jack shafts:
 - .1 25 mm diameter solid shaft, constructed of corrosion resistant metal complete with required number of pillow block bearings to support jack shaft and operate dampers throughout their range.
 - .2 Include corrosion resistant connecting hardware to accommodate connection to damper actuating device.
 - .3 Install using manufacturers installation guidelines.
 - .4 Use same manufacturer as damper sections.
- .6 Standard of Acceptance:
 - .1 Outdoor and exhaust applications: Tamco Series 9000.
 - .2 All other: Tamco Series 1500.
- .7 Acceptable Products:
 - .1 Ventex

- .18 Electronic Control Damper Actuators:
 - .1 Requirements:
 - .1 Direct mount proportional type as indicated.
 - .2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated at full rated torque.
 - .3 Operator: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.
 - .4 Control signal (two position) 24 VAC for two position.
 - .5 Control signal (modulating): 0 - 10 V DC or 4 - 20 mA DC.
 - .6 For VAV box applications floating control type actuators may be used.
 - .7 Damper actuator to drive damper from full open to full closed in less than 120 seconds.
- .19 Control Valves:
 - .1 Body type shall be globe style unless otherwise indicated.
 - .2 Provide CRN for valves when required by Provincial Dept. of Labour Requirements and CSA B51.
 - .3 Body: globe style.
 - .1 All characteristics of control valves shall be suitable for the required operation.
 - .2 Straight through water valves shall be single seated with equal percentage flow characteristics.
 - .3 Three way mixing valves shall be linear for each port giving constant total flow.
 - .4 All valves shall have stainless steel stems and easily replaceable packing rated for maximum fluid temperature:
 - .1 Water and Glycol Services to 250°F: EPDM.
 - .2 Steam and District Heat: Reinforced PTFE.
 - .5 Flow factor (CV) as required to limit pressure drop.
 - .6 Heating valves to be normally open type.
 - .7 Two, three port, as indicated.
 - .8 Leakage rate ANSI class IV, 0.01% of full open valve capacity.
 - .9 Plug and seat, stainless steel.

- .10 Disc, replaceable, material to suite application.
- .11 NPS 2 and under:
 - .1 Bronze body, screwed national pipe thread (NPT) tapered female connections.
 - .2 Valves to ANSI Class 250, valves to be ANSI mark.
 - .3 Rangeability 50:1 minimum.
- .12 NPS 2 ½ and larger:
 - .1 Flanged connections.
 - .2 Cast iron or steel body valves to ANSI Class 150 or 250 as required, valves to bear ANSI mark.
 - .3 Rangeability 100:1 minimum.
 - .4 Butterfly Valves NPS 2 and larger:
 - .1 Body: for chilled water ANSI Class 150 cast iron. For steam and heating water ANSI Class 150 carbon steel.
 - .2 End connections to suite flanges that are ANSI Class 150.
 - .3 Extended stem neck to provide adequate clearance for flanges and insulation.
 - .4 Pressure limit: bubble tight sealing to 170 kilopascals.
 - .5 Disc/vane: 316 stainless steel as required to limit maximum pressure drop.
 - .6 Seat: for service on chilled water PTFE (polytetrafluoroethylene). For service on steam and heating water RTEF (reinforced PTFE).
 - .7 Stem: 316 stainless steel.
 - .8 Flow characteristic linear.
 - .9 Normally open or normally closed as indicated.
 - .10 Valves are to be provided complete with mounting plate for installation of actuators.

- .5 Control valves shall be sized based on the following pressure drops:

| <u>Valve Application</u> | <u>Sizing Pressure Drop</u> |
|--------------------------------------|--|
| 2-way and 3-way modulating type | 3 psi |
| Steam (inlet pressure above 15 psig) | 50% of absolute inlet pressure |
| Steam (inlet pressure below 15 psig) | inlet gauge pressure (i.e. full pressure drop) |
| Radiation and reheat 2 or 3-way | 1 psi |
| Butterfly valves (two position) | Line size |
| Butterfly valves (modulating) | 3 psi at 70 degree sizing angle |

- .20 Electronic/Electric Valve Actuator:

- .1 Requirements:

- .1 Construction: steel, cast iron, aluminum.
- .2 Control signal: 0-10V DC or 4-20 mA DC.
- .3 Positioning time: to suit application. 90 sec maximum.
- .4 Fail to normal position as indicated.
- .5 Scale or dial indication of actual control valve position.
- .6 Size actuator to meet requirements and performance of control valve specifications.
- .7 For interior and perimeter terminal heating and cooling applications floating control actuators are acceptable.
- .8 Minimum shut-off pressure: Torque ratings suitable to close valve against 150% of system design differential pressure. District heat valve actuator shall be suitable for a minimum 150 psig differential pressure or district heat system design differential whichever is greater.

- .21 Watthour Meters and Current Transformers:

- .1 Requirements:

- .1 Include three phases, test and terminal blocks for watthour meter connections and connections for monitoring of current. Provide two transformers for 600 V 3 wire systems for watthour meter use. Accuracy: plus or minus 0.25% of full scale. For chiller applications: to have instantaneous indicator with analog or digital display.
- .2 Watthour meter sockets: to ANSI C12.7.
- .3 Potential and current transformers: to ANSI/IEEE

C57.13.

- .4 Potential transformers: provide two primary fuses.
- .5 Demand meters: configure to measure demand at 15 minute intervals.

.22 Panels:

- .1 Wall mounted enameled steel cabinets with hinged and key-locked front door.
- .2 Multiple panels as required to handle requirements with additional space to accommodate 25% additional capacity as required by Engineer without adding additional cabinets.

.23 Differential Pressure Gauges:

- .1 Provide differential pressure gauges, diaphragm actuated dial type 4 3/4" OD for measuring room pressurization and filter pressure drops as indicated.

.2 Acceptable Products:

| | | |
|--------------------------------|---|--|
| Air Filter Pressure Monitoring | - | Dwyer Magnahelic Series 2000. Pressure range 0-3" W.C. |
|--------------------------------|---|--|

PART THREE - EXECUTION

3.01 General

- .1 Provide operational instructions on all control systems.
- .3 Perform all work in strict accordance with Div. 16, Canadian Electrical Code, and Provincial. Dept. of Labour Regulations.

3.02 Sequence of Operation

- .1 Supply Fan Control:

The variable speed supply fan (SF-V) will be started based on occupancy schedule. When the supply fan status (SF-S) indicates the fan started, the control sequence will be enabled. Upon a loss of airflow (SF-S), the system will attempt to automatically restart until positive status is received. EMCS to monitor and display real-time airflows through airflow stations provided with AHU-8 & AHU-18.
- .2 Return Fan Control:

After the supply fan (SF-V) has been started, the variable speed return fan (RF-V) will be started.
- .3 Economizer Control:

When the outdoor air (OA-T) is cooler than the economizer setpoint, the economizer will act as the initial stage of cooling, working in sequence with the cooling coil.
- .4 Minimum OA Control:

The fresh air intake of the unit will be limited to prevent the preheat temperature (PH-T) from falling below the low limit setpoint (OALT-SP).
- .5 Temperature Control:

The unit will control to maintain a constant discharge air temperature (DA-T).
- .6 Occupied Mode:

The occupancy mode will be controlled via a network input (OCC-SCHEDULE). The occupancy mode can also be overridden by a network input (OCC-OVERRIDE).

Outdoor air damper at louver to be open during all occupied periods.

.7 Unoccupied Mode:

The unit will remain off during unoccupied periods.

.8 Preheat Coil:

The preheat face and bypass damper (PHFBD-O) will remain open to the face when the preheat valve (PH-O) is modulating. The preheat face and bypass damper (PHFBD-O) will be enabled if the outdoor air temperature (OA-T) falls below setpoint (OALT-SP), at which time the preheat valve (PH-O) will be commanded fully open, and the preheat face and bypass damper (PHFBD-O) will modulate to maintain the temperature setpoint. When the unit is shutdown, the preheat coil will be commanded to a preset position should the outdoor air temperature (OAT) fall below the low outdoor air temperature setpoint (OALT-SP). Upon a loss of airflow (SF-S), the preheat coil will be commanded to a preset position should the outdoor air temperature (OA-T) fall below the low outdoor air temperature setpoint (OALT-SP).

.9 Cooling Coil:

The cooling coil (CLG-O) will modulate to maintain the temperature setpoint. When the unit is shutdown, the cooling coil will be commanded to a preset position should the outdoor air temperature (OA-T) fall below the low outdoor air temperature setpoint (OALT-SP). Upon a loss of airflow (SF-S), the cooling coil will be off.

.10 Humidification:

The humidifier will be enabled (HUM-C) and modulate (HUM-O) to maintain the return air relative humidity setpoint (HUM-SP) as sensed by the return air relative humidity sensor (RA-H). The humidity high limit will override the output if necessary to prevent the discharge air humidity from exceeding discharge humidity high limit setpoint.

.11 Dehumidification:

The cooling coil (CLG-O) will modulate to maintain the return air relative dehumidity setpoint (DEHUM-SP) as sensed by the return air relative

humidity sensor (RA-H).

.12 Unit Enable:

A network unit enable signal (UNITEN-MODE) will control the mode of then unit.

.13 Power Fail Restart:

Upon power restoration, the unit restart shall be delayed (60 sec.).

.14 Smoke Mode Control:

Operator can place this AHU in SMOKE MODE (SM) to prevent smoke infiltration to the zone supplied by this AHU. Mode overrides all safety interlocks as well as startup sequences. SM Stops return fan and exhaust fan (EF-8 or EF-18) and SM starts or keeps supply fan running. Outdoor air damper and exhaust air damper open fully. Return air damper closes fully. Existing solenoid valve is energized, closing smoke damper in return air ducts.

.15 Fire Mode Control:

Operator can place this AHU in FIRE MODE to exhaust smoke and keep hallways near stairwells clear of smoke in the zone supplied by this AHU. Mode overrides all safety interlocks as well as startup sequences and overrides SMOKE MODE. FM relay starts or keeps supply fan, return fan and exhaust fans in operation. Outdoor air damper and exhaust air damper open fully. Return air damper closes fully. Existing solenoid valve in panel is energized opening supply duct dampers.

.16 Unit Protection:

- Low Temperature Alarm (LT-A) – When in “Alarm”, the control sequence will stop running, the valve(s) will open and the fan(s) will be disabled via a hard wired shutdown circuit.
- Discharge Air High Duct Pressure Alarm (DAPHI-A) – When in “Alarm”, the control sequence will stop running and the fan(s) will be disabled via a hard wired shutdown circuit.

- Return Air Low Duct Pressure Alarm (RAPLO-A) – When in “Alarm”, the control sequence will stop running and the fan(s) will be disabled via a hard wired shutdown circuit.

- .17 Additional Point Monitored by the EMCS:
- Mixed Air Temperature (MA-T)
 - Return Fan Status (RF-S)
 - Return Air Temperature (RA-T)
 - Prefilter Status (PFILT-S)
 - Final Filter Status (FFILT-S)
 - Supply Airflow (SF-F)
- .18 Temporary AHU:
- Heating: First stage of heat shall be provided by modulating temporary air handling unit outdoor air intake & exhaust dampers to minimum setting of 20% OA. Existing duct mounted heating coils shall be energized on a further call for heating.
 - Fan speed to be controlled to maintain static pressure setpoint. Setpoint to be confirmed with air balancer.

3.03 Installation

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2 Install control components in accordance with manufacturers recommended methods, procedures and instructions.
- .3 Check and verify location of temperature sensors and other exposed control sensors with plans and room details before installation.
- .4 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.
- .5 All equipment installed shall be mechanically stable and, as necessary, fixed to wall or floor. Anti-vibration mounts to be provided, if required for proper isolation of equipment. Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
- .6 Fire stopping: provide space for fire stopping in accordance with section 21 05 01. Maintain fire rating integrity.
- .7 Electrical:

- .1 Complete installation in accordance with Div. 16.
- .2 Modify existing starters to provide for EMCS as required.
- .3 Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by Engineer before beginning work.
- .4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
- .5 Furnish all electrical control wiring in conduit except as specified otherwise in this section.
 - .1 Fire rated plenum cable may be used for all low voltage control wiring in accessible ceiling cavity where the installation of such meets the Canadian Electrical Code.
 - .2 Exposed or concealed wiring must be in conduit. All wiring and conduit to be run parallel to building lines. Contractor to run plenum cable in neat manner and group wiring in J-hooks where practical.
 - .3 Conduit sizes to suite wiring requirements and to allow for future expansion capabilities specified for systems.
 - .4 Maximum conduit fill not to exceed 40%.
 - .5 Design drawings do not show conduit layout.
- .6 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Engineer to review before starting work.
- .7 Obtain and pay for all required electrical permits and inspections at no additional charge to the Owner.
- .8 Pneumatic: provide pneumatic tubing, valves and fittings for field control devices.
- .9 VAV Terminal Units: Supply , install and adjust as required.
 - .1 Air probe, actuator and associated VAV controls.
 - .2 Tubing from air probe to DP sensor as well as installation and adjustment of air flow sensors and actuators.
 - .3 Co-ordinate air flow adjustments with balancing trade.
- .10 Equipment shall be installed so as to allow for easy maintenance access. Equipment shall be installed such that it does not interfere in any way with access to adjacent equipment and personnel traffic.
- .11 Temperature and Humidity Sensors:
 - .1 Stabilize to ensure minimum field adjustments or calibrations.
 - .2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.
 - .3 Outdoor installation:
 - .1 Protect from solar radiation and wind effects by non-corroding shields.

- .2 Install in NEMA 4 enclosures.
- .4 Duct Installations:
 - .1 Do not mount in dead air space.
 - .2 Locate within sensor vibration and velocity limits.
 - .3 Securely mount extended surface sensor used to sense average temperature.
 - .4 Thermally isolate elements from brackets and supports to respond to air temperature only.
 - .5 Support sensor element separately from coils, filter racks.
- .5 Averaging Duct Type Temperature Sensors:
 - .1 Install averaging element horizontally across the ductwork starting 300mm from top of ductwork. Each additional horizontal run to be no more than 300mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.
 - .2 Wire multiple sensors in series for low temperature protection applications.
 - .3 Wire multiple sensors separately for temperature measurement.
 - .4 Use software averaging algorithm to derive overall average for control purposes.
- .6 Thermowells: install for piping installations.
 - .1 Locate well in elbow where pipe diameter is less than well insertion length.
 - .2 Thermowell to restrict flow by less than 30%.
 - .3 Use thermal conducting paste inside wells.
- .7 Magnahelic Pressure Indicators:
 - .1 Install adjacent to fan system static pressure sensor and duct system velocity pressure sensor as reviewed.
 - .2 Locations: as indicated or specified.
- .8 Pressure and Differential Pressure Switches and Sensors:
 - .1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.
 - .2 Protect sensing elements on stream and high temperature hot water service with pigtail siphon between valve and sensor.
- .12 Panels:
 - .1 Arrange for conduit and tubing entry from top, bottom or either side.
 - .2 Wiring and tubing within panels: locate in trays or

- .3 individually clipped to back of panel.
Identify wiring and conduit clearly.

3.04 Identification

- .1 General:
 - .1 Permanently identify each wire, cable and conduit at each termination.
 - .2 Permanently identify all field devices.
- .2 Nameplates for Panels:
 - .1 Identify by plastic laminate, 3mm thick matt white finish, black core, square corners, lettering accurately aligned and engraved into core.
 - .2 Sizes: 25 x 67mm minimum.
 - .3 Lettering: minimum 7mm high, black.
 - .4 Inscriptions: machine engraved to identify function.
- .3 Nameplates for Field Devices:
 - .1 Identify by plastic encased cards attached by chain or plastic tie.
 - .2 Sizes: 50 x 100mm minimum.
 - .3 Lettering: minimum 5mm high produced from laser printer in black.
 - .4 Data to include: point name and point address.
 - .5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.
- .4 Nameplates for Room Sensors:
 - .1 Identify by stick-on labels using point identifier.

- .2 Location: inside cover plate.
- .3 Letter size: to suite, clearly legible.
- .5 Warning Signs:
 - .1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.
 - .2 Sign to read: “Caution: This equipment is under automatic remote control of EMCS”.
- .6 Wiring:
 - .1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.
 - .2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.
 - .3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.
- .7 Pneumatic Tubing:
 - .1 Numbered tape markings on tubing to provide uninterrupted tracing capability.
- .8 Ensure that manufacturer’s nameplates, CSA labels and identification nameplates are visible and legible at all times.
- .9 Correct existing nameplates and legends to reflect changes made during work.

3.05 Start-Up, Verification and Commissioning

- .1 Summary:
 - .1 Methods and procedures for start-up, verification and commissioning, for building Energy Monitoring and Control System (EMCS) and includes:
 - .1 Start-up testing and verification of systems.
 - .2 Check out demonstration or proper operation of

- components.
 - .3 On-site operational tests.
- .2 Commissioning Personnel:
 - .1 Commissioning personnel to be fully aware of and qualified to interpret design criteria and design intents.
- .3 Final Report:
 - .1 Submit final report to Engineer.
 - .1 Include measurements, final settings and certified test results.
 - .2 Bear signature of commissioning technician and supervisor.
 - .3 Report format to be approved by Engineer before commissioning is started.
 - .4 Revise “as-built” documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to Engineer.
 - .5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.
- .4 Commissioning:
 - .1 Carry out commissioning in presence of either commissioning manager or Owner’s representative as applicable.
 - .2 Inform, and obtain approval from Consultant in writing at least 14 days prior to commissioning or each test. Indicate:
 - .1 Location and part of system to be tested or commissioned.
 - .2 Testing/commissioning procedures, anticipated results.
 - .3 Names of testing/commissioning personnel.
 - .3 Correct deficiencies, re-test in presence of either commissioning manager or Owner’s representative as applicable.
 - .4 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of contract.
 - .5 Load system with project software.
 - .6 Perform tests as required.
- .5 Completion of Commissioning:
 - .1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by Consultant.

-
- .6 Issuance of Final Certificate:
 - .1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation, and completion of successful demonstrations to Engineer.

 - .7 Equipment:
 - .1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.
 - .2 Instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.
 - .3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 6 months prior to tests.
 - .4 Locations to be approved, readily accessible and readable.
 - .5 Application: to conform to normal industry standards.

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

 - .9 Field Quality Control:
 - .1 Pre-Installation Testing

- .1 General: consists of field tests of equipment just prior to installation.
 - .2 Testing may be on site or at Contractors premises as approved by Engineer.
 - .3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of building controller's including MCU's, LCU's and TCU's.
 - .4 Equip each building controller with sensor and controlled device of each type (AI, AO, DI, DO).
 - .5 Additional instruments to include:
 - .1 DP transmitters.
 - .2 VAV supply duct SP transmitters.
 - .3 DP switches used for dirty filter indication and fan status.
 - .6 In addition to test equipment, provide inclined manometer, digital micro-manometer, milli-amp meter at source and to BECC.
 - .7 After setting, test zero and span in 10% increments through entire range while both increasing and decreasing pressure.
 - .8 Mark instruments tracking within 0.5% in both directions as "approved for installation".
 - .9 Transmitters above 0.5% error will be rejected.
 - .10 DP switches to open and close within 2% of setpoint.
- .2 Completion Testing.
- .1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.
 - .2 Include following activities:
 - .1 Test and calibrate field hardware including standalone capability of each controller.
 - .2 Verify each A-to-D convertor.
 - .3 Test and calibrate each AI using calibrated digital instruments.
 - .4 Test each DI to ensure proper settings and switching contacts.
 - .5 Test each DO to ensure proper operation and lag time.
 - .6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.
 - .7 Test operating software.
 - .8 Test application software and provide samples of

- logs and commands.
- .9 Verify each CDL including energy optimization programs.
- .10 Debug software.
- .11 Blow out flow measuring and static pressure stations with high pressure air at 700 kPa.
- .12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space for commissioning technician and Owner's representative. This document will be used in final startup testing.
- .3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system and provide:
 - .1 2 technical personnel capable of re-calibrating field hardware and modifying software.
 - .2 Detailed daily schedule showing items to be tested and personnel available.
 - .3 Commissioning to commence during final startup testing.
 - .4 O & M personnel to assist in commissioning procedures as part of training.
 - .5 Commissioning to be supervised by qualified supervisory personnel and Owner's representative.
 - .6 Commission systems considered as life safety systems before affected parts of the facility are occupied.
 - .7 Operate systems as long as necessary to commission entire project.
 - .8 Monitor progress and keep detailed records of activities and results.
- .4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.
 - .1 Prior to beginning of 30 day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.
 - .1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.

- .2 Test to last at least 30 consecutive 24 hour days.
 - .3 Test to include:
 - .1 Demonstration of correct operation of monitored and controlled points.
 - .2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.
 - .4 System will be accepted when:
 - .1 EMCS equipment operates to meet overall performance requirements.
 - .2 Requirements of contract have been met.
 - .5 Correct defects when they occur and before resuming tests.
 - .6 Commissioning manager to verify reported results.
- .10 Adjusting:
- .1 Final adjusting: upon completion of commissioning as reviewed by Consultant, set and lock devices in final position and permanently mark settings.
- .11 Demonstration:
- .1 Demonstrate to commissioning manager and Engineer operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut down interlocks and lock-outs.

3.06 Instruction and Training

- .1 Submittals:
 - .1 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to Consultant 30 days prior to anticipated date of beginning of training.
 - .1 List name of trainer, and type of visual and audio aids to be used.
 - .2 Show co-ordinated interface with other EMCS mechanical and electrical training programs.
 - .2 Submit reports within one week after completion of Phase 1 and

Phase 2 training program that training has been satisfactorily completed.

- .2 Quality Assurance:
 - .1 Provide competent instructors thoroughly familiar with aspects of EMCS installed in facility.
 - .2 Consultant reserves right to approve instructors.
- .3 Instructions:
 - .1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of EMCS installed.
 - .2 Training to be project-specific.
- .4 Time for Instruction:
 - .1 Number of days of instruction to be as specified in this section (1 day = 8 hours including two 15 minute breaks and excluding lunch time).
- .5 Training Materials:
 - .1 Provide equipment, visual and audio aids, and materials for classroom training.
 - .2 Supply manual for each trainee, describing in detail data included in each training program.
 - .1 Review contents of manual in detail to explain aspects of operation and maintenance (O & M).
- .6 Training Program:
 - .1 To be in 2 phases.
 - .2 Phase 1: 1 day program to begin at time mutually agreeable to Contractor and Owner.
 - .1 Train O & M personnel in functional operations and procedures to be employed for system operation.
 - .2 Supplement with on-the-job training during 30 day test period.
 - .3 Include overview of system architecture, communication, operation of computer and peripherals, report generation.

- .4 Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system and elementary preventive maintenance.
- .3 Phase 2: 1 day program to begin after acceptance for operators, equipment maintenance personnel and programmers.
 - .1 Provide multiple instructors on pre-arranged schedule. Include at least following:
 - .1 Operator training: provide operating personnel, maintenance personnel and programmers with condensed version on Phase 1 training plus more detailed training to address operating personnel questions on specific tasks requiring assistance.
 - .2 Detailed instructions and training shall be provided to designated operating personnel to enable them to become fully conversant with diagnostic procedures as well as modifications possible at all levels of access.
 - .3 Equipment maintenance training: provide personnel with 1 days training equipment, including general equipment layout, trouble shooting and preventive maintenance of EMCS components, maintenance and calibration of sensors and controls.
 - .4 At completion of training the O & M personnel shall be familiar and comfortable with the operation of the control system for the facility and shall be capable of responding to alarms, changing control points and operating parameters of the HVAC, refrigeration, energy recovery and heat transfer systems, and any additional operations deemed necessary to properly operate the facility EMCS.
- .7 Additional Training:
 - .1 List courses offered by name, duration and approximate cost per person per week. Note courses recommended for training supervisory personnel.
- .8 Monitoring of Training:
 - .1 Consultant permitted to monitor training program and may modify schedule and content.

3.07 Additional Controls

- .1 Contractor shall include for a minimum of 32 hours total of additional labor for programming, installation, and commissioning that may be used at the Consultant's discretion for additional items or changes to the specified sequences as required that are beyond the scope of normal start-up, adjustment and commissioning.

HOT WORK PERMIT

OWNER COPY

**CAN THIS JOB BE DONE WITHOUT HOT WORK, OR IN THE SHOP?
IF NOT, ENSURE PRECAUTIONS ARE IN PLACE!**

MAKE SURE SPRINKLERS ARE IN SERVICE AND FIRE EXTINGUISHERS ARE READILY AVAILABLE!

This Hot Work Permit is required for any operation involving open flames or producing heat and/or sparks. This includes, but is not limited to, Brazing, Cutting, Grinding, Soldering, Thawing Pipe, Torch-Applied Roofing, and Welding.

Note: The Required Precautions are not optional. They are required for fire-safe hot work. Please explain all "No" responses below.

Instructions

- The Permit-Authorizing Individual must:**
- Verify precautions listed at right (or do not proceed with the work)
 - Complete and retain this page
 - Give the second page to the person doing the work.

Who, When, and Where?

| | |
|--|---------------------------|
| Hot Work Being Done By | |
| <input type="checkbox"/> Employee | |
| <input type="checkbox"/> Contractor | |
| Date | Job/Work Order No. |
| Location/Building and Floor | |
| Nature of Job/Object | |
| Name of Person(s) Doing Hot Work | |
| I verify the above location has been examined, the precautions checked on the Required Precautions Checklist have been taken to prevent fire, and permission is authorized for work. | |
| Signature of Permit-Authorizing Individual | |

Permit Expiration

| | | |
|------------------------|------------------------|-----------------------------|
| Expiration Date | Expiration Time | <input type="checkbox"/> AM |
| | | <input type="checkbox"/> PM |

| |
|------------------------------------|
| Name of Assigned Fire Watch |
|------------------------------------|

**THIS PERMIT IS GOOD FOR
24 HOURS ONLY!**

Required Precautions Checklist

| |
|---|
| <input type="checkbox"/> Available Sprinklers in Normal Automatic mode and valve open. |
| <input type="checkbox"/> Hot Work equipment in good repair. |
| Assess 35 ft radial "sphere" of work for potential fire hazards: |
| <input type="checkbox"/> Floors, work level and <u>below</u> , cleaned or protected. |
| <input type="checkbox"/> All other combustibles removed or shielded from sparks. <ul style="list-style-type: none"> Clean horizontal surfaces (e.g. building structures, equipment, ducts, cable trays, etc.) <u>above</u> and <u>below</u> where possible. Remove flammable liquids, dust, lint, combustible waste, oil deposits, etc., where possible. If removal/cleaning is impractical, protect with fire-retardant covers, or shield with fire-retardant guards and/or curtains. |
| <input type="checkbox"/> Transmission or conveying of sparks to adjacent areas eliminated or protected. <ul style="list-style-type: none"> Tightly cover wall/floor openings with fire-retardant material. Where openings cannot be sealed, suspend fire-retardant tarpaulins to help protect areas beneath. Isolate or shut down fans and conveyors to prevent the capturing and conveying sparks to other areas. |
| <input type="checkbox"/> Explosive atmosphere eliminated or potential not present. |
| Work on walls, ceilings or enclosed equipment: |
| <input type="checkbox"/> Construction materials verified as noncombustible and without combustible covering or insulation. |
| <input type="checkbox"/> Combustibles on other side of walls relocated or protected. |
| <input type="checkbox"/> Enclosed equipment cleaned and protected from all combustibles. |
| <input type="checkbox"/> Containers purged of flammable liquids/vapors. |
| Fire watch/hot work area monitoring requirements: |
| <input type="checkbox"/> Continuous fire watch provided during and for <i>at least 60 minutes</i> after hot work, including all breaks. |
| <input type="checkbox"/> Fire watch supplied with suitable extinguishers/hoses. |
| <input type="checkbox"/> Fire watch trained in the use of fire equipment and sounding alarm. |
| <input type="checkbox"/> Area to be monitored hourly for a <i>minimum 4 hours</i> after job is completed or longer if required. |
| Other precautions that may be required: |
| <input type="checkbox"/> Fire watch provided for adjoining areas, above, or below. |
| <input type="checkbox"/> Confined Space or Lock-Out-Tag-Out required/used. |
| <input type="checkbox"/> Area smoke or heat detection disabled to eliminate false trip. |
| Other: _____ |
| Comments: _____ |
| _____ |
| _____ |
| _____ |

HOT WORK PERMIT

CONTRACTOR COPY

WARNING! HOT WORK IN PROGRESS WATCH FOR FIRE!

Note: The Required Precautions are not optional. They are required for fire-safe hot work. Please explain all "No" responses below.

Instructions

- Person doing hot work:** Indicate time started and post permit at hot work location. After hot work, indicate time completed and leave permit posted for Fire Watch.
- Fire Watch:** Prior to leaving area, do final inspection, sign, leave permit posted and notify Permit-Authorizing Individual.
- Monitor:** After 4 hours, do final inspection, sign, and return to designated area.

Who, When, and Where?

Hot Work Being Done By

- Employee
 Contractor

| | |
|------|--------------------|
| Date | Job/Work Order No. |
|------|--------------------|

| |
|-----------------------------|
| Location/Building and Floor |
|-----------------------------|

| |
|----------------------|
| Nature of Job/Object |
|----------------------|

| |
|----------------------------------|
| Name of Person(s) Doing Hot Work |
|----------------------------------|

I verify the above location has been examined, the precautions checked on the Required Precautions Checklist have been taken to prevent fire, and permission is authorized for work.

| |
|--|
| Signature of Permit-Authorizing Individual |
|--|

| | | | |
|--------------|--|---------------|--|
| Time Started | <input type="checkbox"/> AM <input type="checkbox"/> PM | Time Finished | <input type="checkbox"/> AM <input type="checkbox"/> PM |
|--------------|--|---------------|--|

| | | |
|-----------------|-----------------|--|
| Expiration Date | Expiration Time | <input type="checkbox"/> AM <input type="checkbox"/> PM |
|-----------------|-----------------|--|

Work area and all adjacent areas to which sparks and heat might have spread were inspected during the fire watch period and were found fire safe.

| | |
|-------------------------|------|
| Signature of Fire Watch | Time |
|-------------------------|------|

Work area was monitored for a minimum of 4 hours following hot work and found fire safe.

| | |
|----------------------|------|
| Signature of Monitor | Time |
|----------------------|------|

**THIS PERMIT IS GOOD FOR 24
HOURS ONLY!**

Required Precautions Checklist

(must be retained as record of hot work activity for 6 months minimum)

- Available Sprinklers in Normal Automatic mode and valve open.
 Hot Work equipment in good repair.

Assess 35 ft radial "sphere" of work for potential fire hazards:

- Floors, work level and below, cleaned or protected.
 All other combustibles removed or shielded from sparks.
- Clean horizontal surfaces (e.g. building structures, equipment, ducts, cable trays, etc.) above and below where possible.
 - Remove flammable liquids, dust, lint, combustible waste, oil deposits, etc., where possible.
 - If removal/cleaning is impractical, protect with fire-retardant covers, or shield with fire-retardant guards and/or curtains.
- Transmission or conveying of sparks to adjacent areas eliminated or protected.
- Tightly cover wall/floor openings with fire-retardant material.
 - Where openings cannot be sealed, suspend fire-retardant tarpaulins to help protect areas beneath.
 - Isolate or shut down fans and conveyors to prevent the capturing and conveying sparks to other areas.
- Explosive atmosphere eliminated or potential not present.

Work on walls, ceilings or enclosed equipment:

- Construction materials verified as noncombustible and without combustible covering or insulation.
 Combustibles on other side of walls relocated or protected.
 Enclosed equipment cleaned and protected from all combustibles.
 Containers purged of flammable liquids/vapors.

Fire watch/hot work area monitoring requirements:

- Continuous fire watch provided during and for *at least 60 minutes* after hot work, including all breaks.
 Fire watch supplied with suitable extinguishers/hoses.
 Fire watch trained in the use of fire equipment and sounding alarm.
 Area to be monitored hourly for a *minimum 4 hours* after job is completed or longer if required.

Other precautions that may be required:

- Fire watch provided for adjoining areas, above, or below.
 Confined Space or Lock-Out-Tag-Out required/used.
 Area smoke or heat detection disabled to eliminate false trip.

Other: _____

Comments: _____

WARNING!

HOT WORK IN PROGRESS WATCH FOR FIRE!

IN CASE OF EMERGENCY:

CALL: _____

AT: _____

WARNING!

FIRE WATCH/MONITOR RECORD

| Checked by (initials) | Date | Time | Checked by (initials) | Date | Time |
|-----------------------|------|------|-----------------------|------|------|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |