

INVITATION TO BID

1. PROJECT IDENTIFICATION

PROJECT

City of Charlevoix
City Hall HVAC Upgrades
Charlevoix, Michigan 49720

OWNER

City of Charlevoix
Gerard Doan, Chief of Police
210 State Street
Charlevoix, MI. 49720
231-547-3270

ENGINEERS

Nealis Engineering, Inc.
830 Cottageview Drive, Suite 102
Traverse City, Michigan 49684
Telephone: (231) 933-0510
Fax: (231) 933-3215

Engineer's Commission No.: 17017
Project Manager: Bill Fries PE

2. PROJECT SCOPE

Base Bid: Removal and replacement of existing air cooled chiller and miscellaneous HVAC work.

Add Alternate 1: Removal and replacement of minisplit heat pump

Add Alternate 2: Removal and replacement of heating boiler

Add Alternate 3: Building Management System Upgrade to Web Based

Add Alternate 4: Building Management Upgrade Occupancy and CO2 sensors

Add Alternate 5: Annual HVAC Preventative Maintenance

3. TYPES OF BIDS REQUIRED

The bids shall be in the format as shown in Section 00310 Proposal Form. Bids may be submitted individually for each project scope –or- as a combined bid.

4. RECEIPT OF BIDS

Bids can be mailed or hand delivered to:

Joyce Golding, City Clerk
City of Charlevoix
210 State Street
Charlevoix, MI. 49720

Bids must be received by:

Date: **May 2, 2017**
Time: **10:00 AM**

All Bids must be received by the City Clerk by the time listed above. Bids will be opened and read at that time. Late Bids will be returned to the respective Bidder, unopened. Bidders submitting Bids will be informed of the results.

A Pre-bid Walk Thru will be conducted with interested contractors. Attendance is mandatory for all Prime Bidders and may be scheduled through the Office of the Engineer (231) 933-0510.

5. EXAMINATION AND PROCUREMENT OF DOCUMENTS

Bidding Documents are now on file and may be requested electronically from The Builders Exchange of Northwest Michigan or the Engineer Bill Fries bfries@nealisengineering.com.

6. VISIT TO SITE:

Bidders are instructed to inspect the site and condition under which the work is to be performed, and any obstacles which may be encountered. No extra will be considered because of Bidder's failure to inform himself of the site conditions which can be verified by inspection.

7. BID SECURITY

A five percent (5%) Bid Security for the total amount is required.

8. PERFORMANCE BOND

Add alternate pricing for Performance Bond is required depending on bid amount.

9. MODIFICATION OR WITHDRAWAL OF BID

A bid may not be modified, withdrawn or canceled for a period of thirty (30) calendar days after the time and date designated for receipt of Bids.

10. RIGHT TO REJECT LOWEST BIDDER OR BIDS

City of Charlevoix reserves the right to accept or reject any and all Bids, and is not obligated to award the job to the lowest bidder.

CHARLEVOIX CITY HALL HVAC UPGRADES

**SECTION 00 03 10
PROPOSAL FORM**

PROJECT:

Charlevoix City Hall HVAC Upgrades
210 State Street
Charlevoix Michigan 49720

TO:

City of Charlevoix
Joyce Golding, City Clerk
210 State Street
Charlevoix, MI. 49720

Bids must be received by:

Date: **Tuesday May 2, 2017**

Time: **10:00 AM**

FROM:

Company Name _____

Contact: _____

Address: _____

City: _____

State: _____

Zip Code: _____

Telephone: _____

Email: _____

ACKNOWLEDGEMENTS:

The undersigned acknowledges that they have received the Bidding Documents, which include the Invitation to Bid, Instructions to Bidders, the Bid Form, other Bidding and Contract forms and the proposed Contract Documents including the Specifications titled Charlevoix City Hall HVAC Upgrades, as prepared by Nealis Engineering Inc. and further acknowledges that they have received the following Addenda issued thereto and has incorporated their provisions in his Bid:

ADDENDUM NO. ___ Dated _____

ADDENDUM NO. ___ Dated _____

The undersigned acknowledges that:

1. They have read and carefully examined the Bidding Documents and proposed Contract Documents and that he fully understands them and has made his Bid in accordance therewith.
2. They have visited the site, has familiarized himself with the local conditions under which the work is to be performed and has correlated his observations with the requirements of the proposed Contract Documents.
3. The Bids are based upon the materials, systems and equipment required by the proposed Contract Documents without exception.

PROJECT SCOPE:

Removal and replacement of existing air cooled chiller, minisplit air conditioner, heating boiler, BMS upgrades and PM agreement. Interested contractors may bid any portion of the scope or a combined bid.

BID FORMAT

For all Bids listed below the undersigned hereby proposes to be Prime Contractor, and furnish all subcontractors, labor, material, tools, equipment, and services required to construct and satisfactorily complete the work as identified in the Construction Documents and these contract documents.

Bid Bond: ___ 5% Bid Bond is Attached

___ Certified Check/Money Order of 5% of bid is attached.

ADDENDA:

We (the Bidder) acknowledge receipt of the following Addenda:

Addendum No. _____ Dated: _____

Addendum No. _____ Dated: _____

BASE BID: INSTALLATION OF NEW 40 TON CHILLER

(Amount in Words)

\$

(Amount in Figures)

ADD ALTERNATE 1: INSTALLATION OF NEW 3-ZONE MINISPLIT AC

(Amount in Words)

\$

(Amount in Figures)

ADD ALTERNATE 2: INSTALLATION OF NEW HEATING BOILER

(Amount in Words)

\$

(Amount in Figures)

ADD ALTERNATE 3: TEMPERATURE CONTROLS: BMS UPGRADE / WEB BASED CONTROLS & COMMISSIONING OF EXISTING CONTROLS

(Amount in Words)

\$

(Amount in Figures)

ADD ALTERNATE 4: TEMPERATURE CONTROLS: INSTALLATION OF OCCUPANCY SENSORS AND CO2 SENSORS

(Amount in Words)

\$

(Amount in Figures)

ADD ALTERNATE 5: ANNUAL HVAC PREVENTATIVE MAINTENANCE

ATTACH SHEET FROM SPECIFICATIONS, YOUR COMPANY STANDARD PM AGREEMENT SALES PROPOSAL -OR- ENTER -NO BID-

BID

NO BID

COMBINED BID:

Description: _____

(Amount in Words)

\$

(Amount in Figures)

Provide ADDED cost for Labor & Material Performance Bond Costs for combined bid:

(Amount in Words)

\$

(Amount in Figures)

FEES FOR HANDLING ADDITIONAL WORK:

For additional work to be performed, upon instruction of the Owner, by Subcontractors- (contractors of the undersigned,) the undersigned agrees to add to the Subcontractor's prices for such additional work, a fee of _____percent (%) which fee covers all charges of the undersigned for overhead and profit, including performance and labor and material payment bonds.

For additional work to be performed, upon instructions of the Owner, by persons other than the Subcontractors, the undersigned agrees that the charges shall be actual cost of all labor and materials (less all discounts plus a fee of ____percent (%) which includes all the charges of the undersigned for overhead and profit. The undersigned further agrees to add to the above total the actual cost of insurance, bonds and taxes computed as a percentage of the direct labor cost: _____%.

The undersigned agrees that each proposal covering extra work shall be accompanied with complete itemized material and labor breakdown.

For all revisions involving the deletion (after award) of Contract work, the undersigned agrees that full credit for material and labor costs shall be given the Owner for work deleted. The undersigned further agrees that any credit will not include any factor reflecting undersigned's overhead or profit.

TIME OF COMPLETION:

If awarded the Contract, we estimate we will require _____ consecutive calendar days to complete the project.

The above time(s) assume(s) that:

1. Award of Contract allows start of construction within 30 days of bid due date, but not before, receipt of Notice to Proceed.
2. We are not delayed by strikes or other causes beyond our control.
3. We are not unnecessarily delayed by work of other contractors of the Owner.

Said stated Contract Time will be used to establish the Date of Substantial Completion of the Work.

AGREEMENTS:

In submitting these bids, the undersigned agrees:

1. To hold their Bid open for 30 consecutive calendar days.
2. To accept the provisions of the Instructions to Bidders regarding the disposition of

CHARLEVOIX CITY HALL HVAC UPGRADES

the Bid Security.

- 3. To perform the Work in accord with the proposed Contract Documents and to complete said Work within the time period stipulated in the Bid.

NEGOTIATION:

The Undersigned agrees that should the overall cost of this Project exceed the funds available, after designated as the successful Bidder, they will be willing to negotiate with the Owner and Engineer for making reductions in the Contract Work. The Contractor shall agree to give full credit for all such deductions in the work requested by the Owner, including full value for labor, material and subcontract work, and reasonably proportionate reductions in overhead and profit, thereby arriving at an agreed upon Contract Price.

LEGAL STATUS AND SIGNATURE OF BIDDER:

(Bidder shall fill out the appropriate form, and strike out the other two types of business.)
A **corporation** duly organized and doing business under the laws of the State of Michigan for whom

Bearing the official title of

Whose signature is affixed to this Bid Form, is duly authorized to execute Contracts.

OR

A **partnership**, all the members of which, with address, are:

CHARLEVOIX CITY HALL HVAC UPGRADES

OR

An **individual**, doing business as

Whose signature is affixed to this Bid Form.

SIGNATURE

Contractor

By

Title

Signed and sealed this _____ day of _____

SECTION 01 91 20
HVAC PREVENTATIVE MAINTENANCE

PART 1 GENERAL

1.01 Through this invitation for bid, THE CITY OF CHARLEVOIX is seeking a comprehensive service, repair, preventative maintenance contract for heating, ventilation and air conditioning equipment.

- A. TERM OF CONTRACT: The term of the contract shall be for a yearly period, starting in 2017 and ending 2018 with two (2) additional one-year options for renewal upon mutual agreement between THE CITY OF CHARLEVOIX and the Mechanical Service Contractor.
- B. ALL INTERESTED BIDDERS must carefully examine applicable drawings, and attend a pre-bid walk through of the facility to ensure that they are thoroughly familiar with the requirements and conditions, and to determine the extent of work to be performed under the contract before submitting a bid.
- C. The Pre-bid Conference/Site Visit is MANDATORY for all prospective bidders who wish to have their bid considered. Bids from prospective bidders not attending or who are not present for the entire Pre-bid Conference/Site Visit will not be considered for award.

1.02 REQUIRED INFORMATION:

- A. Prior to commencement of work under this contract, the MC shall provide THE CITY OF CHARLEVOIX with current certificates of insurance. These certificates shall contain a provision that coverage afforded under the policies will not be cancelled or changed until at least thirty (30) days prior written notice has been given to THE CITY OF CHARLEVOIX.

1.03 SCOPE OF WORK:

- A. The MC shall, at a minimum, provide service, repair and preventative maintenance for the equipment listed below:
 - 1. AIR-COOLED WATER CHILLER, AIR COOLED CONDENSER AND BOILER
 - a. Make monthly inspections of the system. Additional inspections maybe required at the contractual hourly rate.
 - b. During each visit, check the general operation of the machine; make minor repairs and adjustments as required. Perform associated preventative maintenance as per the manufacturer's recommendations.
 - c. Instruct the operator or his/her agent in the operation of the system. This will be accomplished during regular inspections.
 - d. Annually check and calibrate all operating and safety controls.
 - e. Annually check the compressor motor for insulation resistance.
 - f. Annually tighten all electrical connections.
 - g. Annually check the starter contacts for excessive wear and replace as needed.
 - h. Annually perform RPZ and CSD1 testing.
 - 2. CIRCULATING WATER PUMPS
 - a. Perform a visual inspection of the pump shaft, bearings, couplings and mechanical seals. Lubricate pump bearings per manufacturer's recommendations.
 - b. Inspect motor bearings.
 - c. Lubricate per manufacturer's recommendations.
 - d. Inspect and check all starter and motor connections for tightness and signs of overheating and contact pitting.
 - e. Check condition of motor overloads.
 - f. Monitor vibration of rotating equipment.

CHARLEVOIX CITY HALL HVAC UPGRADES

3. AIR-HANDLING UNITS

- a. Inspect and grease fan bearings per manufacturer's recommendations.
- b. Inspect condition of belt(s) and adjust fan belt tension. Replace belt(s) as annually.
- c. Replace air filters quarterly.
- d. Lubricate motor bearings per manufacturer's recommendations.
- e. Inspect coils and condensate pans and clean as required. Assure condensate drain lines are clear and flowing.
- f. Inspect seals on access doors and flexible connectors. Repair or replace as required.
- g. Monitor vibration of rotating equipment.
- h. Check and lubricate damper linkages.
- i. Check set screws and blade adjustment for proper operation.
- j. Once Per Year
 1. Clean fan wheels and fan shaft. Utilize a stiff brush and mechanically remove built-up dirt.
 2. Clean, sanitize and disinfect the fan, fan shaft, casing, cooling coils and condensate pans and drain lines. Assure condensate drain lines are clear and flowing. The use of condensate pan tablets for microbiological control is not permitted.
 3. Inspect the unit casing and accessories for paint chipping and/or corrosion. Provide a written recommendation for repairs.

4. FAN COIL UNITS

- a. Replace air filters twice per year.
- b. Inspect condition of fan motors, actuators and linkages.
- c. Lubricate motor bearings per manufacturer's recommendations.
- c. Inspect coils and condensate pans and clean as required. Assure condensate drain lines are clear and flowing.
- e. Inspect seals on access doors and flexible connectors. Repair or replace as required.
- f. Monitor vibration of rotating equipment.
- g. Check and lubricate damper linkages.
- h. Check set screws and blade adjustment for proper operation.
- i. Once Per Year
 1. Clean fan wheels and fan shaft. Utilize a stiff brush and mechanically remove built-up dirt.
 2. Clean, sanitize and disinfect the fan, fan shaft, casing, cooling coils and condensate pans and drain lines. Assure condensate drain lines are clear and flowing. The use of condensate pan tablets for microbiological control is not permitted.
 3. Inspect the unit casing and accessories for paint chipping and/or corrosion.

5. EXHAUST FANS

- a. Lubricate bearings per manufacturer's recommendations.
- b. Inspect fan belt tension and condition of belts.
- c. Lubricate motor per manufacturer's recommendations.
- d. Check rotation of fan wheel.
- e. Monitor vibration of rotating equipment.
- f. Replace fan belt annually.

CHARLEVOIX CITY HALL HVAC UPGRADES

- g. Inspect condition of sheaves and pulleys annually.
 - h. Fan wheel and casing shall be thoroughly cleaned annually.
6. DRAIN PANS
- a. Inspect all drip pans under equipment and piping for evidence of leakage, whether current or past.
 - b. Correct the source of all leakage.

1.04 INITIAL INSPECTION

- A. During the first 30 days of this contract or upon initial startup, if the MC should find any equipment covered under this contract in need of repair or replacement, the MC will inform the owner in writing of the equipment condition with a written proposal for repairs / replacement. When the owner is notified, it is understood that the MC will not be responsible for present or future repair until the equipment is restored to a condition acceptable to the MC.

1.05 WARRANTY

- A. The MC warrants that the work performed hereunder shall be done in a workmanlike manner and that all parts and components shall be free from defects in workmanship and materials. This warranty shall be effective for a period of ninety (90) days from the date the work is done or the part of component is installed or until the date on which this agreement terminates, whichever first occurs. The customer remedy, should any breach of the warranty occur, shall be for the provider to re-perform defective work or to repair or replace, at the provider's option, any parts or components which are shown, to the provider's satisfaction, to be defective, provided that notice is given promptly upon discovery of the defect.

1.06 PAYMENT FOR SERVICES

- A. The MC will prepare and submit invoices for services rendered on a monthly basis.

1.07 UNSATISFACTORY

- A. When services performed by the MC are considered unsatisfactory by THE CITY OF CHARLEVOIX, the MC shall be given five (5) working days to render satisfactory services. If at the end of five (5) days the services are still considered unacceptable, THE CITY OF CHARLEVOIX reserves the right to secure satisfactory services from another vendor and surcharge the MC any and all difference(s) in cost between the contract price and the cost THE CITY OF CHARLEVOIX pays the other contractor.

1.08 DEDUCTIONS IN PAYMENT

- A. THE CITY OF CHARLEVOIX may make deductions from the invoice payments if the MC does not perform the work specified herein in a satisfactory manner. Deductions will be calculated based upon the number of hours required to perform the function(s) multiplied by the labor rate.

1.09 LOCAL CONDITIONS COVERING WORK

- A. The MC must cooperate with those in authority on the premises to prevent the entrance and exit of all workmen and/or others whose presence is forbidden or undesirable and in bringing, storing, or removing of all materials and equipment, to observe all rules and regulations in force on the grounds, to avoid unnecessary dust, accumulated debris, or the undue interference with the convenience, sanitation and to prevent the loss of or damage to the property of THE CITY OF CHARLEVOIX and/or its employees.
- B. The MC must repair any and all damages he/she may cause to the building or property to the full satisfaction of THE CITY OF CHARLEVOIX.

CHARLEVOIX CITY HALL HVAC UPGRADES

1.10 ADDITIONAL CONTRACT REQUIREMENTS

- A. The vendor shall provide all labor and equipment/instruments required for the preventative maintenance check, which includes refrigerants and glycol test strips for the water-cooled water chiller (as required), lubrication for circulating water pumps and air-handling units, belts, seals for the air-handling units, fan belts for the exhaust fans, etc.
- B. All materials, supplies, and services shall conform to federal, state, and local laws and regulations. All parts shall be new and unused.
- C. Schedule changes may be mutually agreed upon by the designated contact person and the vendor, but must be in writing and signed by the authorized representative of both parties.
- D. Upon completion of the inspection/maintenance/repairs, the technician shall provide a report to the designated contact person detailing the condition of each unit along with any recommendations/estimates for repairs needed. This estimate must include all billable parts. This requirement may be waived in the case of an emergency.

1.11 PRICING

A. Contract pricing should be broken out as follows:

- 1. Contract Bid Price (Monthly Rate) Year 1 _____
- 2. Contract Bid Price (Monthly Rate) Year 2 _____
- 3. Contract Bid Price (Monthly Rate) Year 3 _____

- 4. Emergency response (M-F normal working hours-hourly rate) Year 1 _____
Year 2 _____
Year 3 _____
- 5. Emergency response (M-F overtime - hourly rate) Year 1 _____
Year 2 _____
Year 3 _____
- 6. Emergency response (holidays/weekends - hourly) Year 1 _____
Year 2 _____
Year 3 _____

B. Specify cost markup pricing on standard replacement parts and materials

Year 1 _____

Year 2 _____

Year 3 _____

END OF SECTION

SECTION 23 00 00
MECHANICAL GENERAL PROVISIONS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

- A. This Division includes all materials, labor, equipment, tools, supervision, permits, and incidentals necessary to complete installation and successfully test, start-up, and operate, in a practical and efficient manner, all mechanical systems indicated on the Mechanical Drawings and described in this Division. The work shall also include any items which, while not specifically included in the Contract Documents, are reasonable and are accepted trade practices or necessary for the proper completion of the systems.
- B. Mechanical systems in the contract shall include the following:
 - 1. HVAC systems including all equipment, piping, insulation, and temperature control systems indicated in the Drawings and the Specifications.
- C. The Contractor shall coordinate directly with the Owner to complete the necessary documentation for eligible energy rebates from DTE and Charlevoix Power as a result of this project. NOTE: Pre-application has been applied to DTE and Charlevoix Electric Power. The Mechanical Contractor may be required to be / become a Trade Ally for rebate money to be issued.

1.02 DRAWINGS AND SPECIFICATIONS

- A. Drawings are diagrammatic and are intended to convey a general arrangement and scope of the work included in the contract. Should drawings contradict themselves or the Specifications, the better quality or greater quantity of work shall be included.
- B. Drawings and Specifications are intended to include all work and materials necessary for completion of the work. Any incidental item of material, labor or detail required for the proper execution and completion of the work and omitted from either the drawings and specifications or both, but required by governing codes local regulations, trade practices, operational functions, and good workmanship, shall be provided as part of the Contract Work without extra charge, even though not specifically detailed or specified.
- C. Should there be any question as to the scope of work for which the Mechanical Contractor is responsible, they should request an interpretation before submitting their bid. After contracts are awarded, the Owner shall not be responsible for claims for extras for work that was not included because the Mechanical Contractor was unsure if they should include given work in their bid.

1.03 SITE AND PROJECT DOCUMENT EXAMINATION

- A. Submission of a bid proposal is considered evidence that the Mechanical Contractor has completed the following:
 - 1. Visited the site.
 - 2. Informed themselves of the site conditions.
 - 3. Examined Drawings and Specifications including existing drawings and is proficient, experienced and knowledgeable of all standards, codes, ordinances, permits and regulations which affect his respective trade, and that all costs are included in his proposal.
- B. The Mechanical Contractor and/or Sub-Contractor shall insure all required permits, and assessments have been obtained prior to any work beginning. Contractor shall verify requirement to include privilege fees, plan review fees, and permits as part of his formal bid.
- C. The Pre-Bid conference is mandatory for Prime Mechanical Contractors to bid this project.
- D. Field Changes:
 - 1. This Mechanical Contractor shall not make any field changes that affect the system design, equipment manufacturer, timing, costs, or performance without written approval

CHARLEVOIX CITY HALL HVAC UPGRADES

from the Mechanical and Plumbing Engineer. Approval shall be in the form of a written Field Change Request or Change Order to the Engineer.

2. The Contractor assumes liability for any additional costs for changes requested. Should any unauthorized change be determined by the Engineer as lessening the value of the project, a credit will be request, and shall be issued as a change to the contract.

1.04 STANDARDS, CODES, AND PERMITS

- A. All work shall comply with the latest edition of applicable standards and codes of following:
 1. ASA - American Standards Association
 2. ASME - American Society of Mechanical Engineers
 3. ASTM - American Society of Testing Materials
 4. ANSI - American National Standards Institute
 5. AGA - American Gas Association
 6. ASHRAE - American Society of Heating, Refrigerating, and Air Conditioning Engineers
 7. AWWA - American Water Works Association
 8. NFPA - National Fire Protection Association
 9. IBR - Institute of Boiler and Radiator Manufacturers
 10. AWS - American Welding Society
 11. UL - Underwriter's Laboratories
 12. NEMA - National Electric Manufacturers Association
 13. NEC - National Electric Code
 14. ARA - American Refrigeration Association
 15. OSHA - Occupational Safety and Health Act
 16. ABMA - American Boiler Manufacturers Association
 17. International Mechanical Code 2012
 18. International Plumbing Code 2012 (with Michigan Amendments)
 19. Michigan Mechanical Code 2012
- B. All work shall be provided and tested in accordance with all applicable local county, state laws, ordinances, codes, rules and regulations.
- C. No work shall be covered or enclosed by walls, ceilings, or other, until the work is tested in accordance with applicable codes and regulations, and successful tests witnessed and approved by authorized inspection authority. Written approvals shall be secured by the Mechanical Contractor and submitted to Engineer before final acceptance of work will be granted.

1.05 SUBMITTALS

- A. Proposal Supplement:
 1. Contractor to submit ONE (1) copy of Proposal Supplement - SECTION 23 00 10 - MECHANICAL EQUIPMENT AND MATERIALS, prior to post bid interviews.
 2. After Proposal Supplement and Sub-Contractors are approved, no deviation shall be permitted without written approval of Engineer.
- B. Shop Drawings:
 1. Submit shop drawings in PDF format on all equipment and materials indicated on the Drawings for approval, prior to placing delivery orders.
 2. At the time of submittal for review by the Engineer, shop drawings shall include signatures or stamps indicating that the Contractor and/or the Sub-Contractor has reviewed the submittals and has coordinated the required space, quantities required, services and work of other trades for the equipment or system being submitted.
 3. Provide shop drawings of all manufactured equipment and materials except pipe, pipe fittings and galvanized ductwork. Drawings shall include equipment capacities, weights, dimensions, IO&M Manuals, construction details, controls, wiring diagrams, and motor data.
 5. Engineer's approval of shop drawings is for general application only and is a service only and not considered as a guarantee of total compliance with or as relieving the Mechanical

CHARLEVOIX CITY HALL HVAC UPGRADES

Contractor of basic responsibilities under all contract documents, and does not approve changes in time or cost.

6. After approval, the Mechanical Contractor and its subcontractors are responsible to provide information to all other trades involved in, or affected by, the installation of the Mechanical and Plumbing equipment.
- C. Record (As-Built) Drawings:
1. At substantial completion of construction, furnish record (as-built) plans to the Engineer for approval. As part of the Final Punch List/Close-out, approved as-built plans shall be provided to the Owner.
 2. Record drawings shall include, at the minimum:
 - a. The location and performance data on each piece of equipment.
 - b. The general configuration of duct and pipe distribution systems, including sizes.
 - c. The terminal air or water design flow rates.
- D. Operating and Maintenance Manuals:
1. The Mechanical Contractor and subcontractors shall provide TWO (2) bound and indexed (with tabs for each section) sets of operating and maintenance instructions to the Engineer for review as part of the Final Punch List/Close-out. The Engineer will provide approved manuals to the Owner.
 2. These manuals shall be in accordance with industry-accepted standards and shall include, at the minimum:
 - a. Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance.
 - b. Operation and Maintenance manuals for each piece of equipment requiring maintenance. Required routine maintenance actions shall be clearly identified.
 - c. Name, address and phone for service agency for warranty work.
 - d. HVAC controls system maintenance and calibration information, including:
 - 1) Wiring diagrams
 - 2) Control schematics
 - 3) Control sequence of operation descriptions
 - e. HVAC control drawings with desired or field-determined set points permanently recorded and indicated.

PART II PRODUCTS

2.01 STANDARDS

- A. All products shall be furnished by established manufacturers regularly engaged in making the type of materials to be provided and complete with all parts, accessories, connections, etc. as specified or as recommended and/or required by the manufacturer.
- B. All material where applicable shall be labeled or listed by Underwriters Laboratories, Inc.
- C. All materials and equipment shall be installed in strict compliance with manufacturer's installation instructions. Where special installations or deviations are required, written approval from the manufacturer is required, and shall not void the manufacturer warranty.

2.02 SUBSTITUTIONS AND CHANGES

- A. The Contractor and/or Equipment Supplier may propose alternate equipment or materials of EQUAL or better quality. Prior approval is required or equipment may be listed as an alternate.
- B. The Contractor and/or Equipment Supplier is liable for any added costs to himself or others and is responsible for verifying dimensions, clearance and roughing-in requirements, when product not named as the basis of design are used and is responsible for advising other Contractors of variations and submit revised drawing layout for approval of Engineer.
- C. See SECTION 23 00 10 for voluntary alternates.
 1. No substitutions will be accepted after bids are received.

CHARLEVOIX CITY HALL HVAC UPGRADES

2. When only one manufacturer is listed within the description of the mechanical equipment, the design engineering or project requirements will not allow substitution of other manufacturers.
 3. Contractor will be responsible for ALL costs (engineering time, manufacturer's costs, distributor costs, etc.) incurred to replace equipment not approved if substitutions are made by the distributor, manufacturer's rep., contractor or subcontractor.
- D. Equipment not listed in the Mechanical Schedules or this Division 23, or not approved in writing by the Engineer, shall be separated from the Base Bid and shall be listed as a Voluntary Alternate only. Before acceptance, all Voluntary Alternates must be approved by the Engineer and Architect, and must be approved for use by any special Specifications related to the job.
- E. The Mechanical Contractor is responsible and liable for any added costs to themselves or others that may be a result from use of Approved Alternates or Voluntary Alternates.
- F. The Mechanical Contractor is responsible for bidding the Mechanical and Plumbing materials such as pipe and ductwork materials as listed on the Mechanical Drawings and this Division 23 Specification. Alternate materials or value engineering must be pre-approved by the Engineer, prior to bid submittal. Approval of alternate materials must be shared with the Architect, Owner, and other bidders.

2.03 ELECTRICAL REQUIREMENTS AND CONNECTIONS

- A. General:
1. When the Mechanical equipment not named as the basis of design is approved for use, the Mechanical Contractor is responsible for any costs incurred by other trades, including revisions to the Electrical requirements such as conduit, wire, starters, heaters, fused switches, disconnects, or circuit breakers.
 2. Electrical items furnished shall bear the Underwriter's Laboratories label and the installation shall comply with requirements of the National Electric Code, ANSI, IPCEA, IRI, and local codes, ordinances and regulations.
- B. Motor Starters and Controls:
1. The Electrical Contractor shall provide all manual or magnetic motor starters as required for all motors as indicated on all Electrical Drawings.
 2. The Mechanical Contractor shall provide factory installed motor starters integral with packaged equipment containing thermal overcurrent protection in all underground conductors with heater coils selected for specific motor usage for all motors.
- C. Electrical Wiring and Controls:
1. The Mechanical Contractor shall furnish and install all motors, drives, controllers integral to equipment and factory mounted controls for all mechanical equipment.
 2. The Mechanical Contractor or Temperature Control Contractor shall furnish and install all electrical devices requiring mechanical connections, and/or electrical connections, such as thermostats, UL rated temperature control cabinets, etc., as listed in the Division 23 Contract Documents.
 3. The Temperature Control Contractor or Mechanical Contractor shall furnish and install all power and Class 2 and 3 wiring (low voltage), conduit, and electrical boxes associated with the Temperature Control System. Verify with Mechanical and Electrical Engineer whether plenum-rated, low voltage wiring is required.
 4. The Electrical Contractor shall install all Class 1 (120 volt and greater) power wiring, conduit to motors and/or factory mounted control panels as indicated on Electrical Drawings or as indicated in Specifications.
 5. All electrical wiring work by the Mechanical Contractor and Temperature Control Contractor shall be in accordance with Division 26 requirements.

PART III EXECUTION

3.01 COORDINATION OF MECHANICAL WORK

- A. Responsibility:
 - 1. The Mechanical Contractor shall be responsible for all Sub-Contractors and Suppliers, and include in his bid all materials, labor and equipment involved in accordance with all local regulations, jurisdictional awards, decisions, and secure compliance of all parts of the Specifications and Drawings regardless of sectional inclusion in these Specifications.
 - 2. The Mechanical Contractor and Sub-Contractors shall be responsible for all parts applicable to the job in accordance with the Specifications and Drawings, and shall be responsible for coordinating locations and arrangements of all Mechanical and Plumbing work with all other relevant Architectural, Structural, Electrical, and fire protection Mechanical Drawings, shop drawings, and Specifications.
- B. Submission of a bid proposal is considered evidence that the Mechanical Contractor and its Sub-Contractors are fully capable of providing the following and have included the following in their bid proposal:
 - 1. Fully proficient and experienced to do the work described in the contract documents.
 - 2. Knowledgeable of all federal, state, and local standards, codes, ordinances, permits, and regulations that pertain to the work described in the contract documents.
 - 3. Have properly estimated the time and workforce, including subcontractors, needed to complete the job by the due date.
 - 4. Have included all material, equipment, and labor costs for completion of the job, including all subcontractors costs.
 - 5. Have all the equipment, tools, supplies, vehicles, and trailers to complete the job.
 - 6. Have included all travel, food and lodging expenses.
- C. Installation of Mechanical Systems:
 - 1. Install all Mechanical equipment as shown on the Mechanical Drawings. Deviations of the Mechanical systems and/or installation locations shall be approved by the Engineer.
 - 2. Changes or deviations of the Mechanical systems design and/or installation locations may require redrawing and resubmittal of the Mechanical Drawings to the state or local Mechanical or building inspector.
 - 3. Any costs associated with re-drawing and resubmittal of the Mechanical and Plumbing Drawings, that did not have pre-approval from the Mechanical Engineer, may be charged to the Mechanical Contractor or Mechanical subcontractors. All costs shall be based on a time and materials basis.
 - 4. Minor deviations from the original design will be accepted, but a written request or courtesy call to the Engineer is required. The Engineer may request a written report of the situation and a written request for record.

3.02 EQUIPMENT CLEARANCE

- A. The Mechanical Contractor shall coordinate with the Electrical Contractor's equipment location to insure adequate clearance is maintained as required by the National Electrical Code and applicable state and local codes, as well as accessibility for future maintenance and operation.
- B. Mechanical work shall be arranged with building construction to provide minimum 6'-8" overhead clearance where possible.
- C. Install equipment in a neat and workmanlike manner. Install, align, and level all Mechanical equipment so that it may be easily accessed, adjusted, serviced, and balanced.
- D. Install equipment so that filters, valves, and controls may be easily accessed.
- E. Install equipment so that it does not block or limit access to other equipment, access panels, etc.
- F. Install equipment so that it may be easily inspected.

3.03 GENERAL SUPPORTS

- A. Mechanical Contractor shall provide all necessary channel, angle, brackets, vibration isolators, or supplementary steel as required for adequate support for all piping, specialties, ductwork, and equipment which is hung from the ceiling or roof, or mounted to the floor or roof. For equipment requiring welding or bolting to steel framing, or anchoring to concrete structures, the Mechanical Contractor shall require written approval from the Engineer.

3.04 WALL, FLOOR, CEILING, AND ROOF OPENINGS

- A. All openings including saw cuts, cores, and required lintels shall be provided by the Mechanical Contractor, and shall be approved by the Engineer. Size and location are the responsibility of the Mechanical Contractor. Cracks and rough edges left following installation of equipment shall be caulked, fire-caulked if required, or filled by the Mechanical Contractor.
- B. Perform or pay for all cutting, fitting, repairing, patching and finishing of work of other sections where it is necessary to disturb such work to permit installation of mechanical work.
- C. All roof openings including saw cuts and cores through the roof deck shall be provided by the Mechanical Contractor, and shall be approved by the Architect and Structural Engineer. Size and location of the openings are the responsibility of the Mechanical Contractor.
- D. All roof curbs, Pate Curbs, or other specialty curbs shall be the responsibility of the Mechanical Contractor. Specialty roof curb flashings or curb-membranes shall be included.
- E. All roofing materials including standard flashing, and the installation of roofing systems around the Mechanical equipment shall be the responsibility of the Mechanical Contractor.
- F. All roof deck supporting materials including angles, joists, etc., shall be the responsibility of the Mechanical Contractor, and shall be approved by the Engineer.

3.05 FIELD CHANGES

- A. The Mechanical Contractor shall not make any field changes that affect the system design, equipment manufacturer, timing, costs, or performance without written approval from the Mechanical and Plumbing Engineer. Approval shall be in the form of a written Field Change Request or Change Order, or Supplemental Instruction..
- B. The Contractor assumes liability for any additional costs for changes requested. Should any unauthorized change be determined by the Engineer as lessening the value of the project, a credit will be request, and shall be issued as a change to the contract.

3.06 PROJECT CLOSE-OUT

- A. Final Acceptance and payment will only be made after final Punch-List completion and receipt at the Engineer's Office of:
 - 1. Approved Operating and Maintenance Instruction Manuals
 - 2. Approved Record Drawings (As Built)
 - 3. All Guarantees/Warranties
 - 4. Certificates of Inspection
 - 5. Written and signed verification that Owner's Training has taken place
 - 6. Final Test and Balance Report (reference SECTION 23 05 93 for Report requirements)
 - 7. All extra materials specified to be provided within the Contract Documents

3.07 CERTIFICATES OF INSPECTION

- A. Submit to the Engineer's Office evidence that installation has been inspected and approved by local or state mechanical inspector and/or the authority having jurisdiction.

3.08 GUARANTEES AND WARRANTIES

- A. All labor, materials and equipment shall be guaranteed by Contractor and/or warranted by Manufacturer for ONE (1) year after acceptance date except where specified longer for special equipment. Contractor shall secure such warranty from all Suppliers (not one year from shipment date) or Contractor to assume warranty.

CHARLEVOIX CITY HALL HVAC UPGRADES

- B. Acceptance date of substantial completion shall be Owner occupancy as determined by Architect/Engineer.
- C. Contractor shall make all necessary alterations, repairs, adjustments, replacements during guarantee periods as directed by Architect/Engineer to comply with Drawings and Specifications at no cost to Owner.
- D. Repair or replacements made under guarantee bear further ONE (1) year guarantee from date of acceptance of repair or replacement.
- E. At the end of a one year period of continuous operation, make a complete inspection of all systems, fixtures, equipment, safety devices and controls to insure equipment is operating properly, and report to Engineer in writing.

3.09 PLACING EQUIPMENT INTO OPERATION

- A. Mechanical Contractor shall be responsible for all startup procedures, system checks and balancing associated with his equipment. Factory startup is required for new chiller and new boiler.
- B. All equipment shall be installed, tested and operated in accordance with manufacturer's recommendations at normal operating conditions.
- C. All permanent mechanical equipment operated during construction periods shall be cleaned and damaged equipment replaced.

3.10 OWNER'S TRAINING

- A. The Mechanical Contractor shall conduct ONE (1) - 4-hour training session(s) on the operation and maintenance of all mechanical equipment. Schedule training with Owner at least 72 hours prior to session(s).
- B. Refer to 23 08 00 Commissioning of HVAC and 23 09 00 Building Management System for additional owner training information pertaining to the Temperature Control Subcontractor.

END OF SECTION

**SECTION 23 00 10
MECHANICAL EQUIPMENT AND MATERIALS**

PART 1 GENERAL

1.01 INSTRUCTION:

- A. The Mechanical Contractor is to either copy or remove this specification section from the spec book and complete as follows:
 - 1. Indicate the specific manufacturer on which the bidder's base bid price is based in the blank space provided.
 - 2. All equipment is to be bid as specified. Material or equipment from another manufacturer may be bid as a Voluntary Alternate, but the dollar amount must be shown as an "Add" or "Deduct" to the base bid. Provide the name of the alternate manufacturer in the space provided.
 - 3. Insert the name(s) of each subcontractor used in your bid in the space provided in Part 3.
 - 4. **This form shall be submitted as requested by the Owner and Engineer prior to post bid interviews.**

1.02 RELATED DOCUMENTS:

- A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this section.

1.03 DEVIATIONS FROM SPECIFIED MATERIAL:

- A. See SECTION 23 00 00, Part 2, Paragraph 2.02 - Substitutions and Changes. Base bid shall be based on manufacturers listed in this specification or on the drawings.

PART 2 PRODUCTS

2.01 THE FOLLOWING IS A LIST OF APPROVED MANUFACTURERS, GROUPED ACCORDING TO TYPES OF MATERIALS OR EQUIPMENT.

- A. Air Cooled Chiller:
 - 1. Multistack _____
 - 2. Carrier _____
 - 3. Voluntary alternate _____
 - b. Add \$ _____ Deduct \$ _____
- B. Boiler:
 - 1. Lochinvar _____
 - 2. Viessmann _____
 - a. Voluntary alternate _____
 - b. Add \$ _____ Deduct \$ _____
- C. Minisplit:
 - 1. Manufacturer _____
 - a. Voluntary alternate _____
 - b. Add \$ _____ Deduct \$ _____

PART 3 SUB-CONTRACTORS

3.01 INSERT THE NAME OF EACH SUB-CONTRACTOR AND WORK TO BE PERFORMED BELOW:

- A. Subcontractor _____
Work Performed _____
- B. Subcontractor _____
Work Performed _____
- C. Subcontractor _____
Work Performed _____

END OF SECTION

SECTION 23 05 10
PENETRATION FIRESTOPPING FOR HVAC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Section, apply to work specified in this section.

1.02 DEFINITIONS

- A. Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.

1.03 GENERAL DESCRIPTION OF THE WORK OF THIS SECTION

- A. Only tested firestop systems shall be used in specific locations as follows:
- B. Penetrations for the passage of duct, piping, and other mechanical equipment through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.
- C. B. Repetitive plumbing penetrations in fire-rated floor assemblies. Penetrations exist for the installation of tubs, showers, aerators and other plumbing fixtures.

1.04 REFERENCES

- A. Test Requirements: ASTM E 814, "Standard Method of Fire Tests of Through Penetration Fire Stops"
- B. Test Requirements: UL 1479, "Fire Tests of Through-Penetration Firestops"
- C. Underwriters Laboratories (UL) of Northbrook, IL publishes tested systems in their "FIRE RESISTANCE DIRECTORY" that is updated annually.
 - 1. UL Fire Resistance Directory:
 - a. Firestop Devices (XHJI)
 - b. Fire Resistance Ratings (BXRH)
 - c. Through-Penetration Firestop Systems (XHEZ)
 - d. Fill, Voids, or Cavity Material (XHHW)
 - e. Forming Materials (XHKU)
- D. International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments
- E. Inspection Requirements: ASTM E 2174, "Standard Practice for On-site Inspection of Installed Fire Stops."
- F. ASTM E 84, "Standard Test Method for Surface Burning Characteristics of Building Materials."
 - 1. International Building Code (IBC 2009)
 - 2. NFPA 101 - Life Safety Code

1.05 QUALITY ASSURANCE

- A. A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.
- B. Firestop System installation must meet requirements of ASTM E 814 or UL 1479 tested assemblies that provide a fire rating equal to that of construction being penetrated.
- C. Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.
- D. Firestop Systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.

CHARLEVOIX CITY HALL HVAC UPGRADES

- E. For those firestop applications that exist for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar UL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment drawings must follow requirements set forth by the International Firestop Council.

1.06 SUBMITTALS

- A. Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of UL firestop systems to be used and manufacturer's installation instructions to comply with Section 01 30 00.
- B. Manufacturer's engineering judgment identification number and drawing details when no UL system is available for an application. Engineering judgment must include both project name and contractor's name who will install firestop system as described in drawing.
 - 1. Submit material safety data sheets provided with product delivered to job-site.

1.07 INSTALLER QUALIFICATIONS

- A. Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and UL label where applicable.
- B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.
- C. Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.
- D. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
 - 1. Do not use damaged or expired materials.

1.09 PROJECT CONDITIONS

- A. Do not use materials that contain flammable solvents.
- B. Scheduling
 - 1. Schedule installation of CAST IN PLACE firestop devices after completion of floor formwork, metal form deck, or composite deck but before placement of concrete.
 - 2. Schedule installation of other firestopping materials after completion of penetrating item installation but prior to covering or concealing of openings.
- C. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
- D. Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.
- E. During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

PART 2 - PRODUCTS

2.01 FIRESTOPPING - GENERAL

- A. Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.

CHARLEVOIX CITY HALL HVAC UPGRADES

- B. Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.
- C. Penetrations in Fire Resistance Rated Walls: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.
 - 1. F-Rating: Not less than the fire-resistance rating of the wall construction being penetrated.
- D. Penetrations in Horizontal Assemblies: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.
 - 1. F-Rating: Minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
 - 2. T-Rating: when penetrant is located outside of a wall cavity, minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
- E. Penetrations in Smoke Barriers: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.
 - 1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at both ambient and elevated temperatures.
- F. Mold Resistance: Provide penetration firestopping with mold and mildew resistance rating of 0 as determined by ASTM G21.

2.02 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with through penetration firestop systems (XHEZ) listed in Volume II of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:
 - 1. Hilti, Inc., Tulsa, Oklahoma
 - a. 800-879-8000
 - b. www.us.hilti.com
 - c. Provide products from the above acceptable manufacturer; no substitutions will be accepted.

2.03 MATERIALS

- A. Use only firestop products that have been UL 1479 or ASTM E 814 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.
- B. Pre-installed firestop devices for use with noncombustible and combustible pipes (closed and open systems) penetrating concrete floors and/or gypsum walls, the following products are acceptable:
 - 1. Hilti Cast-In Place Firestop Device (CP 680-P) for use with combustible penetrants.
 - 2. Hilti Cast-In Place Firestop Device (CP 680-M) for use with noncombustible penetrants.
 - 3. Hilti Speed Sleeve (CP 653) for use with cable penetrations.
 - 4. Hilti Firestop Drop-In Device (CFS-DID) for use with noncombustible and combustible penetrants.
 - 5. Hilti Firestop Block (CFS-BL)
- C. Sealants, caulking materials, or foams for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following products are acceptable:
 - 1. Hilti Intumescent Firestop Sealant (FS-ONE)
 - 2. Hilti Self-leveling Firestop Sealant (CP 604)
 - 3. Hilti Fire Foam (CP 620)
 - 4. Hilti Flexible Firestop Sealant (CP 606)
 - 5. Hilti Elastomeric Firestop Sealant (CP 601S)
- D. Sealants or caulking materials for use with sheet metal ducts, the following products are acceptable:
 - 1. Hilti Elastomeric Firestop Sealant (CP 601S)

CHARLEVOIX CITY HALL HVAC UPGRADES

2. Hilti Flexible Firestop Sealant (CP 606)
 3. Hilti Intumescent Firestop Sealant (FS-ONE)
- E. Intumescent sealants, caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe, the following products are acceptable:
1. Hilti Intumescent Firestop Sealant (FS-ONE)
- F. Foams, intumescent sealants, or caulking materials for use with flexible cable or cable bundles, the following products are acceptable:
1. Hilti Intumescent Firestop Sealant (FS-ONE)
 2. Hilti Fire Foam (CP 620)
 3. Hilti Elastomeric Firestop Sealant (CP 601S)
 4. Hilti Flexible Firestop Sealant (CP 606)
- G. Non-curing, re-penetrable, intumescent putty or foam materials for use with flexible cable or cable bundles, the following products are acceptable:
1. Hilti Firestop Putty Stick (CP 618)
 2. Hilti Firestop Plug (CFS-PL)
- H. Firestop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems), the following products are acceptable:
- I. Hilti Firestop Collar (CP 643N)
1. Hilti Firestop Collar (CP 644)
 2. Hilti Wrap Strips (CP 648E/648S)
- J. Materials used for large openings and complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
1. Hilti Firestop Mortar (CP 637)
 2. Hilti Firestop Block (CFS-BL)
 3. Hilti Fire Foam (CP 620)
 4. Hilti Firestop Board (CP 675T)
- K. Non curing, re-penetrable materials used for large openings and complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
1. Hilti Firestop Block (CFS-BL)
 2. Hilti Firestop Board (CP 675T)
- L. For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits, or cables is expected, the following products are acceptable:
1. Hilti Firestop Block (CFS-BL)
 2. Hilti Firestop Plug (CFS-PL)
- M. Provide a firestop system with a "F" Rating as determined by UL 1479 or ASTM E 814 which is equal to the time rating of construction being penetrated.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
1. Verify penetrations are properly sized and in suitable condition for application of materials.
 2. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
 3. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
 4. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.

CHARLEVOIX CITY HALL HVAC UPGRADES

5. Do not proceed until unsatisfactory conditions have been corrected.

3.02 COORDINATION

- A. Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.
- B. Responsible trade to provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interferences.

3.03 INSTALLATION

- A. Regulatory Requirements: Install firestop materials in accordance with UL Fire Resistance Directory.
- B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration joint materials.
 1. Seal all holes or voids made by penetrations to ensure an air and water resistant seal.
 2. Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of UL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
 3. Protect materials from damage on surfaces subjected to traffic.

3.04 FIELD QUALITY CONTROL

- A. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- B. Keep areas of work accessible until inspection by applicable code authorities.
- C. Inspection of through-penetration firestopping shall be performed in accordance with ASTM E 2174, "Standard Practice for On-Site Inspection of Installed Fire Stops" or other recognized standard.
- D. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

3.05 ADJUSTING AND CLEANING

- A. Remove equipment, materials and debris, leaving area in undamaged, clean condition.
- B. Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Testing, adjustment, and balancing of hydronic systems.
- B. Water balance for new chiller and new heating boiler.
- C. Water balance for existing system heating pumps and system chilled water pumps.

1.02 REFERENCE STANDARDS

- A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.
- B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008.
- C. NEBB (TAB) - Procedural Standards for Testing Adjusting and Balancing of Environmental Systems; 2015, Eighth Edition.
- D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2002.

1.03 SUBMITTALS

- A. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
 - 1. Include at least the following in the plan:
 - a. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - b. Final test report forms to be used.
- B. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
 - 1. Revise TAB plan to reflect actual procedures and submit as part of final report.
 - 2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Engineer and for inclusion in operating and maintenance manuals.
 - 3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 - 4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 - 5. Units of Measure: Report data in I-P (inch-pound) units only.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
 - 1. AABC (NSTSB), AABC National Standards for Total System Balance.
 - 2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
 - 3. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. TAB Agency Qualifications:
 - 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 - 2. Having minimum of three years documented experience.
 - 3. Certified by one of the following:
 - a. AABC, Associated Air Balance Council: www.aabc.com; upon completion submit AABC National Performance Guaranty.

CHARLEVOIX CITY HALL HVAC UPGRADES

b. NEBB, National Environmental Balancing Bureau: www.nebb.org.

D. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
1. Systems are started and operating in a safe and normal condition.
 2. Temperature control systems are installed complete and operable.
 3. Proper thermal overload protection is in place for electrical equipment.
 4. Hydronic systems are flushed, filled, and vented.
 5. Pumps are rotating correctly.

3.03 PREPARATION

- A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
1. Require attendance by all installers whose work will be tested, adjusted, or balanced.

3.04 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

3.05 SCOPE

- A. Test, adjust, and balance the following:
1. HVAC System Pumps.
 2. Boiler.
 3. Chiller.

3.06 MINIMUM DATA TO BE REPORTED

- A. Pumps:
1. Identification/number.
 2. Manufacturer.
 3. Size/model.
 4. Impeller.
 5. Service.
 6. Design flow rate, pressure drop, BHP.
 7. Actual flow rate, pressure drop, BHP.
 8. Discharge pressure.
 9. Suction pressure.
 10. Total operating head pressure.
 11. Shut off, discharge and suction pressures.
 12. Shut off, total head pressure.
- B. Air Cooled Condensers:
1. Identification/number.
 2. Location.
 3. Manufacturer.
 4. Model number.
 5. Serial number.

CHARLEVOIX CITY HALL HVAC UPGRADES

6. Entering DB air temperature, design and actual.
 7. Leaving DB air temperature, design and actual.
- C. Chillers:
1. Identification/number.
 2. Manufacturer.
 3. Capacity.
 4. Model number.
 5. Serial number.
 6. Evaporator entering water temperature, design and actual.
 7. Evaporator leaving water temperature, design and actual.
 8. Evaporator pressure drop, design and actual.
 9. Evaporator water flow rate, design and actual.

END OF SECTION

**SECTION 23 07 19
PIPING INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping insulation.
- B. Jackets and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 23 21 13 - Hydronic Piping: Placement of hangers and hanger inserts.
- C. Section 23 23 00 - Refrigerant Piping: Placement of inserts.

1.03 REFERENCE STANDARDS

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.
- C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2013.
- D. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2013).
- E. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2014.
- F. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2015.
- G. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2013).
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- I. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- B. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER

- A. Manufacturers:
 - 1. CertainTeed Corporation
 - 2. Johns Manville Corporation
 - 3. Knauf Insulation
 - 4. Owens Corning Corporation; Fiberglas Pipe Insulation ASJ
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
 - 1. 'K' ('Ksi') Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
 - 2. Maximum Service Temperature: 850 degrees F (454 degrees C).
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches (0.029 ng/Pa s m).
- D. Vapor Barrier Lap Adhesive: Compatible with insulation.
- E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturer:
 - 1. Armacell LLC
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM .C534/C534M Grade 3; use molded tubular material wherever possible.
 - 1. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
 - 2. Maximum Service Temperature: 220 degrees F (104 degrees C).
 - 3. Connection: Waterproof vapor barrier adhesive.

2.04 JACKETS

- A. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
 - 1. Thickness: 0.016 inch (0.40 mm) sheet.
 - 2. Finish: Smooth.
 - 3. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Insulated pipes conveying fluids below ambient temperature; insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. Glass fiber insulated pipes conveying fluids below ambient temperature:
 - 1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- F. For hot piping conveying fluids 180 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

CHARLEVOIX CITY HALL HVAC UPGRADES

- G. Inserts and Shields:
 - 1. Application: Piping 1-1/2 inches (40 mm) diameter or larger.
 - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 - 3. Insert location: Between support shield and piping and under the finish jacket.
 - 4. Insert Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
- H. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 84 00.
- I. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.03 SCHEDULE

- A. Heating Systems:
 - 1. Heating Water Supply and Return: 1" Fiberglass w/ ASJ
- B. Cooling Systems:
 - 1. Chilled Water: 1" Fiberglass w/ ASJ and complete vapor barrier.
 - 2. Refrigerant Hot Gas and Discharge: 3/8" wall cellular elastomeric with aluminum jacket

END OF SECTION

**SECTION 23 08 00
COMMISSIONING OF HVAC**

PART 1 GENERAL

1.01 SUMMARY

- A. This section covers the Contractor's responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item.
- B. The intent is for the Temperature Control Contractor to Commissioning the existing HVAC system to determine proper operation of all heating valves, chilled water valves, pumps, AHU's, FCU's and motorized dampers.
- C. The following HVAC equipment is to be commissioned, including commissioning activities for the following specific items:
 - 1. Control system.
 - 2. Air Handling Units
 - 3. Fan Coil Units
 - 4. Exhaust Fans
 - 5. Chiller
 - 6. Boiler
 - 7. Motorized Dampers

1.02 RELATED REQUIREMENTS

- A. Section SECTION 23 09 00 BUILDING MANAGEMENT SYSTEM

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

- A. Provide all standard testing equipment required to perform startup and initial checkout and required functional performance testing; unless otherwise noted such testing equipment will NOT become the property of Owner.

PART 3 EXECUTION

3.01 PREPARATION

- A. Put all HVAC equipment and systems into operation and continue operation during each working day of testing, adjusting, and balancing and commissioning, as required.

3.02 INSPECTING AND TESTING - GENERAL

- A. Submit startup plans, startup reports, and Prefunctional Checklists for each item of equipment or other assembly to be commissioned.
- B. A Factory Start-Up sheet or preventative maintenance sheet for each piece of equipment is sufficient for commissioning.
- C. Valve/Damper Stroke Setup and Check:
 - 1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
 - 2. Set pump/fan to normal operating mode.
 - 3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
 - 4. Command valve/damper open; verify position is full open and adjust output signal as required.
 - 5. Command valve/damper to a few intermediate positions.
 - 6. If actual valve/damper position does not reasonably correspond, furnish cost of replacement to the owner.
 - 7. Closure for Heating Coil Valves - Normally Open:
 - a. Set heating setpoint 20 degrees F (11 degrees C) above room temperature.

CHARLEVOIX CITY HALL HVAC UPGRADES

- b. Observe valve open.
 - c. Remove power from the valve and verify that the valve stem and actuator position do not change.
 - d. Restore to normal.
 - e. Set heating setpoint to 20 degrees F (11 degrees C) below room temperature.
 - f. Observe the valve close.
 - g. Restore to normal.
8. Closure for Cooling Coil Valves - Normally Closed:
- a. Set cooling setpoint 20 degrees F (11 degrees C) above room temperature.
 - b. Observe the valve close.
 - c. Remove power from the valve and verify that the valve stem and actuator position do not change.
 - d. Restore to normal.
 - e. Set cooling setpoint to 20 degrees F (11 degrees C) below room temperature.
 - f. Observe valve open.
 - g. Restore to normal.
- D. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.

3.03 TAB COORDINATION

- A. Chilled water system and heating water system only. Complete air balance of existing HVAC system is not specified.

3.04 CONTROL SYSTEM FUNCTIONAL TESTING

- A. Prefunctional Checklists for control system components will require a signed and dated certification that all system programming is complete as required to accomplish the requirements of the Contract Documents and the detailed Sequences of Operation documentation submittal.
- B. Using a skilled technician who is familiar with this building, execute the Functional Testing of the control system.
- C. Functional Testing of the control system constitutes demonstration and trend logging of control points monitored by the control system.
 - 1. The scope of trend logging is partially specified; trend log up to 50 percent more points than specified at no extra cost to Owner.
 - 2. Perform all trend logging specified in Prefunctional Checklists and Functional Test procedures.
- D. Functionally Test integral or stand-alone controls in conjunction with the Functional Tests of the equipment they are attached to, including any interlocks with other equipment or systems; further testing during control system Functional Test is not required unless specifically indicated below.
- E. Demonstrate the following to the Commissioning Authority during testing of controlled equipment; coordinate with commissioning of equipment.
 - 1. Setpoint changing features and functions.
 - 2. Sensor calibrations.
- F. Demonstrate to the Commissioning Authority:
 - 1. That all specified functions and features are set up, debugged and fully operable.
 - 2. That scheduling features are fully functional and setup, including holidays.
 - 3. That all graphic screens and value readouts are completed.
 - 4. Correct date and time setting in central computer.
 - 5. That field panels read the same time as the central computer; sample 10 percent of field panels; if any of those fail, sample another 10 percent; if any of those fail test all remaining units at no extra cost to Owner.

CHARLEVOIX CITY HALL HVAC UPGRADES

6. Functionality of field panels using local operator keypads and local ports (plug-ins) using portable computer/keypad; demonstrate 100 percent of panels and 10 percent of ports; if any ports fail, sample another 10 percent; if any of those fail, test all remaining units at no extra cost to Owner.
 7. Power failure and battery backup and power-up restart functions.
 8. Global commands features.
 9. Security and access codes.
 10. Occupant over-rides (manual, telephone, key, keypad, etc.).
 11. O&M schedules and alarms.
 12. Occupancy sensors and controls.
 13. All control strategies and sequences not tested during controlled equipment testing.
- G. If the control system, integral control components, or related equipment do not respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice, under any of the conditions, sequences, or modes tested, correct all systems, equipment, components, and software required at no additional cost to Owner.

3.05 DEMONSTRATION AND TRAINING

- A. Demonstrate operation and maintenance of HVAC system to Owner' personnel; if during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.
- B. Provide classroom and hands-on training of Owner's designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated to be commissioned. Provide the following minimum durations of training:
 1. HVAC Control System: 8 hours.
- C. HVAC Control System Training: Perform training in at least three phases:
 1. Phase 1 - Basic Control System: Provide minimum of 3 hours of actual training on the control system itself. Upon completion of training, each attendee, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.
 2. Phase 2 - Integrating with HVAC Systems: Provide minimum of 3 hours of on-site, hands-on training after completion of Functional Testing. Include instruction on:
 - a. The specific hardware configuration of installed systems in this facility and specific instruction for operating the installed system, including interfaces with other systems, if any.
 - b. Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
 - c. Trend logging and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends; provide practice in setting up trend logging and monitoring during training session.
 - d. Every display screen, allowing time for questions.
 - e. Point database entry and modifications.
 3. Phase 3 - Post-Occupancy: after occupancy conduct minimum of 4 hours of training. Tailor training session to questions and topics solicited beforehand from Owner. Also be prepared to address topics brought up and answer questions concerning operation of the system.

CHARLEVOIX CITY HALL HVAC UPGRADES

- D. Provide the services of the HVAC service technician at other training sessions, when requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

END OF SECTION

SECTION 23 09 00
BUILDING MANAGEMENT SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Building Management System (BMS), utilizing direct digital controls.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 23 08 00 Commissioning of HVAC
- B. Products Not Furnished or Installed But Integrated with the Work of This Section:
 - 1. Chiller control systems.
 - 2. Boiler control systems.
- C. Work Required Under Other Divisions Related to This Section:
 - 1. Power wiring to line side of motor starters, disconnects or variable frequency drives.
 - 2. Provision and wiring of smoke detectors and other devices relating to fire alarm system.
 - 3. Campus LAN (Ethernet) connection adjacent to JACE network management controller.

1.03 SYSTEM DESCRIPTION

- A. Scope: Furnish all labor, materials and equipment necessary for a complete and operating Building Management System (BMS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only. All controllers furnished in this section shall communicate on a peer-to-peer bus over an open protocol bus (Examples: LonTalk, BACnet, MODBUS).
 - 1. The intent of this specification is to provide a system that is consistent with BMS systems throughout the owner's facilities running the Niagara 4 Framework.
 - 2. System architecture shall fully support a multi-vendor environment and be able to integrate third party systems via existing vendor protocols including, as a minimum, LonTalk, BACnet and MODBUS.
 - 3. System architecture shall provide secure Web access using any of the current versions of Microsoft Internet Explorer, Mozilla Firefox, or Google Chrome browsers from any computer on the owner's LAN.
 - 4. All control devices furnished with this Section shall be programmable directly from the Niagara 4 Workbench embedded toolset upon completion of this project. The use of configurable or programmable controllers that require additional software tools for post-installation maintenance shall not be acceptable.
 - 5. Any control vendor that shall provide additional BMS server software shall be unacceptable. Only systems that utilize the Niagara 4 Framework shall satisfy the requirements of this section.
 - 6. The BMS server shall host all graphic files for the control system. All graphics and navigation schemes for this project shall match those that are on the existing campus NiagaraAX or Niagara 4 Framework server.
 - 7. A laptop computer including engineering/programming software to modify Operating System Server BMS programs and graphics shall be included.
 - 8. Owner shall receive all Administrator level login and passwords for engineering toolset at first training session. The Owner shall have full licensing and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the BMS.
 - 9. OPEN NIC STATEMENTS - All Niagara 4 software licenses shall have the following NiCS: "accept.station.in=*"; "accept.station.out=*"; "accept.wb.in=*"; "accept.wb.out=*". All open NIC statements shall follow Niagara Open NIC specifications.
 - 10. All JACE hardware licenses and certificates shall be stored on local MicroSD memory card employing encrypted "safe boot" technology.

CHARLEVOIX CITY HALL HVAC UPGRADES

11. To ensure quality, any JACE 3E, 6E, or 7 hardware products used on this project shall come through the Tridium Richmond, VA shipping facility. JACE hardware products not meeting this requirement will not be allowed.
- B. All products of the BMS shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided on request, with the submittal package. Systems or products not currently offering the following approvals are not acceptable.
 1. Federal Communications Commission (FCC), Rules and Regulations, Volume II -July 1986 Part 15 Class A Radio Frequency Devices.
 2. FCC, Part 15, Subpart B, Class B
 3. FCC, Part 15, Subpart C
 4. FCC, Part 15, Subpart J, Class A Computing Devices.
 5. UL 504 - Industrial Control Equipment.
 6. UL 506 - Specialty Transformers.
 7. UL 910 - Test Method for Fire and Smoke Characteristics of Electrical and Optical-Fiber Cables Used in Air-Handling Spaces.
 8. UL 916 - Energy Management Systems All.
 9. UL 1449 - Transient Voltage Suppression.
 10. Standard Test for Flame Propagation Height of Electrical and Optical - Fiber Cables Installed Vertically in Shafts.
 11. EIA/ANSI 232-E - Interface Between Data Technical Equipment and Data Circuit Terminal Equipment Employing Serial Binary Data Interchange.
 12. EIA 455 - Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices.
 13. IEEE C62.41- Surge Voltages in Low-Voltage AC Power Circuits.
 14. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - a. NEMA 250 - Enclosures for Electrical Equipment.
 15. NEMA ICS 1 - Industrial Controls and Systems.
 16. NEMA ST 1 - Specialty Transformers.
 17. NCSBC Compliance, Energy: Performance of control system shall meet or surpass the requirements of ASHRAE/IESNA 90.1-1999.
 18. CE 61326
 19. C-Tick
 20. cUL

1.04 SPECIFICATION NOMENCLATURE

- A. Acronyms used in this specification are as follows:
 1. Actuator: Control device that opens or closes valve or damper in response to control signal.
 2. AI: Analog Input.
 3. AO: Analog Output.
 4. Analog: Continuously variable state over stated range of values.
 5. BMS: Building Management System.
 6. DDC: Direct Digital Control.
 7. Discrete: Binary or digital state.
 8. DI: Discrete Input.
 9. DO: Discrete Output.
 10. FC: Fail Closed position of control device or actuator. Device moves to closed position on loss of control signal or energy source.
 11. FO: Fail open (position of control device or actuator). Device moves to open position on loss of control signal or energy source.
 12. GUI: Graphical User Interface.
 13. HVAC: Heating, Ventilating and Air Conditioning.
 14. IDC: Interoperable Digital Controller.

CHARLEVOIX CITY HALL HVAC UPGRADES

15. ILC: Interoperable Lon Controller.
16. LAN: Local Area Network.
17. Modulating: Movement of a control device through an entire range of values, proportional to an infinitely variable input value.
18. Motorized: Control device with actuator.
19. NAC: Network Area Controller.
20. NC: Normally closed position of switch after control signal is removed or normally closed position of manually operated valves or dampers.
21. NO: Normally open position of switch after control signal is removed; or the open position of a controlled valve or damper after the control signal is removed; or the usual position of a manually operated valve.
22. OSS: Operating System Server, host for system graphics, alarms, trends, etc.
23. Operator: Same as actuator.
24. PC: Personal Computer.
25. Peer-to-Peer: Mode of communication between controllers in which each device connected to network has equal status and each shares its database values with all other devices connected to network.
26. P: Proportional control; control mode with continuous linear relationship between observed input signal and final controlled output element.
27. PI: Proportional-Integral control, control mode with continuous proportional output plus additional change in output based on both amount and duration of change in controller variable (reset control).
28. PICS: BACnet Product Interoperability Compliance Statement.
29. PID: Proportional-Integral-Derivative control, control mode with continuous correction of final controller output element versus input signal based on proportional error, its time history (reset) and rate at which it's changing (derivative).
30. Point: Analog or discrete instrument with addressable database value.
31. WAN: Wide Area Network.

1.05 SUBMITTALS

- A. Submit in PDF format.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.
 3. Installation methods.
- C. Submit documentation of contractor qualifications, including those indicated in "Quality Assurance" if requested by the A-E.
- D. Drawings of the entire control system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers' catalog data sheets and installation instructions. Submit in printed electronic format.
- E. Shop drawings shall also contain complete wiring and schematic diagrams, sequences of operation, control system bus layout and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings.
- F. Upon completion of the work, provide 'as-built' drawings and other project-specific documentation in 3-ring hard-backed binders and on Flash media.
- G. Any deviations from these specifications or the work indicated on the drawings shall be clearly identified in the Submittals.

1.06 QUALITY ASSURANCE

- A. The Control System Contractor shall have a full service DDC office within 50 miles of the job site. This office shall be staffed with applications engineers, software engineers and field technicians. This office shall maintain parts inventory and shall have all testing and diagnostic equipment necessary to support this work, as well as staff trained in the use of this equipment.

CHARLEVOIX CITY HALL HVAC UPGRADES

This office shall NOT be the only office within 50 miles of the job site, from which parts, software, and authorized service can be provided by the system manufacturer. This office will employ at least four NiagaraN4 programmer.

- B. Single Source Responsibility of Supplier: The Control System Contractor shall be responsible for the complete installation and proper operation of the control system. The Control System Contractor shall exclusively be in the regular and customary business of design, installation and service of computerized building management systems similar in size and complexity to the system specified. The Control System Contractor shall be the manufacturer of the primary DDC system components or shall have been the authorized representative for the primary DDC components manufacturer for at least 5 years. At least two other approved/authorized Control System Contractors providing the same DDC system components, software and support shall have an office located within 50 miles of the job site. All control panels shall be assembled by the Control System Contractor in a UL-Certified 508A panel shop.
- C. Equipment and Materials: Equipment and materials shall be cataloged products of manufacturers regularly engaged in the production and installation of HVAC control systems. Products shall be manufacturer's latest standard design and have been tested and proven in actual use.

1.07 PRE-INSTALLATION MEETINGS

- A. Convene minimum two weeks prior to starting work of this section.

PART 2 PRODUCTS

2.01 PRODUCT MANUFACTURERS AND CONTRACTORS

- A. Acceptable Niagara N4 Manufacturers: Honeywell WEBS Building Control Systems, Vykon, JCI Facility Explorer. Others not permitted.
- B. Acceptable Field Controllers: Field controllers must be available from local supply house to multiple contractors: Honeywell WEBS Spyder, JCI Facility Explorer PCG, KMC. Others not permitted.
- C. Acceptable Contractors: Smart Building Services; Control Resource; Temperature Control Inc. Others by prior approval only.

2.02 GENERAL

- A. The Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers, a network area controller, graphics and programming and other control devices for a complete system as specified herein.
- B. The installed system shall provide secure password access to all features, functions and data contained in the overall BMS.

2.03 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURE

- A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system utilizing Open protocols in one open, interoperable system.
- B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. Physical connection of any BACnet control equipment, such as chillers, shall be via Ethernet or IP.
- C. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.
- D. The supplied system shall incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on the Operating System Server located in the Facilities Office on the LAN. Systems requiring proprietary database and user interface programs shall not be acceptable.

CHARLEVOIX CITY HALL HVAC UPGRADES

- E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.
 - 1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
 - 2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.04 BAS SERVER HARDWARE

- A. Minimum Computer Configuration (Hardware Independent).
 - 1. Central Server. Owner shall provide a dedicated BAS server with configuration that includes the following components as a minimum:
 - 2. Processor: Intel Xeon CPU E5-2640 x64 (or better), compatible with dual- and quad-core processors.
 - 3. Memory: 2 GB or more recommended for large systems, 8 GB or more recommended for the Windows 64-bit version.
 - 4. Hard Drive: 4 GB minimum, more recommended depending on archiving requirements.
 - 5. Display: Video card and monitor capable of displaying 1024 x 768 pixel resolution or greater.
 - 6. Network Support: Ethernet adapter (10/100 Mb with RJ-45 connector).
 - 7. Connectivity: Full-time high-speed ISP connection recommended for remote site access (i.e. T1, ADSL, cable modem).
- B. Standard Client: The thin-client Web Browser BAS GUI shall be Microsoft Internet Explorer (10.0 or later) running on Microsoft 7+. No special software shall be required to be installed on the PCs used to access the BAS via a web browser.

2.05 SYSTEM NETWORK CONTROLLER (SNC)

- A. These controllers are designed to manage communications between the programmable equipment controllers (PEC), application specific controllers (ASC) and advanced unitary controllers (AUC) which are connected to its communications trunks, manage communications between itself and other system network controllers (SNC) and with any operator workstations (OWS) that are part of the BAS, and perform control and operating strategies for the system based on information from any controller connected to the BAS.
- B. The controllers shall be fully programmable to meet the unique requirements of the facility it shall control.
- C. The controllers shall be capable of peer-to-peer communications with other SNC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via cellular modem or connected via the Internet.
- D. The communication protocols utilized for peer-to-peer communications between SNC's will be Niagara 4 Fox, BACnet TCP/IP and SNMP. Use of a proprietary communication protocol for peer-to-peer communications between SNC's is not allowed.
- E. The SNC shall employ a device count capacity license model that supports expansion capabilities.
- F. The SNC shall be enabled to support and shall be licensed with the following Open protocol drivers (client and server) by default:
 - 1. BACnet
 - 2. Lon
 - 3. MODBUS
 - 4. SNMP
 - 5. KNX

CHARLEVOIX CITY HALL HVAC UPGRADES

- G. The SNC shall be capable of executing application control programs to provide:
 - 1. Calendar functions.
 - 2. Scheduling.
 - 3. Trending.
 - 4. Alarm monitoring and routing.
 - 5. Time synchronization.
 - 6. Integration of LonWorks, BACnet, and MODBUS controller data.
 - 7. Network management functions for all SNC, PEC and ASC based devices.
- H. The SNC shall provide the following hardware features as a minimum:
 - 1. Two 10/100 Mbps Ethernet ports.
 - 2. Two Isolated RS-485 ports with biasing switches.
 - 3. 1 GB RAM
 - 4. 4 GB Flash Total Storage / 2 GB User Storage
 - 5. Wi-Fi (Client or WAP)
 - 6. USB Flash Drive
 - 7. High Speed Field Bus Expansion
 - 8. -20-60°C Ambient Operating Temperature
 - 9. Integrated 24 VAC/DC Global Power Supply
 - 10. MicroSD Memory Card Employing Encrypted Safe Boot Technology
- I. The SNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.
- J. The SNC shall provide alarm recognition, storage, routing, management and analysis to supplement distributed capabilities of equipment or application specific controllers.
- K. The SNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via cellular modem, or wide-area network.
 - 1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
 - a. Alarm.
 - b. Return to normal.
 - c. To default.
 - 2. Alarms shall be annunciated in any of the following manners as defined by the user:
 - a. Screen message text.
 - b. Email of complete alarm message to multiple recipients.
 - c. Pagers via paging services that initiate a page on receipt of email message.
 - d. Graphics with flashing alarm object(s).
 - 3. The following shall be recorded by the SNC for each alarm (at a minimum):
 - a. Time and date.
 - b. Equipment (air handler #, access way, etc.).
 - c. Acknowledge time, date, and user who issued acknowledgement.
- L. Programming software and all controller "Setup Wizards" shall be embedded into the SNC.
- M. The SNC shall support the following security functions.
 - 1. Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.
 - 2. Role-Based Access Control (RBAC) for managing user roles and permissions.
 - 3. Require users to use strong credentials.
 - 4. Data in Motion and Sensitive Data at Rest be encrypted.
 - 5. LDAP and Kerberos integration of access management.
- N. The SNC shall support the following data modeling structures to utilize Search; Hierarchy; Template; and Permission functionality:
 - 1. Metadata: Descriptive tags to define the structure of properties.
 - 2. Tagging: Process to apply metadata to components
 - 3. Tag Dictionary

CHARLEVOIX CITY HALL HVAC UPGRADES

- O. The SNC shall employ template functionality. Templates are a containerized set of configured data tags, graphics, histories, alarms... that are set to be deployed as a unit based upon manufacturer's controller and relationships. All lower level communicating controllers (PEC, AUC, AVAV, VFD...) shall have an associated template file for reuse on future project additions.
- P. The SNC shall be provided with a 5 Year Software Maintenance license. Labor to implement not included.

2.06 PROGRAMMABLE EQUIPMENT CONTROLLER (PEC)

- A. HVAC control shall be accomplished using LonMark or BACnet based devices where the application has a LonMark profile or BTL Listed PICS defined. Where LonMark devices are not available for a particular application, devices based on LonWorks shall be acceptable. For each LonWorks device that does not have LonMark certification, the device supplier shall provide an XIF file for the device. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara 4 Framework, that allow standard and customizable control solutions required in executing the "Sequence of Operation".
- B. All PECs shall be application programmable and shall at all times maintain their certification. All control sequences within or programmed into the PEC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
- C. The PEC shall provide LED indication of communication and controller performance to the technician, without cover removal.
- D. The PEC shall not require any external configuration tool or programming tool. All configuration and programming tasks shall be accomplished and accessible from within the Niagara 4 environment.
- E. The following integral and remote Inputs/Outputs shall be supported per each PEC:
 - 1. Eight integral dry contact digital inputs.
 - 2. Any two digital inputs may be configured as pulse counters with a maximum pulse read rate of 15 Hz.
 - 3. Eight integral analog inputs (configurable as 0-10V, 0-10,000 ohm or, 20K NTC).
 - 4. Six integral 4-20 ma analog outputs.
 - 5. Eight integral 24 Vac Triac digital outputs, configurable as maintained or floating motor control outputs.
 - 6. One integral 20 Vdc, 65-mA power supply for auxiliary devices.
 - 7. If a 20 Vdc 65-mA power supply terminal is not integral to the PEC, provide at each PEC a separate, fully isolated, enclosed, current limited and regulated UL listed auxiliary power supply for power to auxiliary devices.
- F. Each PEC shall have expansion ability to support additional I/O requirements through the use of remote input/output modules.
- G. PEC Controllers shall support at minimum the following control techniques:
 - 1. General-purpose control loops that can incorporate Demand Limit Control strategies, Set point reset, adaptive intelligent recovery, and time of day bypass.
 - 2. General-purpose, non-linear control loops.
 - 3. Start/stop Loops.
 - 4. If/Then/Else logic loops.
 - 5. Math Function loops (MIN, MAX, AVG, SUM, SUB, SQRT, MUL, DIV, ENTHALPY).

2.07 ADVANCED UNITARY CONTROLLER (AUC)

- A. The advanced unitary controller (AUC) platform shall be designed specifically to control HVAC - ventilation, filtration, heating, cooling, humidification, and distribution. Equipment includes: constant volume air handlers, VAV air handlers, packaged RTU, heat pumps, unit vents, fan coils, natural convection units and radiant panels. The control shall use LonMark or BACnet based devices where the application has a LonMark profile or BTL Listed PICS defined. Where LonMark devices are not available for a particular application, devices based on LonWorks shall be acceptable. For each LonWorks device that does not have LonMark certification, the

CHARLEVOIX CITY HALL HVAC UPGRADES

device supplier shall provide an XIF file for the device. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara 4 Framework, that allow standard and customizable control solutions required in executing the "Sequence of Operation".

B. Minimum Requirements:

1. The controller shall be fully programmable with full functionality on any Niagara 4 brand platform.
 - a. Support downloads to the controller from any brand of Niagara 4 platform.
 - b. Support uploads from the controller to any brand of Niagara 4 platform.
 - c. Support simulation/debug mode of the controller.
 - d. Maintain native GUI.
 - e. Native function-block programming software and all controller "Setup Wizards" shall be embedded within the Niagara 4 environment.
2. The controller shall be capable of either integrating with other devices or stand-alone operation.
3. The controller shall have two microprocessors. The Host processor contains on-chip FLASH program memory, FLASH information memory, and RAM to run the main HVAC application. The second processor for network communications. Controller memory minimum requirements include:
 - a. FLASH Memory Capacity: 60 Kilobytes with 8 Kilobytes for application program.
 - b. FLASH Memory settings retained for ten years.
 - c. RAM: 2 Kilobytes.
4. The controller shall have an internal time clock with the ability to automatically revert from a master time clock on failure.
 - a. Operating Range: 24 hour, 365 day, multi-year calendar including day of week and configuration for automatic day-light savings time adjustment to occur on configured start and stop dates.
 - b. Accuracy: ± 1 minute per month at 77 degrees F (25 degrees C).
 - c. Power Failure Backup: 24 hours at 32 degrees to 122 degrees F (0 degrees to 50 degrees C).
5. The controller shall have Significant Event Notification, Periodic Update capability, and Failure Detect when network inputs fail to be detected within their configurable time frame.
6. The controller shall have an internal DC power supply to power external sensors.
 - a. Power Output: 20 VDC $\pm 10\%$ at 75 mA.
7. The controller shall have a visual indication (LED) of the status of the device:
 - a. Controller operating normally.
 - b. Controller in process of download.
 - c. Controller in manual mode under control of software tool.
 - d. Controller lost its configuration.
 - e. No power to controller, low voltage, or controller damage.
 - f. Processor and/or controller are not operating.
8. The minimum controller Environmental ratings.
 - a. Operating Temperature Ambient Rating: -40 degrees to 150 degrees F (-40 degrees to 65.5 degrees C).
 - b. Storage Temperature Ambient Rating: -40 degrees to 150 degrees F (-40 degrees to 65.5 degrees C).
 - c. Relative Humidity: 5% to 95% non-condensing.
9. The controller shall have the additional approval requirements, listings, and approvals:
 - a. UL/cUL (E87741) listed under UL916 (Standard for Open Energy Management Equipment) with plenum rating.
 - b. CSA (LR95329-3) Listed.
 - c. Meets FCC Part 15, Subpart B, Class B (radiated emissions) requirements.
 - d. Meets Canadian standard C108.8 (radiated emissions).

CHARLEVOIX CITY HALL HVAC UPGRADES

- e. Conforms requirements European Consortium standard EN 61000-6-1; 2001 (EU Immunity).
 - f. Conforms requirements European Consortium standard EN 61000-6-3; 2001 (EU Emission).
10. The controller housing shall be UL plenum rated mounting to either a panel or DIN rail (standard EN50022; 7.5mm x 35mm).
 11. The controller shall have a mix of digital inputs (DI), digital Triac outputs (DO), analog outputs (AO), and universal inputs (UI).
 - a. Analog outputs (AO) shall be capable of being configured as digital outputs (DO).
 - b. Input and Output wiring terminal strips shall be removable from the controller without disconnecting wiring.
 - c. Input and Output wiring terminals shall be designated with color coded labels.
 - d. Universal inputs shall be capable of being configured as binary inputs, resistive inputs, voltage inputs (0-10 VDC), or current inputs (4-20 mA).
 12. The controller shall provide "continuous" automated loop tuning with an Adaptive Integral Algorithm Control Loop.
 13. The controller platform shall have standard HVAC application programs that are modifiable to support both the traditional and specialized "sequence of operations" as outlined in Section 4.
 - a. Discharge air control and low limit.
 - b. Pressure-dependent dual duct without flow mixing.
 - c. Variable air volume with return flow tracking.
 - d. Economizer with differential enthalpy.
 - e. Minimum airflow coordinated with CO₂.
 - f. Unit ventilator cycle (1, 2, 3) 2-pipe.
 - g. Unit ventilator cycle (1, 2, 3) 2-pipe with face/bypass.
 - h. Unit ventilator cycle (1, 2, 3) 4-pipe.
 - i. Unit ventilator cycle (1, 2, 3) 4-pipe with EOC valve.

2.08 CONTROL SYSTEM HARDWARE

- A. Motorized control dampers that will not be integral to the equipment shall be furnished by the Control System Contractor. Control damper frames shall be constructed of galvanized steel, formed into changes and welded or riveted. Dampers shall be galvanized, with nylon bearings. Blade edge seals shall be vinyl. Blade edge and tip seals shall be included for all dampers. Blades shall be 16-gauge minimum and 6 inches wide maximum and frame shall be of welded channel iron. Damper leakage shall not exceed 10 CFM per square foot, at 1.5 inches water gauge static pressure. Honeywell is basis of design.
- B. Control damper actuators shall be furnished by the Control System Contractor. Two-position or proportional electric actuators shall be direct-mount type sized to provide a minimum of 5 in-lb torque per square foot of damper area. Damper actuators shall be spring return type. Operators shall be heavy-duty electronic type for positioning automatic dampers in response to a control signal. Motor shall be of sufficient size to operate damper positively and smoothly to obtain correct sequence as indicated. All applications requiring proportional operation shall utilize truly proportional electric actuators. Honeywell is basis of design.
- C. Control Valves: Control valves shall be 2-way or 3-way pattern as shown and constructed for tight shutoff at the pump shut-off head or steam relief valve pressure. Control valves shall operate satisfactorily against system pressures and differentials. Two-position valves shall be 'line' size. Proportional control valves shall be sized for a maximum pressure drop of 5.0 psi at rated flow (unless otherwise noted or scheduled on the drawings). Valves with sizes up to and including 2 inches (51 mm) shall be "screwed" configuration and 2-1/2 inches (63.5 mm) and larger valves shall be "flanged" configuration. All control valves, including terminal unit valves, less than 2 inches (51 mm) shall be globe valves. Electrically-actuated control valves shall include spring return type actuators sized for tight shut-off against system pressures (as specified above) and, when specified, shall be furnished with integral switches for indication of

CHARLEVOIX CITY HALL HVAC UPGRADES

- valve position (open-closed). Pneumatic actuators for valves, when utilized, shall be sized for tight shut-off against system pressures (as specified above). Honeywell is basis of design.
- D. Control Valve Actuators: Actuators for VAV terminal unit heating coils shall be "drive-open; drive-closed" type. All actuators shall have inherent current limiting motor protection. Valve actuators shall be 24-volt, electronic type, modulating or two-position as required for the correct operating sequence. Actuators on valves needing 'fail-safe' operation shall have spring return to Normal position. Modulating valves shall be positive positioning in response to the signal. All valve actuators shall be UL listed. Honeywell is basis of design.
 - E. All control valves 2-1/2 inches (63.5 mm) or larger shall have position indication. All hot water control valves shall be Normally-Open arrangement; all chilled water control valves shall be Normally-Closed arrangement. Honeywell is basis of design.
 - F. Wall Mount Room Temperature sensors: Each room temperature sensor shall provide temperature indication to the digital controller, provide the capability for a software-limited occupant set point adjustment (warmer-cooler slider bar or switch) and limited operation override capability. Room Temperature Sensors shall be 20,000-ohm thermistor type with a temperature range of -40 to 140 degrees F (-38 to 60 degrees C). The sensor shall be complete with a decorative cover and suitable for mounting over a standard electrical utility box. These devices shall have an accuracy of 0.5 degrees F (.024 degrees C) over the entire range. Honeywell is basis of design.
 - G. Duct-mounted and Outside Air Temperature Sensors: 20,000-ohm thermistor temperature sensors with an accuracy of \pm ; 0.2 degrees C. Outside air sensors shall include an integral sun shield. Duct-mounted sensors shall have an insertion measuring probe of a length appropriate for the duct size, with a temperature range of -40 to 160 degrees F (-38 to 71 degrees C) The sensor shall include a utility box and a gasket to prevent air leakage and vibration noise. For all mixed air and preheat air applications, install bendable averaging duct sensors with a minimum 8 feet (2438 mm) long sensor element. These devices shall have accuracy of 0.5 degrees F (.024 degrees C) over the entire range. Honeywell is basis of design.
 - H. Humidity sensors shall be thin-film capacitive type sensor with on-board nonvolatile memory, accuracy to plus or minus two percent (2%) at 0 to 90% RH, 12 - 30 VDC input voltage, analog output (0 - 10 VDC or 4 - 20mA output). Operating range shall be 0 to 100% RH and 32 to 140 degrees F (0 to 60 degrees C). Sensors shall be selected for wall, duct or outdoor type installation as appropriate. Honeywell is basis of design.
 - I. Carbon Dioxide Sensors (CO2): Sensors shall utilize Non-dispersive infrared technology (N.D.I.R.), repeatable to plus or minus 20 PPM. Sensor range shall be 0 - 2000 PPM. Accuracy shall be plus or minus five percent (5%) or 75 PPM, whichever is greater. Response shall be less than one minute. Input voltage shall be 20 to 30 VAC or DC. Output shall be 0 - 10 VDC. Sensor shall be wall or duct mounted type, as appropriate for the application, housed in a high impact plastic enclosure. Honeywell is basis of design.
 - J. Current Sensitive Switches: Solid state, split core current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point. Current switch to include an integral LED for indication of trip condition and a current level below trip set point. Honeywell is basis of design.
 - K. Differential Analog (duct) Static Pressure Transmitters Provide a pressure transmitter with integral capacitance type sensing and solid-state circuitry. Accuracy shall be plus or minus 1% of full range; range shall be selected for the specific application. Provide zero and span adjustment capability. Device shall have integral static pickup tube. Honeywell is basis of design.
 - L. Differential Air Pressure Switches: Provide SPDT type, UL-approved, and selected for the appropriate operating range where applied. Switches shall have adjustable set points and barbed pressure tips. Honeywell is basis of design.

CHARLEVOIX CITY HALL HVAC UPGRADES

- M. Water Flow Switches: Provide a SPST type contact switch with bronze paddle blade, sized for the actual pipe size at the location. If installed outdoors, provide a NEMA-4 enclosure. Flow switch shall be UL listed.
- N. Temperature Control Panels: Furnish temperature control panels of code gauge steel with locking doors for mounting all devices as shown. All electrical devices within a control panel shall be factory wired. Control panel shall be assembled by the BMS in a UL-Certified 508A panel shop. A complete set of 'as-built' control drawings (relating to the controls within that panel) shall be furnished within each control panel.
- O. Pipe and Duct Temperature sensing elements: 20,000-ohm thermistor temperature sensors with and accuracy of $\pm 1\%$ accuracy. Their range shall be -5 to 250 degrees F (-20 to 121 degrees C). Limited range sensors shall be acceptable provided they are capable of sensing the range expected for the point at the specified accuracy. Thermal wells with heat conductive gel shall be included. Honeywell is basis of design.
- P. Low Air Temperature Sensors: Provide SPST type switch, with 15 to 55 degrees F (-9 to 13 degrees C), range, vapor-charged temperature sensor. Honeywell model L482A, or approved equivalent.
- Q. Relays: Start/stop relay model shall provide either momentary or maintained switching action as appropriate for the motor being started. All relays shall be plugged in, interchangeable, mounted on a sub base and wired to numbered terminals strips. Relays installed in panels shall all be DPDT with indicating lamp. Relays installed outside of controlled devices shall be enclosed in a NEMA enclosure suitable for the location. Relays shall be labeled with UR symbol. RIB-style relays are acceptable for remote enable/disable.
- R. Emergency Stop Switches: Provide toggle-type switch with normally-closed contact. Switch shall be labeled "AIR HANDLER EMERGENCY SHUTOFF, NORMAL - OFF."
- S. Transducers: Differential pressure transducers shall be electronic with a 4-20 mA output signal compatible to the Direct Digital Controller. Wetted parts shall be stainless steel. Unit shall be designed to operate in the pressure ranges involved.
- T. Control Power Transformers: Provide step-down transformers for all DDC controllers and devices as required. Transformers shall be sized for the load, but shall be sized for 50 watts, minimum. Transformers shall be UL listed Class 2 type, for 120 VAC/24 VAC operation. Honeywell is basis of design.
- U. Line voltage protection: All DDC system control panels that are powered by 120 VAC circuits shall be provided with surge protection. This protection is in addition to any internal protection provided by the manufacturer. The protection shall meet UL, ULC 1449, IEEE C62.41B. A grounding conductor, (minimum 12 AWG), shall be brought to each control panel.

2.09 BAS SERVER & WEB BROWSER GUI - SYSTEM OVERVIEW

- A. The BAS Contractor shall provide system software based on server/thin-client architecture, designed around the open standards of web technology. The BAS server shall communicate using Ethernet and TCP. Server shall be accessed using a web browser over Owner intranet and remotely over the Internet.
- B. The intent of the thin-client architecture is to provide the operator(s) complete access to the BAS system via a web browser. The thin-client web browser Graphical User Interface (GUI) shall be browser and operating system agnostic, meaning it will support HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. Microsoft, Firefox, and Chrome browsers (current released versions), and Windows as well as non-Windows operating systems.
- C. The BAS server software shall support at least the following server platforms (Windows 7, 8.1, 10, Server 12). The BAS server software shall be developed and tested by the manufacturer of the system stand-alone controllers and network controllers/routers.

CHARLEVOIX CITY HALL HVAC UPGRADES

- D. The web browser GUI shall provide a completely interactive user interface and shall provide a HTML5 experience that supports the following features as a minimum:
1. Trending.
 2. Scheduling.
 3. Electrical demand limiting.
 4. Duty Cycling.
 5. Downloading Memory to field devices.
 6. Real time 'live' Graphic Programs.
 7. Tree Navigation.
 8. Parameter change of properties.
 9. Set point adjustments.
 10. Alarm / event information.
 11. Configuration of operators.
 12. Execution of global commands.
 13. Add, delete, and modify graphics and displayed data.
- E. Software Components: All software shall be the most current version. All software components of the BAS system software shall be provided and installed as part of this project. BAS software components shall include:
1. Server Software, Database and Web Browser Graphical User Interface.
 2. 5 Year Software Maintenance license. Labor to implement not included.
 3. Embedded System Configuration Utilities for future modifications to the system and controllers.
 4. Embedded Graphical Programming Tools.
 5. Embedded Direct Digital Control software.
 6. Embedded Application Software.
- F. BAS Server Database: The BAS server software shall utilize a Java Database Connectivity (JDBC) compatible database such as: MS SQL 8.0, Oracle 8i or IBM DB2. BAS systems written to Non -Standard and/or Proprietary databases are NOT acceptable.
- G. Thin Client - Web Browser Based: The GUI shall be thin client or browser based and shall meet the following criteria:
1. Web Browser's for PC's: Only the current released browser (Explorer/Firefox/Chrome) will be required as the GUI and a valid connection to the server network. No installation of any custom software shall be required on the operator's GUI workstation/client. Connection shall be over an intranet or the Internet.
 2. Secure Socket Layers: Communication between the Web Browser GUI and BAS server shall offer encryption using 128-bit encryption technology within Secure Socket Layers (SSL). Communication protocol shall be Hyper-Text Transfer Protocol Secure (HTTPS).

2.10 WEB BROWSER GRAPHICAL USER INTERFACE

- A. Web Browser Navigation: The Thin Client web browser GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application, and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser to accomplish requirements of this specification. The Web Browser GUI shall (as a minimum) provide for navigation, and for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic set point controls, configuration menus for operator access, reports and reporting actions for events.
- B. Login: On launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name and strong password. Navigation in the system shall be dependent on the operator's role-based application control privileges.
- C. Navigation: Navigation through the GUI shall be accomplished by clicking on the appropriate level of a navigation tree (consisting of an expandable and collapsible tree control like Microsoft's Explorer program) and/or by selecting dynamic links to other system graphics. Both

CHARLEVOIX CITY HALL HVAC UPGRADES

the navigation tree and action pane shall be displayed simultaneously, enabling the operator to select a specific system or equipment and view the corresponding graphic. The navigation tree shall as a minimum provide the following views: Geographic, Network, Groups and Configuration.

1. Geographic View shall display a logical geographic hierarchy of the system including: cities, sites, buildings, building systems, floors, equipment and objects.
 2. Groups View shall display Scheduled Groups and custom reports.
 3. Configuration View shall display all the configuration categories (Operators, Schedule, Event, Reporting and Roles).
- D. Action Pane: The Action Pane shall provide several functional views for each subsystem specified. A functional view shall be accessed by clicking on the corresponding button:
1. Graphics: Using graphical format suitable for display in a web browser, graphics shall include aerial building/campus views, color building floor-plans, equipment drawings, active graphic set point controls, web content and other valid HTML elements. The data on each graphic page shall automatically refresh.
 2. Dashboards: User customizable data using drag and drop HTML5 elements. Shall include Web Charts, Gauges, and other custom developed widgets for web browser. User shall have ability to save custom dashboards. See Section 2.13 below.
 3. Search: User shall have multiple options for searching data based upon Tags. Associated equipment, real time data, Properties, and Trends shall be available in result.
 4. Properties: Shall include graphic controls and text for the following: Locking or overriding objects, demand strategies, and any other valid data required for setup. Changes made to the properties pages shall require the operator to depress an 'accept/cancel' button.
 5. Schedules: Shall be used to create, modify/edit and view schedules based on the systems hierarchy (using the navigation tree).
 6. Alarms: Shall be used to view alarm information geographically (using the navigation tree), acknowledge alarms, sort alarms by category, actions and verify reporting actions.
 7. Charting: Shall be used to display associated trend and historical data, modify colors, date range, axis and scaling. User shall have ability to create HTML charts through web browser without utilizing chart builder. User shall be able to drag and drop single or multiple data points, including schedules, and apply status colors for analysis.
 8. Logic - Live Graphic Programs: Shall be used to display 'live' graphic programs of the control algorithm, (micro block programming) for the mechanical/electrical system selected in the navigation tree.
 9. Other actions such as Print, Help, Command, and Logout shall be available via a drop-down window.
- E. Color Graphics: The Web Browser GUI shall make extensive use of color in the graphic pane to communicate information related to set points and comfort. Animated .gifs or .jpg, vector scalable, active set point graphic controls shall be used to enhance usability. Graphics tools used to create Web Browser graphics shall be non-proprietary and conform to the following basic criteria:
1. Display Size: The GUI workstation software shall graphically display in a minimum of 1024 by 768 pixels 24 bit True Color.
 2. General Graphic: General area maps shall show locations of controlled buildings in relation to local landmarks.
 3. Color Floor Plans: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, as selected by Owner. Provide a visual display of temperature relative to their respective set points. The colors shall be updated dynamically as a zone's actual comfort condition changes.
 4. Mechanical Components: Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to enhance usability. .

CHARLEVOIX CITY HALL HVAC UPGRADES

5. Minimum System Color Graphics: Color graphics shall be selected and displayed via a web browser for the following:
 - a. Each piece of equipment monitored or controlled including each terminal unit.
 - b. Each building.
 - c. Each floor and zone controlled.
- F. Hierarchical Schedules: Utilizing the Navigation Tree displayed in the web browser GUI, an operator (with proper access credentials) shall be able to define a Normal, Holiday or Override schedule for an individual piece of equipment or room, or choose to apply a hierarchical schedule to the entire system, site or floor area. For example, Independence Day 'Holiday' for every level in the system would be created by clicking at the top of the geographic hierarchy defined in the Navigation Tree. No further operator intervention would be required and every control module in the system with would be automatically downloaded with the 'Independence Day' Holiday. All schedules that affect the system/area/equipment highlighted in the Navigation Tree shall be shown in a summary schedule table and graph.
 1. Schedules: Schedules shall comply with the LonWorks and BACnet standards, (Schedule Object, Calendar Object, Weekly Schedule property and Exception Schedule property) and shall allow events to be scheduled based on:
 - a. Types of schedule shall be Normal, Holiday or Override.
 - b. A specific date.
 - c. A range of dates.
 - d. Any combination of Month of Year (1-12, any), Week of Month (1-5, last, any), Day of Week (M-Sun, Any).
 - e. Wildcard (example, allow combinations like second Tuesday of every month).
 2. Schedule Categories: The system shall allow operators to define and edit scheduling categories (different types of "things" to be scheduled; for example, lighting, HVAC occupancy, etc.). The categories shall include: name, description, icon (to display in the hierarchy tree when icon option is selected) and type of value to be scheduled.
 3. Schedule Groups: In addition to hierarchical scheduling, operators shall be able to define functional Schedule Groups, comprised of an arbitrary group of areas/rooms/equipment scattered throughout the facility and site. For example, the operator shall be able to define an 'individual tenant' group - who may occupy different areas within a building or buildings. Schedules applied to the 'tenant group' shall automatically be downloaded to control modules affecting spaces occupied by the 'tenant group'.
 4. Intelligent Scheduling: The control system shall be intelligent enough to automatically turn on any supporting equipment needed to control the environment in an occupied space. If the operator schedules an individual room in a VAV system for occupancy, for example, the control logic shall automatically turn on the VAV air handling unit, chiller, boiler and/or any other equipment required to maintain the specified comfort and environmental conditions within the room.
 5. Partial Day Exceptions: Schedule events shall be able to accommodate a time range specified by the operator (ex: board meeting from 6 pm to 9 pm overrides Normal schedule for conference room).
 6. Schedule Summary Graph: The schedule summary graph shall clearly show Normal versus Holiday versus Override Schedules and the net operating schedule that results from all contributing schedules. Note: In case of priority conflict between schedules at the different geographic hierarchy, the schedule for the more detailed geographic level shall apply.
- G. Alarms: Alarms associated with a specific system, area, or equipment selected in the Navigation Tree, shall be displayed in the Action Pane by selecting an 'Alarms' view. Alarms, and reporting actions shall have the following capabilities:
 1. Alarms View: Each Alarm shall display an Alarms Category (using a different icon for each alarm category), date/time of occurrence, current status, alarm report and a bold URL link to the associated graphic for the selected system, area or equipment. The URL link shall indicate the system location, address and other pertinent information. An operator shall

CHARLEVOIX CITY HALL HVAC UPGRADES

- easily be able to sort events, edit event templates and categories, acknowledge or force a return to normal in the Events View as specified in this section.
2. Alarm Categories: The operator shall be able to create, edit or delete alarm categories such as HVAC, Maintenance, Fire, or Generator. An icon shall be associated with each alarm category, enabling the operator to easily sort through multiple events displayed.
 3. Alarm Templates: Alarm template shall define different types of alarms and their associated properties. As a minimum, properties shall include a reference name, verbose description, severity of alarm, acknowledgement requirements, and high/low limit and out of range information.
 4. Alarm Areas: Alarm Areas enable an operator to assign specific Alarm Categories to specific Alarm Reporting Actions. For example, it shall be possible for an operator to assign all HVAC Maintenance Alarm on the 1st floor of a building to email the technician responsible for maintenance. The Navigation Tree shall be used to setup Alarm Areas in the Graphic Pane.
 5. Alarm Time/Date Stamp: All events shall be generated at the DDC control module level and comprise the Time/Date Stamp using the standalone control module time and date.
 6. Alarm Configuration: Operators shall be able to define the type of Alarm generated per object. A 'network' view of the Navigation Tree shall expose all objects and their respective Alarm Configuration. Configuration shall include assignment of Alarm, type of Acknowledgement and notification for return to normal or fault status.
 7. Alarm Summary Counter: The view of Alarm in the Graphic Pane shall provide a numeric counter, indicating how many Alarms are active (in alarm), require acknowledgement and total number of Alarms in the BAS Server database.
 8. Alarm Auto-Deletion: Alarms that are acknowledged and closed shall be auto-deleted from the database and archived to a text file after an operator defined period.
 9. Alarm Reporting Actions: Alarm Reporting Actions specified shall be automatically launched (under certain conditions) after an Alarm is received by the BAS server software. Operators shall be able to easily define these Reporting Actions using the Navigation Tree and Graphic Pane through the web browser GUI. Reporting Actions shall be as follows:
 - a. Print: Alarm information shall be printed to the BAS server's PC or a networked printer.
 - b. Email: Email shall be sent via any POP3-compatible e-mail server (most Internet Service Providers use POP3). Email messages may be copied to several email accounts. Note: Email reporting action shall also be used to support alphanumeric paging services, where email servers support pagers.
 - c. File Write: The ASCII File write reporting action shall enable the operator to append operator defined alarm information to any alarm through a text file. The alarm information that is written to the file shall be completely definable by the operator. The operator may enter text or attach other data point information (such as AHU discharge temperature and fan condition upon a high room temperature alarm).
 - d. Write Property: The write property reporting action updates a property value in a hardware module.
 - e. SNMP: The Simple Network Management Protocol (SNMP) reporting action sends an SNMP trap to a network in response to receiving an alarm.
 - f. Run External Program: The Run External Program reporting action launches specified program in response to an event.
- H. Trends: As system is engineered, all points shall be enabled to trend. Trends shall both be displayed and user configurable through the Web Browser GUI. Trends shall comprise analog, digital or calculated points simultaneously. A trend log's properties shall be editable using the Navigation Tree and Graphic Pane.
1. Viewing Trends: The operator shall have the ability to view trends by using the Navigation Tree and selecting a Trends button in the Graphic Pane. The system shall allow y- and x-axis maximum ranges to be specified and shall be able to simultaneously graphically display multiple trends per graph.

CHARLEVOIX CITY HALL HVAC UPGRADES

2. Local Trends: Trend data shall be collected locally by Multi-Equipment/Single Equipment general-purpose controllers, and periodically uploaded to the BAS server if historical trending is enabled for the object. Trend data, including run time hours and start time date shall be retained in non-volatile module memory. Systems that rely on a gateway/router to run trends are NOT acceptable.
 3. Resolution. Sample intervals shall be as small as one second. Each trended point will have the ability to be trended at a different trend interval. When multiple points are selected for displays that have different trend intervals, the system will automatically scale the axis.
 4. Dynamic Update. Trends shall be able to dynamically update at operator-defined intervals.
 5. Zoom/Pan. It shall be possible to zoom-in on a particular section of a trend for more detailed examination and 'pan through' historical data by simply scrolling the mouse.
 6. Numeric Value Display. It shall be possible to pick any sample on a trend and have the numerical value displayed.
 7. Copy/Paste. The operator shall have the ability to pan through a historical trend and copy the data viewed to the clipboard using standard keystrokes (i.e. CTRL+C, CTRL+V).
- I. Security Access: Systems that Security access from the web browser GUI to BAS server shall require a Login Name and Strong Password. Access to different areas of the BAS system shall be defined in terms of Role-Based Access Control privileges as specified:
1. Roles: Roles shall reflect the actual roles of different types of operators. Each role shall comprise a set of 'easily understood English language' privileges. Roles shall be defined in terms of View, Edit and Function Privileges.
 - a. View Privileges shall comprise: Navigation, Network, and Configuration Trees, Operators, Roles and Privileges, Alarm/Event Template and Reporting Action.
 - b. Edit Privileges shall comprise: Set point, Tuning and Logic, Manual Override, and Point Assignment Parameters.
 - c. Function Privileges shall comprise: Alarm/Event Acknowledgement, Control Module Memory Download, Upload, Schedules, Schedule Groups, Manual Commands, Print and Alarm/Event Maintenance.
 2. Geographic Assignment of Roles: Roles shall be geographically assigned using a similar expandable/collapsible navigation tree. For example, it shall be possible to assign two HVAC Technicians with similar competencies (and the same operator defined HVAC Role) to different areas of the system.

2.12 GRAPHICAL PROGRAMMING

- A. The system software shall include a Graphic Programming Language (GPL) for all DDC control algorithms resident in all control modules. Any system that does not use a drag and drop method of graphical icon programming shall not be accepted. All systems shall use a GPL method used to create a sequence of operations by assembling graphic microblocks that represent each of the commands or functions necessary to complete a control sequence. Microblocks represent common logical control devices used in conventional control systems, such as relays, switches, high signal selectors etc., in addition to the more complex DDC and energy management strategies such as PID loops and optimum start. Each microblock shall be interactive and contain the programming necessary to execute the function of the device it represents.
- B. Graphic programming shall be performed while on screen and using a mouse; each microblock shall be selected from a microblock library and assembled with other microblocks necessary to complete the specified sequence. Microblocks are then interconnected on screen using graphic "wires," each forming a logical connection. Once assembled, each logical grouping of microblocks and their interconnecting wires then forms a graphic function block which may be used to control any piece of equipment with a similar point configuration and sequence of operation.
- C. Graphic Sequence: The clarity of the graphic sequence shall be such that the operator has the ability to verify that system programming meets the specifications, without having to learn or interpret a manufacturer's unique programming language. The graphic programming shall be

CHARLEVOIX CITY HALL HVAC UPGRADES

self-documenting and provide the operator with an understandable and exact representation of each sequence of operation.

- D. GPL Capabilities: The following is a minimum definition of the capabilities of the Graphic Programming software:
1. Function Block (FB): Shall be a collection of points, microblocks and wires which have been connected together for the specific purpose of controlling a piece of HVAC equipment or a single mechanical system.
 2. Logical I/O: Input/Output points shall interface with the control modules in order to read various signals and/or values or to transmit signal or values to controlled devices.
 3. Microblocks: Shall be software devices that are represented graphically and may be connected together to perform a specified sequence. A library of microblocks shall be submitted with the control contractors bid.
 4. Wires: Shall be Graphical elements used to form logical connections between microblocks and between logical I/O.
 5. Reference Labels: Labels shall be similar to wires in that they are used to form logical connections between two points. Labels shall form a connection by reference instead of a visual connection, i.e. two points labeled 'A' on a drawing are logically connected even though there is no wire between them.
 6. Parameter: A parameter shall be a value that may be tied to the input of a microblock.
 7. Properties: Dialog boxes shall appear after a microblock has been inserted which has editable parameters associated with it. Default parameter dialog boxes shall contain various editable and non-editable fields, and shall contain 'push buttons' for the purpose of selecting default parameter settings.
 8. Icon: An icon shall be graphic representation of a software program. Each graphic microblock has an icon associated with it that graphically describes its function.
 9. Menu-bar Icon: Shall be an icon that is displayed on the menu bar on the GPL screen, which represents its associated graphic microblock.
 10. Live Graphical Programs: The Graphic Programming software shall support a 'live' mode, where all input/output data, calculated data and set points shall be displayed in a 'live' real-time mode.

2.13 ENERGY DASHBOARD

- A. Furnish and install dashboard display graphics as a subset of the standard graphics package. Dashboard display graphics shall consist of a minimum of the following user selectable viewlets or widget libraries for easy visualization changes:
1. Circular and Semi-Circular Gauge
 2. Column and Drilldown Charts
 3. Demand Duration
 4. Pie and Drilldown Charts
 5. Axis Charts
 6. History Color Grid and Line Charts
 7. Visual Electric Meters
 8. Point Line and Table Charts
 9. Utility Usage Rankings Charts
 10. Resource Consumption Charts
 11. Scatter Plot
 12. Spyder Charts

PART 3 EXECUTION

3.01 GENERAL

- A. Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.

CHARLEVOIX CITY HALL HVAC UPGRADES

- B. Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by the Control System Contractor in accordance with these specifications.
- C. Equipment furnished by the Mechanical Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by the Control System Contractor.
- D. All control devices mounted on the face of control panels shall be clearly identified as to function and system served with permanently engraved phenolic labels.

3.02 WIRING

- A. All electrical control wiring to the control panels shall be the responsibility of the Control System Contractor.
- B. All wiring shall be in accordance with the Project Electrical Specifications (Division 16), the National Electrical Code and any applicable local codes. All control wiring shall be installed in raceways.
- C. Excess wire shall not be looped or coiled in the controller cabinet.
- D. Incorporate electrical noise suppression techniques in relay control circuits.
- E. There shall be no drilling on the controller cabinet after the controls are mounted inside.
- F. Careful stripping of wire while inside the cabinet is required to ensure that no wire strand fragments land on circuit boards.
- G. Use manufacturer-specified wire for all network connections.
- H. Use approved optical isolation and lightning protection when penetrating building envelope.
- I. Read installation instructions carefully. Any unavoidable deviations shall be approved by owner's rep prior to installation.

3.03 ACCEPTANCE TESTING

- A. Upon completion of the installation, the Control System Contractor shall load all system software and start-up the system. The Control System Contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.
- B. The Control System Contractor shall perform tests to verify proper performance of components, routines and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.
- C. System Acceptance: Satisfactory completion is when the Control System Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.04 OPERATOR TRAINING

- A. During system commissioning and at such time acceptable performance of the Control System hardware and software has been established, the Control System Contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.
- B. The Control System Contractor shall provide 24 total hours of comprehensive training in multiple sessions for system orientation, product maintenance and troubleshooting, programming and engineering. These classes are to be spread out during the 1st year warranty period. The first class starting after final commissioning and the last class is to be in the last month of 1-year warranty period.

3.05 WARRANTY PERIOD SERVICES

- A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.
- B. Within this period, upon notice by the Owner, any defects in the BMS due to faulty materials, methods of installation or workmanship shall be promptly repaired or replaced by the Control System Contractor at no expense to the Owner.
- C. Maintenance of Computer Software Programs: The Control System Contractor shall maintain all software during the standard first year warranty period. In addition, all factory or sub-vendor upgrades to software during the first year warranty period shall be added to the systems, when they become available, at no additional cost. In addition to first year standard warranty, software provided by Control System Contractor shall come with a 5 Year Software Maintenance license. All SNC and BAS Servers are included in this coverage. Labor to implement upgrades in years two through five are not included in standard warranty.
- D. Maintenance of Control Hardware: The Control System Contractor shall inspect, repair, replace, adjust, and calibrate, as required, the controllers, control devices and associated peripheral units during the warranty period. The Control System Contractor shall then furnish a report describing the status of the equipment, problem areas (if any) noticed during service work, and description of the corrective actions taken. The report shall clearly certify that all hardware is functioning correctly.
- E. Service Period: Calls for service by the Owner shall be honored within 24 hours and are not to be considered as part of routine maintenance.
- F. Service Documentation: A copy of the service report associated with each owner-initiated service call shall be provided to the owner.

3.06 WARRANTY ACCESS

- A. The Owner shall grant to the Control System Contractor reasonable access to the BMS during the warranty period. Remote access to the BMS (for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period) will be allowed.

3.07 OPERATION & MAINTENANCE MANUALS

- A. See Division 1 for requirements. O&M manuals shall include the following elements, as a minimum:
 - 1. As-built control drawings for all equipment.
 - 2. As-built Network Communications Diagram.
 - 3. General description and specifications for all components.
 - 4. Completed Performance Verification sheets.
 - 5. Completed Controller Checkout/Calibration Sheets.

END OF SECTION

**SECTION 23 21 13
HYDRONIC PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Hydronic system requirements.
- B. Pipe and pipe fittings for:
 - 1. Heating water piping system.
 - 2. Chilled water piping system.
- C. Pipe hangers and supports.
- D. Unions, flanges, mechanical couplings, and dielectric connections.
- E. Valves:
 - 1. Ball valves.
 - 2. Butterfly valves.
 - 3. Check valves.
- F. Flow controls.

1.02 REFERENCE STANDARDS

- A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications; 2015.
- B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2011.
- C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.
- D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.
- E. ASME B31.9 - Building Services Piping; 2014.
- F. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2001 (R2005).
- G. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; 2008 (ANSI/ASME B31.9).
- H. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- I. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service; 2014.
- J. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- K. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2015.
- L. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).
- M. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2014.
- N. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2013.
- O. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2015.
- P. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2013.
- Q. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80; 2006.
- R. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2013).

CHARLEVOIX CITY HALL HVAC UPGRADES

- S. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011-AMD 1.
- T. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems; 2007.
- U. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015.
- V. AWWA C606 - Grooved and Shouldered Joints; 2011.
- W. AWWA C606 - Standard Specification for Grooved and Shouldered Joints; American Water Works Association; 2006.
- X. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.

1.03 SYSTEM DESCRIPTION

- A. Equipment shall be piped completely according to the Manufacturers standard installation instructions with flow switches, relief valves, unions, isolation valves, inlet and outlet 9" thermometers, sensor wells, strainers, insulation etc.
- B. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- C. Use grooved mechanical couplings and fasteners in accessible locations.
- D. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
- E. Provide pipe hangers and supports in accordance with ASME B31.9 unless indicated otherwise.
- F. Use ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- G. Use globe valves for throttling, bypass, or manual flow control services.
- H. Use 3/4 inch (20 mm) ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.

1.04 SUBMITTALS

- A. Product Data:
 - 1. Include data on pipe materials, pipe fittings, valves, and accessories.
 - 2. Provide manufacturers catalogue information.
 - 3. Indicate valve data and ratings.
 - 4. Show grooved joint couplings, fittings, valves, and specialties on drawings and product submittals, specifically identified with the manufacturer's style or series designation.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with minimum 5 years of commercial pipefitting experience.
- C. Provide all grooved joint couplings, fittings, valves, specialties, and grooving tools from a single manufacturer.
- D. Date stamp all castings used for coupling housings, fittings, valve bodies, etc. for quality assurance and traceability.

1.06 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 code for installation of piping system.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

PART 2 PRODUCTS

2.01 HYDRONIC SYSTEM REQUIREMENTS

- A. Comply with ASME B31.9 and applicable federal, state, and local regulations.
- B. Piping: Provide piping, fittings, hangers and supports as required, as indicated, and as follows:
 - 1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
 - 2. Grooved mechanical joints may be used in accessible locations only.
 - a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by Engineer.
 - b. Use rigid joints unless otherwise indicated.
 - 3. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
 - 4. Provide pipe hangers and supports in accordance with ASME B31.9 unless indicated otherwise.
- C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.
- D. Valves: Provide valves where indicated:
 - 1. Provide drain valves where indicated, and if not indicated provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch (20 mm) gate valves with cap; pipe to nearest floor drain.
 - 2. Isolate equipment using butterfly valves with lug end flanges or grooved mechanical couplings.
 - 3. For throttling, bypass, or manual flow control services, use globe, ball, or butterfly valves.
 - 4. For shut-off and to isolate parts of systems or vertical risers, use ball or butterfly valves.

2.02 HEATING WATER PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:
 - 1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
 - 2. Threaded Joints: ASME B16.3, malleable iron fittings.
 - 3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
 - 4. Fittings: ASTM B 16.3, malleable iron or ASTM A 234/A 234M, wrought steel welding type fittings.
 - 5. Joints: Threaded, or AWS D1.1 welded.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn, using one of the following joint types:
 - 1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
 - a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
 - b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.
 - 2. Grooved Joints: AWWA C606 grooved tube, fittings of same material, and copper-tube-dimension mechanical couplings.
 - 3. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.

2.03 CHILLED WATER PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black; using one of the following joint types:
 - 1. Threaded Joints: ASME B16.3, malleable iron fittings.

CHARLEVOIX CITY HALL HVAC UPGRADES

2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
3. Fittings: ASME B16.3, malleable iron or ASTM A 234/A 234M, wrought steel welding type.
4. Joints: Threaded or AWS D1.1 welded.

2.04 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.
 1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
- B. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch (13 to 38 mm): Malleable iron, adjustable swivel, split ring.
- C. Hangers for Cold Pipe Sizes 2 Inches (50 mm) and Greater: Carbon steel, adjustable, clevis.
- D. Hangers for Hot Pipe Sizes 2 to 4 Inches (50 to 100 mm): Carbon steel, adjustable, clevis.
- E. Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Greater: Adjustable steel yoke, cast iron roll, double hanger.
- F. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- G. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Greater: Steel channels with welded spacers and hanger rods, cast iron roll.
- H. Wall Support for Pipe Sizes to 3 Inches (76 mm): Cast iron hook.
- I. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded with nylock nuts.
- J. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
- K. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.
- L. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
 1. Bases: High density polypropylene.
 2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 3. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
 4. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
 5. Height: Provide minimum clearance of 12 inches under pipe to top of roofing.

2.05 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

- A. Unions for Pipe 2 Inches (50 mm) and Less:
- B. Flanges for Pipe 2 Inches (50 mm) and Greater:
- C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
 1. Dimensions and Testing: In accordance with AWWA C606.
 2. Mechanical Couplings: Comply with ASTM F1476.
 3. Housing Material: Malleable iron or ductile iron, galvanized.
 4. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel, nylock nuts.
 5. When pipe is field grooved, provide coupling manufacturer's grooving tools.

CHARLEVOIX CITY HALL HVAC UPGRADES

6. Manufacturers:
 - a. Grinnell Products.
 - b. Victaulic Company

2.06 BALL VALVES

- A. Manufacturers:
 1. Grinnell Products
 2. Victaulic Company
- B. Up To and Including 2 Inches (50 mm):
 1. Bronze one piece body, chrome plated brass ball, teflon seats and stuffing box ring, lever handle with balancing stops, solder ends with union.

2.07 BUTTERFLY VALVES

- A. Manufacturers:
 1. Grinnell Products
 2. Victaulic Company
- B. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer, lug, grooved ends, extended neck.
- C. Disc: Construct of aluminum bronze, chrome plated ductile iron, stainless steel, ductile iron with EPDM encapsulation or Buna-N encapsulation.
- D. Operator: 10 position lever handle.

2.08 SWING CHECK VALVES

- A. Manufacturers:
 1. Grinnell Products
 2. Victaulic Company
- B. Up To and Including 2 Inches
 1. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder ends.
- C. Over 2 Inches:
 1. Iron body, bronze trim, stainless steel, bronze, bronze faced rotating, swing disc, renewable disc and seat, flanged, grooved ends.

2.09 SPRING LOADED CHECK VALVES

- A. Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer or threaded lug ends.

2.10 FLOW CONTROLS

- A. Manufacturers:
 1. Griswold Controls
 2. ITT Bell & Gossett
 3. Taco, Inc
 4. Victaulic Company
- B. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi (24 kPa).
- C. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi (24 kPa).

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.
- C. Remove scale and dirt on inside and outside before assembly.

CHARLEVOIX CITY HALL HVAC UPGRADES

- D. Prepare piping connections to equipment using jointing system specified.
- E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- F. After completion, fill, clean, and treat systems. Refer to Section 23 25 00 for additional requirements.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and to avoid interfere with use of space.
- D. Group piping whenever practical at common elevations.
- E. Slope piping and arrange to drain at low points.

END OF SECTION

**SECTION 23 23 00
REFRIGERANT PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping.
- B. Refrigerant.
- C. Valves.
- D. Check valves.
- E. Pressure relief valves.
- F. Solenoid valves.
- G. Flexible connections.

1.02 RELATED REQUIREMENTS

- A. Equipment shall be piped completely according to the Manufacturers standard installation instructions for condenser on roof / chiller in basement. Refrigerant specialties shall include the following field / factory furnished equipment: filter drier; sight glass; solenoid valve; isolation valve; receivers, liquid line check valves, nitrogen, refrigerant, insulation, etc.

1.03 REFERENCE STANDARDS

- A. AHRI 710 - Performance Rating of Liquid-Line Driers; 2009.
- B. AHRI 760 - Standard for Performance Rating of Solenoid Valves for Use With Volatile Refrigerants; 2007.
- C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2013.
- D. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications; 2015.
- E. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.
- F. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2013.
- G. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2013.
- H. ASME B31.9 - Building Services Piping; 2014.
- I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- J. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2014.
- K. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2013.
- L. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2013.
- M. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011-AMD 1.
- N. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.
- O. UL 429 - Electrically Operated Valves; Current Edition, Including All Revisions.

1.04 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- B. Provide pipe hangers and supports in accordance with ASME B31.5 unless indicated otherwise.

CHARLEVOIX CITY HALL HVAC UPGRADES

- C. Valves:
 - 1. Use check valves on condenser liquid lines on multiple condenser systems.
- D. Pressure Relief Valves: Use on ASME receivers and pipe to outdoors.
- E. Solenoid Valves:
 - 1. Use in liquid line of single or multiple evaporator systems.
- F. Receivers:
 - 1. Use on systems with long piping runs.
- G. Flexible Connectors: Utilize at or near compressors where piping configuration does not absorb vibration.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum 5 years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and specialties in shipping containers with labeling in place.
- B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.
- C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 for installation of piping system.
- B. Welding Materials and Procedures: Conform to ASME BPVC-IX and applicable state labor regulations.
- C. Welders Certification: In accordance with ASME BPVC-IX.

2.02 PIPING

- A. Copper Tube: ASTM B280, H58 hard drawn or O60 soft annealed.
 - 1. Fittings: ASME B16.22 wrought copper.
 - 2. Joints: Braze, AWS A5.8M/A5.8 BCuP silver/phosphorus/copper alloy.
- B. Copper Tube to 7/8 inch (22 mm) OD: ASTM B88 (ASTM B88M), Type K (A), annealed.
 - 1. Fittings: ASME B16.26 cast copper.
 - 2. Joints: Flared.
- C. Pipe Supports and Anchors:
 - 1. Provide hangers and supports that comply with MSS SP-58.
 - a. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 - 2. Hangers for Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
 - 3. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 4. Wall Support for Pipe Sizes to 3 Inches (75 mm): Cast iron hook.
 - 5. Vertical Support: Steel riser clamp.
 - 6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
 - 7. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
 - 8. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
 - 9. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
 - a. Bases: High density, UV tolerant, polypropylene or reinforced PVC.

CHARLEVOIX CITY HALL HVAC UPGRADES

- b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
- c. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
- d. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
- e. Height: Provide minimum clearance of 6 inches (150 mm) under pipe to top of roofing.

2.03 REFRIGERANT

- A. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.

2.04 MOISTURE AND LIQUID INDICATORS

- A. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F (93 degrees C) and maximum working pressure of 500 psi (3450 kPa).

2.05 VALVES

- A. Diaphragm Packless Valves:
 - 1. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends, with positive backseating; for maximum working pressure of 500 psi (3450 kPa) and maximum temperature of 275 degrees F (135 degrees C).
- B. Ball Valves:
 - 1. Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi (3450 kPa) and maximum temperature of 300 degrees F (149 degrees C).
- C. Service Valves:
 - 1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends, for maximum pressure of 500 psi (3450 kPa).

2.06 CHECK VALVES

- A. Straight Through Type:
 - 1. Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seat; for maximum working pressure of 500 psi (3450 kPa) and maximum temperature of 200 degrees F (93 degrees C).

2.07 SOLENOID VALVES

- A. Valve: AHRI 760 I-P, pilot operated, copper, brass or steel body and internal parts, synthetic seat, stainless steel stem and plunger assembly (permitting manual operation in case of coil failure), integral strainer, with flared, solder, or threaded ends; for maximum working pressure of 500 psi (3450 kPa).
- B. Coil Assembly: UL 429, UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box with pilot light.

2.08 FLEXIBLE CONNECTORS

- A. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches (230 mm) long with copper tube ends; for maximum working pressure of 500 psi (3450 kPa).

CHARLEVOIX CITY HALL HVAC UPGRADES

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and avoid interference with use of space.
- D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- E. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.5.
 - 2. Support horizontal piping as scheduled.
 - 3. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.
 - 4. Place hangers within 12 inches (300 mm) of each horizontal elbow.
 - 5. Provide copper plated hangers and supports for copper piping.
- F. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
- G. Provide clearance for installation of insulation and access to valves and fittings.
- H. Flood piping system with nitrogen when brazing.
- I. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.
- J. Fully charge completed system with refrigerant after testing.

3.02 FIELD QUALITY CONTROL

- A. Test refrigeration system in accordance with ASME B31.5.
- B. Pressure test system with dry nitrogen to 200 psi (1380 kPa). Perform final tests at 27 inches (92 kPa) vacuum and 200 psi (1380 kPa) using halide torch. Test to no leakage.

END OF SECTION

**SECTION 23 25 00
HVAC WATER TREATMENT**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Materials.
 - 1. System cleaner.
 - 2. Closed system treatment (water).

1.02 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience. Company shall have local representatives with water analysis laboratories and full time service personnel.

1.03 REGULATORY REQUIREMENTS

- A. Conform to applicable code for addition of non-potable chemicals to building mechanical systems and to public sewage systems.

PART 2 PRODUCTS

2.01 MATERIALS

- A. System Cleaner:
 - 1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products; sodiumtripoly phosphate and sodium molybdate.
 - 2. Biocide chlorine release agents such as sodium hypochlorite or calcium hypochlorite or microbiocides such as quarternary ammonia compounds, tributyltin oxide, methylene bis (thiocyanate).
- B. Closed System Treatment (Water):
 - 1. Sequestering agent to reduce deposits and adjust pH; polyphosphate.
 - 2. Corrosion inhibitors; boron-nitrite, sodium nitrite and borax, sodium totyltriazone, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.
 - 3. Conductivity enhancers; phosphates or phosphonates.

PART 3 EXECUTION

3.01 PREPARATION

- A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.
- B. Place terminal control valves in open position during cleaning.
- C. Verify that electric power is available and of the correct characteristics.

3.02 CLEANING SEQUENCE

- A. Concentration:
 - 1. As recommended by manufacturer.
- B. Hot Water Heating Systems:
 - 1. Apply heat while circulating, slowly raising temperature to 160 degrees F (71 degrees C) and maintain for 12 hours minimum.
 - 2. Remove heat and circulate to 100 degrees F (37.8 degrees C) or less; drain systems as quickly as possible and refill with clean water.
 - 3. Circulate for 6 hours at design temperatures, then drain.
 - 4. Refill with clean water and repeat until system cleaner is removed.
- C. Chilled Water Systems:
 - 1. Circulate for 48 hours, then drain systems as quickly as possible.
 - 2. Refill with clean water, circulate for 24 hours, then drain.
 - 3. Refill with clean water and repeat until system cleaner is removed.

CHARLEVOIX CITY HALL HVAC UPGRADES

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.04 CLOSED SYSTEM TREATMENT

- A. Introduce closed system treatment through bypass feeder when required or indicated by test.

3.05 MAINTENANCE

- A. Provide a separate maintenance contract for specified maintenance service.
- B. Perform maintenance work using competent and qualified personnel under the supervision and in the direct employ of the equipment manufacturer or original installer.
- C. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of Owner.
- D. Provide service and maintenance of treatment systems for one year from Date of Substantial Completion.
- E. Provide monthly technical service visits to perform field inspections and make water analysis on-site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report after each visit.
- F. Provide laboratory and technical assistance services during this maintenance period.
- G. Provide on-site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.

END OF SECTION

**SECTION 23 51 00
BREECHINGS, CHIMNEYS, AND STACKS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufactured breechings.

PART 2 PRODUCTS

2.01 BREECHINGS, CHIMNEYS, AND STACKS - GENERAL REQUIREMENTS

2.02 MANUFACTURED BREECHINGS

- A. Provide factory-built, modular connector and manifold system, tested to UL 103 with positive pressure rating.
- B. Assembly to be UL listed for use with building equipment in compliance with NFPA 211.
- C. Fabricate with 1 inch (25 mm) minimum air space between walls and construct inner liner of 304 stainless steel and outer jacket of aluminized steel.
- D. Design, fabricate, and install gas-tight preventing products of combustion leaking into the building.
 - 1. Securely connect inner joints and seal with factory supplied overlapping V-bands and appropriate sealant in accordance with manufacturer's instructions.
 - 2. System design to compensate for all flue gas induced thermal expansion.

2.03 PVC VENTING METHODS

- A. Where approved by the equipment manufacturer, the flue and combustion air shall be Category IV approved PVC, CPVC, PP, AL29-4C terminating at the roof with the manufacturers specified vent termination.
- B. A separate pipe shall supply combustion air directly to the boiler from outside. The air inlet pipe must be sealed.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NFPA 54.
- C. Install breechings with minimum of joints. Align accurately at connections, with internal surfaces smooth.
- D. Support breechings from building structure, rigidly with suitable ties, braces, hangers and anchors to hold to shape and prevent buckling. Support vertical breechings, chimneys, and stacks at 12 foot (4 m) spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA (DCS) for equivalent duct support configuration and size.
- E. Pitch breechings with positive slope up from fuel-fired equipment to chimney or stack.
- F. Furnish galvanized steel weatherproof flashing at termination of venting through existing masonry chimney.

END OF SECTION

**SECTION 23 52 16
CONDENSING BOILERS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufactured units.
- B. Boiler construction.
- C. Boiler trim.
- D. Fuel burning system.
- E. Factory installed controls.

1.02 REFERENCE STANDARDS

- A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); current edition at www.ahrinet.org.
- B. ANSI Z21.13 - American National Standard for Gas-Fired Low-Pressure Steam and Hot Water Boilers; 2012.
- C. ASHRAE Std 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings; 2013, Including All Addenda.
- D. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2015.
- E. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); current edition at www.nationalboard.org.
- F. NFPA 54 - National Fuel Gas Code; 2015.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.04 SUBMITTALS

- A. Product Data: Provide data indicating general assembly, components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements, and service connections.
- B. Manufacturer's Installation Instructions: Indicate assembly, support details, connection requirements, and include start up instructions.
- C. Manufacturer's Factory Inspection Report: Submit boiler inspection prior to shipment.
- D. Manufacturer's Field Reports: Burner manifold gas pressure, percent carbon monoxide (CO), percent oxygen (O), percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output.
- E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide standard one year parts and labor warranty and ten year warranty to include coverage for heat exchanger (parts only).
- C. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Natural Gas, Propane, or Combination Natural Gas/Propane for Indoor Applications:
 - 1. Lochinvar
 - 2. Viessmann
 - 3. Aerco
 - 4. Bradford White

2.02 MANUFACTURED UNITS

- A. Factory assembled, factory fire-tested, self-contained, readily transported unit ready for automatic operation except for connection of water, fuel, electrical, and vent services.

2.03 BOILER CONSTRUCTION

- A. Conform to the minimum requirements of ASME BPVC-IV and ANSI Z21.13 for construction of boilers.
- B. External separate gas pressure regulator furnished with boiler package.
- C. Assembly to bear the ASME "H" stamp and comply with the efficiency requirements of the latest edition of ASHRAE Std 90.1.
- D. Required Directory Listings:
 - 1. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); current edition at www.ahrinet.org.
 - 2. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); current edition at www.nationalboard.org.
- E. Heat Exchanger: Construct with materials that are impervious to corrosion where subject to contact with corrosive condensables.
- F. Provide adequate tappings, observation ports, removable panels, and access doors for entry, cleaning, and inspection.
- G. Insulate casing with insulation material, protected and covered by heavy-gage metal jacket.
- H. Factory apply boiler base and other components, that are subject to corrosion, with durable, acrylic, powder coated, painted, weather-proofed finish.

2.04 BOILER TRIM

- A. ASME rated pressure relief valve.
- B. Flow switch.
- C. Electronic Low Water Cut-off: Complete with test light and manual reset button to automatically prevent firing operation whenever boiler water falls below safe level.
- D. Temperature and pressure gage.
- E. Pressure Switches:
 - 1. High gas pressure.
 - 2. Low gas pressure.
 - 3. Air pressure.
- F. Manual reset high limit.
- G. Boiler Pump (where required by boiler design):
 - 1. Primary pump, factory supplied and sized for field installation to ensure minimum, continuous circulation through boiler.
 - 2. Where pump is not provided by boiler manufacturer, provide pump in accordance with boiler manufacturer's recommendations.
 - 3. Pump time delay.

2.05 FUEL BURNING SYSTEM

- A. Provide forced draft automatic burner or pulse combustion, integral to boiler, designed to burn natural gas and maintain fuel-air ratios automatically.
 - 1. Blower Design: Statically and dynamically balanced to supply combustion air; direct connected to motor.
 - 2. Forced Draft Design: Mixes combustion air and gas to achieve 90 percent combustion efficiency.
 - 3. Pulse Combustion Design: Self-aspirating, not requiring blower for combustion.
 - 4. Combustion Air Filter: Protects fuel burning system from debris.
- B. Gas Train: Plug valve, safety gas valve, gas-air ratio control valve, and pressure regulator controls air and gas mixture.
- C. Intakes: Combustion air intake capable of accepting free mechanical room air or direct outside air through a sealed intake pipe

2.06 FACTORY INSTALLED CONTROLS

- A. Option for BACnet card.
- B. Temperature Controls:
 - 1. Automatic reset type to control fuel burning system on-off, firing rate, and maintain temperature.
 - 2. Manual reset type to control fuel burning system to prevent boiler water temperature from exceeding safe system water temperature.
 - 3. Low-fire start time delay relay.
- C. Electronic PI setpoint/modulation control system.
- D. Microprocessor-based, fuel/air mixing controls.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install boiler and provide connection of natural gas service in accordance with requirements of NFPA 54 and applicable codes.
- C. Coordinate factory installed controls with Section 23 09 13.
- D. Coordinate provisions for water treatment in accordance with Section 23 25 00.
- E. Pipe relief valves to nearest floor drain.
- F. Install primary boiler pump in accordance with Section 23 21 23.
- G. Provide piping connection and accessories in accordance with Section 23 21 14.
- H. Provide for connection to electrical service in accordance with Section 26 27 17.
- I. Vent combustion fumes in accordance with manufacturer's recommendations. Refer to Section 23 51 00.

3.02 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate operation of system to Owner's personnel.
 - 1. Use operation and maintenance data as reference during demonstration.
 - 2. Briefly describe function, operation, and maintenance of each component.

END OF SECTION

SECTION 23 64 29
MODULAR WATER CHILLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Factory-assembled packaged chiller.
- B. Controls and control connections.
- C. Chilled water connections.
- D. Electrical power connections.

1.02 REFERENCE STANDARDS

- A. AHRI 550/590 (I-P) - Performance Rating of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle; 2011.
- B. AHRI 575 - Method of Measuring Machinery Sound Within an Equipment Space; 2008.
- C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2013.
- D. ASHRAE Std 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings; 2013, Including All Addenda.
- E. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; 2015.
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- G. UL 984 - Hermetic Refrigerant Motor-Compressors; Current Edition, Including All Revisions.
- H. UL 1995 - Heating and Cooling Equipment; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate physical size, weight and location of major pieces of equipment to be installed. Notify Engineer of any major deviations from the equipment originally specified prior to ordering equipment.
- B. Coordinate with the Mechanical Contractor for the Manufacturers standard installation instructions for condenser on roof / chiller in basement. Refrigeration specialties shall include the following field / factory furnished equipment: filter drier; sight glass; solenoid valve; isolation valve; receivers, liquid line check valves, nitrogen, refrigerant, insulation, etc.
- C. It is the Manufacturers responsibility to coordinate equipment furnished with the chiller and equipment required to be field supplied / installed.

1.04 SUBMITTALS

- A. Product Data: Provide rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.
- B. Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.
- C. Manufacturer's Performance Data: Indicate energy input versus cooling load output from 0 to 100 percent of full load at specified and minimum condenser water temperature for water-cooled chillers and at specified and minimum outdoor air temperature for air-cooled chillers.
- D. Manufacturer's Instructions: Submit manufacturer's complete installation instructions.
- E. Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories; include trouble-shooting guide.
- F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

CHARLEVOIX CITY HALL HVAC UPGRADES

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Conform to manufacturer's written installation instructions for rigging, unloading, and transporting units.
- B. Deliver units to the job site completely assembled and charged with refrigerant and oil by manufacturer.

1.07 WARRANTY

- A. Manufacturer's Warranty: Provide minimum five year warranty to include coverage for materials and labor for compressor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ClimaCool Corp.
- B. Multistack.
- C. Carrier.
- D. Substitutions: Others by prior approval only.
 - 1. The chilled water system has been designed based on specific capacities and characteristics of equipment specified in this section and other sections.
 - 2. When substitution of a different manufacturer or model number is desired, submit sufficient information to demonstrate to Engineer that the substitute will have the same or better performance as that specified AND that the related equipment in the system will perform acceptably with the substitute.
 - 3. If the related equipment must be modified to perform acceptably with the substitute, the entity proposing the substitution is responsible for all additional costs due to re-design and provision of different related equipment.

2.02 CHILLERS

- A. Chillers: Factory assemble and test module consisting of compressor(s), compressor motor(s), evaporator, condenser, enclosure, refrigeration circuits(s) and specialties, interconnecting piping, water circuit isolation valves, starters, and microprocessor-based controls.
 - 1. Rating: AHRI 550/590 (I-P).
 - 2. Safety: UL 1995 and ASHRAE Std 15.
 - 3. Machinery Sound Testing: AHRI 575.
 - 4. Construction & Testing: ASME BPVC-VIII-1 if applicable for construction type.
 - 5. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. or testing firm acceptable to the Authority Having Jurisdiction as suitable for the purpose specified and indicated.
 - 6. Energy Efficiency: ASHRAE Std 90.1.
 - a. Less than or equal to 1.2 kW per ton.
 - 7. Enclosures:
 - a. Frame:
 - 1) Heavy gage steel.
 - 2) Factory painted finish.
 - b. Steel Chiller Cabinets:
 - 1) Factory baked on enamel finish.
 - c. Electrical Equipment: NEMA 250 or UL 1995 as applicable.
 - 8. Motors: UL 984. See Section 23 05 13 for additional requirements.

2.03 COMPRESSORS AND EVAPORATOR

- A. Compressors: Hermetic scroll type.
 - 1. Module: Fully hermetic with two, direct drive compressors, adequate valve types and specialties required for operation and servicing in accordance with manufacturer's recommendations.
 - 2. Vibration Control: Factory installed internal rubber-in-shear isolators.
 - 3. Oil Lubrication System: Initial oil charge, oil pump, oil level sight glass, and oil charging valve.
 - 4. Capacity Reduction System: Compressor staging with duty cycling based on run time.
 - 5. Motor: 3600 rpm, suction gas-cooled, with overload protection.
- B. Evaporator: Brazed plate type.
 - 1. Plate Material: 316 stainless steel.
 - 2. Refrigerant Working-Side Pressure Rating: 650 psig (4482 kPa) minimum.
 - 3. Water Working-Side Pressure Rating: 285 psig (1965 kPa) minimum.
 - 4. Provide with flanged connections.
 - 5. Insulation for all cold surfaces.
 - a. Insulation is factory or field installed on evaporator, connections, and suction piping.
 - b. 0.75 inches (20 mm) minimum thick, closed cell, expanded polyvinyl chloride, polyurethane, or Armaflex II insulation with a maximum k value of 0.28.
 - 6. Provide factory or field installed vents and water drain connections on evaporator or piping.
 - 7. Provide factory or field installed fittings for temperature control sensors on evaporator or piping.

2.04 AIR-COOLED CONDENSER AND FANS

- A. Provide finned-tube type.
 - 1. Mechanically bond aluminum fins to copper tubing and protect with corrosion resistant materials or coatings.
 - 2. Clean, dehydrate and test.
 - 3. Leak Test: 650 psig (4482 kPa) minimum.
- B. Coil Guards: Provide corrosion proof, heavy gage wire panels, factory installed. Provide coil protection for shipping by enclosing entire condenser coil with heavy plastic to prevent coil damage during shipping or rigging.
- C. Fans and Motors:
 - 1. Fans: Dynamically balance propeller, shrouded-axial, or airfoil type fans of reinforced polymer or glass fiber reinforced composite corrosion resistant construction equipped with sealed, permanently lubricated ball bearings.
 - 2. Discharge Fan Guards: Corrosion resistant, heavy gage, steel wire.
 - 3. Discharge Direction: Vertical.
 - 4. Motors: Direct drive, totally enclosed for outdoor use with current overload protection.

2.05 REFRIGERATION CIRCUITS

- A. Provide two independent refrigeration circuits with one compressor per circuit.
- B. Provide liquid line shut-off valve, filter-drier, thermal expansion valve, refrigerant relief device, and compressor discharge check valve for each independent circuit.

2.06 INTEGRATED MICROPROCESSOR BASED DDC CONTROLS PACKAGE

- A. BACnet, pre-wired, assembled, factory mount, and test operating and safety control system consisting of a digital display or gages, on-auto-off switch, motor starting contactors, disconnect switches, power and control wiring. Provide controls, monitoring, programmable set-points, alarms, and BAS as defined below:
 - 1. Automatic Adjustable Operating Controls:
 - a. Temperature of chilled water leaving chiller.

CHARLEVOIX CITY HALL HVAC UPGRADES

- b. Number of compressor circuits required to operate based on set-points and system load.
- c. Compressor short-cycling prevention.
- d. Lead/lag operation for compressors. New lead compressor selected every 24 hours to equalize run time.
- e. Automatic reset on power source failure.
- f. Load limiting.
2. Normal Operation Monitoring and Open Cover-less Displays:
 - a. Hours of operation.
 - b. Suction and discharge refrigerant pressures.
 - c. Automatic diagnostics.
 - d. Number of starts.
 - e. On/off compressor status.
 - f. Entering and leaving chilled water temperatures.
 - g. Status of operation.
 - h. Compressor winding temperature.
 - i. Suction temperature.
 - j. Oil pressure.
3. Set-Points:
 - a. Leaving chilled water temperature.
 - b. Date/time.
4. Automatic Chiller Shut-Down Safety Controls and Alarm:
 - a. Automatic Reset:
 - 1) Chilled water flow interlock.
 - 2) Voltage protection (over/under).
 - 3) Phase reversal protection.
 - b. Manual Reset:
 - 1) Low suction pressure.
 - 2) High motor winding temperature.
 - 3) Low chilled water temperature.
 - 4) Low chilled water flow.
 - 5) High condenser refrigerant discharge pressure.
 - 6) Motor current overload and phase loss.
 - 7) Low oil flow.
 - c. Remote Alarm: Activate remote, audible bell upon safety shutdown of chiller.
5. Building Automation System (BAS) Communications via Shielded Cable:
 - a. Minimum Data Transmission to BAS:
 - 1) All system operating conditions.
 - 2) Capacity control information.
 - 3) Safety shutdown conditions.
 - b. Minimum Operating Commands from BAS:
 - 1) Remote unit start/stop.
 - 2) Chilled water reset.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Align chiller package on steel or concrete foundations.
- C. Install units on vibration isolators.
- D. Connect to electrical service.
- E. Connect to chilled water piping.
- F. Arrange piping for easy dismantling to permit tube cleaning and removal.

CHARLEVOIX CITY HALL HVAC UPGRADES

3.02 MANUFACTURER'S FIELD SERVICES

- A. Perform factory startup of the chiller by factory trained and authorized servicing technicians confirming equipment has been correctly installed prior to equipment becoming operational and covered under the manufacturer's warranty.
- B. Demonstrate system operations and verify specified performance.

3.03 CLOSEOUT ACTIVITIES

- A. Demonstrate proper operation of equipment to Owner's designated representative.
- B. Demonstration: Demonstrate operation of system to Owner's personnel.
 - 1. Use operation and maintenance data as reference during demonstration.
 - 2. Briefly describe function, operation, and maintenance of each component.
- C. Training: Train Owner's personnel on operation and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.

3.04 MAINTENANCE

- A. Provide a separate maintenance contract for specified maintenance service.

END OF SECTION