TOWN OF CARLETON PLACE
REQUEST FOR PROPOSAL
CARLETON PLACE ARENA BUILDING AUTOMATION SYSTEM

PM – 04 -2025

The Town Carleton Place is accepting Proposals for the supply and installation of:

BUILDING AUTOMATION SYSTEM
75 NEELIN STREET, CARLETON PLACE, ONTARIO, K7C 4H1

The purpose of this request is to prompt a response from Proponents actively engaged in the provision of Building Automation System installations.

If you are in a position to submit a Proposal, the completed Form of Proposal and all required attachments and schedules, must be returned via email to rrankin@carletonplace.ca prior to the closing date. You are encouraged to make a full copy of the submitted documents for your file.

During the period for Proposal preparation, any questions concerning the requirements or intent of the statements contained herein should be directed to **Ross Rankin, Property and Project Manager at 613-257- 6256 or via email rrankin@carletonplace.ca**

This Request for Proposal is advertised with a closing date of **2:00 pm, local time, Thursday June 4, 2026.**

We look forward to your response.

Sincerely,

Ross Rankin, CRFP
Property and Project Manager

TOWN OF CARLETON PLACE
REQUEST FOR PROPOSAL
CARLETON PLACE ARENA BUILDING AUTOMATION SYSTEM

Proposals will be received via email to rrankin@carletonplace.ca by

2:00 O'CLOCK NOON, LOCAL TIME (EASTERN) THURSDAY June 4, 2026 for supply and installation of:

BUILDING AUTOMATION SYSTEM
75 NEELIN STREET, CARLETON PLACE, ONTARIO, K7C 4H1

A Mandatory Site inspection is scheduled for **Wednesday May 13, 2026 at 10:00 am** accompanied by Ross Rankin, (phone) 613-257-6256, (email) rrankin@carletonplace.ca or designate. Is recommended required prior to submitting a Proposal for supply and installation of this equipment.

The lowest or any Proposal will not necessarily be accepted.

Ross Rankin,
Property and Project Manager

I N D E X

SECTION 1

INFORMATION TO PROPONENTS

1. *Delivery and Opening of Proposals*

Proposals indicating the Name of Proponent, the Proposal Name & File Number, and the Proposal Closing Date & Time shall be received by the Property and Project Manager. Ross Rankin, via email to rrankin@carletonplace.ca until 2:00 o'clock pm., local time, Thursday June 4, 2026. Late Proposals will not be accepted and will be returned unopened.

The Town of Carleton Place reserves the right to reject any or all Proposals. The lowest or any Proposal will not necessarily be accepted.

2. *Errors, Omissions, Clarifications*

All questions and requests for clarification, including Terms of Reference and technical information, relating to the Request for Proposal process and/or identification of any errors or omissions in the Request for Proposal documents shall be directed to Ross Rankin, Property and Project Manager, ~~v~~ia email rrankin@carletonplace.ca.

The Property and Project Manager may, at his sole discretion, issue a written addendum. The Property and Project Manager will not make oral interpretations or clarifications, as to the meaning of the Proposal documents.

3. *Informal Proposals*

Proposals shall conform to the terms and conditions set out herein. Proposals which are incomplete, conditional, or obscure, or which contain additions not called for, erasures, alterations, or irregularities of any kind, may be rejected as informal. The Form of Proposal must be legibly signed in ink by an authorized officer of the firm.

4. *Ability and Experience of Proponents*

No Proposal will be considered from any Proponent unless known to have a background of experience in a related enterprise of a character similar to that covered by this document**.**

Important - Demonstrable successful experience in the supply and installation of commercial Building Automation Systems by the Proponent is required. Details should be provided as part of the references submitted with the Proposal.

5. Conditions and Requirements for Performance

The Proponent is required to submit their Proposal upon the express conditions that they shall satisfy themselves by personal examination of the proposed location for the Building Automation System, or by such other means, as they may prefer, as to the actual conditions of the location and requirements for the Building Automation System.

Each Proponent by careful examination of the RFQ documents and any subsequent addenda shall satisfy themselves as to the nature of the equipment required as well as all conditions which might affect the execution of the contract and will make the necessary changes to their proposal.

6. ***Agreement***

The Proponent agrees that the Town of Carleton Place's Letter of Acceptance issued to the successful Proponent, along with the Proposal Document submitted in response to, and in compliance with, the RFP shall constitute the basis of the Agreement. If any other document is required, Proponents shall clearly identify this requirement in the Proposal as submitted. It is preferred that a sample document be included with the Proposal for review. In the absence of notification from the Proponent of the requirement for additional documents, it shall be deemed that the documentation outlined in the first sentence of this paragraph shall constitute the whole of the agreement.

7. ***Proposal Left Open***

The Proponent shall keep their Proposal open for acceptance for ninety (90) days after the closing date.

8. ***Right to Accept or Reject Proposals***

The Town of Carleton Place reserves the right to reject any or all Proposal or to accept any Proposal should it be deemed in the interests of the Town of Carleton Place to do so and if only one Proposal is received, the Town of Carleton Place reserves the right to reject it.

Notwithstanding the foregoing, in the event that a preferred Proposal does not exactly and entirely meet the Town of Carleton Place's requirements, the Town of Carleton Place reserves the right to enter into negotiations with the selected Proponent to arrive at a mutually satisfactory arrangement with respect to any modifications to the Proposal.

9. ***Schedule***

A- Release of RFP	May 6, 2026
B- Mandatory Site Visit	May 13, 2026
C- Written Questions Received	May 20, 2026
D- Response to Written Questions	May 22, 2026
E- Submission of Proposal	June 4, 2026
F- Proposal Presentation/BAS Demonstration	June 10, 2026
G- Proposal Review and Award	June 24, 2026
H- Delivery & Installation	August 3. 2026
I –Substantial Completion	September 11, 2026

The Town of Carleton Place reserves the right to alter the scheduling of items "C" to "I".

10. ***Indemnity***

The Proponent shall defend, indemnify and save harmless The Town of Carleton Place, its elected officials, officers, employees and agents from and against any and all claims of any nature, actions, causes of action, losses, expenses, fines, costs (including legal costs), interest or damages of every nature and kind whatsoever, including but not limited to bodily injury, sickness, disease or death or to damage to or destruction of tangible property including loss of revenue or incurred expense resulting from disruption of service, arising out of or allegedly attributable to the negligence, acts, errors, omissions, misfeasance, nonfeasance, fraud or willful misconduct of the Proponent, its directors, officers, employees, agents, contractors and subcontractors, or any of them, in connection with or in any way related to the delivery or performance of this Contract. This indemnity shall be in addition to and not in lieu of any insurance to be provided by the Proponent in accordance with this Contract and shall survive this Contract.

The Proponent agrees to defend, indemnify and save harmless The Town of Carleton Place from and against any and all claims of any nature, actions, causes of action, losses, expenses, fines, costs (including legal costs), interest or damages of every nature and kind whatsoever arising out of or related to the Supplier's status with WSIB. This indemnity shall be in addition to and not in lieu of any proof of WSIB status and compliance to be provided by the Supplier in accordance with this Contract, and shall survive this Contract.

11. ***Insurance Policy & Certificate***

Evidence of insurance covering all of the following areas, in a form satisfactory to the Town, shall be provided prior to and maintained during the Contract:

Commercial General Liability issued on an occurrence basis for an amount of not less than $5,000,000. per occurrence / $5,000,000. annual aggregate for any negligent acts or omissions by the Contractor relating to their obligations under the Contract. Such insurance shall include, but is not limited to bodily injury and property damage including loss of use; personal injury; contractual liability; premises, property & operations; non-owned automobile; broad form property damage; owners & Contractors protective; occurrence property damage; products & completed operations; employees as Additional Insured(s); contingent employers liability; tenants legal liability; cross liability and severability of interest clause.

Such insurance shall add the Corporation of the Town of Carleton Place as additional insured with respect to the operations of the Contractor. This insurance shall be non-contributing with and apply as primary and not as excess of any insurance available to the Town and contain a waiver of subrogation in favour of the Town. The Contractor shall indemnify and hold the Corporation of the Town of Carleton Place harmless from and against any liability, loss, claims, demands, costs and expenses, including reasonable legal fees,

occasioned wholly or in part by any negligence or acts or omissions whether willful or otherwise by the Contractor, its agents, officers, employees or other persons for whom the Contractor is legally responsible.

Environmental Impairment Liability with a limit of not less than $1,000,000 per Incident /Annual Aggregate. Coverage shall include Third Party Bodily Injury and Property Damage including on-site and off-site clean-up. If coverage is written on a claim made basis, the policy shall be maintained for a period of 2 years following completion of the contract or a 2-year extended reporting period shall be executed.

Such insurance shall add the Corporation of the Town of Carleton as additional insured with respect to the operations of the Contractor. This insurance shall be non-contributing with and apply as primary and not as excess of any insurance available to the Town and contain a waiver of subrogation in favour of the Town. The Contractor shall indemnify and hold the Corporation of the Town of Carleton Place harmless from and against any liability, loss, claims, demands, costs and expenses, including reasonable legal fees, occasioned wholly or in part by any negligence or acts or omissions whether willful or otherwise by the Contractor, its agents, officers, employees or other persons for whom the Contractor is legally responsible.

Automobile Liability Insurance with respect to owned or leased vehicles used directly or indirectly in the performance of the services, covering liability for bodily injury, death and damage to property with a limit of not less than $5,000,000 inclusive for each and every loss.

The Policies shown above shall not be cancelled or materially changed unless the Insurer notifies the Town in writing at least sixty (60) days prior to the effective date of the cancellation or change. The insurance must be with a recognized company registered within the Province of Ontario and acceptable to the Town.

It is further agreed that any deductible or the self-insured retention (SIR) is the sole responsibility of the Contractor. The deductible shall be subject to approval by the Town and cannot for any of the above referenced insurance exceed $100,000. It is also the Contractor’s responsibility to maintain physical damage coverage on its equipment, either through insurance or self-insurance and at no time will the Town be liable for such damage.

If the Contractor fails to provide or maintain insurance as required in the above insurance provisions, then the Town shall have the right, at its option and discretion and in addition to any rights the Town may have, to provide and maintain such insurance and give evidence thereof to the Contractor. The cost thereof shall be payable by the Contractor on demand. If the amount owing is not paid to the Town within 30 days, the Town shall be entitled to offset the damages so assessed against any monies that the Town may owe the

Contractor under this Contract. The Contractor shall not do or omit to be done anything whereby any policy of insurance required by the Town shall be rendered cancelable or the amount payable pursuant to its terms rendered non-payable.

Prior to execution of the contract, the Contractor shall provide the Town with a certificate of insurance evidencing the required coverage. The Contractor shall also provide the Town with an updated certificate of insurance prior to any policy renewal terms.

12. *Occupational Health and Safety*

The successful Proponent shall ensure that all Services are provided in a manner that complies with the Occupational Health and Safety Act, R.S.O. 1990, c.O.1, as amended, and the regulations made thereunder.

WORKPLACE SAFETY AND INSURANCE BOARD

All of the Contractor's personnel must be covered by the insurance plan under the Workplace Safety and Insurance Act. Upon execution of the Contract , and prior to the beginning of every year thereafter for the duration of the Term of the Contract, and at any other time when requested by the Town, a Letter of Good Standing from the Workplace Safety and Insurance Board shall be provided to the Town indicating that all payments have been made by the Contractor to the Board.

Prior to final payment, a Certificate of Clearance must be issued indicating that all payments by the Contractor to the Board in conjunction with this Contract have been made and that the Town shall not be liable to the Board for future payments in connection with the Contractor's fulfillment of the Contract. Certificates of Clearance must be submitted within thirty (30) days of the conclusion of each year for the duration of the Term of the Contract or at any time upon request by the Town.

13. *Subletting*

The successful Proponent shall keep the work under their personal control, and shall not assign, transfer or sublet any portion without first obtaining the written consent of the Property and Project Manager, or his designate. The consent of the Property and Project Manager of any such assignment, transfer or subletting, shall not, however, relieve the successful Proponent of any responsibility for the proper commencement, execution and completion of the work according to the terms of the contract, and the successful Proponent shall, either in person or through an accredited agent, receive all notices, communications, orders, instructions or legal service as if the Proponent were performing the work with their own plant and employees.

14. *Job Showing*

Proponents will be required to attend a Job Showing at Town Hall located at 175 Bridge Street in the Town of Carleton Place on **May 13, 2026 at 10:00 am**. Any costs associated with attendance are the responsibility of the Proponent (see Paragraph 15 below).

15. ***Incurred Costs***

The Town of Carleton Place will not be liable nor reimburse any Proponent for costs incurred in the preparation of Proposals, inspections, demonstrations, or any other services that may be required as part of the evaluation process. **Whenever possible, at the sole determination of the Town of Carleton Place, additional information and/or clarifications will be obtained by telephone or other electronic means.**

16. ***Alterations to Documents***

No electronic reproduction or alteration of the original document will be permitted under any circumstance. The Proponent shall not change the wording of the Proposal after submission; and no words or comments shall be added to the general conditions or detailed specifications unless requested by the Property and Project Manager for the purpose of clarification.

17. ***Confidentiality & Post-Award Comment***

No Proponent shall have the right to review or receive any information with respect to a Proposal, documentation, or information submitted by any other Proponent. The content of the Proposal, and all documentation, and information shall be held in confidence by the Town of Carleton Place, subject only to the provision of freedom of information and privacy legislation, including without limitation, the *Municipal Freedom of Information and Protection of Privacy Act*. Post-Award Comment by the Town of Carleton Place regarding this Request for Proposal will be limited to written notification to all Proponents of the successful Proponent's name and address **only**. In submitting a Proposal, Proponents acknowledge and agree to this provision.

18. ***Municipal Freedom of Information & Protection of Privacy Act***

The Town of Carleton Place is governed by the provisions of the Municipal Freedom of Information and Protection of Privacy Act. The Act gives persons a right of access to information held by the Town. The right of access is subject to the exemptions contained in the Act.

SECTION 2

FORM OF PROPOSAL

TOWN OF CARLETON PLACE
REQUEST FOR PROPOSAL
CARLETON PLACE ARENA BUILDING AUTOMATION SYSTEM

FORM OF PROPOSAL

Building Automation System

Mr. Ross Rankin,
Property and Project Manager
175 Bridge Street
Carleton Place, ON K7C 2V8

I/We the undersigned, hereby submit the attached Proposal to satisfy the requirements laid out by the Town of Carleton Place.

I/We have reviewed and understand the Information to Proponents (Section 1) of the RFQ and agree to the terms and conditions contained therein in submitting this Proposal.

I/We have submitted all Pricing Schedules **(in Canadian Dollars),** Product Information, and other information requested with the Proposal (required to qualify).

I/We agree that this Proposal shall be irrevocable from the time and date that the Proposals are opened in accordance with the time period stated in Paragraph 1 of the Information to Proponents.

I/We agree that this Proposal is made without any connection, knowledge, comparison of figures or arrangements with any other person or persons submitting a Proposal for the same purpose and is in all respects fair and without collusion or fraud.

It is further understood and agreed that the lowest or any Proposal will not necessarily be accepted and that the Town of Carleton Place reserves the right in its absolute discretion to reject any or all Proposals, or accept the Proposal deemed most acceptable to the Town of Carleton Place. The Town of Carleton Place Public further reserves the right to negotiate further with the successful Proponent to finalize the terms and conditions of the Proposal.

I/We agree that the Town of Carleton Place's Public Purchase Order and Request for Proposal Document; as well as the Proposal submitted shall constitute the whole of the Agreement with the successful Proponent unless stated below:

_____

_____

This **"Form of Proposal"** must be completed, legibly signed in ink, and returned as part of the Proposal submission to qualify

FORM OF PROPOSAL (cont'd)

BID AMOUNT

Building Automation System	**Bid Amount**

Note: Quoted Prices are in Canadian Dollars and do not include Harmonized Sales Taxes.

It is understood that the pricing above is the total price for all items in the requested quantities, freight and installation per the specifications listed in Section 3.

In the case of a mathematical discrepancy in the bid pricing per category, the Unit Prices bid for each item shall prevail.

_____
NAME OF COMPANY (SEAL)

_____
ADDRESS

_____ _____
CITY POSTAL CODE

_____ _____
SIGNING OFFICER SIGNATURE WITNESS' SIGNATURE (must be present if Corporate Seal is not affixed to Form of Proposal)

_____ _____
SIGNING OFFICER (PRINT NAME) TELEPHONE NUMBER

_____ _____
EMAIL of SIGNING OFFICER DATE

SECTION 3

TERMS OF REFERENCE

TOWN OF CARLETON PLACE
REQUEST FOR PROPOSAL
CARLETON PLACE ARENA BUILDING AUTOMATION SYSTEM

TERMS OF REFERENCE

Building Automation System

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1. ***Introduction***

The Town of Carleton Place intends to receive bids for purchase and installation of a Building Automation System which will include acquisition, freight and installation of the Building Automation System at 75 Neelin Street, Carleton Place, ON.

The areas shown on drawing M1, M2, M3, M4, M5, M6, M7, M8, M9, and M10 attached are the areas to be quoted.

Bidders are required to provide with their RFQ submission a projected Project Timeline and Installation schedule for the Building Automation System showing anticipated total number of days/hours ***each component*** of the Work shall require. The exact installation schedule will be approved by the Property and Project Manager upon the awarding of the contract and may include daytime as well as evening and weekend work (if required). No allowance will be given for premiums associated with evening and weekend work.

2. ***Familiarity with Requirements – Proponent's Responsibility***

Proponents should address any questions regarding technical information or clarification of the Terms of Reference to Ross Rankin, Property and Project Manager by email to rrankin@carletonplace.ca no later than 12:00 noon May 20, 2026.

3. ***General***

Scope of work includes:

- As indicated in **drawings M1, M2, M3, M4, M5, M6, M7, M8, M9, and M10**
- Ensuring the delivery of the said lighting to the worksite no later than August 3, 2026.
- Ensuring installation occurs as scheduled.
- Unpacking all materials and providing quality control to ensure that all ordered items arrived in new condition.
- Following up on missing or damaged items including arranging for the return of damaged goods and ensuring replacement items are delivered in time for the installation.
- Disposal of packing materials
- Installation of all works in accordance to the Town's specifications.
- Handling all warrantee issues on behalf of the Town for the duration of the Bidder's warrantee.
- In the case of a mathematical discrepancy in the bid pricing, the Unit Prices bid for each item shall prevail.

4. ***Direction of Installation, Manuals & Training***

The successful Proponent shall comply with the Manufacturer's Instructions for preparation and installation of the acquired components. The Proponent must ensure that the installation process used does not negate any applicable warranties. The Proponent shall provide the Town with a copy of the Manufacturer's Installation Instructions, Warranties and other documentation per item type acquired.

The installation schedule will need to be approved upon the awarding of the contract(s) by the Property and Project Manager or their designate. Installation may therefore occur every day of the week except statutory holidays and may include daytime as well as evening and weekend work (if required). No allowance will be given for premiums associated with evening and weekend work.

The Town of Carleton Place will be responsible for controlling access to the work area.

The successful Proponent will provide a competent Supervisor **onsite for the entire installation period** to direct and supervise the installation.

Supervision of the installation shall not be considered complete until the installation is completed, inspected, and approved by the Property and Project Manager, or his designate. Bidder must clearly indicate the length of warranty and whether or not it is a bidder warranty or a manufacturer's warranty, or both. The bidder must also provide documentation on the warranties for each quoted item type.

5. ***Pricing – to be submitted in Canadian Dollars***

Proponents shall provide Pricing Schedules (HST extra) for supply, delivery and installation of all electrical works

All other applicable pricing should be detailed. (HST extra)

6. ***Installation Time Period***

Bidders are required to provide with their RFQ submission a projected Project Timeline and Installation schedule showing anticipated total number of days the Work shall require. The exact installation schedule will be approved by the Project and Property Manager upon the awarding of the contract and may include daytime as well as evening and weekend work (if required). No allowance will be given for premiums associated with evening and weekend work.

7. *Proposal Content*

Proposals are to include only the criteria described in this section and any Addenda issued thereto**. A complete Proposal includes both a Technical Proposal and a Price Proposal.** Proponents are advised to present their information in a clear and concise manner and in the format requested.

The Stipulated Price Bid Form found in **Appendix A** of this RFP may be reproduced by Proponents in their own format provided that the order and content of the items remains unchanged and the pages are to be numbered.

The Proposal is to be submitted in two separate electronic documents: Envelope 1 shall contain the Technical Proposal that includes all technical information in response to the rated technical criteria. And Envelope 2 shall contain the Stipulated Price Bid Form that includes all price information.

The Technical Proposal shall be no more than 25 pages in length, provided on paper

size 8.5" x 11", and include the information requested in the following paragraphs.

Experience of the Proponent – Proponents should list and describe two projects with comparable scope and construction value completed within the last five (5) years including:

- A description of the project and clearly indicate how it is comparable and relevant in size and scope, and any challenges faced in completing the project.
- Identify the construction cost as well as the start and completion dates.
- Client references - name, phone and email of client contact. Note references may be checked.

Corporate Profile - Proponents should describe their firm's overall experience including an organizational chart, years in operation, capability and expertise in delivering Building Automation Systems similar scale, complexity or within the retail sector.

Experience and Qualification of Project Team – Proponents should describe the relevant experience and qualifications of the proposed Project Team to be assigned to this project including the Project Manager, Designer, Technicians. Include a Resume/CV for each proposed team member.

Sustainability - TOWN OF CARLETON PLACE is committed to improving energy efficiency and reducing the carbon footprint of its buildings by 40% by 2030. Proponents should describe the features and capabilities for integrating energy efficiency into the delivery of the proposed BAS.

Work Plan – Proponents should provide a schedule for the proposed work plan including the sequencing of the main tasks and activities.

8. *Proposal Presentation/BAS Demonstration*

Upon review of the submitted proposals TOWN OF CARLETON PLACE will invite short-listed BAS Vendors to demonstrate the features and benefits of their proposal submissions, provide a BAS demonstration, and answer questions. The anticipated date for the interviews is as indicated in Section 1.9 above on page 6. The presentation will outline the BAS Vendor's understanding of the project, work plan, proposed team, and demonstrate the features and capabilities of the proposed BAS. This will be followed by question and answers from the TOWN OF CARLETON PLACE evaluation team.

9. Proposal Conditions

Proposals will not be opened publicly.

This Request for Proposal does not constitute an offer to contract. Proponents shall make no claim for compensation because of participating in the RFP. TOWN OF CARLETON PLACE at its sole discretion may choose to select a proponent through the RFP process and formalize an agreement with same or may abandon the RFP process and independently procure a BAS through alternate methods.

The Proponent shall treat all information and materials pertaining to this project including all information in this RFP as CONFIDENTIAL and may not release any information without the prior written approval of TOWN OF CARLETON PLACE. Unsuccessful proponents will be notified in writing. A debrief will be available upon written request.

A proposal will be disqualified if it fails to satisfy the minimum requirements of one or more criteria outlined in the Request for Proposal, including, but not limited to:

- Failing to submit the requirements of this RFP;
- Failing to attend the mandatory site visit;
- Making changes to the terms and conditions of this Request for Proposal;
- Failing to keep details of this RFP confidential and/or attempting to influence.

10. Evaluation and Selection of Proposals

The proponent understands and acknowledges that TOWN OF CARLETON PLACE reserves the right to select any BAS Vendor for any reason for any award. The proponent understands and acknowledges that TOWN OF CARLETON PLACE reserves the right to award the work in whole or in parts.

Scoring Matrix

The following scoring matrix will be the basis of scoring for each submitting Proponent.

RFP Section	**Points Score**
Executive Summary – Scored on project understanding	5
Experience of the Proponent	5
Corporate Profile	10
Experience and Qualification of Project Team	10
Sustainability	10
Work Plan	10
Price Proposal	50
Sub-total	**100**
Interview	50
Total	**150**

As noted, the Town of Carleton Place reserves the right, in its sole and absolute discretion to select a preferred Proponent with which to negotiate a final contract, terminate the Proposal call and negotiate with one or more Proponents, or reject any and all Proposals. The Town of Carleton Place will not necessarily select the Proposal with the lowest proposed cost; or any other Proposal.

Proponents are reminded that there is no recourse to the Town of Carleton Place Public for its decision and the Town of Carleton Place will not provide any compensation to Proponents for costs incurred in the preparation of Proposals; or preparation for, or attendance at, any interview or demonstration requested as part of the evaluation process for Proposals received. The Town of Carleton Place will attempt to obtain any further required information or clarification by electronic means whenever possible.

The Town of Carleton Place will endeavour to complete the evaluation process in the shortest time possible. **The Town of Carleton Place reserves the right to contact Proponents to seek clarification of the Proposals, as submitted, to assist in the evaluation process.**

APPENDIX A

100-2608 ME-2026-04-30 Issued for Tender

ME-1, ME-2, ME-3, ME-4, ME-5, ME-6, ME-7, ME-8, M-9, AND ME-10

MECHANICAL LEGEND

SYMBOL	DESCRIPTION
	LINEAR DIFFUSER
	LIGHT TROFFER
	SQUARE DIFFUSER
	RETURN AIR GRILLE
T	THERMOSTAT
	SUPPLY DUCT
	ACOUSTIC INSULATION
	FLEXIBLE DUCT
	CAP DUCT OR PIPE AS INDICATED
	CONICAL TAKE–OFF C/W BALANCING DAMPER (BD)
	CONICAL TAKE–OFF (CAPPED, NO BD, W/ BD)
	ROUND DUCT TO ROUND DUCT TAKE–OFF
	VERTICAL ROUND DUCT TAKE–OFF (W/BD, W/O BD)
	VARIABLE AIR VOLUME (VAV) TERMINAL DEVICE (W/O ATTENUATOR, W/ ATTENUATOR)
	FAN–POWERED VAV TERMINAL DEVICE (W/O ATTENUATOR, W/ ATTENUATOR)
CO	CLEAN OUT
VTR	PLUMBING VENT THROUGH ROOF
	TRANSFER DUCT
FD	FIRE DAMPER
	SPRINKLER HEAD (UPRIGHT, PENDANT, WALL MOUNTED
	FIRE HOSE CABINET
FD	FLOOR DRAIN
	FUNNEL DRAIN
HD	HUB DRAIN
D	D.C.W. PIPING
	D.H.W. PIPING
	SANITARY UNDERGROUND
	SANITARY UNDER FLOOR
V	SANITARY VENT PIPING
	GATE VALVE
	BALL VALVE
	SOLENOID VALVE
	PUMP
S	SUCTION DIFFUSER
	CHECK VALVE
	TEMPERATURE SENSOR
	TEMPERATURE GAUGE
	PRESSURE RELIEF VALVE
	AIR VENT
	GAS VALVE
	GAS SHUT OFF VALVE
	ELECTRIC CONVECTOR
#	DRAWING NOTE

NOT ALL SYMBOLS SHOWN IN LEGEND ARE NECESSARILY USED IN THE DRAWING SET.

ELECTRICAL LEGEND

ITEM	DESCRIPTION
	T–BAR CEILING LIGHT FIXTURE
	EMERGENCY NIGHT LIGHTING FIXTURE
	2X2 T–BAR CEILING LIGHT FIXTURE
	DOWNLIGHT
	CEILING/WALL MOUNTED EXIT SIGN
$	SWITCH
$OS (OS)	WALL/CEILING MOUNTED OCCUPANCY SENSOR
	ALARM PANEL
	ELECTRICAL PANEL
CR	CARD READER
JB	JUNCTION BOX
	DUPLEX RECEPTACLE WALL MOUNTED
	DUPLEX RECEPTACLE MOUNTED ABOVE COUNTER
	SPECIALTY RECEPTACLE
	QUAD RECEPTACLE
	DEDICATED 5–20R DUPLEX RECEPTACLE
	DIRECT CONNECTION
	FLOOR/CEILING MOUNTED RECEPTACLE
	TRANSFORMER
	NON–FUSED/FUSED DISCONNECT SWITCH
	1ø/3ø MOTOR DIRECT CONNECTION

NOT ALL SYMBOLS SHOWN IN LEGEND ARE NECESSARILY USED IN THE DRAWING SET.

GENERAL NOTES:

1. ALL MECHANICAL/ELECTRICAL EQUIPMENT SHOWN IN THIN SOLID LINES IS EXISTING TO REMAIN.
2. ALL MECHANICAL/ELECTRICAL EQUIPMENT SHOWN IN THICK SOLID LINES IS NEW TO BE PROVIDED UNDER THIS CONTRACT. FOR ELECTRICAL ITEMS, TO BE PROVIDED TOGETHER WITH ALL ASSOCIATED CONDUITS AND WIRING.
3. ALL MECHANICAL/ELECTRICAL EQUIPMENT SHOWN IN DASHED LINES WITH LETTER 'R' IS EXISTING TO BE RELOCATED AS SHOWN. FOR ELECTRICAL ITEMS, EXTEND ALL CONDUITS AND WIRING TO SUIT.
4. ALL MECHANICAL/ELECTRICAL EQUIPMENT SHOWN IN DASHED LINES WITH LETTER 'X' IS EXISTING TO BE REMOVED BACK TO SOURCE. FOR ELECTRICAL ITEMS, THEY ARE TO BE REMOVED C/W ALL CONDUIT, WIRING AND ASSOCIATED HARDWARE BACK TO NEAREST J/B.
5. THIS DRAWING WAS BASED ON PARTIAL SITE REVIEW. ALL EQUIPMENT, DUCTS, PIPING AND ALL ACCESSORIES' SIZES, LOCATIONS AND DETAILS OF INSTALLATIONS TO BE CONFIRMED BY MECHANICAL CONTRACTOR ON SITE.
6. MECHANICAL CONTRACTOR SHALL BE RESPONSIBLE FOR ALL ROOF, WALL AND BUILDING ENVELOPE CUTTING, PATCHING AND REPAIRS, AS REQUIRED FOR EXECUTION OF WORK INCLUDED IN THIS CONTRACT.
7. PROVIDE ALL NEW EQUIPMENT, CONTROLS, DUCTWORK, PIPING, VALVES AND ACCESSORIES AS SHOWN AND NOTED ON DETAILS AND AS REQUIRED FOR COMPLETE FUNCTIONING SYSTEMS.
8. PROVIDE ADDITIONAL DUCTWORK, PIPING, FITTINGS AND OFFSETS WHERE REQUIRED TO SUIT EXISTING CONDITIONS AND TO AVOID COLLISIONS WITH EXISTING SYSTEMS AND BUILDING STRUCTURE.
9. NOT ALL MECHANICAL/ELECTRICAL ELEMENTS SHOWN, AFFECTED AREAS ONLY.
10. SEISMIC RESTRAINT SYSTEM (SRS) – PROVIDE DESIGN, SUPPLY AND INSTALLATION OF COMPLETE SRS FOR ALL SYSTEMS, EQUIPMENT SPECIFIED FOR INSTALLATION ON THIS PROJECT AS PER ONTARIO BUILDING CODE LATEST EDITION.
11. HATCHED AREA INDICATED ON FLOOR PLANS NOT IN CONTRACT.
12. FIRE ALARM SYSTEM DEVICES SHALL BE INSTALLED AS PER CAN/ULC S524 AND SHALL BE VERIFIED AS PER CAN/ULC S537.
13. FOR ANY REQUIRED SHUT DOWN, CONTRACTOR TO COORDINATE WITH SITE MANAGER AND OBTAIN APPROVAL BEFORE SHUT DOWN CAN BE PERFORMED.
14. FIRE ALARM SYSTEM TO REMAIN OPERATIONAL FOR DURATION OF THIS PROJECT, PROVIDE DUST PROTECTION. PROVIDE FIRE WATCH IF REQUIRED.
15. PROVIDE NEW BREAKERS AS REQUIRED IN EXISTING ELECTRICAL PANELS TO ACCOMMODATE NEW CONNECTIONS, ALSO PROVIDE BLANK PLATES WHERE CIRCUIT BREAKERS ARE NOT INSTALLED, PROVIDE NEW TYPED PANEL LEGEND TYPICAL FOR ALL PANELS TOUCHED BY THIS CONTRACT. TURN OVER TO THE OWNER ALL BREAKERS REMOVED UNDER THIS CONTRACT.
16. ALL EXISTING AND NEW CONDUITS AND WIRING PASSING THRU FLOOR AND FIRE RATED WALLS TO BE FIRESTOPPED USING FIRE RETARDANT MASTIC SEALANT, CAN/ULC–S115 RATED PRODUCT.
17. ALL WIRING TO BE R/RW90, MINIMUM SIZE #12AWG COPPER, IN EMT CONDUIT UNLESS OTHERWISE NOTED.
18. ALL ELECTRICAL CIRCUITS ARE SHOWN FOR GROUPING PURPOSES ONLY, CONTRACTOR TO USE AVAILABLE CIRCUITS IN EXISTING ELECTRICAL PANELS. REUSE EXISTING AND/OR PROVIDE NEW ELECTRICAL BREAKERS AS REQUIRED.
19. REGROUP CIRCUITS AS REQUIRED.
20. GENERAL CONTRACTOR TO CARRY FOR ALL NECESSARY SUB–TRADES TO INSTALL BUILDING AUTOMATION SYSTEM INFRASTRUCTURE FOR A COMPLETE AND FUNCTIONAL SYSTEM

DRAWING LIST

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No	DESCRIPTION	DATE
1	ISSUED FOR TENDER	APRIL 30, 2026
0	ISSUED FOR REVIEW	APRIL 28, 2026

REVISIONS

client:
TOWN OF CARLETON PLACE
175 BRIDGE STREET
CARLETON PLACE, ON K7C 2V8

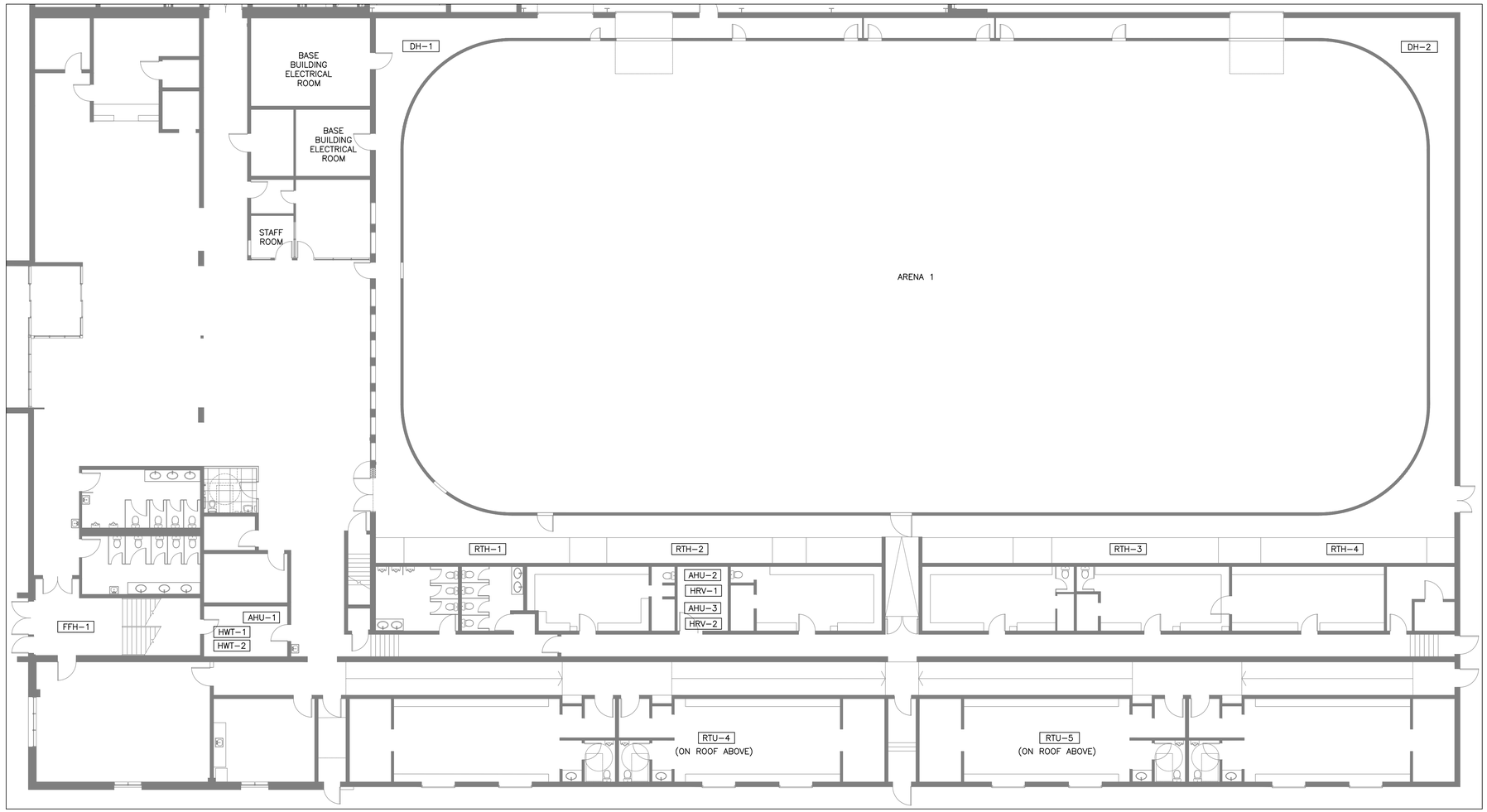
project:
CARLETON PLACE ARENA – BUILDING AUTOMATION SYSTEM INSTALLATION
75 NEELIN STREET
CARLETON PLACE, ON K7C 4H1

drawing title:
MECHANICAL LEGEND, GENERAL NOTES, & DRAWING LIST

scale:	AS NOTED	drawn by:	P.P. / M.G.
designed by:	P.P. / M.G.	reviewed by:	JRP ENG.
approved by:	JRP ENG.	date:	APRIL 2026

project no.: 100–2608

drawing no.: ME–1 of 10



1 ME-2 PARTIAL GROUND FLOOR (SOUTH) – BAS POINTS, EQUIPMENT & DEVICES
3/32" = 1'-0"

AHU-1: ENTRANCE LOBBY VERTICAL AIR HANDLING UNIT WITH DX (EXISTING)

- PROVIDE A NEW DDC BACNET IP CONTROLLER.
- REPLACE EXISTING HONEYWELL THERMOSTAT WITH SPACE WITH HUMIDITY, CO2. RE-USE THE EXISTING THERMOSTAT GUARD/PROTECTION COVER FOR THE NEW THERMOSTAT.
- PROVIDE AND INSTALL MOTION SENSORS TO COVER THE ENTIRE ENTRANCE LOBBY, QUANTITY OF MOTION SENSORS TO BE VERIFIED BASED ON COVERAGE.
- PROVIDE AND INSTALL TWO (2) DUCT TEMPERATURE SENSORS TO MONITOR SAT & RAT (TO PREVENT OVERHEATING / DETECTING SHORT CYCLING / COOLING EFFECTIVENESS MONITORING

SEQUENCE OF OPERATION

RUN CONDITIONS – SCHEDULED

THE UNIT SHALL RUN ACCORDING TO A USER DEFINABLE TIME SCHEDULE IN THE FOLLOWING MODES:

OCCUPIED MODE

THE UNIT SHALL MAINTAIN:

- 75°F (ADJ.) COOLING SETPOINT
- 70°F (ADJ.) HEATING SETPOINT.

STANDBY MODE

THE UNIT SHALL MAINTAIN:

- 80°F (ADJ.) COOLING SETPOINT.
- 65°F (ADJ.) HEATING SETPOINT.

UNOCCUPIED MODE (NIGHT SETBACK)

THE UNIT SHALL MAINTAIN:

- 85°F (ADJ.) COOLING SETPOINT.
- 55°F (ADJ.) HEATING SETPOINT.
- DEADBAND: 1-2°F (ADJ.)

OCCUPANCY / STANDBY LOGIC

DURING SCHEDULED OCCUPIED PERIODS:

- IF NO MOTION IS DETECTED FOR FIFTEEN (15) MINUTES (ADJ.), SWITCH TO STANDBY.
- UPON MOTION DETECTION VALIDATED FOR THIRTY (30) SECONDS (ADJ.), RETURN TO OCCUPIED MODE.

UNOCCUPIED MODE LOGIC

OUTSIDE OCCUPIED SCHEDULE – IF MOTION IS DETECTED DURING UNOCCUPANCY SCHEDULE, A TIMED LOCAL OVERRIDE CONTROL SHALL ALLOW US TO OVERRIDE THE SCHEDULE AND PLACE THE UNIT INTO AN OCCUPIED MODE FOR AN ADJUSTABLE PERIOD (MAYBE 1 HR), AT THE EXPIRATION OF THIS TIME, CONTROL OF THE UNIT SHALL AUTOMATICALLY RETURN TO THE SCHEDULE.

ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH ZONE TEMPERATURE: IF THE ZONE TEMPERATURE IS GREATER THAN THE COOLING SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).
- LOW ZONE TEMPERATURE: IF THE ZONE TEMPERATURE IS LESS THAN THE HEATING SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).

ZONE SETPOINT ADJUST: THE OCCUPANT SHALL BE ABLE TO ADJUST THE ZONE TEMPERATURE HEATING AND COOLING SETPOINTS AT THE WEBSERVER ONLY.

SUPPLY FAN: THE SUPPLY FAN SHALL RUN ANYTIME THE UNIT IS COMMANDED TO RUN, UNLESS IT SHUTS DOWN ON SAFETY. TO PREVENT SHORT CYCLING, THE SUPPLY FAN SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.

ALARMS SHALL BE PROVIDED AS FOLLOWS:

- SUPPLY FAN FAILURE: COMMANDED ON, BUT THE STATUS IS OFF.
- SUPPLY FAN IN HAND: COMMANDED OFF, BUT THE STATUS IS ON.

COOLING: THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND STAGE THE COOLING TO MAINTAIN ITS COOLING SETPOINT. TO PREVENT SHORT CYCLING, THE STAGE SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME. THE COOLING SHALL BE ENABLED WHENEVER:

- OUTSIDE AIR TEMPERATURE IS GREATER THAN °F (ADJ.), AND
- ZONE TEMPERATURE IS ABOVE COOLING SETPOINT + DEADBAND, AND
- SUPPLY FAN STATUS IS ON, AND
- HEATING IS NOT ACTIVE.

GAS HEATING STAGES: THE CONTROLLER SHALL MEASURE THE ZONE TEMPERATURE AND STAGE THE HEATING TO MAINTAIN ITS HEATING SETPOINT. TO PREVENT SHORT CYCLING, THERE SHALL BE A USER DEFINABLE (ADJ.) DELAY BETWEEN STAGES, AND EACH STAGE SHALL HAVE A USER DEFINABLE (ADJ.) MINIMUM RUNTIME.
THE HEATING SHALL BE ENABLED WHENEVER:

- OUTSIDE AIR TEMPERATURE IS LESS THAN °F (ADJ.), AND
- ZONE TEMPERATURE IS BELOW HEATING SETPOINT–DEADBAND, AND
- THE SUPPLY FAN STATUS IS ON, AND
- COOLING IS NOT ACTIVE.

SPACE AIR CARBON DIOXIDE (CO2) CONCENTRATION MONITORING: THE CONTROLLER SHALL MEASURE THE RETURN AIR CO2 CONCENTRATION. ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH SPACE AIR CARBON DIOXIDE CONCENTRATION: IF THE AIR CO2 CONCENTRATION IS GREATER THAN 1000PPM (ADJ.) WHEN IN OCCUPIED MODE.

SPACE AIR HUMIDITY: THE CONTROLLER SHALL MONITOR THE SPACE AIR HUMIDITY AND IF RH>65% FOR MORE THAN TEN (10) MINUTES.

OPTIONAL LIMITED DEHUMIDIFICATION ASSIST: IF RH > 60% AND SPACE TEMP IS WITHIN 2°F OF COOLING SETPOINT,BAS MAY TEMPORARILY REDUCE COOLING SETPOINT BY UP TO 2°F MAXIMUM.

ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH SPACE AIR HUMIDITY: IF THE SPACE AIR HUMIDITY IS GREATER THAN 70% (ADJ.).
- LOW SPACE AIR HUMIDITY: IF THE SPACE AIR HUMIDITY IS LESS THAN 35% (ADJ.).

RETURN AIR TEMPERATURE: THE CONTROLLER SHALL MONITOR THE RETURN AIR TEMPERATURE. ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS GREATER THAN 90°F (ADJ.).
- LOW RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS LESS THAN 45°F (ADJ.).

SUPPLY AIR TEMPERATURE: THE CONTROLLER SHALL MONITOR THE AIR TEMPERATURE SUPPLY. ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH SUPPLY AIR TEMP: IF THE AIR SUPPLY TEMPERATURE IS GREATER THAN 120°F (ADJ.).
- LOW SUPPLY AIR TEMP: IF THE AIR SUPPLY TEMPERATURE IS LESS THAN 45°F (ADJ.).

TRENDING REQUIREMENTS:
- SPACE TEMP, RH, CO?
- SAT, RAT
- HEAT CALL, COOL CALL
- FAN STATUS/COMMAND
- OCCUPANCY STATE (OCCUPIED/STANDBY/UNOCCUPIED)

HWT-1, HWT-2: HOT WATER HEATERS (EXISTING)

PROVIDE DDC MONITORING USING A BACNET IP CONTROLLER FOR HOT WATER TANK 1, HOT WATER TANK 2, AND ASSOCIATED HOT WATER RECIRCULATION PUMPS. THE SYSTEM SHALL MONITOR TANK WATER TEMPERATURES AND PUMP OPERATING STATUS AND REPORT THESE VALUES TO THE BUILDING AUTOMATION SYSTEM (BAS). NO AUTOMATIC CONTROL OF THE TANKS OR PUMPS IS REQUIRED UNLESS OTHERWISE SPECIFIED.

TANK TEMPERATURE MONITORING: TWO (2) STRAP-ON TEMPERATURE SENSORS SHALL BE INSTALLED TO MONITOR THE WATER TEMPERATURE OF:

- HOT WATER TANK 1
- HOT WATER TANK 2

THE BACNET CONTROLLER SHALL CONTINUOUSLY MONITOR AND TRANSMIT THE TEMPERATURE VALUES TO THE BAS.

TEMPERATURE ALARMS: THE FOLLOWING ALARMS SHALL BE GENERATED:

- HIGH TANK TEMPERATURE ALARM: IF TANK TEMPERATURE RISES ABOVE A USER DEFINABLE THRESHOLD (ADJUSTABLE).
- LOW TANK TEMPERATURE ALARM: IF TANK TEMPERATURE FALLS BELOW A USER DEFINABLE THRESHOLD (ADJUSTABLE).

PUMP STATUS MONITORING: TWO DIGITAL INPUTS (DI) SHALL MONITOR THE RUN STATUS OF THE HOT WATER RECIRCULATION PUMPS:

- HOT WATER PUMP 1 STATUS
- HOT WATER PUMP 2 STATUS

PUMP STATUS SHALL BE DETERMINED FROM CURRENT SENSING DEVICES PROVIDE AND INSTALLED BY CONTROLS CONTRACTOR.

PUMP STATUS NOTIFICATION: PUMP RUNNING STATUS SHALL BE DISPLAYED AT THE BAS.

TRENDING REQUIREMENTS: THE BAS SHALL TREND THE FOLLOWING POINTS:

- HOT WATER TANK 1 TEMPERATURE
- HOT WATER TANK 2 TEMPERATURE
- PUMP 1 STATUS
- PUMP 2 STATUS

TRENDING INTERVALS SHALL BE CONFIGURABLE THROUGH THE BAS.

DH-1 THROUGH DH-5: DEHUMIDIFIERS (EXISTING)

- FIVE (5) DEHUMIDIFIERS SHALL BE CONNECTED TO THE NEAREST BAS CONTROLLER FOR ENABLE/DISABLE CONTROL.

SEQUENCE OF OPERATION

THE BAS SHALL PROVIDE BINARY ENABLE/DISABLE CONTROL FOR EACH DEHUMIDIFIER:

- WHEN ENABLED, THE DEHUMIDIFIER SHALL OPERATE BASED ON ITS INTERNAL HUMIDITY CONTROL LOGIC.
- WHEN DISABLED, THE DEHUMIDIFIER SHALL REMAIN OFF.

RTH-1 THROUGH RTH-7: RADIANT TUBE HEATERS FOR ICE RINKS SEATING (EXISTING)

MODIFY WIRING FOR EXISTING ROTARY SWITCHES SET UP IN STAFF ROOM TO INCLUDE NO MOMENTARY PUSH BUTTON FOR EACH RADIANT TUBE HEATER.

EACH HEATER IS CONTROLLED THROUGH A BACNET IP CONTROLLER AND CAN BE ACTIVATED BY:

- LOCAL PUSH BUTTONS (7 TOTAL, ONE (1) EACH PER HEATER APPLIANCE) LOCATED IN STAFF ROOM.
- REMOTE COMMAND OF THE BAS

EACH HEATER OPERATES ON AN ADJUSTABLE RUNTIME TIMER WITH A DEFAULT DURATION OF 20 MINUTES (ADJ)

TRENDING REQUIREMENTS – THE BAS SHALL TREND:

- HEATER COMMAND OUTPUTS
- PUSH BUTTON ACTIVATIONS
- RUN-TIME TIMERS

FFH-1: STAIRWELL HEATER (EXISTING)

- PROVIDE A BACNET IP CONTROLLER TO CONTROL THE HEATER SERVING THE STAIRWELL.
- A ROOM TEMPERATURE SENSOR SHALL BE INSTALLED TO MONITOR THE GARAGE TEMPERATURE.

SEQUENCE OF OPERATION

OUTSIDE AIR TEMPERATURE CONTROL: THE UNIT HEATER SHALL OPERATE BASED ON OUTSIDE AIR TEMPERATURE (OAT).

HEATING ENABLE – THE UNIT HEATER SHALL BE ENABLED WHEN OAT FALLS BELOW AN ADJUSTABLE HEATING THRESHOLD:

- HEATING ENABLE: OAT < 50°F (ADJUSTABLE)
- HEATING DISABLE: THE UNIT HEATER SHALL BE DISABLED WHEN OAT RISES ABOVE THE HEATING THRESHOLD.

THE LOCAL THERMOSTAT OR HEATER CONTROL SHALL MAINTAIN THE SPACE TEMPERATURE ONCE ENABLED.

DRAWING NOTES:

1. TYPICAL: PROVIDE 15A CIRCUIT COMPLETE WITH CIRCUIT BREAKER, ALL CONDUIT, AND WIRING FOR ALL BAS EQUIPMENT, AS REQUIRED. SOURCE FROM BASE BUILDING ELECTRICAL ROOM. MULTIPLE CONTROLLERS CAN BE FED FROM SAME CIRCUIT, INSTALL AS PER MANUFACTURER'S WRITTEN INSTRUCTIONS.

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No	DESCRIPTION	DATE
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0	ISSUED FOR REVIEW	APRIL 28, 2026

REVISIONS

client:
TOWN OF CARLETON PLACE
175 BRIDGE STREET
CARLETON PLACE, ON K7C 2V8

project:
CARLETON PLACE ARENA – BUILDING AUTOMATION SYSTEM INSTALLATION
75 NEELIN STREET
CARLETON PLACE, ON K7C 4H1

drawing title:
BAS POINTS – EQUIPMENT AND DEVICES

scale:	AS NOTED	drawn by:	P.P. / M.G.
designed by:	P.P. / M.G.	reviewed by:	JRP ENG.
approved by:	JRP ENG.	date:	APRIL 2026

project no.: 100-2608

drawing no.: ME-2 of 10

AHU–2: ARENA 1 OLD DRESSING ROOM 1&2 VERTICAL AHU WITH HRV–1 (EXISTING)

PROVIDE DDC CONTROL OF ONE (1) GAS FURNACE AND ONE (1) LIFE BREATH 300DCS HEAT RECOVERY VENTILATOR (HRV) SERVING TWO (2) CHANGE ROOMS.

- PROVIDE NEW SPACE THERMOSTAT WITH HUMIDITY, CO2 AND MOTION FOR EACH ROOM 1 & 2
- PROVIDE AND INSTALL 2 DUCT TEMP SENSORS TO MONITOR SAT & RAT.

THE BAS SHALL CONTROL THE HRV VIA DRY CONTACTS AS FOLLOWS:

- HRV LOW SPEED CONTACT
- HRV HIGH SPEED CONTACT
- HRV DE HUMIDISTAT CONTACT

SEQUENCE OF OPERATIONS

RUN CONDITIONS – SCHEDULED:THE UNIT SHALL RUN ACCORDING TO A USER DEFINABLE TIME SCHEDULE IN THE FOLLOWING MODES:

OCCUPIED MODE: THE UNIT SHALL MAINTAIN:

- 72°F (ADJ.) HEATING SETPOINT.
- HRV ENABLED
- VENTILATION BASED ON CO2 AND HUMIDITY DEMAND

STANDBY MODE: THE UNIT SHALL MAINTAIN:

- 68°F (ADJ.) HEATING SETPOINT
- HRV OPERATES AT LOW SPEED UNLESS DEMAND REQUIRES HIGH SPEED

UNOCCUPIED MODE (NIGHT SETBACK): THE UNIT SHALL MAINTAIN:

- 60°F (ADJ.) HEATING SETBACK
- HRV OFF EXCEPT FOR:
  - HUMIDITY PURGE
  - CO PURGE
  - MANUAL OVERRIDE

DEADBAND: 1–2°F (ADJ.)

OCCUPANCY / STANDBY LOGIC

DURING SCHEDULED OCCUPIED PERIODS:

- IF NO MOTION IS DETECTED IN BOTH ROOMS FOR FIFTEEN (15) MINUTES (ADJ.), SYSTEM SHALL SWITCH TO STANDBY MODE.
- UPON MOTION DETECTION FOR THIRTY (30) SECONDS (ADJ.) IN EITHER ROOM, SYSTEM SHALL RETURN TO OCCUPIED MODE.
- EACH ROOM SHALL GENERATE ITS OWN OCCUPANCY STATUS; SYSTEM MODE SHALL BE BASED ON OCCUPANCY STATUS OF EITHER ROOM.

UNOCCUPIED OVERRIDE: IF MOTION IS DETECTED DURING UNOCCUPIED SCHEDULE:

- BAS SHALL ENABLE A TIMED LOCAL OVERRIDE.
- SYSTEM SHALL SWITCH TO OCCUPIED MODE FOR SIXTY (60) MINUTES (ADJ.).
- AT EXPIRATION, SYSTEM RETURNS AUTOMATICALLY TO SCHEDULED MODE.

GAS FURNACE CONTROL: THE CONTROLLER SHALL MEASURE BOTH ROOM TEMPERATURES. THE FURNACE SHALL ENABLE WHEN:

- EITHER ROOM TEMPERATURE IS BELOW ITS HEATING SETPOINT – DEADBAND AND HRV FAN PROVING (IF INTERLOCKED), AND
- FURNACE SAFETY IS NORMAL

IF BOTH ROOMS CALL FOR HEAT: FURNACE RUNS NORMALLY.

IF ONLY ONE ROOM CALLS: FURNACE STILL RUNS.

TO PREVENT SHORT CYCLING:

- MINIMUM FURNACE RUNTIME: 5 MINUTES (ADJ.)
- MINIMUM OFF TIME: 5 MINUTES (ADJ.)

FURNANCE ALARMS:

- FURNACE FAILURE: COMMANDED ON, BUT NO HEAT PROOF AFTER ADJUSTABLE TIME.
- HIGH SUPPLY AIR TEMP: >120°F (ADJ.)
- LOW SUPPLY AIR TEMP: <80°F (ADJ.) DURING HEAT CALL
- HIGH RETURN AIR TEMP: >90°F (ADJ.)
- LOW RETURN AIR TEMP: <45°F (ADJ.)

HRV CONTROL

OCCUPIED MODE:
* DEFAULT OPERATION: LOW SPEED
* HIGH SPEED ENABLED IF:

O CO? ≥ 900 PPM (ADJ.) IN EITHER ROOM
O OR RH ≥ 60% (ADJ.) IN EITHER ROOM
O OR BOTH ROOMS ARE OCCUPIED SIMULTANEOUSLY (OPTIONAL LOGIC)

STANDBY MODE: HRV OPERATES AT LOW SPEED, HIGH SPEED ONLY IF:

- CO ≥ 1000 PPM, OR
- RH ≥ 65%

UNOCCUPIED MODE: HRV OFF UNLESS:

- CO ≥ 1000 PPM RUN HIGH SPEED UNTIL <800 PPM
- RH ≥ 65% FOR TEN (10) MINUTES, RUN HIGH SPEED UNTIL <55%
- MANUAL OVERRIDE ACTIVE

DEMAND CONTROLLED VENTILATION: THE CONTROLLER SHALL MONITOR CO IN BOTH ROOMS.

CONTROL LOGIC:

- CO ≤ 700 PPM HRV LOW SPEED
- CO 700-900 PPM HRV LOW SPEED
- CO ≥ 900 PPM HRV HIGH SPEED
- CO ≥ 1100 PPM HIGH CO ALARM

SYSTEM SHALL RESPOND TO THE HIGHEST CO READING BETWEEN THE TWO ROOMS AND RAISE AN ALARM IF CO2 READING GOES ABOVE 1000 PPM (ADJ.)

HUMIDITY CONTROL: THE CONTROLLER SHALL MONITOR RH IN BOTH ROOMS.

HUMIDITY RESPONSE:

- RH ≥ 60% (ADJ.) HRV HIGH SPEED
- RH ≥ 65% FOR TEN (10) MINUTES FORCE HIGH SPEED
- RH ≥ 70% HIGH HUMIDITY ALARM

SYSTEM SHALL RESPOND TO HIGHEST RH READING BETWEEN ROOMS.

DEHUMIDIFICATION ASSIST (HEATING MODE): IF RH > 60% AND SPACE TEMPERATURE IS WITHIN 2°F OF HEATING SETPOINT, THEN:
- BAS MAY ENABLE HRV HIGH SPEED
- BAS MAY ENERGIZE HRV DEHUMIDISTAT CONTACT

(NOTE: FURNACE ITSELF DOES NOT PROVIDE ACTIVE DEHUMIDIFICATION.)

HRV DEHUMIDISTAT CONTACT: BAS SHALL ENERGIZE HRV DEHUMIDISTAT CONTACT WHEN:

- RH > 60% (ADJ.), OR
- DURING HUMIDITY PURGE SEQUENCE CONTACT SHALL DE–ENERGIZE WHEN RH < 55%.

SUPPLY FAN / HRV INTERLOCK: HRV SHALL OPERATE ANYTIME FURNACE IS RUNNING UNLESS IN SAFETY SHUTDOWN.OPTIONAL: FURNACE HEATING SHALL BE INTERLOCKED WITH HRV OPERATION TO ENSURE AIRFLOW. HRV MINIMUM RUNTIME: 5 MINUTES (ADJ.)

SPACE AIR HUMIDITY ALARMS: THE CONTROLLER SHALL MONITOR THE SPACE AIR HUMIDITY:

- HIGH SPACE AIR HUMIDITY: IF THE SPACE AIR HUMIDITY IS GREATER THAN 70% (ADJ.).
- LOW SPACE AIR HUMIDITY: IF THE SPACE AIR HUMIDITY IS LESS THAN 35% (ADJ.).

RETURN AIR TEMPERATURE: THE CONTROLLER SHALL MONITOR THE RETURN AIR TEMPERATURE. ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS GREATER THAN 90°F (ADJ.).
- LOW RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS LESS THAN 45°F (ADJ.).

SUPPLY AIR TEMPERATURE: THE CONTROLLER SHALL MONITOR THE AIR TEMPERATURE SUPPLY. ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH SUPPLY AIR TEMP: IF THE AIR SUPPLY TEMPERATURE IS GREATER THAN 120°F (ADJ.).

LOW SUPPLY AIR TEMP: IF THE AIR SUPPLY TEMPERATURE IS LESS THAN 45°F (ADJ.).

TRENDING REQUIREMENTS – THE BAS SHALL TREND:

- ROOM 1 TEMP, RH, CO
- ROOM 2 TEMP, RH, CO
- SUPPLY AIR TEMP (SAT)
- RETURN AIR TEMP (RAT)
- FURNACE COMMAND
- HRV LOW SPEED COMMAND
- HRV HIGH SPEED COMMAND
- HRV DEHUMIDISTAT COMMAND
- OCCUPANCY STATUS PER ROOM
- SYSTEM MODE (OCCUPIED / STANDBY / UNOCCUPIED)

AHU–3: ARENA 1 OLD DRESSING ROOM 5 FURNACE WITH HRV–2 ARENA 1 OLD HALLWAY BY CHANGE ROOMS

PROVIDE DDC CONTROL OF ONE (1) GAS FURNACE AND ONE (1) LIFE BREATH 300DCS HEAT RECOVERY VENTILATOR (HRV) SERVING A CHANGE ROOM:

- PROVIDE NEW SPACE THERMOSTAT WITH HUMIDITY, CO2 AND MOTION FOR ROOM 5.
- PROVIDE AND INSTALL 2 DUCT TEMP SENSORS TO MONITOR SAT & RAT.
- THE BAS SHALL CONTROL THE HRV VIA DRY CONTACTS AS FOLLOWS: HRV LOW SPEED CONTACT, HRV HIGH SPEED CONTACT, HRV DE HUMIDISTAT CONTACT

SEQUENCE OF OPERATION

THE UNIT SHALL RUN ACCORDING TO A USER DEFINABLE TIME SCHEDULE IN THE FOLLOWING MODES:

OCCUPIED MODE: THE UNIT SHALL MAINTAIN:
- 72°F (ADJ.) HEATING SETPOINT.
- HRV ENABLED
- VENTILATION BASED ON CO2 AND HUMIDITY DEMAND

STANDBY MODE: THE UNIT SHALL MAINTAIN:

- 68°F (ADJ.) HEATING SETPOINT
- HRV OPERATES AT LOW SPEED UNLESS DEMAND REQUIRES HIGH SPEED

UNOCCUPIED MODE (NIGHT SETBACK): THE UNIT SHALL MAINTAIN:
- 60°F (ADJ.) HEATING SETBACK
- HRV OFF EXCEPT FOR:
  - HUMIDITY PURGE
  - CO PURGE
  - MANUAL OVERRIDE

DEADBAND: 1–2°F (ADJ.)

OCCUPANCY / STANDBY LOGIC

DURING SCHEDULED OCCUPIED PERIODS:

- IF NO MOTION IS DETECTED IN THE ROOM FOR FIFTEEN (15) MINUTES (ADJ.), SYSTEM SHALL SWITCH TO STANDBY MODE.
- UPON MOTION DETECTION FOR THIRTY (30) SECONDS (ADJ.), SYSTEM SHALL RETURN TO OCCUPIED MODE.

UNOCCUPIED OVERRIDE: IF MOTION IS DETECTED DURING UNOCCUPIED SCHEDULE:

- BAS SHALL ENABLE A TIMED LOCAL OVERRIDE.
- SYSTEM SHALL SWITCH TO OCCUPIED MODE FOR SIXTY (60) MINUTES (ADJ.).
- AT EXPIRATION, SYSTEM RETURNS AUTOMATICALLY TO SCHEDULED MODE.

GAS FURNACE CONTROL: THE CONTROLLER SHALL MEASURE THE ROOM TEMPERATURE. THE FURNACE SHALL ENABLE WHEN:

- IF THE ROOM TEMPERATURE IS BELOW ITS HEATING SETPOINT – DEADBAND, AND
- HRV FAN PROVING (IF INTERLOCKED), AND
- FURNACE SAFETY IS NORMAL

TO PREVENT SHORT CYCLING:

- MINIMUM FURNACE RUNTIME: FIVE (5) MINUTES (ADJ.)
- MINIMUM OFF TIME: FIVE (5) MINUTES (ADJ.)

FURNACE ALARMS:

- FURNACE FAILURE: COMMANDED ON, BUT NO HEAT PROOF AFTER ADJUSTABLE TIME.
- HIGH SUPPLY AIR TEMP: >120°F (ADJ.)
- LOW SUPPLY AIR TEMP: <80°F (ADJ.) DURING HEAT CALL
- HIGH RETURN AIR TEMP: >90°F (ADJ.)
- LOW RETURN AIR TEMP: <45°F (ADJ.)

HRV CONTROL

OCCUPIED MODE – DEFAULT OPERATION: LOW SPEED, HIGH SPEED ENABLED IF:

- CO ≥ 900 PPM (ADJ.) IN EITHER ROOM
- OR RH ≥ 60% (ADJ.) IN EITHER ROOM
- OR BOTH ROOMS ARE OCCUPIED SIMULTANEOUSLY

STANDBY MODE – HRV OPERATES AT LOW SPEED, HIGH SPEED ONLY IF:
- CO ≥ 1000 PPM, OR
- RH ≥ 65%

UNOCCUPIED MODE – HRV OFF UNLESS:

- CO ≥ 1000 PPM ? RUN HIGH SPEED UNTIL <800 PPM
- RH ≥ 65% FOR 10 MINUTES ? RUN HIGH SPEED UNTIL <55%
- MANUAL OVERRIDE ACTIVE

DEMAND CONTROLLED VENTILATION (CO BASED):THE CONTROLLER SHALL MONITOR CO IN THE ROOMS.

CONTROL LOGIC:

- CO ≤ 700 PPM HRV LOW SPEED
- CO 700-900 PPM HRV LOW SPEED
- CO ≥ 900 PPM HRV HIGH SPEED
- CO ≥ 1100 PPM HIGH CO ALARM

HIGH CO ALARM: >1000 PPM (ADJUSTABLE)

HUMIDITY CONTROL: THE CONTROLLER SHALL MONITOR RH IN THE ROOMS.

HUMIDITY RESPONSE:

- RH ≥ 60% (ADJ.) HRV HIGH SPEED
- RH ≥ 65% FOR TEN (10) MINUTES, FORCE HIGH SPEED
- RH ≥ 70% HIGH HUMIDITY ALARM

DEHUMIDIFICATION ASSIST (HEATING MODE) – IF RH > 60% AND SPACE TEMPERATURE IS WITHIN 2°F OF HEATING SETPOINT, THEN:

- BAS MAY ENABLE HRV HIGH SPEED
- BAS MAY ENERGIZE HRV DEHUMIDISTAT CONTACT

(NOTE: FURNACE ITSELF DOES NOT PROVIDE ACTIVE DEHUMIDIFICATION.)

HRV DEHUMIDISTAT CONTACT: BAS SHALL ENERGIZE HRV DEHUMIDISTAT CONTACT WHEN RH > 60% (ADJ.), OR DURING HUMIDITY PURGE SEQUENCE. CONTACT SHALL DE–ENERGIZE WHEN RH < 55%.

SUPPLY FAN / HRV INTERLOCK: HRV SHALL OPERATE ANYTIME FURNACE IS RUNNING UNLESS IN SAFETY SHUTDOWN. OPTIONAL: FURNACE HEATING SHALL BE INTERLOCKED WITH HRV OPERATION TO ENSURE AIRFLOW. MINIMUM RUNTIME: HRV MINIMUM RUNTIME: FIVE (5) MINUTES (ADJ.)

SPACE AIR HUMIDITY ALARMS – THE CONTROLLER SHALL MONITOR THE SPACE AIR HUMIDITY:

- HIGH SPACE AIR HUMIDITY: IF THE SPACE AIR HUMIDITY IS GREATER THAN 70% (ADJ.).
- LOW SPACE AIR HUMIDITY: IF THE SPACE AIR HUMIDITY IS LESS THAN 35% (ADJ.).

RETURN AIR TEMPERATURE – THE CONTROLLER SHALL MONITOR THE RETURN AIR TEMPERATURE. ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS GREATER THAN 90°F (ADJ.).
- LOW RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS LESS THAN 45°F (ADJ.).

SUPPLY AIR TEMPERATURE – THE CONTROLLER SHALL MONITOR THE AIR TEMPERATURE SUPPLY. ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH SUPPLY AIR TEMP: IF THE AIR SUPPLY TEMPERATURE IS GREATER THAN 120°F (ADJ.).
- LOW SUPPLY AIR TEMP: IF THE AIR SUPPLY TEMPERATURE IS LESS THAN 45°F (ADJ.).

TRENDING REQUIREMENTS – THE BAS SHALL TREND:

- ROOM 5 TEMP, RH, CO
- SUPPLY AIR TEMP (SAT)
- RETURN AIR TEMP (RAT)
- FURNACE COMMAND
- HRV SPEEDS
- HRV DEHUMIDISTAT COMMAND
- ROOM 5 OCCUPANCY STATUS
- SYSTEM MODE (OCCUPIED / STANDBY / UNOCCUPIED)

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0	ISSUED FOR REVIEW	APRIL 28, 2026

REVISIONS

client:
TOWN OF CARLETON PLACE
175 BRIDGE STREET
CARLETON PLACE, ON K7C 2V8

project:
CARLETON PLACE ARENA – BUILDING AUTOMATION SYSTEM INSTALLATION
75 NEELIN STREET
CARLETON PLACE, ON K7C 4H1

drawing title:
BAS POINTS – EQUIPMENT AND DEVICES (CONTINUED)

scale:	AS NOTED	drawn by:	P.P. / M.G.
designed by:	P.P. / M.G.	reviewed by:	JRP ENG.
approved by:	JRP ENG.	date:	APRIL 2026

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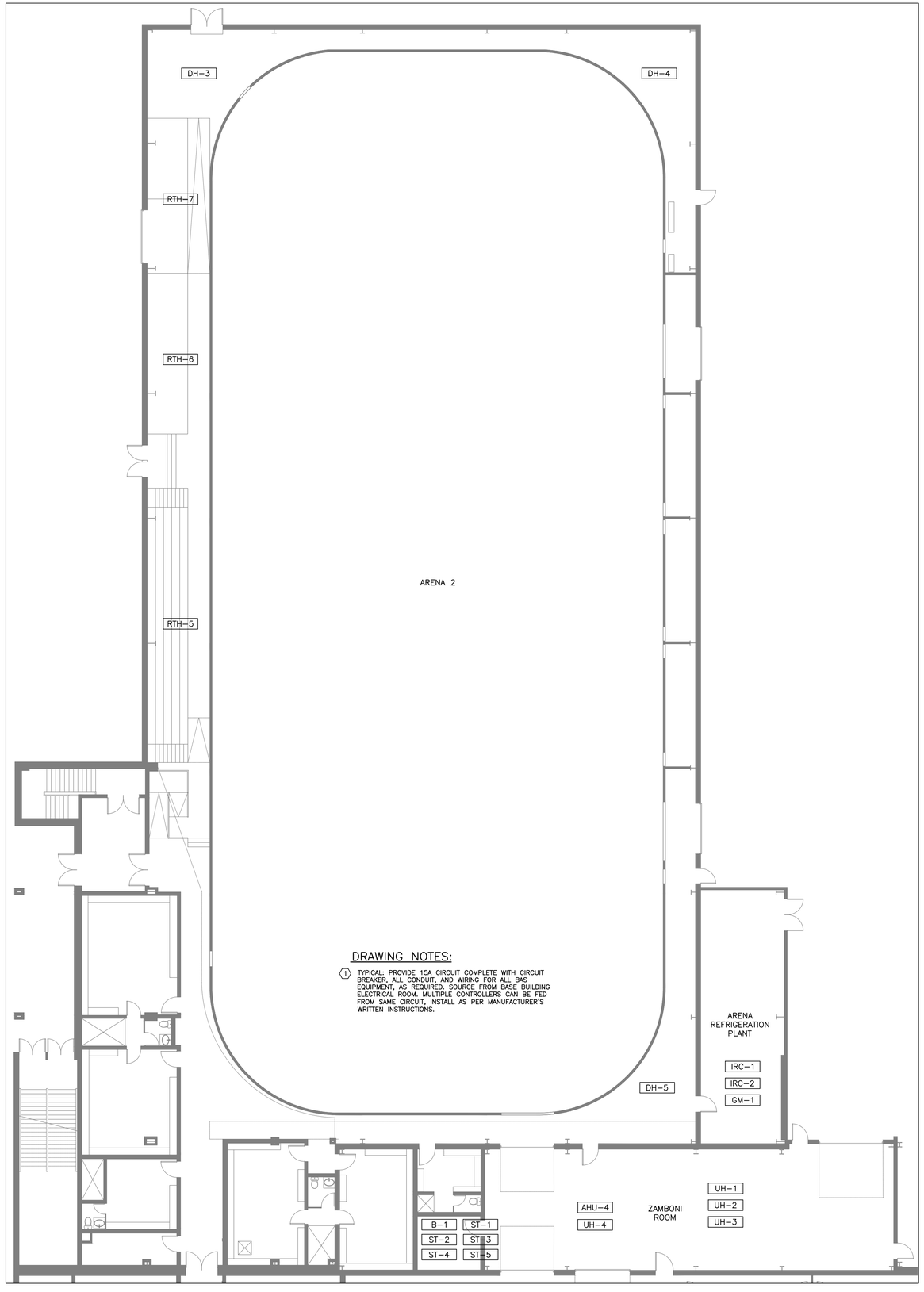
drawing no.: ME–3 of 10



DRAWING NOTES:

1. TYPICAL: PROVIDE 15A CIRCUIT COMPLETE WITH CIRCUIT BREAKER, ALL CONDUIT, AND WIRING FOR ALL BAS EQUIPMENT, AS REQUIRED. SOURCE FROM BASE BUILDING ELECTRICAL ROOM. MULTIPLE CONTROLLERS CAN BE FED FROM SAME CIRCUIT, INSTALL AS PER MANUFACTURER'S WRITTEN INSTRUCTIONS.

1 PARTIAL GROUND FLOOR (NORTH) – BAS POINTS, EQUIPMENT & DEVICES

ME-3

3/32" = 1'-0"

AHU-4: ZAMBONI BOILER ROOM (MEZZANINE)

- PROVIDE DDC CONTROLLER FOR ONE (1) GAS FURNACE
- PROVIDE A THERMOSTAT WITH MOTION SENSING.
- PROVIDE AND INSTALL TWO (2) DUCT TEMPERATURE SENSORS TO MONITOR SUPPLY AIR TEMPERATURE (SAT) AND RETURN AIR TEMPERATURE (RAT).

SEQUENCE OF OPERATION

RUN CONDITIONS - SCHEDULED: THE UNIT SHALL OPERATE ACCORDING TO A USER-DEFINABLE TIME SCHEDULE IN THE FOLLOWING MODES:

OCCUPIED MODE – THE UNIT SHALL MAINTAIN 70'F (ADJ.) HEATING SETPOINT

STANDBY MODE – THE UNIT SHALL MAINTAIN 65'F (ADJ.) HEATING SETPOINT

UNOCCUPIED MODE (NIGHT SETBACK)– THE UNIT SHALL MAINTAIN: 55'F (ADJ.)

HEATING SETPOINT DEADBAND: 1-2'F (ADJ.)

OCCUPANCY / STANDBY LOGIC

DURING SCHEDULED OCCUPIED PERIODS: IF NO MOTION IS DETECTED FOR 15 MINUTES (ADJ.), THE UNIT SHALL SWITCH TO STANDBY MODE.UPON MOTION DETECTION VALIDATED FOR 30 SECONDS (ADJ.), THE UNIT SHALL RETURN TO OCCUPIED MODE.

UNOCCUPIED MODE – OUTSIDE THE OCCUPIED SCHEDULE, THE UNIT SHALL OPERATE IN UNOCCUPIED MODE:

- ZONE UNOCCUPIED OVERRIDE
- IF MOTION IS DETECTED DURING THE UNOCCUPIED SCHEDULE: AT THE EXPIRATION OF THE OVERRIDE PERIOD, THE UNIT SHALL AUTOMATICALLY RETURN TO SCHEDULED OPERATION.

ALARMS (ZONE CONDITIONS) – THE FOLLOWING ALARMS SHALL BE GENERATED:

- HIGH ZONE TEMPERATURE: IF ZONE TEMPERATURE IS GREATER THAN THE HEATING SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).
- LOW ZONE TEMPERATURE: IF ZONE TEMPERATURE IS LESS THAN THE HEATING SETPOINT BY A USER DEFINABLE AMOUNT (ADJ.).

ZONE SETPOINT ADJUSTMENT: THE OCCUPANT SHALL BE ABLE TO ADJUST THE HEATING SETPOINT THROUGH THE BAS WEB INTERFACE ONLY. LOCAL ADJUSTMENT FROM THE ZONE SENSOR MAY BE DISABLED UNLESS OTHERWISE REQUIRED.

GAS HEATING CONTROL: THE CONTROLLER SHALL MONITOR THE ZONE TEMPERATURE AND ENABLE HEATING STAGES TO MAINTAIN THE HEATING SETPOINT.

HEATING SHALL BE ENABLED WHENEVER:

- ZONE TEMPERATURE < HEATING SETPOINT - DEADBAND
- SUPPLY FAN STATUS = ON
- HEATING SAFETY IS NORMAL

HEATING STAGES SHALL INCLUDE: USER-DEFINABLE STAGE DELAY, USER-DEFINABLE MINIMUM RUNTIME TO PREVENT SHORT CYCLING.

HEATING SHALL DISABLE WHEN: ZONE TEMPERATURE ≥ HEATING SETPOINT

SUPPLY FAN CONTROL – THE SUPPLY FAN SHALL RUN WHENEVER THE FURNACE IS COMMANDED TO OPERATE, UNLESS SHUTDOWN OCCURS DUE TO A SAFETY CONDITION.
TO PREVENT SHORT CYCLING: THE SUPPLY FAN SHALL HAVE A USER-DEFINABLE MINIMUM RUNTIME (ADJ.).
FAN ALARMS:

- SUPPLY FAN FAILURE: COMMANDED ON BUT STATUS OFF.
- SUPPLY FAN IN HAND: COMMANDED OFF BUT STATUS ON.

RETURN AIR TEMPERATURE: THE CONTROLLER SHALL MONITOR THE RETURN AIR TEMPERATURE. ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS GREATER THAN 90'F (ADJ.).
- LOW RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS LESS THAN 45'F (ADJ.).

SUPPLY AIR TEMPERATURE: THE CONTROLLER SHALL MONITOR THE AIR TEMPERATURE SUPPLY. ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH SUPPLY AIR TEMP: IF THE AIR SUPPLY TEMPERATURE IS GREATER THAN 120'F (ADJ.).
- LOW SUPPLY AIR TEMP: IF THE AIR SUPPLY TEMPERATURE IS LESS THAN 45'F (ADJ.).

TRENDING REQUIREMENTS – THE BAS SHALL TREND THE FOLLOWING POINTS:

- SPACE TEMPERATURE
- SUPPLY AIR TEMPERATURE
- RETURN AIR TEMPERATURE
- HEATING CALL / STAGE STATUS
- SUPPLY FAN COMMAND
- SUPPLY FAN STATUS
- OCCUPANCY MODE (OCCUPIED / STANDBY / UNOCCUPIED)

(UH-1 THROUGH UH-3): ZAMBONI AND STORAGE GAS HEATERS (EXISTING)

- PROVIDE DDC CONTROLLER FOR CONTROLLING THE STORAGE GAS HEATERS.
- PROVIDE A NEW SPACE BLANK TYPE THERMOSTAT
- PROVIDE AND INSTALL A DOOR CONTACT SWITCHES ON EACH OVERHEAD DOOR TO MONITOR DOOR STATUS AND PREVENT HEATING WHEN DOORS ARE OPEN.

SEQUENCE OF OPERATION

TEMPERATURE CONTROL: THE CONTROLLER SHALL MONITOR THE SPACE TEMPERATURE FROM THE BLANK THERMOSTAT.THE HEATERS SHALL OPERATE TO MAINTAIN THE SPACE HEATING SETPOINT (ADJUSTABLE). WHEN THE SPACE TEMPERATURE DROPS BELOW THE HEATING SETPOINT MINUS DEADBAND, THE CONTROLLER SHALL ENABLE THE STORAGE GAS HEATERS.HEATING SHALL CONTINUE UNTIL THE SPACE TEMPERATURE REACHES THE HEATING SETPOINT.

DEADBAND – HEATING DEADBAND: 1-2'F (ADJUSTABLE)

OVERHEAD DOOR INTERLOCK –TO PREVENT UNNECESSARY HEATING WHEN DOORS ARE OPEN:

- THE CONTROLLER SHALL CONTINUOUSLY MONITOR THE OVERHEAD DOOR CONTACT STATUS.
- IF ANY OVERHEAD DOOR IS OPEN, THE CONTROLLER SHALL DISABLE ALL STORAGE GAS HEATERS.
- WHEN ALL OVERHEAD DOORS ARE CLOSED, NORMAL TEMPERATURE CONTROL SHALL RESUME.

AN ADJUSTABLE TIME DELAY (E.G., 1-2 MINUTES) MAY BE IMPLEMENTED AFTER DOOR CLOSURE BEFORE ALLOWING HEATING TO RESTART TO PREVENT SHORT CYCLING.

ALARMS – THE BAS SHALL GENERATE THE FOLLOWING ALARMS:

- LOW SPACE TEMPERATURE ALARM: IF SPACE TEMPERATURE FALLS BELOW THE HEATING SETPOINT BY A USER DEFINABLE AMOUNT.
- HIGH SPACE TEMPERATURE ALARM: IF SPACE TEMPERATURE RISES ABOVE THE HEATING SETPOINT BY A USER DEFINABLE AMOUNT.
- DOOR OPEN NOTIFICATION: IF AN OVERHEAD DOOR REMAINS OPEN LONGER THAN A USER DEFINABLE PERIOD.

TRENDING THE BAS SHALL TREND THE FOLLOWING POINTS:

- SPACE TEMPERATURE
- HEATING COMMAND
- HEATER STATUS
- OVERHEAD DOOR STATUS

IRC-1, IRC-2: ARENA ICE REFRIGERATION PLANT (EXISTING)

INTEGRATE EXISTING AREA ICE REFRIGERATION PLANT VIA BACNET IP CONTROLLER.

CONTROL POINTS FOR FOLLOWING EQUIPMENT:

- COMPRESSOR (START/STOP/STATUS, QUANTITY OF FOUR)
- COLD FLOOR PUMP (START/STOP/STATUS, QUANTITY OF TWO)
- WARM FLOOR PUMP (START/STOP/STATUS)
- CONDENSER WATER PUMP (START/STOP/STATUS)
- CONDENSER FAN (VFD), (START/STOP/STATUS, ALARM, FAN SPEED MODULATION, VFD – BACNET MS/TP INTEGRATION

THE FOLLOWING PARAMETERS ARE TO BE MONITORED:

- EQUIPMENT RUN STATUS AND VFD ACTUAL SPEED
- REFRIGERANT PPM READING AND ALARM (SEE 'GM-1' ON THIS DRAWING SHEET).
- HIGH-LEVEL ALARM STATUS
- EMERGENCY STOP CIRCUIT STATUS
- DDC MODE SWITCHES (IF APPLICABLE)
- COMPRESSOR COOLING PUMP RUN STATUS

THE FOLLOWING SENSING EQUIPMENT IS TO BE INSTALLED:

- SUCTION PRESSURE TRANSDUCER (QUANTITY OF TWO), COMPRESSOR
- DISCHARGE PRESSURE TRANSDUCER (QUANTITY OF TWO), COMPRESSOR
- RINK 1 RETURN TEMPERATURE SENSOR
- RINK 1 SUPPLY TEMPERATURE SENSOR
- RINK 2 RETURN TEMPERATURE SENSOR
- RINK 2 SUPPLY TEMPERATURE SENSOR
- COLD FLOOR SLAB SENSOR (QUANTITY OF TWO)
- WARM FLOOR SLAB SENSOR (QUANTITY OF TWO)
- OUTSIDE AIR TEMPERATURE AND HUMIDITY
- DUCT HUMIDITY AND TEMPERATURE
- ICE RINK INFRARED SENSOR

UH-4: GAS HEATER, UPPER GARAGE (EXISTING)

- PROVIDE A BACNET IP CONTROLLER TO CONTROL THE GAS HEATER SERVING THE UPPER GARAGE.
- A ROOM TEMPERATURE SENSOR SHALL BE INSTALLED TO MONITOR THE GARAGE TEMPERATURE.

SEQUENCE OF OPERATION

TEMPERATURE CONTROL – THE CONTROLLER SHALL MONITOR THE GARAGE SPACE TEMPERATURE:

- WHEN THE SPACE TEMPERATURE FALLS BELOW THE HEATING SETPOINT MINUS DEADBAND, THE CONTROLLER SHALL ENABLE THE GAS HEATER.
- WHEN THE SPACE TEMPERATURE RISES ABOVE THE HEATING SETPOINT, THE CONTROLLER SHALL DISABLE THE HEATER.

DEADBAND – HEATING DEADBAND: 1-2'F (ADJUSTABLE)

HEATER CONTROL: THE BAS SHALL PROVIDE A BINARY ENABLE/DISABLE COMMAND TO THE GAS HEATER. THE HEATER SHALL OPERATE WHEN ENABLED AND STOP WHEN DISABLED.

ALARMS – THE BAS SHALL GENERATE THE FOLLOWING ALARMS:

- LOW GARAGE TEMPERATURE ALARM – IF SPACE TEMPERATURE FALLS BELOW AN ADJUSTABLE THRESHOLD.
- HIGH GARAGE TEMPERATURE ALARM – IF SPACE TEMPERATURE RISES ABOVE AN ADJUSTABLE THRESHOLD.

B-1, ST-1 THROUGH ST-5: ZAMBONI BOILER ROOM (EXISTING)

PROVIDE A BACNET IP CONTROLLER TO MONITOR AND CONTROL THE ZAMBONI BOILER ROOM HEATING SYSTEM CONSISTING OF:

- FIVE (5) STORAGE TANKS (ST-1 THROUGH ST-5)
- ONE (1) CONDENSING BOILER (B-1)
- ONE (1) BOILER PUMP

THE CONTROLLER SHALL MONITOR TANK TEMPERATURES, BOILER TEMPERATURES, AND EQUIPMENT STATUS, AND PROVIDE BOILER ENABLE/DISABLE AND MODULATION CONTROL THROUGH THE BAS.

STORAGE TANK TEMPERATURE MONITORING – FIVE (5) STRAP-ON TEMPERATURE SENSORS SHALL BE INSTALLED TO MONITOR THE WATER TEMPERATURE OF:

- STORAGE TANK 1
- STORAGE TANK 2
- STORAGE TANK 3
- STORAGE TANK 4
- STORAGE TANK 5

THE BACNET CONTROLLER SHALL CONTINUOUSLY MONITOR AND TRANSMIT THESE TEMPERATURES TO THE BAS.

STORAGE TANK ALARMS – THE FOLLOWING ALARMS SHALL BE GENERATED:
- HIGH TANK TEMPERATURE ALARM: IF TANK TEMPERATURE EXCEEDS A USER DEFINABLE LIMIT (ADJUSTABLE).
- LOW TANK TEMPERATURE ALARM: IF TANK TEMPERATURE FALLS BELOW A USER DEFINABLE LIMIT (ADJUSTABLE).

BOILER AND PUMP TEMPERATURE MONITORING – TWO (2) STRAP-ON TEMPERATURE SENSORS SHALL BE INSTALLED TO MONITOR:

- BOILER SUPPLY WATER TEMPERATURE
- BOILER RETURN WATER TEMPERATURE

THESE VALUES SHALL BE MONITORED AND TRANSMITTED TO THE BAS.
TEMPERATURE ALARMS AND THE BAS SHALL GENERATE ALARMS IF TEMPERATURES EXCEED ADJUSTABLE THRESHOLDS.

SEQUENCE OF OPERATIONS

BOILER CONTROL – THE BAS SHALL PROVIDE ENABLE/DISABLE COMMANDS FOR:

- CONDENSING BOILER
- BOILER PUMP

THE EQUIPMENT SHALL OPERATE WHEN ENABLED BY THE BAS AND DISABLED WHEN THE COMMAND IS REMOVED.

BOILER MODULATION CONTROL: THE BACNET CONTROLLER SHALL PROVIDE A MODULATING ANALOG OUTPUT SIGNAL (AO) TO CONTROL THE FIRING RATE OF THE CONDENSING BOILER.THE MODULATION SIGNAL SHALL TYPICALLY BE 0-10 VDC (OR MANUFACTURER SPECIFIED.THE BOILER SHALL MODULATE TO MAINTAIN THE DESIRED HOT WATER TEMPERATURE SETPOINT. THE MODULATION OUTPUT SHALL TERMINATE AT THE BOILER CONTROL PANEL AS REQUIRED BY THE BOILER MANUFACTURER.

PUMP STATUS MONITORING: THE BACNET CONTROLLER SHALL MONITOR THE BOILER PUMP STATUS VIA STATUS INPUTS. THE BAS SHALL DISPLAY PUMP STATUS AS RUNNING / STOPPED.

PUMP ALARM: PUMP FAILURE ALARM TO BE INDICATED IF THE PUMP IS COMMANDED ON BUT THE STATUS INDICATES OFF.

BOILER STATUS MONITORING: THE BAS SHALL MONITOR BOILER OPERATIONAL STATUS.

BOILER ALARM: BOILER FAILURE ALARM TO BE INDICATED IF THE BOILER IS ENABLED BUT NO OPERATIONAL STATUS IS DETECTED WITHIN A USER DEFINABLE TIME PERIOD.

TRENDING REQUIREMENTS – THE BAS SHALL TREND THE FOLLOWING POINTS:

- ALL STORAGE TANK TEMPERATURES
- BOILER SUPPLY TEMPERATURE
- BOILER RETURN TEMPERATURE
- BOILER MODULATION SIGNAL
- BOILER STATUS
- PUMP STATUS

TRENDING INTERVALS SHALL BE CONFIGURABLE WITHIN THE BAS.

GM-1: QEL GAS MONITORING (EXISTING)

PROVIDE MODBUS INTEGRATION WITH THE EXISTING QEL GAS MONITORING CONTROLLER (M-CONTROLLER) TO ALLOW THE BUILDING AUTOMATION SYSTEM (BAS) TO MONITOR ALL AVAILABLE CONTROL POINTS FROM THE QEL CONTROLLER.

PRIOR TO INTEGRATION, THE CONTROLS CONTRACTOR SHALL VERIFY COMPATIBILITY OF THE EXISTING QEL CONTROLLER WITH MODBUS COMMUNICATION AND CONFIRM THE AVAILABLE MODBUS REGISTER MAP FOR INTEGRATION.

SENSOR ALARM MONITORING: THE BAS SHALL MONITOR ALARM AND VENTILATION STATUS SIGNALS FOR EACH CONNECTED GAS SENSOR. AT MINIMUM, THE FOLLOWING POINTS SHALL BE MONITORED:

- AMMONIA VENTILATION STAGE ACTIVE
- AMMONIA ALARM ACTIVE
- CO VENTILATION STAGE ACTIVE
- CO ALARM ACTIVE

BAS ALARMS – THE FOLLOWING CONDITIONS SHALL GENERATE BAS ALARMS:

- AMMONIA HIGH ALARM
- CO HIGH ALARM
- GAS MONITORING SYSTEM FAULT
- GAS MONITORING COMMUNICATION LOSS
- COMPRESSOR ROOM ALARM RELAY ACTIVE
- RINK VENTILATION ACTIVE (MAY BE CONFIGURED AS AN ALARM OR SUPERVISORY NOTIFICATION DEPENDING ON OWNER PREFERENCE)

ALL ALARMS SHALL BE DISPLAYED AT THE BAS WORKSTATION AND LOGGED IN THE ALARM HISTORY.

TRENDING REQUIREMENTS – THE BAS SHALL TREND THE FOLLOWING POINTS OBTAINED FROM THE QEL CONTROLLER:

ANALOG TRENDS:

- AMMONIA CONCENTRATION (PPM)
- RINK CO CONCENTRATION (PPM)

BINARY / STATUS TRENDS:

- AMMONIA VENTILATION STAGE
- AMMONIA ALARM
- CO VENTILATION STAGE
- CO ALARM
- RELAY 1 STATUS
- RELAY 2 STATUS
- RELAY 3 STATUS

ANALOG VALUES SHALL BE TRENDED AT REGULAR TIME INTERVALS, AND BINARY POINTS SHALL BE TRENDED USING CHANGE-OF-VALUE LOGGING.
TREND DATA SHALL BE RETAINED IN THE BAS FOR SYSTEM DIAGNOSTICS, SAFETY VERIFICATION, AND OPERATIONAL REVIEW.

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CARLETON PLACE ARENA – BUILDING AUTOMATION SYSTEM INSTALLATION
75 NEELIN STREET
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drawing title:

BAS POINTS – EQUIPMENT AND DEVICES (CONTINUED)

scale:	AS NOTED	drawn by:	P.P. / M.G.
designed by:	P.P. / M.G.	reviewed by:	JRP ENG.
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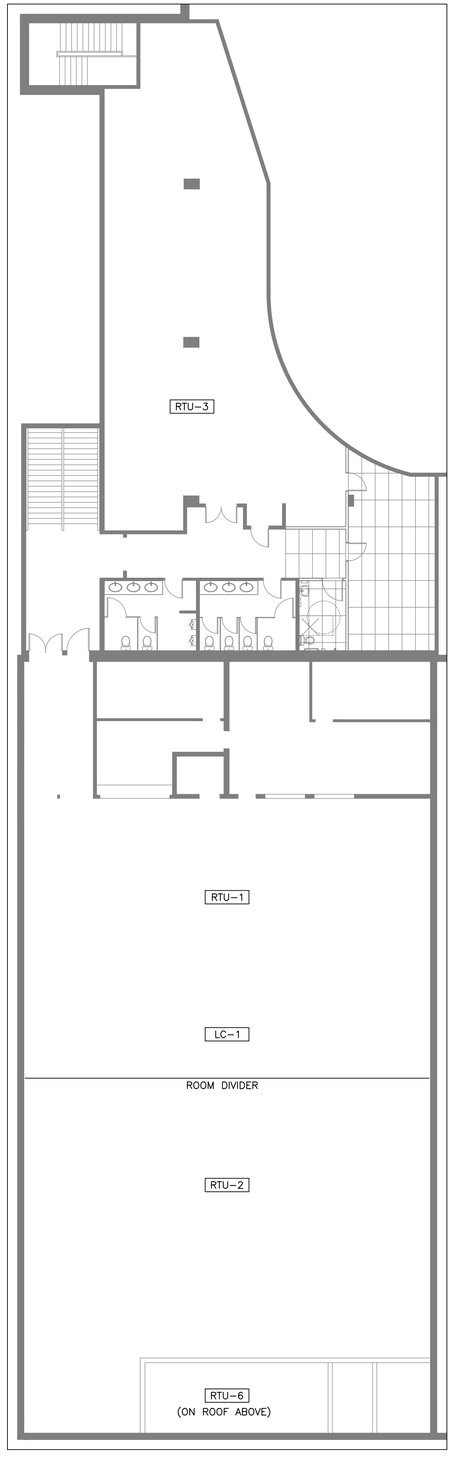
project no.:	drawing no.:
100-2608	ME-4 of 10



1 ME-5

PARTIAL SECOND FLOOR – BAS POINTS, EQUIPMENT & DEVICES

3/32" = 1'-0"

DRAWING NOTES:

1. TYPICAL: PROVIDE 15A CIRCUIT COMPLETE WITH CIRCUIT BREAKER, ALL CONDUIT, AND WIRING FOR ALL BAS EQUIPMENT, AS REQUIRED. SOURCE FROM BASE BUILDING ELECTRICAL ROOM. MULTIPLE CONTROLLERS CAN BE FED FROM SAME CIRCUIT, INSTALL AS PER MANUFACTURER'S WRITTEN INSTRUCTIONS.

RTU-1, RTU-2: LARGE HALL (EXISTING)

INTEGRATE EXISTING EQUIPMENT CONTROLLER OR RETROFIT EXISTING EQUIPMENT WITH CONTROLLER SO THAT BACNET POINTS SHALL BE AVAILABLE WITH READ/WRITE

OCCUPIED MODE:

- MINIMUM DAMPER POSITION
- MAXIMUM DAMPER POSITION
- MINIMUM CO SETPOINT FOR DCV ACTIVATION (ENABLE POINT)
- MAXIMUM CO SETPOINT FOR DCV TO FULLY OPEN THE OUTSIDE AIR (OA) DAMPER
- HEATING SETPOINT
- COOLING SETPOINT

UNOCCUPIED MODE:

- HEATING SETPOINT
- COOLING SETPOINT

COMMUNICATION FAIL-SAFE: A DEFAULT TEMPERATURE SETPOINT SHALL BE IMPLEMENTED. IN THE EVENT OF LOSS OF BACNET COMMUNICATION, THE CONTROLLER SHALL RELINQUISH TO THE DEFAULT SETPOINT AND CONTINUE OPERATING LOCALLY.

DDC CONTROLLER TO MONITOR BELOW MENTIONED POINTS:

- PARTITION SENSOR OPERATION: AN INFRARED PARTITION SENSOR SHALL DETECT WHETHER THE LARGE HALL IS PARTITIONED OR OPEN.
- PARTITION OPEN: WHEN THE PARTITION IS OPEN, RTU-1 AND RTU-2 SHALL OPERATE TO CONDITION THE ENTIRE HALL SPACE AND WORK AS ONE SYSTEM.
- PARTITION CLOSED: WHEN THE PARTITION IS CLOSED, THE UNITS MAY OPERATE INDEPENDENTLY TO CONDITION THEIR RESPECTIVE ZONES.

THE BAS SHALL MONITOR PARTITION STATUS.

SEQUENCE OF OPERATION

OCCUPANCY CONTROL: OCCUPANCY MODE SHALL BE DETERMINED BY USING CEILING-MOUNTED MOTION SENSORS (2 FOR EACH RTU).

OCCUPIED MODE: THE RTU SHALL OPERATE IN OCCUPIED MODE WHEN MOTION IS DETECTED IN SPACE.

UNOCCUPIED MODE: IF NO MOTION IS DETECTED FOR A CONFIGURABLE TIMEOUT PERIOD, THE RTU SHALL TRANSITION TO UNOCCUPIED MODE.

THE BAS SHALL ALLOW MANUAL OVERRIDE TO FORCE THE UNIT INTO OCCUPIED MODE IF REQUIRED.

UNIT INTERNAL CONTROL: THE UNIT INTERNAL DDC CONTROLLER SHALL MODULATE HEATING, COOLING, AND FAN SPEEDS TO MAINTAIN THE SETPOINTS PROVIDED THROUGH BAS INTEGRATION.

OUTDOOR AIR DAMPER: THE MINIMUM OUTSIDE AIR DAMPER POSITION FOR 'OCCUPIED LOW BLOWER' AND 'OCCUPIED HIGH BLOWER' MODES SHALL BE ADJUSTED DURING UNIT SETUP AND COMMISSIONING TO PROVIDE THE MINIMUM VENTILATION AIRFLOW REQUIRED BY ASHRAE STANDARD 62.1, CORRESPONDING TO THE RESPECTIVE SUPPLY AIR BLOWER SPEEDS.

RETURN AIR CARBON DIOXIDE (CO2) CONCENTRATION MONITORING: THE CONTROLLER SHALL MEASURE THE RETURN AIR CO2 CONCENTRATION. ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH RETURN AIR CARBON DIOXIDE CONCENTRATION: IF THE RETURN AIR CO2 CONCENTRATION IS GREATER THAN 1000 PPM (ADJ.) WHEN IN OCCUPIED MODE.

RETURN AIR TEMPERATURE: THE CONTROLLER SHALL MONITOR THE RETURN AIR TEMPERATURE AND USE AS REQUIRED FOR ECONOMIZER CONTROL (IF PRESENT). ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS GREATER THAN 90 °F (ADJ.).
- LOW RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS LESS THAN 45°F (ADJ.).

MIXED AIR TEMPERATURE: THE CONTROLLER SHALL MONITOR THE MIXED AIR TEMPERATURE AND USE AS REQUIRED FOR ECONOMIZER CONTROL (IF PRESENT) OR PREHEATING CONTROL (IF PRESENT). ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH MIXED AIR TEMP: IF THE MIXED AIR TEMPERATURE IS GREATER THAN °F (ADJ.).
- LOW MIXED AIR TEMP: IF THE MIXED AIR TEMPERATURE IS LESS THAN °F (ADJ.).

SUPPLY AIR TEMPERATURE: THE CONTROLLER SHALL MONITOR THE AIR TEMPERATURE SUPPLY. ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH SUPPLY AIR TEMP: IF THE AIR SUPPLY TEMPERATURE IS GREATER THAN 120°F (ADJ.).
- LOW SUPPLY AIR TEMP: IF THE AIR SUPPLY TEMPERATURE IS LESS THAN 45°F (ADJ.).

TRENDING REQUIREMENTS – THE BAS SHALL TREND:

- SUPPLY AIR TEMP (SAT)
- RETURN AIR TEMP (RAT)
- HEATING SETPOINT
- COOLING SETPOINT
- MOTION DETECTION STATUS (EACH SENSOR)
- OCCUPANCY MODE
- PARTITION STATUS
- OUTSIDE AIR DAMPER POSITION
- MINIMUM DAMPER POSITION
- MAXIMUM DAMPER POSITION

RTU-3: SMALL HALL (EXISTING)

INTEGRATE EXISTING EQUIPMENT CONTROLLER OR RETROFIT EXISTING EQUIPMENT WITH CONTROLLER SO THAT BACNET POINTS SHALL BE AVAILABLE WITH READ/WRITE FUNCTIONALITY:

OCCUPIED MODE:

- MINIMUM DAMPER POSITION
- MAXIMUM DAMPER POSITION
- MINIMUM CO SETPOINT FOR DCV ACTIVATION (ENABLE POINT)
- MAXIMUM CO SETPOINT FOR DCV TO FULLY OPEN THE OUTSIDE AIR (OA) DAMPER
- HEATING SETPOINT
- COOLING SETPOINT

UNOCCUPIED MODE:

- HEATING SETPOINT
- COOLING SETPOINT

COMMUNICATION FAIL-SAFE: A DEFAULT TEMPERATURE SETPOINT SHALL BE IMPLEMENTED. IN THE EVENT OF LOSS OF BACNET COMMUNICATION, THE CONTROLLER SHALL RELINQUISH TO THE DEFAULT SETPOINT AND CONTINUE OPERATING LOCALLY.

SEQUENCE OF OPERATION

OCCUPANCY CONTROL: OCCUPANCY MODE SHALL BE DETERMINED BY USING CEILING-MOUNTED MOTION SENSORS (MINIMUM QUANTITY: 2)

OCCUPIED MODE: THE RTU SHALL OPERATE IN OCCUPIED MODE WHEN MOTION IS DETECTED IN SPACE.

UNOCCUPIED MODE: IF NO MOTION IS DETECTED FOR A CONFIGURABLE TIMEOUT PERIOD, THE RTU SHALL TRANSITION TO UNOCCUPIED MODE. THE BAS SHALL ALLOW MANUAL OVERRIDE TO FORCE THE UNIT INTO OCCUPIED MODE IF REQUIRED.

UNIT INTERNAL CONTROL: THE UNIT INTERNAL DDC CONTROLLER SHALL MODULATE HEATING, COOLING, AND FAN SPEEDS TO MAINTAIN THE SETPOINTS PROVIDED THROUGH BAS INTEGRATION.

OUTDOOR AIR DAMPER: THE MINIMUM OUTSIDE AIR DAMPER POSITION FOR 'OCCUPIED LOW BLOWER' AND 'OCCUPIED HIGH BLOWER' MODES SHALL BE ADJUSTED DURING UNIT SETUP AND COMMISSIONING TO PROVIDE THE MINIMUM VENTILATION AIRFLOW REQUIRED BY ASHRAE STANDARD 62.1, CORRESPONDING TO THE RESPECTIVE SUPPLY AIR BLOWER SPEEDS.

RETURN AIR CARBON DIOXIDE (CO2) CONCENTRATION MONITORING: THE CONTROLLER SHALL MEASURE THE RETURN AIR CO2 CONCENTRATION. ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH RETURN AIR CARBON DIOXIDE CONCENTRATION:

IF THE RETURN AIR CO2 CONCENTRATION IS GREATER THAN 1000 PPM (ADJ.) WHEN IN OCCUPIED MODE.

RETURN AIR TEMPERATURE: THE CONTROLLER SHALL MONITOR THE RETURN AIR TEMPERATURE AND USE AS REQUIRED FOR ECONOMIZER CONTROL (IF PRESENT). ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS GREATER THAN 90 °F (ADJ.).
- LOW RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS LESS THAN 45°F (ADJ.).

SUPPLY AIR TEMPERATURE: THE CONTROLLER SHALL MONITOR THE AIR TEMPERATURE SUPPLY. ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH SUPPLY AIR TEMP: IF THE AIR SUPPLY TEMPERATURE IS GREATER THAN 120°F (ADJ.).
- LOW SUPPLY AIR TEMP: IF THE AIR SUPPLY TEMPERATURE IS LESS THAN 45°F (ADJ.).

TRENDING REQUIREMENTS – THE BAS SHALL TREND:

- SUPPLY AIR TEMP (SAT)
- RETURN AIR TEMP (RAT)
- HEATING SETPOINT
- COOLING SETPOINT
- MOTION DETECTION STATUS (EACH SENSOR)
- OCCUPANCY MODE
- OUTSIDE AIR DAMPER POSITION
- MINIMUM DAMPER POSITION
- MAXIMUM DAMPER POSITION

RTU-4, RTU-5, RTU-6: ARENA 1 CHANGE ROOMS, OFFICES (EXISTING)

- PROVIDE NEW SPACE THERMOSTAT WITH HUMIDITY, CO2, AND MOTION FOR EACH ROOM SERVED.
- PROVIDE AND INSTALL 2 DUCT TEMP SENSORS TO MONITOR SAT & RAT.

INTEGRATE EXISTING EQUIPMENT CONTROLLER OR RETROFIT EXISTING EQUIPMENT WITH CONTROLLER SO THAT BACNET POINTS SHALL BE AVAILABLE WITH READ/WRITE FUNCTIONALITY:

OCCUPIED MODE:

- MINIMUM DAMPER POSITION
- MAXIMUM DAMPER POSITION
- MINIMUM CO SETPOINT FOR DCV ACTIVATION (ENABLE POINT)
- MAXIMUM CO SETPOINT FOR DCV TO FULLY OPEN THE OUTSIDE AIR (OA) DAMPER
- HEATING SETPOINT
- COOLING SETPOINT

UNOCCUPIED MODE:

- HEATING SETPOINT
- COOLING SETPOINT

COMMUNICATION FAIL-SAFE: A DEFAULT TEMPERATURE SETPOINT SHALL BE IMPLEMENTED. IN THE EVENT OF LOSS OF BACNET COMMUNICATION, THE CONTROLLER SHALL RELINQUISH TO THE DEFAULT SETPOINT AND CONTINUE OPERATING LOCALLY.

SEQUENCE OF OPERATION

OCCUPANCY CONTROL: OCCUPANCY MODE SHALL BE DETERMINED BY USING CEILING-MOUNTED MOTION SENSORS (MINIMUM QUANTITY: ONE SENSOR PER ROOM SUPPLIED BY ROOFTOP UNIT)

OCCUPIED MODE: THE RTU SHALL OPERATE IN OCCUPIED MODE WHEN MOTION IS DETECTED IN SPACE.

UNOCCUPIED MODE: IF NO MOTION IS DETECTED FOR A CONFIGURABLE TIMEOUT PERIOD, THE RTU SHALL TRANSITION TO UNOCCUPIED MODE. THE BAS SHALL ALLOW MANUAL OVERRIDE TO FORCE THE UNIT INTO OCCUPIED MODE IF REQUIRED.

UNIT INTERNAL CONTROL: THE UNIT INTERNAL DDC CONTROLLER SHALL MODULATE HEATING, COOLING, AND FAN SPEEDS TO MAINTAIN THE SETPOINTS PROVIDED THROUGH BAS INTEGRATION.

OUTDOOR AIR DAMPER: THE MINIMUM OUTSIDE AIR DAMPER POSITION FOR 'OCCUPIED LOW BLOWER' AND 'OCCUPIED HIGH BLOWER' MODES SHALL BE ADJUSTED DURING UNIT SETUP AND COMMISSIONING TO PROVIDE THE MINIMUM VENTILATION AIRFLOW REQUIRED BY ASHRAE STANDARD 62.1, CORRESPONDING TO THE RESPECTIVE SUPPLY AIR BLOWER SPEEDS.

RETURN AIR CARBON DIOXIDE (CO2) CONCENTRATION MONITORING: THE CONTROLLER SHALL MEASURE THE RETURN AIR CO2 CONCENTRATION. ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH RETURN AIR CARBON DIOXIDE CONCENTRATION: IF THE RETURN AIR CO2 CONCENTRATION IS GREATER THAN 1000 PPM (ADJ.) WHEN IN OCCUPIED MODE.

RETURN AIR TEMPERATURE: THE CONTROLLER SHALL MONITOR THE RETURN AIR TEMPERATURE AND USE AS REQUIRED FOR ECONOMIZER CONTROL (IF PRESENT). ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS GREATER THAN 90 °F (ADJ.).
- LOW RETURN AIR TEMP: IF THE RETURN AIR TEMPERATURE IS LESS THAN 45°F (ADJ.).

SUPPLY AIR TEMPERATURE: THE CONTROLLER SHALL MONITOR THE AIR TEMPERATURE SUPPLY. ALARMS SHALL BE PROVIDED AS FOLLOWS:

- HIGH SUPPLY AIR TEMP: IF THE AIR SUPPLY TEMPERATURE IS GREATER THAN 120°F (ADJ.).
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- HEATING SETPOINT
- COOLING SETPOINT
- MOTION DETECTION STATUS (EACH SENSOR)
- OCCUPANCY MODE
- OUTSIDE AIR DAMPER POSITION
- MINIMUM DAMPER POSITION
- MAXIMUM DAMPER POSITION

LC-1: LIGHTING CONTROLS (EXISTING)

INTEGRATE EXISTING WAVELINX WAL-120 WIRELESS AREA CONTROLLER, CONTROLLING THE FOLLOWING FOUR (4) LIGHTING ZONES:

- CONSTRUCTION AREA
- KITCHEN
- ZONE#1
- ZONE 2

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No	DESCRIPTION	DATE
1	ISSUED FOR TENDER	APRIL 30, 2026
0	ISSUED FOR REVIEW	APRIL 28, 2026

REVISIONS

client:

TOWN OF CARLETON PLACE
175 BRIDGE STREET
CARLETON PLACE, ON K7C 2V8

project:

CARLETON PLACE ARENA – BUILDING AUTOMATION SYSTEM INSTALLATION
75 NEELIN STREET
CARLETON PLACE, ON K7C 4H1

drawing title:

BAS POINTS – EQUIPMENT AND DEVICES (CONTINUED)

scale:	AS NOTED	drawn by:	P.P. / M.G.
designed by:	P.P. / M.G.	reviewed by:	JRP ENG.
approved by:	JRP ENG.	date:	APRIL 2026

project no.:	drawing no.:
100-2608	ME-5 of 10

GENERAL INSTRUCTIONS (MECHANICAL)

1.0 CONDITIONS OF CONTRACT

THE INSTRUCTIONS TO BIDDERS AND THE GENERAL CONDITIONS ARE AN INTEGRAL PART OF THIS DIVISION AND SHALL BE READ IN CONJUNCTION HEREWITH. THESE INSTRUCTIONS TO BIDDERS AND GENERAL CONDITIONS SHALL BE FULLY BINDING ON THE GENERAL CONTRACTOR AND THEIR SUB–CONTRACTORS TO THE FULL SATISFACTION OF THE ENGINEER AND OWNER.

THE RESPONSIBILITY AND SCOPE OF EACH SUB–TRADE RESTS SOLELY WITH THE MECHANICAL CONTRACTOR. EXTRAS WILL NOT BE CONSIDERED BASED ON THE GROUNDS OF DIFFERENCE IN INTERPRETATION OF SPECIFICATIONS AND DRAWINGS AS TO WHICH TRADE INVOLVED SHALL PROVIDE CERTAIN SPECIALITIES OR MATERIALS.

2.0 EXAMINATION OF WORK

EXAMINE THE SITE AND LOCAL CONDITIONS LIKELY TO AFFECT WORK INDICATED AND SPECIFIED PRIOR TO SUBMITTING FINAL PRICE.

THIS PROJECT INVOLVES CHANGES TO HE BUILDING, WHICH IS PRESENTLY OCCUPIED. THEREFORE, EXAMINE HE SITE AND LOCAL CONDITIONS TO DETERMINE THE DIFFICULTIES IN CARRYING OUT THE WORK INDICATED AND SPECIFIED PRIOR TO SUBMITTING A FINAL PRICE.

3.0 LIABILITY

THIS CONTRACTOR SHALL ASSUME FULL RESPONSIBILITY FOR LAYING OUT THEIR WORK AND FOR ANY DAMAGE CAUSED TO THE OWNER AND OTHER CONTRACTORS BY IMPROPER LOCATION OR CARRYING OUT OF THIS WORK. CARRY ALL NECESSARY INSURANCE COVERAGE.

THIS CONTRACTOR SHALL PROTECT ALL FINISHED AND UNFINISHED WORK OF THEIR OWN AND OTHER CONTRACTORS INCLUDING EXISTING FROM DAMAGE DUE TO HE CARRYING OUT OF THEIR WORK.

4.0 INTENT

IT IS THE INTENT OF THIS SPECIFICATION AND DRAWINGS TO PROVIDE FOR A COMPLETE AND FULLY–OPERATING SYSTEM IN COMPLETE ACCORD WITH ALL APPLICABLE CODES. THESE SPECIFICATIONS MAY NOT COVER EACH AND VERY ITEM REQUIRED FOR THE COMPLETE MECHANICAL INSTALLATION; THEREFORE, THE CONTRACTOR SHALL MAKE PROVISIONS FOR ALL LABOUR, MATERIAL, AND EQUIPMENT DEEMED NECESSARY TO COMPLETE THE SYSTEM(S) AFFECTED BY THE WORK DESCRIBED IN THE SPECIFICATIONS AND DRAWINGS.

5.0 CERTIFICATES, FEES, ETC.

THIS CONTRACTOR TO PAY ALL FEES AND OBTAIN ALL PERMITS, PROVIDE AUTHORITIES WITH PLANS AND INFORMATION FOR ACCEPTANCE CERTIFICATES. FURNISH INSPECTION CERTIFICATES AS EVIDENCE THAT WORK CONFORMS WITH REQUIREMENTS OF AUTHORITIES HAVING JURISDICTION (AHJs).

6.0 CUTTING AND PATCHING

THE MECHANICAL CONTRACTOR WILL CONFER WITH THE GENERAL CONTRACTOR IN REGARDS TO THIS WORK AND SHALL GIVE LOCATIONS FOR ALL HOLES/PENETRATIONS FOR PIPES, DUCTS THROUGH FLOORS AND ROOF, ETC., AND PROVIDE SLEEVES REQUIRED TO EXECUTE THE MECHANICAL INSTALLATION.

7.0 PIPE HANGERS, SUPPORTS, AND SLEEVES

HANGERS AND SUPPORTS SHALL SECURE PIPES N PLACE, PREVENT VIBRATION, MAINTAIN GRADE BY ADJUSTMENT, PROVIDE FOR EXPANSION AND CONTRACTION, ND SHALL BE DIRECTLY SUPPORTED FROM THE STRUCTURE. PERFORATED STRAP HANGERS ARE NOT ACCEPTABLE.

8.0 TESTING

TEST ALL EQUIPMENT AND MATERIAL WHERE REQUIRED BY SPECIFICATIONS OR AUTHORITIES HAVING JURISDICTION (AHJs) TO DEMONSTRATE ITS PROPER OPERATION TO THE OWNER'S REPRESENTATIVE. TEST PROCEDURES SHALL BE IN ACCORDANCE WITH THE APPLICABLE PORTIONS OF THE ASME, ASHRAE, AND OTHER RECOGNIZED TEST CODES AS FAR AS FIELD CONDITIONS PERMIT.

- PERFORM TESTING UPON COMPLETION OF THE MECHANICAL INSTALLATION, URN OVER TO THE OWNER A CERTIFICATION OF THE TEST COMPLETE WITH DETAILED DATA AS REQUIRED BY EACH.
- TESTS SHALL BE ITEMIZED AS TO THE TIME PERFORMED AND PERSONNEL RESPONSIBLE FOR THE TEST. HYDRAULIC TESTS SHALL BE CARRIED OUT FOR A PERIOD OF 8 HOURS AND PRESSURE MAINTAINED WITH NO APPRECIABLE PRESSURE DROP. WHERE LEAKAGE OCCURS, REPAIRS SHALL BE MADE AND THE ENTIRE SYSTEM RETESTED TO THE SATISFACTION OF BUILDING OWNER AND ENGINEER.
- ALL TESTS TO BE MADE BEFORE BACK–FILLING AND FURRING.
- ALL LOW AND HIGH VELOCITY DUCT SYSTEMS, INCLUDING SUPPLY SHALL BE CHECKED FOR TIGHTNESS. ALL LEAKS SHALL BE REPAIRED BEFORE DUCTS ARE FURRED IN TO ENSURE TOTAL OUTLET CAPACITY IS WITHIN 5% OF THE TOTAL QUANTITY BEING SUPPLIED BY THE AIR SYSTEM

9.0 RECORD "AS–BUILT" DRAWINGS

KEEP IN THE JOB OFFICE AN EXTRA SET OF WHITE PRINTS AND SPECIFICATIONS ON WHICH ALL CHANGES AND DEVIATIONS SHALL BE RECORDED DAILY. AT COMPLETION OF THIS PROJECT, TURN OVER TO ENGINEER TWO (2) SETS OF NEAT AND LEGIBLE "AS–BUILT" RECORD DRAWINGS AND SPECIFICATIONS. USE RED INK TO MARK ALL CHANGES AND DEVIATIONS AND SEAL WITH CONTRACTOR'S IDENTIFYING SEAL. THESE EXTRA SETS OF WHITE PRINTS AND SPECIFICATIONS WILL BE PROVIDED BY THE ENGINEER UPON REQUEST.

10.0 SHOP DRAWINGS

BEFORE FABRICATION OF MAJOR EQUIPMENT AND MATERIALS, SUBMIT THROUGH THE GENERAL CONTRACTOR SHOP DRAWINGS AND DATA SHEETS COVERING ALL ITEMS OF EQUIPMENT AND MATERIALS FURNISHED AND INSTALLED UNDER THIS CONTRACT FOR REVIEW BY THE ENGINEER.

11.0 TEMPORARY AND TRIAL USAGE

ANY PERMANENT EQUIPMENT USED TEMPORARILY FOR HEAT OR OTHERWISE WILL BE REPAIRED AND REPLACED TO THE FULL SATISFACTION OF THE OWNER.

12.0 CLEANING

DUCTS, PIPEWORK, AND EQUIPMENT SHALL BE THOROUGHLY CLEANED OF DIRT, CUTTINGS, AND OTHER FOREIGN SUBSTANCES. DISCONNECT, CLEAN, AND RE–CONNECT WHENEVER NECESSARY FOR THE PURPOSE OF LOCATING AND REMOVING OBSTRUCTIONS. REPAIR WORK THAT HAS BEEN DAMAGED IN THE COURSE OF REMOVING OBSTRUCTIONS. DUCTS SHALL BE POWER–VACUUM CLEANED BEFORE BEING TURNED OVER TO THE OWNER.

13.0 GUARANTEE

THE MECHANICAL CONTRACTOR, AS A CONDITION PRECEDENT TO FINAL PAYMENT AFTER COMPLETION OF THIS WORK, SHALL GIVE THE OWNER A WRITTEN GUARANTEE WARRANTING ALL APPARATUS FURNISHED UNDER THE CONTRACT TO REMAIN IN PERFECT SERVICEABLE CONDITION FOR A PERIOD OF ONE (1) CALENDAR YEAR FROM THE DATE OF FINAL ACCEPTANCE OF THEIR WORK BY THE OWNER AND THE ENGINEER.

14.0 INSTALLATION

INSTALL EQUIPMENT IN ACCORDANCE TO MANUFACTURER'S INSTRUCTIONS.

15.0 OPERATING AND MAINTENANCE DATA

FURNISH OPERATING AND MAINTENANCE DATA FOR ALL EQUIPMENT AND SYSTEMS AS PROVIDED AND/OR INSTALLED UNDER THE CONTRACT. DATA SHALL BE ASSEMBLED IN BOOKLET FORM WITH SOFT COVER AND INDEX. IDENTIFY FRONT COVER WITH NAME AND LOCATION OF THE PROJECT, CONSULTING ENGINEER, AND CONTRACTOR. SUBMIT REVIEW COPY TO OWNER AND ENGINEER FOR ACCEPTANCE. IF AGREEABLE TO THE OWNER, AND AGREED UPON IN WRITING, THE OPERATING AND MAINTENANCE DATA MAY BE SUBMITTED IN ELECTRONIC FORM (.PDF FILE FORMAT ONLY).

16.0 MATERIALS

REPLACE MATERIAL AND WORKMANSHIP BELOW SPECIFIED QUALITY AND RELOCATE WORK WRONGLY PLACED TO THE SATISFACTION OF OWNER AND ENGINEER.

MATERIALS AND EQUIPMENT INSTALLED SHALL BE NEW, FULL WEIGHT, ND OF THE BEST QUALITY SPECIFIED. USE SAME BRAND OF MANUFACTURER FOR EACH SPECIFIC INSTALLATION.

STATICALLY AND DYNAMICALLY BALANCE ROTATING EQUIPMENT FOR MINIMUM VIBRATION AND LOW OPERATING NOISE LEVEL.

17.0 APPROVALS

THE PRICE SUBMITTED FOR THIS CONTRACT SHALL BE BASED ON THE USE OF MATERIALS AND EQUIPMENT AS SPECIFIED. IF THIS CONTRACTOR WISHES TO QUOTE ON EQUIVALENT MATERIALS AND EQUIPMENT, THEY MUST QUOTE ON PRODUCTS REVIEWED AND APPROVED BY THE ENGINEER (WRITTEN APPROVAL), AS EQUIVALENT TO THE PRODUCT SPECIFIED. MANUFACTURER'S LISTED IN SPECIFICATIONS DO NOT HAVE TO REQUEST APPROVAL BUT MUST MEET ALL PERFORMANCE REQUIREMENTS.

CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR ANY ADDITIONAL WORK OR MATERIALS REQUIRED BY THE MECHANICAL TRADE OR OTHER CONTRACTORS TO ACCOMMODATE APPROVED EQUIVALENT MATERIALS OR EQUIPMENT. EXTRA COSTS ASSOCIATED WILL NOT BE APPROVED.

BUILDING AUTOMATION SYSTEM (BAS)

1.0 DEFINITIONS

BUILDING AUTOMATION SYSTEM (BAS): THE INTEGRATED MONITORING AND CONTROL SYSTEM FOR HEATING, VENTILATION, AND AIR–CONDITIONING (HVAC), LIGHTING SYSTEMS, AND RELATED BUILDING SYSTEMS, INCLUDING (BUT NOT LIMITED TO) CONTROLLERS, SOFTWARE, GATEWAYS, AND OPERATOR WORK STATIONS.

CONTROL SYSTEM PLATFORM MODEL:

- SaaS–BASED BAS CONTROL SYSTEM: A VENDOR–OPERATED, MULTI–TENANT (OR LOCALLY SEGREGATED) BAS APPLICATION DELIVERED AS A SUBSCRIPTION SERVICE WHERE THE VENDOR OWNS AND OPERATES THE APPLICATION AND PLATFORM, DELIVERS CONTINUOUS UPDATES/PATCHIGN, PROVIDES HIGH AVAILABILITY AND DISASTER RECOVERY, AND THE TWON CONSUMES THE SERVICES VIA SECURE WEB ACCESS. THE DOWN DOES NOT MANAGE SERVERS/VMS/OS/APPLICATION PATCHING.

- CLOUD–BASED INFRASTRUCTURE HOSTED BAS: BASE APPLICATION HOSTED IN A CLOUD ENVIRONMENT (IaaS/PaaS) BUT WHERE THE SOLUTION BEHAVES AS A SINGLE–TENANT HOSTED DEPLOYMENT AND/OR REQUIRES MATERIAL TOWN/VENDOR ADMINISTRATION OF DEDICATED INSTANCES (DEDICATED VM(S), DEDICATED DATABASE INSTANCE, BESPOKE PATCH WINDOWS, ETC.). VENDOR MAY HOST/MANAGE, BUT IT IS NOT DELIVERED AS A STANDARDIZED SaaS OFFERING.

- ON–PREMESIS BAS CONTROL SERVER: BAS HEAD–END/SERVER SOFTWARE INSTALLED ON TOWN–MANAGED OR VENDOR–MANAGED INFRASTRUCTURE LOCATED IN TOWN FACILITIES (INCLUDING TOWN DATA CENTRES, SERVER ROOMS, ETC.) AND/OR REQUIRING TOWN–PROVIDED COMPUTING/STORAGE FOR THE HEAD–END.

ABBREVIATIONS:

THE FOLLOWING ABBREVIATIONS ARE UTILIZED WITHIN THIS SECTION AND THE SEQUENCES OF OPERATIONS. REFER TO MECHANICAL DRAWINGS FOR ADDITIONAL ABBREVIATIONS:

AC - AIR CONDITIONING
ACU -AIR CONDITIONING UNIT
AHU - AIR HANDLING UNIT
AI - ANALOG INPUT
AO - ANALOG OUTPUT
ATC - AUTOMATIC TEMPERATURE CONTROL
AUTO - AUTOMATIC
AUX - AUXILIARY
AV - ANALOG VALUE
BAS - BUILDING AUTOMATION SYSTEM
BI - BINARY INPUT
BO - BINARY OUTPUT
BV - BINARY VALUE
C - COMMON
CFM - CUBIC FEET PER MINUTE
CHW - CHILLED WATER
CHWP - CHILLED WATER PUMP
CHWR - CHILLED WATER RETURN
CHWS - CHILLED WATER SUPPLY
COND - CONDENSER
CV - CONSTANT VOLUME
CW - CONDENSER WATER
CWP - CONDENSER WATER PUMP
CWR - CONDENSER WATER RETURN
CWS - CONDENSER WATER SUPPLY
DA - DISCHARGE AIR
DDC – DIRECT DIGITAL CONTROL
DI -DIGITAL INPUT
DO - DIGITAL OUTPUT
EA - EXHAUST AIR
EF - EXHAUST FAN
EVAP - EVAPORATORS
FAS - FIRE ALARM SYSTEM
FCU - FAN COIL UNIT
HOA - HAND / OFF / AUTO
HP - HEAT PUMP
HRU - HEAT RECOVERY UNIT
HVAC - HEATING, VENTILATING, AND AIR CONDITIONING
HW - HOT WATER
HWP - HOT WATER PUMP
HWR - HOT WATER RETURN
HWS - HOT WATER SUPPLY
HX – HEAT EXCHANGER
IU - INDUCTION UNIT
LAN - LOCAL AREA NETWORK
MER - MECHANICAL EQUIPMENT ROOM
NC - NORMALLY CLOSED
NO - NORMALLY OPEN
OA - OUTDOOR AIR
PID - PROPORTIONAL INTEGRAL DERIVATIVE
POT - PORTABLE OPERATORS TERMINAL
RA - RETURN AIR
RF - RETURN FAN
RH - RELATIVE HUMIDITY
RTU - ROOFTOP UNIT
SA - SUPPLY AIR
SF - SUPPLY FAN
SP - STATIC PRESSURE
TEMP - TEMPERATURE
UH - UNIT HEATER
UV - UNIT VENTILATOR
VAV - VARIABLE AIR VOLUME
VFD - VARIABLE FREQUENCY DRIVE
VRF -VARIABLE REFRIGERANT FLOW
VRV - VARIABLE REFRIGERANT VOLUME
WSHP - WATER SOURCE HEAT PUMP

TERMS USED WITHIN THE SPECIFICATION TEXT:

ADJUSTABLE (ADJ.): ADJUSTABLE BY THE END USER, THROUGH THE SUPPLIED USER INTERFACE.

ADVANCED APPLICATION CONTROLLER (AAC): A FULLY PROGRAMMABLE CONTROL MODULE. THIS CONTROL MODULE MAY BE CAPABLE OF SOME OF THE ADVANCED FEATURES FOUND IN BUILDING CONTROLLERS (STORING TRENDS, INITIATING READ AND WRITE REQUESTS, ETC.) BUT IT DOES NOT SERVE AS A MASTER CONTROLLER. ADVANCED APPLICATION CONTROLLERS MAY RESIDE ON EITHER THE ETHERNET/IP BACKBONE OR ON A SUBNET.

ALARM: THE CONTROL SYSTEM SHALL BE CONFIGURED TO GENERATE AN ALARM WHEN THIS OBJECT EXCEEDS USER DEFINABLE LIMITS, AS DESCRIBED IN THE SEQUENCE OF CONTROLS.

ANALOG VALUE: AN INTERMEDIATE (SOFTWARE) POINT THAT MAY BE EDITABLE OR READ–ONLY. EDITABLE AVS ARE TYPICALLY USED TO ALLOW THE USER TO SET A FIXED CONTROL PARAMETER, SUCH AS A SETPOINT. READ ONLY AVS ARE TYPICALLY USED TO DISPLAY THE STATUS OF A CONTROL OPERATION.

APPLICATION SPECIFIC CONTROLLER (ASC): A PRE–PROGRAMMED CONTROL MODULE WHICH IS INTENDED FOR USE IN A SPECIFIC APPLICATION. ASCS MAY BE CONFIGURABLE, IN THAT THE USER CAN CHOOSE BETWEEN VARIOUS PRE–PROGRAMMED OPTIONS, BUT IT DOES NOT SUPPORT FULL CUSTOM PROGRAMMING. ASCS ARE OFTEN USED ON TERMINAL EQUIPMENT SUCH AS VAV BOXES OR FAN COIL UNITS. IN MANY VENDORS ARCHITECTURES ASCS DO NOT STORE TRENDS OR SCHEDULES BUT INSTEAD RELY UPON A BUILDING CONTROLLER TO PROVIDE THOSE FUNCTIONS.

BACNET INTEROPERABILITY BUILDING BLOCKS (BIBB): A BIBB DEFINES A SMALL PORTION OF BACNET FUNCTIONALITY THAT IS NEEDED TO PERFORM A PARTICULAR TASK. BIBBS ARE COMBINED TO BUILD THE BACNET FUNCTIONAL REQUIREMENTS FOR A DEVICE IN A SPECIFICATION.

BACNET/BACNET STANDARD: BACNET COMMUNICATION REQUIREMENTS AS DEFINED BY THE LATEST VERSION OF ASHRAE/ANSI 135 AND APPROVED ADDENDA.

BINARY VALUE: AN INTERMEDIATE (SOFTWARE) POINT THAT MAY BE EDITABLE OR READ–ONLY. EDITABLE BVS ARE TYPICALLY USED TO ALLOW THE USER TO SET A FIXED CONTROL PARAMETER, SUCH AS A SETPOINT. READ ONLY BVS ARE TYPICALLY USED TO DISPLAY THE STATUS OF A CONTROL OPERATION.

BUILDING CONTROLLER (BC): A FULLY PROGRAMMABLE CONTROL MODULE WHICH IS CAPABLE OF STORING TRENDS AND SCHEDULES, SERVING AS A ROUTER TO DEVICES ON A SUBNET, AND INITIATING READ AND WRITE REQUESTS TO OTHER CONTROLLERS. TYPICALLY THIS CONTROLLER IS LOCATED ON THE ETHERNET/IP BACKBONE OF THE BAS. IN MANY VENDORS' ARCHITECTURES A BUILDING CONTROLLER WILL SERVE AS A MASTER CONTROLLER, STORING SCHEDULES AND TRENDS FOR CONTROLLERS ON A SUBNET UNDERNEATH THE BUILDING CONTROLLER.

CONTROL SYSTEMS SERVER: A COMPUTER(S) THAT MAINTAIN(S) THE SYSTEMS CONFIGURATION AND PROGRAMMING DATABASE.

CONTROLLER: INTELLIGENT STAND–ALONE CONTROL DEVICE. CONTROLLER IS A GENERIC REFERENCE TO BUILDING CONTROLLERS, CUSTOM APPLICATION CONTROLLERS, AND APPLICATION SPECIFIC CONTROLLERS.

DIRECT DIGITAL CONTROL (DDC): MICROPROCESSOR–BASED CONTROL INCLUDING ANALOG/DIGITAL CONVERSION AND PROGRAM LOGIC.

FURNISHED OR PROVIDED: THE ACT OF SUPPLYING A DEVICE OR PIECE OF EQUIPMENT AS REQUIRED MEETING THE SCOPE OF WORK SPECIFIED AND MAKING THAT DEVICE OR EQUIPMENT OPERATIONAL. ALL COSTS REQUIRED TO FURNISH THE SPECIFIED DEVICE OR EQUIPMENT AND MAKE IT OPERATIONAL ARE BORNE BY THE DIVISION SPECIFIED TO BE RESPONSIBLE FOR PROVIDING THE DEVICE OR EQUIPMENT.

GATEWAY: BI–DIRECTIONAL PROTOCOL TRANSLATOR CONNECTING CONTROL SYSTEMS THAT USE DIFFERENT COMMUNICATION PROTOCOLS.

INSTALL OR INSTALLED: THE PHYSICAL ACT OF MOUNTING, PIPING OR WIRING A DEVICE OR PIECE OF EQUIPMENT IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS AND THE SCOPE OF WORK AS SPECIFIED. ALL COSTS REQUIRED TO COMPLETE THE INSTALLATION ARE BORNE BY THE DIVISION SPECIFIED TO INCLUDE LABOR AND ANY ANCILLARY MATERIALS.

INTEGRATE: THE PHYSICAL CONNECTIONS FROM A CONTROL SYSTEM TO ALL SPECIFIED EQUIPMENT THROUGH AN INTERFACE AS REQUIRED TO ALLOW THE SPECIFIED CONTROL AND MONITORING FUNCTIONS OF THE EQUIPMENT TO BE PERFORMED VIA THE CONTROL SYSTEM.

INTERFACE: THE PHYSICAL DEVICE REQUIRED TO PROVIDE INTEGRATION CAPABILITIES FROM AN EQUIPMENT VENDOR'S PRODUCT TO THE CONTROL SYSTEM. THE EQUIPMENT VENDOR MOST NORMALLY FURNISHES THE INTERFACE DEVICE. AN EXAMPLE OF AN INTERFACE IS THE CHILLED WATER TEMPERATURE RESET INTERFACE CARD PROVIDED BY THE CHILLER MANUFACTURER IN ORDER TO ALLOW THE CONTROL SYSTEM TO INTEGRATE THE CHILLED WATER TEMPERATURE RESET FUNCTION INTO THE CONTROL SYSTEM.

LOCAL AREA NETWORK: COMPUTER OR CONTROL SYSTEM COMMUNICATIONS NETWORK LIMITED TO LOCAL BUILDING OR CAMPUS.

LOOP OR CONTROL LOOP: MOST COMMONLY A PID CONTROL LOOP. TYPICALLY A CONTROL LOOP WILL INCLUDE A SETPOINT, AN INPUT WHICH IS COMPARED TO THE SETPOINT, AND AN OUTPUT WHICH CONTROLS SOME ACTION BASED UPON THE DIFFERENCE BETWEEN THE INPUT AND THE SETPOINT. A PID CONTROL LOOP WILL ALSO INCLUDE GAINS FOR THE PROPORTIONAL, INTEGRAL, AND DERIVATIVE RESPONSE AS WELL AS AN INTERVAL WHICH CONTROLS HOW FREQUENTLY THE CONTROL LOOP UPDATES ITS OUTPUT. THESE GAINS MAY BE ADJUSTABLE BY THE END USER FOR CONTROL LOOP "TUNING," BUT IN SELF–TUNING CONTROL LOOPS OR LOOPS WHICH HAVE BEEN OPTIMIZED FOR A SPECIFIC APPLICATION THE GAINS MAY NOT BE ADJUSTABLE.

MASTER–SLAVE/TOKEN PASSING (MS/TP): DATA LINK PROTOCOL AS DEFINED BY THE BACNET STANDARD.

POINT–TO–POINT: SERIAL COMMUNICATION AS DEFINED IN THE BACNET STANDARD.

PRIMARY CONTROLLING LAN: HIGH SPEED, PEER–TO–PEER CONTROLLER LAN CONNECTING BCS AND OPTIONALLY AACS AND ASCS. REFER TO SYSTEM ARCHITECTURE BELOW.

PROTOCOL IMPLEMENTATION CONFORMANCE STATEMENT (PICS): A WRITTEN DOCUMENT THAT IDENTIFIES THE PARTICULAR OPTIONS SPECIFIED BY BACNET THAT ARE IMPLEMENTED IN A DEVICE.

ROUTER: A DEVICE THAT CONNECTS TWO OR MORE NETWORKS AT THE NETWORK LAYER.

SCHEDULE: THE CONTROL ALGORITHM FOR THIS EQUIPMENT SHALL INCLUDE A USER EDITABLE SCHEDULE.

TREND: THE CONTROL SYSTEM SHALL BE CONFIGURED TO COLLECT AND DISPLAY A TREND LOG OF THIS OBJECT. THE TRENDING INTERVAL SHALL BE NO LESS THAN ONE SAMPLE EVERY 5 MINUTES. (CHANGE OF VALUE TRENDING, WHERE A SAMPLE IS TAKEN EVERY TIME THE VALUE CHANGES BY MORE THAN A USER–DEFINED MINIMUM, IS AN ACCEPTABLE ALTERNATIVE.)

WEB SERVICES: WEB SERVICES ARE A STANDARD METHOD OF EXCHANGING DATA BETWEEN COMPUTER SYSTEMS USING THE XML (EXTENSIBLE MARKUP LANGUAGE) AND SOAP (SIMPLE OBJECT ACCESS PROTOCOL) STANDARDS. WEB SERVICES CAN BE USED AT ANY LEVEL WITHIN A BUILDING AUTOMATION SYSTEM (BAS), BUT MOST COMMONLY THEY ARE USED TO TRANSFER DATA BETWEEN BAS USING DIFFERENT PROTOCOLS OR BETWEEN A BAS AND A NON–BAS SYSTEM SUCH AS A TENANT BILLING SYSTEM OR A UTILITY MANAGEMENT SYSTEM.

WIRING: RACEWAY, FITTINGS, WIRE, BOXES AND RELATED ITEMS.

2.0 MANDATORY REQUIREMENTS

2.1 ARCHITECTURE & HOSTING:

THE PROPOSED BAS HEAD–END/CONTROL PLATFORM SHALL BE DELIVERED AS A SaaS OFFERING HOSTED AND OPERATED BY THE PROPONENT (OR THE PROPONENT'S CONTRACTED CLOUD SERVICE PROVIDER) AND ACCESSED VIA HTTPS WEB INTERFACE.

THE TOWN SHALL NOT BE REQUIRED TO PROCURE, HOST, OR MAINTAIN ON–PREMESIS BAS APPLICATION SERVERS, DATABASES, OR VIRTUALIZATION OFOR THE BAS HEAD–END.

THE SOLUTION SHALL SUPPORT SECURE REMOTE ACCESS FOR AUTHORIZED TOWN STAFF WITHOUT RELIANCE ON INBOUND FIREWALL PORT–FORWARDING TO TOWN FACILITIES.

ALL COMMUNICATIONS BETWEEN SITES/CONTROLLERS AND THE CLOUD SERVICE SHALL BE ENCRYPTED IN TRANSIT (TLS 1.2+ OR EQUIVALENT).

2.2 DATA RESIDENCY / SOVEREIGNTY:

THE PROPONENT SHALL CLEARLY STATE WHERE DATA IS STORED AND PROCESSED (COUNTRY, REGION). PREFERENCE MAY BE GIVEN TO SOLUTIONS WITH CANADIAN DATA RESIDENCY.

THE PROPONENT SHALL DISCLOSE ANY CROSS–BORDER ACCESS POSSIBILITIES (SUPPORT, OPERATIONS, ETC.), AND CONTROLS USED TO MITIGATE PRIVACY/SECURITY RISKS.

2.3 SECURITY CONTROLS:

THE SOLUTION SHALL SUPPORT:
- ROLE–BASED ACCESS CONTROL (RBAC) WITH LEAST–PRIVILEGE.
- MULTI–FACTOR AUTHENTIFICATION (MFA) FOR ADMINISTRATIVE AND REMOTE ACCESS.
- AUDIT LOGGING OF OPERATOR ACTIONS (LOGINS, OVERRIDES, SETPOINT CHANGES, ALARM ACKNOWLEDGEMENTS, USER ADMINISTRATION, ETC.)

THE PROPONENT SHALL DESCRIBE VULNERABILITY AND PATCH MANAGEMENT PRACTICES, INCLUDING:

- PATCH CADENCE, EMERGENCY PATCH PROCESS, AND CUSTOMER NOTIFICATION.
- ANNUAL (OR MORE FREQUENT) PENETRATION TESTING AND SUMMARY REPORTING AVAILABLE UPON REQUEST.

THE PROPONENT SHALL DESCRIBE THEIR INCIDENT RESPONSE PROCESS AND CUSTOMER NOTIFICATION TIMELINES.

2.4 AVAILABILITY, DR, AND SUPPORT:

SaaS SERVICE UPTIME COMMITMENT: PROPONENT SHALL PROVIDE AN SLA (FOR EXAMPLE, 99.5%+ MONTHLY, EXCLUDING SCHEDULED MAINTENANCE).

PROPONENT SHALL DESCRIBE BACK–UP FREQUENCY, RETENTION, AND DISASTER RECOVERY OBJECTIVES (RPO/RTO).

THE SOLUTION SHALL CONTINUE SAFE LOCAL CONTROL AT THE CONTROLLER LEVEL DURING WAN/INTERNET OUTAGES (FOR EXAMPLE, CLOUD LOSS SHALL NOT STOP LOCAL CONTROL SEQUENCES).

2.5 INTEROPERABILITY / OPEN PROTOCOLS:

THE BAS SHALL SUPPORT OPEN PROTOCOLS FOR INTEGRATION AND FUTURE FLEXIBILITY (BACnet/IP, BACnet MSTP WHERE REQUIRED, MODBUS WHERE REQUIRED.)

THE PROPONENT SHALL DESCRIBE INTEGRATION CAPABILITY WITH THIRD–PARTY SYSTEMS (SENSORS, METERS, MECHANICAL EQUIPMENT, VFD/VSDs, ETC.) AND DATA EXPORT OPTIONS (APIs, REPORTS).

2.6 IMPLEMENTATION & TRANSITION

PROPONENT SHALL PROVIDE AN IMPLEMENTATION PLAN INCLUDING COMMISSIONING, POINT–TO–POINT CHECKOUT, TRAINING, AND DOCUMENTATION.

PROPONENT SHALL PROVIDE A DATA OWNERSHIP STATEMENT: TOWN RETAINS OWNERSHIP OF TOWN OPERATIONAL DATA; PROVIDE EXPORT AT CONTRACT END IN A USEABLE FORMAT.

3.0 GENERAL

VARIABLE FREQUENCY DRIVES:

CONTRACTOR TO PROVIDE AN INTERFACE TO THE EXISTING VARIABLE FREQUENCY DRIVES (VFD) TO ALLOW FOR THE CONTROL AND MONITORING POINTS AS SPECIFIED WITHIN THE DRAWINGS. THE CONNECTION TO THESE POINTS SHALL BE BY ONE OF THE FOLLOWING METHODS:

- HARDWIRED CONNECTION SUCH AS RELAY, 0–10VDC, OR 4–20MA
- BACNET/IP NETWORK CONNECTION.
- BACNET OVER ARCNET NETWORK CONNECTION. (D) BACNET MS/TP NETWORK CONNECTION.

HEATING BOILERS (EXISTING):

CONTRACTOR TO PROVIDE AN INTERFACE TO THE EXISTING BOILER EQUIPMENT TO ALLOW FOR THE CONTROL AND MONITORING POINTS AS SPECIFIED WITHIN THE DRAWINGS. THE CONNECTION TO THESE POINTS SHALL BE BY ONE OF THE FOLLOWING METHODS:

- HARDWIRED CONNECTION SUCH AS RELAY, 0–10VDC, OR 4–20MA
- BACNET/IP NETWORK CONNECTION.
- BACNET OVER ARCNET NETWORK CONNECTION. (D) BACNET MS/TP NETWORK CONNECTION.

CENTRAL HVAC EQUIPMENT (EXISTING):

PACKAGED AHU OR EVAPORATIVE COOLER CONTROLS: UNIT SHALL BE UPGRADED/MODIFIED TO ACCEPT CONTROL INPUTS FROM AN EXTERNAL BUILDING AUTOMATION SYSTEM CONTROLLER AS SPECIFIED WITHIN THE DRAWINGS. FACTORY–MOUNTED SAFETIES AND OTHER CONTROLS SHALL NOT INTERFERE WITH THIS CONTROLLER.

THIRD–PARTY EQUIPMENT (EXISTING):

THE BMS SHALL BE CAPABLE OF INTEGRATING TO ANY THIRD–PARTY EQUIPMENT USING ANY OF THE FOLLOWING STANDARD OPEN PROTOCOLS:

- BACNET (IP, SC, ARCNET, OR MS/TP)
- MODBUS (RTU OR IP)

CONTRACTOR TO VERIFY AND PROVIDE THE DETAILS OF THE PROPOSED INTERFACE INCLUDING PICS FOR BACNET EQUIPMENT, HARDWARE AND SOFTWARE IDENTIFIERS FOR THE INTERFACE POINTS, NETWORK IDENTIFIERS, WIRING REQUIREMENTS, COMMUNICATION SPEEDS, AND REQUIRED NETWORK ACCESSORIES.

CONTRACTOR IS RESPONSIBLE FOR FURNISHING AND INSTALLING THIS INTERFACE PRE–PROGRAMMED AND CONFIGURED WITH THE CORRECT PARAMETERS TO INTEGRATE WITH THE BMS. THESE PARAMETERS INCLUDE, BUT ARE NOT LIMITED TO THE FOLLOWING:

- COMMUNICATION PROTOCOL
- CORRECT COMMUNICATION PROTOCOL BAUD RATE
- POINTS REQUIRED TO BE VIEWED THROUGH THE BMS. THIS INCLUDES ENSURING THE POINTS ARE 'IN SERVICE' AND VISIBLE TO THE BMS.
- ADDRESSING OF CONTROLLER/INTERFACE. THE BMS PROVIDER SHALL FURNISH THE ADDRESS.
- THE THIRD–PARTY EQUIPMENT MANUFACTURER SHALL INCLUDE A MINIMUM OF 16 HOURS OF ONSITE TECHNICAL SUPPORT FOR INTEGRATION INTO THE BMS.

BUILDING AUTOMATION SYSTEM (BAS):

THE CONTROL SYSTEM SHALL CONSIST OF A HIGH–SPEED PEER–TO–PEER NETWORK OF BACNET CONTROLLERS CONNECTED THROUGH A SECURE GATEWAY TO A CLOUD–HOSTED BAS PLATFORM. THE CLOUD PLATFORM SHALL HOST THE BAS APPLICATION SOFTWARE, DATABASE, HISTORICAL TREND STORAGE, ALARM MANAGEMENT SERVICES, AND WEB–BASED OPERATOR INTERFACE. NO ON–PREMISES BAS SERVER OR WORKSTATION SHALL BE REQUIRED UNLESS SPECIFICALLY NOTED.

SYSTEM SOFTWARE SHALL BE BASED ON A SERVER/THIN CLIENT ARCHITECTURE, DESIGNED AROUND THE OPEN STANDARDS OF WEB TECHNOLOGY. THE CONTROL SYSTEM CLOUD SERVER SHALL BE ACCESSED USING A WEB BROWSER OVER THE CONTROL SYSTEM NETWORK, THE OWNER'S LOCAL AREA NETWORK, AND (AT THE OWNER'S DISCRETION) OVER THE INTERNET.

THE INTENT OF THE THIN–CLIENT ARCHITECTURE IS TO PROVIDE OPERATORS COMPLETE ACCESS TO THE CONTROL SYSTEM VIA A WEB BROWSER. NO SPECIAL SOFTWARE OTHER THAN A WEB BROWSER SHALL BE REQUIRED TO ACCESS GRAPHICS, POINT DISPLAYS, AND TRENDS, CONFIGURE TRENDS, CONFIGURE POINTS AND CONTROLLERS, OR TO DOWNLOAD PROGRAMMING INTO THE CONTROLLERS.

SYSTEM SHALL USE THE BACNET PROTOCOL FOR COMMUNICATION BETWEEN THE CONTROL MODULES AND WEB BASED CLOUD SERVER. COMMUNICATION BETWEEN THE WEB SERVER AND THE USER'S BROWSER SHALL BE HTTP OR HTTPS PROTOCOL UTILIZING HTML5. USE OF ADOBE FLASH TECHNOLOGY IS NOT ACCEPTABLE.

THE CONTRACTOR SHALL USE ONLY OPERATOR WORKSTATION SOFTWARE, CONTROLLER SOFTWARE, CUSTOM APPLICATION PROGRAMMING LANGUAGE, AND CONTROLLERS FROM THE CORRESPONDING MANUFACTURER AND PRODUCT LINE UNLESS OWNER APPROVES USE OF MULTIPLE MANUFACTURERS.

OTHER PRODUCTS SPECIFIED HEREIN (SUC

BUILDING AUTOMATION SYSTEM (CONTINUED)

4.0 SYSTEM PERFORMANCE

PERFORMANCE STANDARDS: SYSTEM SHALL CONFORM TO THE FOLLOWING MINIMUM STANDARDS OVER NETWORK CONNECTIONS. SYSTEMS SHALL BE TESTED USING MANUFACTURER'S RECOMMENDED HARDWARE AND SOFTWARE FOR DISPLAY THROUGH THE USER'S WEB BROWSER:

- GRAPHIC DISPLAY: A GRAPHIC WITH TWENTY (20) DYNAMIC POINTS SHALL DISPLAY WITH CURRENT DATA WITHIN TEN (10) SECONDS.
- GRAPHIC REFRESH: A GRAPHIC WITH TWENTY (20) DYNAMIC POINTS SHALL UPDATE WITH CURRENT DATA WITHIN EIGHT (8) SECONDS AND SHALL AUTOMATICALLY REFRESH EVERY FIFTEEN (15) SECONDS.
- CONFIGURATION AND TUNING SCREENS: SCREENS USED FOR CONFIGURING, CALIBRATING, OR TUNING POINTS, PID LOOPS, AND SIMILAR CONTROL LOGIC SHALL AUTOMATICALLY REFRESH WITHIN SIX (6) SECONDS.
- OBJECT COMMAND: DEVICES SHALL REACT TO COMMAND OF A BINARY OBJECT WITHIN TWO (2) SECONDS. DEVICES SHALL BEGIN REACTING TO COMMAND OF AN ANALOG OBJECT WITHIN TWO (2) SECONDS.

–ALARM RESPONSE TIME: AN OBJECT THAT GOES INTO ALARM SHALL BE ANNUNCIATED AT THE BROWSER WITHIN FORTY–FIVE (45) SECONDS.

- PROGRAM EXECUTION FREQUENCY: CUSTOM AND STANDARD APPLICATIONS SHALL BE CAPABLE OF RUNNING AS OFTEN AS ONCE EVERY FIVE (5) SECONDS.
- PERFORMANCE: PROGRAMMABLE CONTROLLERS SHALL BE ABLE TO COMPLETELY EXECUTE DDC PID CONTROL LOOPS AT A FREQUENCY ADJUSTABLE DOWN TO ONCE PER SEC. SELECT EXECUTION TIMES CONSISTENT WITH THE MECHANICAL PROCESS UNDER CONTROL.
- MULTIPLE ALARM ANNUNCIATION: EACH USER, CONNECTED TO NETWORK ACCESSING THE SYSTEM THROUGH THEIR BROWSER (WORKSTATION), SHALL RECEIVE ALARMS WITHIN 5 SECONDS OF ONE ANOTHER.
- REPORTING ACCURACY. SYSTEM SHALL REPORT VALUES WITH MINIMUM END–TO–END AS FOLLOWS (MEASURED VALUE – REPORTED ACCURACY:

-- SPACE TEMPERATURE ±0.5°C (±1°F)
-- DUCTED AIR ±0.5°C (±1°F)
-- OUTSIDE AIR ±1.0°C (±2°F)
-- DEW POINT ±1.5°C (±3°F)
-- WATER TEMPERATURE ±0.5°C (±1°F)
-- DELTA–T ±0.15° (±0.25°F)
-- RELATIVE HUMIDITY ±5% RH
-- WATER FLOW ±2% OF FULL SCALE
-- AIRFLOW (TERMINAL)±10% OF FULL SCALE (ACCURACY APPLIES TO 10%–100% OF SCALE)
-- AIRFLOW (MEASURING STATIONS)±5% OF FULL SCALE
-- AIRFLOW (PRESSURIZED SPACES)±3% OF FULL SCALE
-- AIR PRESSURE (DUCTS)±25 PA (±0.1 IN. W.G.)
-- AIR PRESSURE (SPACE)±3 PA (±0.01 IN. W.G.)
-- WATER PRESSURE ±2% OF FULL SCALE (FOR BOTH ABSOLUTE AND DIFFERENTIAL PRESSURE)
-- ELECTRICAL (A, V, W, POWER FACTOR) ±1% OF READING (NOT INCLUDING UTILITY–SUPPLIED METERS)
-- CARBON MONOXIDE (CO) ±5% OF READING
-- CARBON DIOXIDE (CO2)±50 PPM

- CONTROL STABILITY AND ACCURACY. CONTROL LOOPS SHALL MAINTAIN MEASURED VARIABLE AT SETPOINT WITHIN TOLERANCES AS FOLLOWS (CONTROLLED VARIABLE / CONTROL ACCURACY | RANGE OF MEDIUM):

-- AIR PRESSURE ±50 PA (±0.2 IN. W.G.),±3 PA (±0.01 IN. W.G.)| 0–1.5 KPA (0–6 IN. W.G.), –25 TO 25 PA (–0.1 TO 0.1 IN. W.G.)
-- AIRFLOW ±10% OF FULL SCALE
-- SPACE TEMPERATURE ±1.0°C (±2.0°F)
-- DUCT TEMPERATURE ±1.0°C (±2.0°F)
-- HUMIDITY ±5% RH
-- FLUID PRESSURE ±10 KPA (±1.5 PSI, ±250 PA (±1.0 IN. W.G.)
MPA (1–150 PSI)| 0–12.5 KPA (0–50 IN. W.G.) DIFFERENTIAL

5.0 SUBMITTALS

PRODUCT DATA AND SHOP DRAWINGS: THE CONTRACTOR SHALL PROVIDE SHOP DRAWINGS AND PRODUCT DATA ON HARDWARE, SOFTWARE, AND EQUIPMENT TO BE INSTALLED OR PROVIDED. NO WORK MAY BEGIN ON ANY SEGMENT OF THIS PROJECT UNTIL SUBMITTALS HAVE BEEN APPROVED FOR CONFORMITY WITH DESIGN INTENT. PROVIDE SUBMITTAL DATA IN A DIGITAL FORMAT ON SUITABLE DIGITAL MEDIA SUCH AS A USB DRIVE. THE SUBMITTAL DATA SHALL BE IN STANDARD MICROSOFT (WORD, EXCEL, ETC.) OR PDF FILE FORMATS. THE SHOP DRAWINGS SHALL BE FORMATTED TO FIT ON 11" X 17" PAGES AND HARDWARE/SOFTWARE PRODUCT DATA SHALL BE FORMATTED TO FIT ON 8.5" X 11" PAGES. WHEN MANUFACTURER'S CUTSHEETS APPLY TO A PRODUCT SERIES RATHER THAN A SPECIFIC PRODUCT, THE DATA SPECIFICALLY APPLICABLE TO THE PROJECT SHALL BE HIGHLIGHTED OR CLEARLY INDICATED BY OTHER MEANS. EACH SUBMITTED PIECE OF LITERATURE AND DRAWING SHALL CLEARLY REFERENCE THE SPECIFICATION AND/OR DRAWING THAT THE SUBMITTAL IS TO COVER. GENERAL CATALOGS SHALL NOT BE ACCEPTED AS CUTSHEETS TO FULFILL SUBMITTAL REQUIREMENTS. SELECT AND SHOW SUBMITTAL QUANTITIES APPROPRIATE TO SCOPE OF WORK. SUBMITTAL APPROVAL DOES NOT RELIEVE CONTRACTOR OF RESPONSIBILITY TO SUPPLY SUFFICIENT QUANTITIES TO COMPLETE WORK. SUBMITTALS SHALL BE PROVIDED WITHIN 12 WEEKS OF CONTRACT AWARD.

SUBMITTALS SHALL INCLUDE:

DDC SYSTEM HARDWARE:

- A COMPLETE BILL OF MATERIALS TO BE USED INDICATING QUANTITY, MANUFACTURER, MODEL NUMBER, AND RELEVANT TECHNICAL DATA OF EQUIPMENT TO BE USED.
- MANUFACTURER'S DESCRIPTION AND TECHNICAL DATA SUCH AS PERFORMANCE CURVES, PRODUCT SPECIFICATIONS, AND INSTALLATION AND MAINTENANCE INSTRUCTIONS FOR ITEMS LISTED BELOW AND FOR RELEVANT ITEMS NOT LISTED BELOW:

-- DIRECT DIGITAL CONTROLLERS (CONTROLLER PANELS)
-- TRANSDUCERS AND TRANSMITTERS
-- SENSORS (INCLUDING ACCURACY DATA)
-- ACTUATORS
-- VALVES
-- RELAYS AND SWITCHES
-- CONTROL PANELS
-- POWER SUPPLIES
-- BATTERIES
-- WIRING

- WIRING DIAGRAMS AND LAYOUTS FOR EACH CONTROL PANEL. SHOW TERMINATION NUMBERS.
- SCHEMATIC DIAGRAMS FOR ALL FIELD SENSORS AND CONTROLLERS. PROVIDE FLOOR PLANS OF ALL SENSOR LOCATIONS AND CONTROL HARDWARE. RISER DIAGRAMS SHOWING CONTROL NETWORK LAYOUT, COMMUNICATION PROTOCOL, AND WIRE TYPES.

CENTRAL BAS PLATFORM AND SOFTWARE: A COMPLETE BILL OF MATERIALS IDENTIFYING:
- BAS CLOUD PLATFORM SERVICES
- SITE GATEWAY DEVICE(S)
- NETWORK SWITCHES OR COMMUNICATION HARDWARE REQUIRED FOR BAS CONNECTIVITY

MANUFACTURER'S DESCRIPTION AND TECHNICAL DATA FOR:
- BAS CLOUD PLATFORM
- GATEWAY HARDWARE CYBERSECURITY ARCHITECTURE
- BACKUP AND DATA RETENTION METHODS
- WEB–BASED OPERATOR INTERFACE

NETWORK ARCHITECTURE DIAGRAMS SHOWING:
- BAS CONTROLLER NETWORK
- GATEWAY CONNECTION
- SECURE CONNECTION TO CLOUD BAS PLATFORM CONTROLLED SYSTEMS

CONTROLLED SYSTEMS:
- RISER DIAGRAMS SHOWING CONTROL NETWORK LAYOUT, COMMUNICATION PROTOCOL, AND WIRE TYPES.
- A SCHEMATIC DIAGRAM OF EACH CONTROLLED SYSTEM. THE SCHEMATICS SHALL HAVE ALL CONTROL POINTS LABELED WITH POINT NAMES SHOWN OR LISTED. THE SCHEMATICS SHALL GRAPHICALLY SHOW THE LOCATION OF ALL CONTROL ELEMENTS IN THE SYSTEM.
- A SCHEMATIC WIRING DIAGRAM OF EACH CONTROLLED SYSTEM. LABEL CONTROL ELEMENTS AND TERMINALS. WHERE A CONTROL ELEMENT IS ALSO SHOWN ON CONTROL SYSTEM SCHEMATIC, USE THE SAME NAME.
- AN INSTRUMENTATION LIST (BILL OF MATERIALS) FOR EACH CONTROLLED SYSTEM. LIST EACH CONTROL SYSTEM ELEMENT IN A TABLE. SHOW ELEMENT NAME, TYPE OF DEVICE, MANUFACTURER, MODEL NUMBER, AND PRODUCT DATA SHEET NUMBER.
- A MOUNTING, WIRING, AND ROUTING PLAN–VIEW DRAWING. THE DESIGN SHALL TAKE INTO ACCOUNT HVAC, ELECTRICAL, AND OTHER SYSTEMS DESIGN AND ELEVATION REQUIREMENTS. THE DRAWING SHALL SHOW THE SPECIFIC LOCATION OF ALL CONCRETE PADS AND BASES AND ANY SPECIAL WALL BRACING FOR PANELS TO ACCOMMODATE THIS WORK.
- A COMPLETE DESCRIPTION OF THE OPERATION OF THE CONTROL SYSTEM, INCLUDING SEQUENCES OF OPERATION. THE DESCRIPTION SHALL INCLUDE AND REFERENCE A SCHEMATIC DIAGRAM OF THE CONTROLLED SYSTEM.
- A POINT LIST FOR EACH CONTROL SYSTEM. LIST I/O POINTS AND SOFTWARE POINTS REQUIRED TO PROVIDE SPECIFIED SEQUENCE OF OPERATIONS. INDICATE ALARMED AND TRENDED POINTS.

QUANTITIES OF ITEMS SUBMITTED SHALL BE REVIEWED BUT ARE THE RESPONSIBILITY OF THE CONTRACTOR.

BACNET PROTOCOL IMPLEMENTATION CONFORMANCE STATEMENT (PICS) FOR EACH SUBMITTED TYPE OF CONTROLLER AND OPERATOR INTERFACE:

6.0 PROJECT DOCUMENTATION

UPON COMPLETION OF INSTALLATION, SUBMIT RECORD (AS–BUILT) DOCUMENTS FOR APPROVAL BEFORE FINAL COMPLETION. PROVIDE RECORD DOCUMENTS IN A DIGITAL FORMAT ON SUITABLE DIGITAL MEDIA SUCH AS A USB DRIVE. THE RECORD DOCUMENTS SHALL BE IN STANDARD MICROSOFT (WORD, EXCEL, ETC.) OR PDF FILE FORMATS EXCEPT AS NOTED BELOW. RECORD DOCUMENTATION SHALL INCLUDE THE FOLLOWING:

- PROJECT RECORD DRAWINGS.
- TESTING AND COMMISSIONING REPORTS AND CHECKLISTS.
- OPERATION AND MAINTENANCE (O&M) MANUAL.
- AS–BUILT VERSIONS OF SUBMITTAL PRODUCT DATA.
- NAMES, ADDRESSES, AND TELEPHONE NUMBERS OF INSTALLING CONTRACTORS AND SERVICE REPRESENTATIVES FOR EQUIPMENT AND CONTROL SYSTEMS.
- OPERATOR'S MANUAL WITH PROCEDURES FOR OPERATING CONTROL SYSTEMS: LOGGING ON AND OFF, HANDLING ALARMS, PRODUCING POINT REPORTS, TRENDING DATA, OVERRIDING COMPUTER CONTROL, AND CHANGING SETPOINTS AND VARIABLES.
- PROGRAMMING MANUAL OR SET OF MANUALS WITH DESCRIPTION OF PROGRAMMING LANGUAGE AND SYNTAX, OF STATEMENTS FOR ALGORITHMS AND CALCULATIONS USED, OF POINT DATABASE CREATION AND MODIFICATION, OF PROGRAM CREATION AND MODIFICATION, AND OF EDITOR USE.
- ENGINEERING, INSTALLATION, AND MAINTENANCE MANUAL OR SET OF MANUALS THAT EXPLAINS HOW TO DESIGN AND INSTALL NEW POINTS, PANELS, AND OTHER HARDWARE; HOW TO PERFORM PREVENTIVE MAINTENANCE AND CALIBRATION; HOW TO DEBUG HARDWARE PROBLEMS, AND HOW TO REPAIR OR REPLACE HARDWARE.
- DOCUMENTATION OF PROGRAMS OPERATING IN THE SYSTEM AND OBJECT DATABASE THAT CAN BE VIEWED USING TECHNICIAN SOFTWARE TOOLS FURNISHED WITH SYSTEM.
- GRAPHIC FILES, PROGRAMS, AND DATABASE TO BE VIEWED USING TECHNICIAN SOFTWARE TOOLS FURNISHED WITH SYSTEM.
- LIST OF RECOMMENDED SPARE PARTS WITH PART NUMBERS AND SUPPLIERS.
- COMPLETE ORIGINAL–ISSUE DOCUMENTATION, INSTALLATION, AND MAINTENANCE INFORMATION FOR FURNISHED THIRD–PARTY HARDWARE INCLUDING COMPUTER EQUIPMENT AND SENSORS.
- COMPLETE ORIGINAL–ISSUE COPIES OF FURNISHED SOFTWARE, INCLUDING OPERATING SYSTEMS, CUSTOM PROGRAMMING LANGUAGE, OPERATOR WORKSTATION OR WEB SERVER SOFTWARE, AND GRAPHICS SOFTWARE.
- LICENSES, GUARANTEES, AND WARRANTY DOCUMENTS FOR EQUIPMENT AND SYSTEMS.
- RECOMMENDED PREVENTIVE MAINTENANCE PROCEDURES FOR SYSTEM COMPONENTS, INCLUDING SCHEDULE OF TASKS SUCH AS INSPECTION, CLEANING, AND CALIBRATION; TIME BETWEEN TASKS; AND TASK DESCRIPTIONS.

LOAD INTO THE CONTROL SYSTEM FOR ACCESS BY THE OPERATOR THROUGH ANY OPERATOR WORKSTATION CLOSEOUT DOCUMENTATION. THERE SHALL BE A MENU OR NAVIGATION TAB TO ACCESS THE DOCUMENTATION. THE DOCUMENTATION CAN BE LOADED INTO THE CONTROL SYSTEM IN A PDF FORMAT. THE FOLLOWING DOCUMENTATION SHALL BE INCLUDED:

- AS–BUILT CONTROL DIAGRAMS INCLUDING WIRING DIAGRAMS AND SEQUENCES OF OPERATIONS FOR EACH CONTROLLER/PIECE OF EQUIPMENT.
- ALL IOM DATA AS FOLLOWS:

-- IOM FROM EACH EQUIPMENT MANUFACTURER FOR EACH PIECE OF EQUIPMENT (AHUS, FCUS, CHILLERS, PUMPS ETC.)
-- IOM FOR EACH CONTROL MODULE AND END DEVICE INSTALLED IN THE SYSTEM.

TRAINING MATERIALS: PROVIDE COURSE OUTLINE AND MATERIALS FOR EACH CLASS AT LEAST SIX WEEKS BEFORE FIRST CLASS. TRAINING SHALL BE FURNISHED VIA INSTRUCTOR–LED SESSIONS, COMPUTER–BASED TRAINING, OR WEB–BASED TRAINING. ENGINEER WILL MODIFY COURSE OUTLINES AND MATERIALS IF NECESSARY TO MEET OWNER'S NEEDS. ENGINEER WILL REVIEW AND APPROVE COURSE OUTLINES AND MATERIALS AT LEAST THREE WEEKS BEFORE FIRST CLASS.

7.0 WARRANTY

WARRANT WORK AS FOLLOWS:

- WARRANT LABOR AND MATERIALS FOR SPECIFIED CONTROL SYSTEM FREE FROM DEFECTS FOR A PERIOD OF TWELVE (12) MONTHS AFTER FINAL ACCEPTANCE. CONTROL SYSTEM FAILURES DURING WARRANTY PERIOD SHALL BE ADJUSTED, REPAIRED, OR REPLACED AT NO ADDITIONAL COST OR REDUCTION IN SERVICE TO OWNER. RESPOND DURING NORMAL BUSINESS HOURS WITHIN TWENTY–FOUR (24) HOURS OF OWNER'S WARRANTY SERVICE REQUEST.
- WORK SHALL HAVE A SINGLE WARRANTY DATE, EVEN IF OWNER RECEIVES BENEFICIAL USE DUE TO EARLY SYSTEM START–UP. IF SPECIFIED WORK IS SPLIT INTO MULTIPLE CONTRACTS OR A MULTI–PHASE CONTRACT, EACH CONTRACT OR PHASE SHALL HAVE A SEPARATE WARRANTY START DATE AND PERIOD.
- IF THE ENGINEER DETERMINES THAT EQUIPMENT AND SYSTEMS OPERATE SATISFACTORILY AT THE END OF FINAL START–UP, TESTING, AND COMMISSIONING PHASE, THE ENGINEER WILL CERTIFY IN WRITING THAT CONTROL SYSTEM OPERATION HAS BEEN TESTED AND ACCEPTED IN ACCORDANCE WITH THE TERMS OF THIS SPECIFICATION. DATE OF ACCEPTANCE SHALL BEGIN WARRANTY PERIOD.
- ALL CLOUD BAS PLATFORM SOFTWARE, GATEWAY FIRMWARE, AND CONTROLLER FIRMWARE SHALL BE UPDATED TO THE LATEST STABLE RELEASE VERSIONS DURING THE WARRANTY PERIOD WITH OWNER APPROVAL TO THE LATEST VERSIONS THAT ARE AVAILABLE FROM THE MANUFACTURER WITHIN THIRTY (30) DAYS FROM THE DATE OF END OF THE WARRANTY. THESE UPDATES SHALL BE INSTALLED AND CHECKED OUT BEFORE THE END OF THE WARRANTY.
- PROVIDE UPDATES TO WEB SERVER SOFTWARE, PROJECT–SPECIFIC SOFTWARE, GRAPHIC SOFTWARE, DATABASE SOFTWARE, AND FIRMWARE THAT RESOLVE THE CONTRACTOR–IDENTIFIED SOFTWARE DEFICIENCIES AT NO CHARGE DURING WARRANTY PERIOD. IF AVAILABLE, OWNER CAN PURCHASE IN–WARRANTY SERVICE AGREEMENT TO RECEIVE UPGRADES FOR FUNCTIONAL ENHANCEMENTS ASSOCIATED WITH ABOVE–MENTIONED ITEMS. DO NOT INSTALL UPDATES OR UPGRADES WITHOUT OWNER'S WRITTEN AUTHORIZATION.
- EXCEPTION: CONTRACTOR SHALL NOT BE REQUIRED TO WARRANT REUSED DEVICES EXCEPT THOSE THAT HAVE BEEN REBUILT OR REPAIRED AND FACTORY RECERTIFIED. INSTALLATION LABOR AND MATERIALS SHALL BE WARRANTED. DEMONSTRATE OPERABLE CONDITION OF REUSED DEVICES AT TIME OF ENGINEER'S ACCEPTANCE.

OWNERSHIP OF PROPRIETARY MATERIAL: PROJECT–SPECIFIC SOFTWARE AND DOCUMENTATION SHALL BECOME OWNER'S PROPERTY. THIS INCLUDES, BUT IS NOT LIMITED TO:

- GRAPHICS
- RECORD DRAWINGS
- DATABASE
- APPLICATION PROGRAMMING CODE
- DOCUMENTATION

8.0 PRODUCTS

MATERIALS: USE NEW PRODUCTS THE MANUFACTURER IS CURRENTLY MANUFACTURING AND SELLING FOR USE IN NEW INSTALLATIONS. DO NOT USE THIS INSTALLATION AS A PRODUCT TEST SITE UNLESS EXPLICITLY APPROVED IN WRITING BY OWNER. SPARE PARTS SHALL BE AVAILABLE FOR AT LEAST FIVE YEARS AFTER COMPLETION OF THIS CONTRACT.

COMMUNICATION:

- CONTROL PRODUCTS, COMMUNICATION MEDIA, CONNECTORS, REPEATERS, HUBS, AND ROUTERS SHALL COMPRISE A BACNET INTERNETWORK. CONTROLLER AND OPERATOR INTERFACE COMMUNICATION SHALL CONFORM TO ANSI/ASHRAE STANDARD 135, BACNET.
- ALL IP BASED CONTROLLERS SHALL BE CAPABLE OF PROVIDING IPV4 AND IPV6 PROTOCOL STANDARDS AS DEFINED BY THE INTERNET DATA COMMUNICATIONS STANDARD.
- THE BMS CONTRACTOR SHALL FURNISH AND INSTALL ALL COMMUNICATION MEDIA, CONNECTORS, REPEATERS AND NETWORK SWITCHES/ROUTERS, AND NETWORK DEVICES NECESSARY TO PROVIDE A COMPLETE AND WORKABLE CONTROL NETWORK FOR BOTH HIGH–SPEED ETHERNET COMMUNICATIONS NETWORK/LAN AND SERIAL NETWORKS. THE CONTROL NETWORK SHALL ADHERE TO THE OWNER'S TESTING, LABELING, ADMINISTRATION, AND DOCUMENTATION REQUIREMENTS ESTABLISHED AND PRESENTED FOR THE SITE. THE DEDICATED CONTROL'S NETWORK SHALL BE CAPABLE OF CONNECTING TO A SEPARATE OWNER/CUSTOMER LAN.

–EACH CONTROLLER SHALL HAVE A COMMUNICATION PORT FOR TEMPORARY CONNECTION TO A LAPTOP COMPUTER OR OTHER OPERATOR INTERFACE. CONNECTION SHALL SUPPORT MEMORY DOWNLOADS AND OTHER COMMISSIONING AND TROUBLESHOOTING OPERATIONS.
- INTERNETWORK OPERATOR INTERFACE AND VALUE PASSING SHALL BE TRANSPARENT TO INTERNETWORK ARCHITECTURE.

-- AN OPERATOR INTERFACE CONNECTED TO A CONTROLLER SHALL ALLOW THE OPERATOR TO INTERFACE WITH EACH INTERNETWORK CONTROLLER AS IF DIRECTLY CONNECTED. CONTROLLER INFORMATION SUCH AS DATA, STATUS, AND CONTROL ALGORITHMS SHALL BE VIEWABLE AND EDITABLE FROM EACH INTERNETWORK CONTROLLER.
-- INPUTS, OUTPUTS, AND CONTROL VARIABLES USED TO INTEGRATE CONTROL STRATEGIES ACROSS MULTIPLE CONTROLLERS SHALL BE READABLE BY EACH CONTROLLER ON THE INTERNETWORK. PROGRAM AND TEST ALL CROSS–CONTROLLER LINKS REQUIRED TO EXECUTE SPECIFIED SEQUENCES OF OPERATION. AN AUTHORIZED OPERATOR SHALL BE ABLE TO EDIT CROSS–CONTROLLER LINKS BY TYPING A STANDARD OBJECT ADDRESS OR BY USING A POINT–AND–CLICK INTERFACE.

- BACNET SECURE CONNECT (BACNET/SC). BACNET/SC IS A DATALINK OPTION THAT MAKES THE FULL USE OF TLS WEBSOCKET CONNECTIONS AS DEFINED BY ADDENDUM BJ TO THE ANSI/ASHRAE STANDARD 135.

-- THE BMS CONTRACTOR SHALL FURNISH AND INSTALL A NETWORK DESIGNED TO ALLOW FOR IMPLEMENTATION OF BACNET/SC. THE NETWORK SHALL BE INSTALLED WITH AS MANY DEVICES CAPABLE OF USING BACNET/SC AT TIME OF INSTALLATION.
-- REMOTE ACCESS TO THE BAS SHALL BE PROVIDED THROUGH THE CLOUD–HOSTED PLATFORM USING BACNET/SC AS DEFINED IN THE BAS CLOUD INFRASTRUCTURE SPECIFICATION.
-- THE BMS CONTRACTOR SHALL FURNISH AND INSTALL ALL BACNET WORKSTATIONS/SERVERS, ROUTERS, AND BUILDING CONTROLLERS CAPABLE OF USING BACNET/SC. ANY BACNET WORKSTATIONS/SERVERS, ROUTERS, OR BUILDING CONTROLLERS THAT DO NOT HAVE BACNET/SC CAPABILITY AT TIME OF INSTALLATION SHALL HAVE THE ABILITY TO PROVIDE BACNET/SC CAPABILITY WITH A SOFTWARE/FIRMWARE UPDATE/PATCH. BACNET/SC CAPABILITY SHALL NOT REQUIRE THE PHYSICAL REPLACEMENT OF THE BACNET WORKSTATION/SERVER, ROUTER, OR BUILDING CONTROLLER HARDWARE.

- BUILDING CONTROL PANELS, AND CONTROLLERS WITH REAL–TIME CLOCKS SHALL USE THE BACNET TIME SYNCHRONIZATION SERVICE. SYSTEM SHALL AUTOMATICALLY SYNCHRONIZE SYSTEM CLOCKS DAILY FROM AN OPERATOR–DESIGNATED DEVICE VIA THE INTERNETWORK. THE SYSTEM SHALL AUTOMATICALLY ADJUST FOR DAYLIGHT SAVING AND STANDARD TIME AS APPLICABLE.
- SYSTEM SHALL BE EXPANDABLE TO AT LEAST TWICE THE REQUIRED BACNET OBJECTS. NO ADDITIONAL LICENSING/SOFTWARE FEES SHALL BE REQUIRED TO ADD CONTROLLERS, ASSOCIATED DEVICES, AND WIRING.
- SYSTEM SHALL SUPPORT WEB SERVICES DATA EXCHANGE WITH ANY OTHER SYSTEM THAT COMPLIES WITH XML (EXTENSIBLE MARKUP LANGUAGE) AND SOAP (SIMPLE OBJECT ACCESS PROTOCOL) STANDARDS. WEB SERVICES SUPPORT SHALL AS A MINIMUM BE PROVIDED AT THE WORKSTATION OR WEB SERVER LEVEL AND SHALL ENABLE DATA TO BE READ FROM OR WRITTEN TO THE SYSTEM.

-- SYSTEM SHALL SUPPORT WEB SERVICES READ DATA REQUESTS BY RETRIEVING REQUESTED TREND DATA OR POINT VALUES (/O HARDWARE POINTS, ANALOG VALUE SOFTWARE POINTS, OR BINARY VALUE SOFTWARE POINTS) FROM ANY SYSTEM CONTROLLER OR FROM THE TREND HISTORY DATABASE.
-- SYSTEM SHALL SUPPORT WEB SERVICES WRITE DATA REQUEST TO EACH ANALOG AND BINARY OBJECT THAT CAN BE EDITED THROUGH THE SYSTEM OPERATOR INTERFACE BY DOWNLOADING A NUMERIC VALUE TO THE SPECIFIED OBJECT.
-- FOR READ OR WRITE REQUESTS, THE SYSTEM SHALL REQUIRE USER NAME AND PASSWORD AUTHENTICATION AND SHALL SUPPORT TLS (TRANSPORT LAYER SECURITY) OR EQUIVALENT DATA ENCRYPTION.
-- SYSTEM SHALL SUPPORT DISCOVERY THROUGH A WEB SERVICES CONNECTION OR SHALL PROVIDE A TOOL AVAILABLE THROUGH THE OPERATOR INTERFACE THAT WILL REVEAL THE PATH/IDENTIFIER NEEDED TO ALLOW A THIRD PARTY WEB SERVICES DEVICE TO READ DATA FROM OR WRITE DATA TO ANY OBJECT IN THE SYSTEM WHICH SUPPORTS THIS SERVICE.

9.0 OPERATOR INTERFACE

HARDWARE:

CLOUD SERVER PLATFORM:

- THE BAS FRONT–END SERVER SHALL BE A CLOUD–HOSTED PLATFORM PROVIDED IN ACCORDANCE WITH THE REQUIREMENTS OF THE BAS CLOUD INFRASTRUCTURE SPECIFICATION. THE CLOUD SERVER HOST THE BAS DATABASE, APPLICATION SOFTWARE, GRAPHICS, HISTORICAL TREND STORAGE, AND OPERATOR INTERFACE SERVICES.
- THE CLOUD PLATFORM SHALL PROVIDE SUFFICIENT COMPUTING RESOURCES, STORAGE CAPACITY, AND REDUNDANCY TO SUPPORT ALL BAS FUNCTIONS INCLUDING, BUT NOT LIMITED TO:

-- BAS APPLICATION SOFTWARE AND SERVICES
-- BAS DATABASE AND SYSTEM CONFIGURATION
-- HISTORICAL TREND DATA STORAGE
-- ALARM AND EVENT LOGS
-- OPERATOR INTERFACE ACCESS FOR AUTHORIZED USERS

- CLOUD INFRASTRUCTURE, INCLUDING SERVER HARDWARE, OPERATING SYSTEMS, REDUNDANCY, BACKUP PROCEDURES, CYBERSECURITY PROTECTIONS, AND DATA RETENTION, SHALL COMPLY WITH THE BAS CLOUD INFRASTRUCTURE SPECIFICATION.
- THE BAS CONTRACTOR SHALL COORDINATE WITH THE OWNER AND THE BAS CLOUD SERVICE PROVIDER TO ENSURE PROPER INTEGRATION BETWEEN THE BUILDING CONTROL NETWORK AND THE CLOUD BAS PLATFORM.

CLIENT DEVICES: AUTHORIZED USERS SHALL ACCESS THE BAS THROUGH STANDARD CLIENT DEVICES USING A WEB BROWSER.

- CLIENT DEVICES MAY INCLUDE:

-- OWNER–PROVIDED DESKTOP COMPUTERS
-- LAPTOPS
-- TABLETS
-- MOBILE DEVICES

- NO SPECIALIZED BAS SOFTWARE INSTALLATION SHALL BE REQUIRED ON CLIENT DEVICES OTHER THAN A STANDARD WEB BROWSER COMPATIBLE WITH THE BAS WEB INTERFACE.

- CLIENT DEVICES SHALL MEET OR EXCEED THE BAS MANUFACTURER'S RECOMMENDED SPECIFICATIONS FOR PROPER OPERATION OF THE WEB–BASED OPERATOR INTERFACE.

SITE GATEWAY DEVICE:

WHERE REQUIRED, THE BAS CONTRACTOR SHALL PROVIDE A BAS GATEWAY DEVICE TO SECURELY CONNECT THE BUILDING BAS NETWORK TO THE CLOUD BAS PLATFORM. THE GATEWAY DEVICE SHALL:

- INTERFACE WITH THE BUILDING BAS NETWORK USING BACNET/IP OR BACNET/SC
- PROVIDE SECURE ENCRYPTED COMMUNICATION TO THE CLOUD BAS PLATFORM USING BACNET/SC
- MAINTAIN LOCAL BUFFERING OF CRITICAL ALARMS AND TREND DATA IN THE EVENT OF TEMPORARY LOSS OF INTERNET CONNECTIVITY.

GATEWAY HARDWARE REQUIREMENTS AND CYBERSECURITY PROVISIONS SHALL COMPLY WITH THE BAS CLOUD INFRASTRUCTURE SPECIFICATION.

COMMUNICATION. WEB SERVER AND CONTROLLERS SHALL COMMUNICATE USING BACNET PROTOCOL, INCLUDING BACNET/SC. WEB SERVER AND CONTROL NETWORK BACKBONE SHALL COMMUNICATE USING ISO 8802–3 (ETHERNET) DATA LINK/PHYSICAL LAYER PROTOCOL AND BACNET/IP ADDRESSING AS SPECIFIED IN ANSI/ASHRAE 135, BACNET ANNEX J. COMMUNICATION BETWEEN THE WEB SERVER AND CLIENT SERVER SHALL BE HTTP OR HTTPS PROTOCOL UTILIZING HTML5 LANGUAGE. USE OF ADOBE FLASH IN ANY PART OF THE COMMUNICATION INFRASTRUCTURE IS NOT ACCEPTABLE.

SYSTEM SOFTWARE:

OPERATING SYSTEM. BAS SERVER OPERATING SYSTEM AND INFRASTRUCTURE SHALL COMPLY WITH THE BAS CLOUD INFRASTRUCTURE SPECIFICATION.

SECURITY: THE WEB SERVER APPLICATION SHALL SUPPORT TRANSPORT LAYER SECURITY (TLS) 1.3 CAPABLE OF ENCRYPTION OF UP TO 256 BIT ELLIPTICAL CURVE FOR TRANSMITTING PRIVATE INFORMATION OVER THE INTERNET USING HTTPS. ADDITIONALLY, THE WEB SERVER SHALL HAVE SHA–2 CERTIFICATE SUPPORT CAPABILITY.

DATABASE: SYSTEM SHALL SUPPORT ANY JDBC (JAVA DATABASE CONNECTIVITY) COMPLIANT ENGINE. THIS INCLUDES: MS SQL, MY SQL, APACHE DERBY, POSTGRESQL AND ORACLE.

THE BMS MANUFACTURER SHALL PROVIDE ALL SOFTWARE AND TOOLS NECESSARY TO PROVIDE THE FOLLOWING CAPABILITIES:

- CREATE AND/OR EDIT ANY PROGRAMMING USED IN CONTROLLERS
- CREATE AND/OR EDIT ANY GRAPHICS USED IN THE SYSTEM
- SOFTWARE SHALL NOT BE SUBSCRIPTION BASED AND BE GIVEN TO OWNER AT TIME OF TURNOVER. IF SOFTWARE IS SUBSCRIPTION BASED, MANUFACTURER SHALL INCLUDE 10 YEARS OF SUBSCRIPTION SERVICE.
- THE OWNER SHALL HAVE THE ABILITY TO INSTALL SOFTWARE ON A MINIMUM OF FIVE (5) ADDITIONAL OWNER FURNISHED COMPUTERS WITHOUT ADDITIONAL LICENSES OR FEES.

SYSTEM GRAPHICS: THE OPERATOR INTERFACE SOFTWARE SHALL BE GRAPHICALLY BASED AND SHALL INCLUDE AT LEAST ONE GRAPHIC PER PIECE OF EQUIPMENT OR OCCUPIED ZONE. GRAPHICS FOR EACH CHILLED WATER AND HOT WATER SYSTEM, AND GRAPHICS THAT SUMMARIZE CONDITIONS ON EACH FLOOR OF EACH BUILDING INCLUDED IN THIS CONTRACT. INDICATE THERMAL COMFORT ON FLOOR PLAN SUMMARY GRAPHICS USING DYNAMIC COLORS TO REPRESENT ZONE TEMPERATURE RELATIVE TO ZONE SETPOINT.

- MINIMUM GRAPHICS RESOLUTION SHALL BE 1920 X 1080 FOR DISPLAY OF DETAILED SYSTEM GRAPHICS.
- FLOOR PLAN GRAPHICS. FLOOR PLAN GRAPHICS SHALL BE CAPABLE OF ALLOWING THE FLOOR PLAN GRAPHIC TO DYNAMICALLY SIZE RELATIVE TO THE END USER'S MONITOR RESOLUTION.
- FUNCTIONALITY. GRAPHICS SHALL ALLOW OPERATOR TO MONITOR SYSTEM STATUS, TO VIEW A SUMMARY OF THE MOST IMPORTANT DATA FOR EACH CONTROLLED ZONE OR PIECE OF EQUIPMENT, TO USE POINT–AND–CLICK NAVIGATION BETWEEN ZONES OR EQUIPMENT, AND TO EDIT SETPOINTS AND OTHER SPECIFIED PARAMETERS.
- ANIMATION. GRAPHICS SHALL BE ABLE TO ANIMATE BY DISPLAYING DIFFERENT IMAGE FILES FOR CHANGED OBJECT STATUS.
- ALARM INDICATION. INDICATE AREAS OR EQUIPMENT IN AN ALARM CONDITION USING COLOR OR OTHER VISUAL INDICATOR.
- FORMAT. GRAPHICS SHALL BE SAVED IN AN INDUSTRY–STANDARD FORMAT SUCH AS BMP, JPEG, PNG, GIF, OR SVG. WEB–BASED SYSTEM GRAPHICS SHALL BE VIEWABLE ON BROWSERS COMPATIBLE WITH WORLD WIDE WEB CONSORTIUM BROWSER STANDARDS. WEB GRAPHIC FORMAT SHALL REQUIRE NO PLUG–IN O

BUILDING AUTOMATION SYSTEM (CONTINUED)

VARIABLES: OPERATOR SHALL BE ABLE TO USE VARIABLE VALUES IN PROGRAM CONDITIONAL STATEMENTS AND MATHEMATICAL FUNCTIONS.

- TIME VARIABLES. OPERATOR SHALL BE ABLE TO USE PREDEFINED VARIABLES TO REPRESENT TIME OF DAY, DAY OF THE WEEK, MONTH OF THE YEAR, AND DATE. OTHER PREDEFINED VARIABLES OR SIMPLE CONTROL LOGIC SHALL PROVIDE ELAPSED TIME IN SECONDS, MINUTES, HOURS, AND DAYS. OPERATOR SHALL BE ABLE TO START, STOP, AND RESET ELAPSED TIME VARIABLES USING THE PROGRAM LANGUAGE.
- SYSTEM VARIABLES. OPERATOR SHALL BE ABLE TO USE PREDEFINED VARIABLES TO REPRESENT STATUS AND RESULTS OF CONTROLLER SOFTWARE AND SHALL BE ABLE TO ENABLE, DISABLE, AND CHANGE SETPOINTS OF CONTROLLER SOFTWARE AS DESCRIBED IN CONTROLLER SOFTWARE SECTION.

CONTROLLER SOFTWARE

ALL CONTROLLER SOFTWARE APPLICATIONS SHALL RESIDE AND OPERATE IN THE SYSTEM CONTROLLERS.

ALL APPLICATION SOFTWARE IN CONTROLLERS FURNISHED BY BMS MANUFACTURERS SHALL BE EDITABLE THROUGH WEB BROWSER INTERFACE, OR WORKSTATION IF PRESENT.

CONTROLLER SOFTWARE BACKUPS SHALL BE STORED ON THE BAS CLOUD PLATFORM OR GATEWAY DEVICE AS DEFINED IN THE BAS CLOUD INFRASTRUCTURE SPECIFICATION. CONTROLLERS FURNISHED BY OTHERS AND INTEGRATED INTO THE BMS ARE NOT REQUIRED TO BE BACKED UP TO BMS SERVER.

FURNISH THE FOLLOWING APPLICATIONS FOR BUILDING AND ENERGY MANAGEMENT:

- SYSTEM SECURITY.
- SCHEDULING. PROVIDE THE CAPABILITY TO EXECUTE CONTROL FUNCTIONS ACCORDING TO A USER CREATED OR EDITED SCHEDULE. EACH SCHEDULE SHALL PROVIDE THE FOLLOWING SCHEDULE OPTIONS AS A MINIMUM:

-- WEEKLY SCHEDULE. PROVIDE SEPARATE SCHEDULES FOR EACH DAY OF THE WEEK. EACH SCHEDULE SHALL BE ABLE TO INCLUDE UP TO 5 OCCUPIED PERIODS (5 START–STOP PAIRS OR 10 EVENTS).
-- EXCEPTION SCHEDULES. PROVIDE THE ABILITY FOR THE OPERATOR TO DESIGNATE ANY DAY OF THE YEAR AS AN EXCEPTION SCHEDULE. EXCEPTION SCHEDULES MAY BE DEFINED UP TO A YEAR IN ADVANCE. ONCE AN EXCEPTION SCHEDULE HAS EXECUTED, THE SYSTEM SHALL DISCARD AND REPLACE THE EXCEPTION SCHEDULE WITH THE STANDARD SCHEDULE FOR THAT DAY OF THE WEEK.
-- HOLIDAY SCHEDULES. PROVIDE THE CAPABILITY FOR THE OPERATOR TO DEFINE UP TO 24 SPECIAL OR HOLIDAY SCHEDULES. THESE SCHEDULES WILL BE REPEATED EACH YEAR. THE OPERATOR SHALL BE ABLE TO DEFINE THE LENGTH OF EACH HOLIDAY PERIOD.

- SYSTEM COORDINATION: OPERATOR SHALL BE ABLE TO GROUP RELATED EQUIPMENT BASED ON FUNCTION AND LOCATION AND TO USE THESE GROUPS FOR SCHEDULING AND OTHER APPLICATIONS.
- BINARY ALARMS: EACH BINARY OBJECT SHALL HAVE THE CAPABILITY TO BE CONFIGURED TO ALARM BASED ON THE OPERATOR–SPECIFIED STATE. PROVIDE THE CAPABILITY TO AUTOMATICALLY AND MANUALLY DISABLE ALARMING.
- ANALOG ALARMS: EACH ANALOG OBJECT SHALL HAVE BOTH HIGH AND LOW ALARM LIMITS. THE OPERATOR SHALL BE ABLE TO ENABLE OR DISABLE THESE ALARMS.
- ALARM REPORTING: THE OPERATOR SHALL BE ABLE TO DETERMINE THE ACTION TO BE TAKEN IN THE EVENT OF AN ALARM. AN ALARM SHALL BE ABLE TO START PROGRAMS, PRINT, BE LOGGED IN THE EVENT LOG, GENERATE CUSTOM MESSAGES, AND DISPLAY ON GRAPHICS.
- REMOTE COMMUNICATION: SYSTEM SHALL AUTOMATICALLY CONTACT OPERATOR WORKSTATION OR SERVER ON RECEIPT OF CRITICAL ALARMS. REMOTE ACCESS TO THE BAS SHALL BE PROVIDED THROUGH THE CLOUD–HOSTED PLATFORM AS DEFINED IN THE BAS CLOUD INFRASTRUCTURE SPECIFICATION.
- DEMAND LIMITING:

-- THE DEMAND–LIMITING PROGRAM SHALL MONITOR BUILDING POWER CONSUMPTION FROM A BUILDING POWER METER (PROVIDED BY OTHERS) WHICH GENERATES PULSE SIGNALS OR A BACNET COMMUNICATIONS INTERFACE. AN ACCEPTABLE ALTERNATIVE IS FOR THE SYSTEM TO MONITOR A WATT TRANSDUCER OR CURRENT TRANSFORMER ATTACHED TO THE BUILDING FEEDER LINES.
-- WHEN POWER CONSUMPTION EXCEEDS ADJUSTABLE LEVELS, SYSTEM SHALL AUTOMATICALLY ADJUST SETPOINTS, DE–ENERGIZE LOW–PRIORITY EQUIPMENT, AND TAKE OTHER PROGRAMMATIC ACTIONS TO REDUCE DEMAND AS SPECIFIED IN IN SEQUENCES OF OPERATION. WHEN DEMAND DROPS BELOW ADJUSTABLE LEVELS, SYSTEM SHALL RESTORE LOADS AS SPECIFIED.

MAINTENANCE MANAGEMENT: THE SYSTEM SHALL BE CAPABLE OF GENERATING MAINTENANCE ALARMS WHEN EQUIPMENT EXCEEDS ADJUSTABLE RUNTIME, EQUIPMENT STARTS, OR PERFORMANCE LIMITS. CONFIGURE AND ENABLE MAINTENANCE ALARMS AS SPECIFIED IN SEQUENCES OF OPERATION.

- SEQUENCING: APPLICATION SOFTWARE SHALL SEQUENCE CHILLERS, BOILERS, AND PUMPS AS SPECIFIED IN SEQUENCES OF OPERATION.
- PID CONTROL: SYSTEM SHALL PROVIDE DIRECT– AND REVERSE–ACTING PID (PROPORTIONAL–INTEGRAL–DERIVATIVE) ALGORITHMS. EACH ALGORITHM SHALL HAVE ANTI–WINDUP AND SELECTABLE CONTROLLED VARIABLE, SETPOINT, AND PID GAINS. EACH ALGORITHM SHALL CALCULATE A TIME–VARYING ANALOG VALUE THAT CAN BE USED TO POSITION AN OUTPUT OR TO STAGE A SERIES OF OUTPUTS. THE CALCULATION INTERVAL, PID GAINS, AND OTHER TUNING PARAMETERS SHALL BE ADJUSTABLE BY A USER WITH THE CORRECT SECURITY LEVEL.

STAGGERED START: SYSTEM SHALL STAGGER CONTROLLED EQUIPMENT RESTART AFTER POWER OUTAGE. OPERATOR SHALL BE ABLE TO ADJUST EQUIPMENT RESTART ORDER AND TIME DELAY BETWEEN EQUIPMENT RESTARTS.

- ENERGY CALCULATIONS:

-- THE SYSTEM SHALL ACCUMULATE AND CONVERT INSTANTANEOUS POWER (KW) OR FLOW RATES (L/S [GPM]) TO ENERGY USAGE DATA.
-- THE SYSTEM SHALL CALCULATE A SLIDING–WINDOW AVERAGE (ROLLING AVERAGE). OPERATOR SHALL BE ABLE TO ADJUST WINDOW INTERVAL TO FIFTEEN (15) MINUTES, THIRTY (30) MINUTES, OR SIXTY (60) MINUTES.

- ANTI–SHORT CYCLING: ALL BINARY OUTPUT OBJECTS SHALL BE PROTECTED FROM SHORT CYCLING BY MEANS OF ADJUSTABLE MINIMUM ON–TIME AND OFF–TIME SETTINGS.
- ON AND OFF CONTROL WITH DIFFERENTIAL: PROVIDE AN ALGORITHM THAT ALLOWS A BINARY OUTPUT TO BE CYCLED BASED ON A CONTROLLED VARIABLE AND A SETPOINT. THE ALGORITHM SHALL BE DIRECT–ACTING OR REVERSE–ACTING.
- RUNTIME TOTALIZATION. PROVIDE SOFTWARE TO TOTALIZE RUNTIME FOR EACH BINARY INPUT AND OUTPUT. OPERATOR SHALL BE ABLE TO ENABLE RUNTIME ALARM BASED ON EXCEEDED ADJUSTABLE RUNTIME LIMIT. CONFIGURE AND ENABLE RUNTIME TOTALIZATION AND ALARMS AS REQUIRED BY SEQUENCES OF OPERATION.

CONTROLLERS:

GENERAL: PROVIDE AN ADEQUATE NUMBER OF BUILDING CONTROLLERS (BC), ADVANCED APPLICATION CONTROLLERS (AAC), APPLICATION SPECIFIC CONTROLLERS (ASC), SMART ACTUATORS (SA), AND SMART SENSORS (SS) AS REQUIRED TO ACHIEVE PERFORMANCE SPECIFIED BY SYSTEM PERFORMANCE. EVERY DEVICE IN THE SYSTEM WHICH EXECUTES CONTROL LOGIC AND DIRECTLY CONTROLS HVAC EQUIPMENT MUST CONFORM TO A STANDARD BACNET DEVICE PROFILE AS SPECIFIED IN ANSI/ASHRAE 135, BACNET ANNEX L UNLESS OTHERWISE SPECIFIED, HARDWIRED ACTUATORS AND SENSORS MAY BE USED IN LIEU OF COMMUNICATING ACTUATORS, COMMUNICATING SENSORS, BACNET SMART ACTUATORS AND BACNET SMART SENSORS.

BACNET:

- BUILDING CONTROLLERS (BCS). EACH BC SHALL CONFORM TO BACNET BUILDING CONTROLLER (B–BC) DEVICE PROFILE AS SPECIFIED IN ANSI/ASHRAE 135, BACNET ANNEX L AND SHALL BE LISTED AS A CERTIFIED B–BC IN THE BACNET TESTING LABORATORIES (BTL) PRODUCT LISTING.
- ADVANCED APPLICATION CONTROLLERS (AACS). EACH AAC SHALL CONFORM TO BACNET ADVANCED APPLICATION CONTROLLER (B–AAC) DEVICE PROFILE AS SPECIFIED IN ANSI/ASHRAE 135, BACNET ANNEX L AND SHALL BE LISTED AS A CERTIFIED B–AAC IN THE BACNET TESTING LABORATORIES (BTL) PRODUCT LISTING.
- APPLICATION SPECIFIC CONTROLLERS (ASCS). EACH ASC SHALL CONFORM TO BACNET APPLICATION SPECIFIC CONTROLLER (B–ASC) DEVICE PROFILE AS SPECIFIED IN ANSI/ASHRAE 135, BACNET ANNEX L AND SHALL BE LISTED AS A CERTIFIED B–ASC IN THE BACNET TESTING LABORATORIES (BTL) PRODUCT LISTING.
- SMART ACTUATORS (SAS). AN ACTUATOR WHICH IS CONTROLLED BY A NETWORK CONNECTION RATHER THAN A BINARY OR ANALOG SIGNAL (0–10V, 4–20MA, RELAY, ETC.). EACH SA SHALL CONFORM TO BACNET SMART ACTUATOR (B–SA) DEVICE PROFILE AS SPECIFIED IN ANSI/ASHRAE 135, BACNET ANNEX L AND SHALL BE LISTED AS A CERTIFIED B–SA IN THE BACNET TESTING LABORATORIES (BTL) PRODUCT LISTING.
- SMART SENSORS (SSS). A SENSOR WHICH PROVIDES INFORMATION TO THE BAS VIA NETWORK CONNECTION RATHER THAN A BINARY OR ANALOG SIGNAL (0–10000 OHM, 4–20MA, DRY CONTACT, ETC.). EACH SS SHALL CONFORM TO BACNET SMART SENSOR (B–SS) DEVICE PROFILE AS SPECIFIED IN ANSI/ASHRAE 135, BACNET ANNEX L AND SHALL BE LISTED AS A CERTIFIED B–SS IN THE BACNET TESTING LABORATORIES (BTL) PRODUCT LISTING.
- BACNET COMMUNICATION:

- EACH CONTROLLER RESIDING ON THE ETHERNET DATA LINK SHALL CAPABLE OF PROVIDING BACNET/SC CAPABILITY AS DESCRIBED IN THE ABOVE COMMUNICATION SECTION.
- EACH BC SHALL RESIDE ON OR BE CONNECTED TO A BACNET NETWORK USING ISO 8802–3 (ETHERNET) DATA LINK/PHYSICAL LAYER PROTOCOL AND BACNET/IP OR BACNET/SC.
- BACNET ROUTING SHALL BE PERFORMED BY BCS OR OTHER BACNET DEVICE ROUTERS AS NECESSARY TO CONNECT BCS TO NETWORKS OF AACS AND ASCS.
- EACH AAC SHALL RESIDE ON A BACNET NETWORK USING ISO 8802–3 (ETHERNET) DATA LINK/PHYSICAL LAYER PROTOCOL USING BACNET/IP OR BACNET/SC,
- EACH ASC SHALL RESIDE ON A BACNET NETWORK USING ISO 8802–3 (ETHERNET) DATA LINK/PHYSICAL LAYER PROTOCOL WITH BACNET/IP ADDRESSING

- SECURITY:

-- PROVIDE BACNET FIREWALL CAPABILITY, AS DEFINED IN THE BACNET STANDARD, FOR CONTROLLERS THAT ARE IP CAPABLE.

- COMMUNICATION:

-- SERVICE PORT. EACH CONTROLLER SHALL PROVIDE A SERVICE COMMUNICATION PORT FOR CONNECTION TO A PORTABLE OPERATOR'S TERMINAL.
-- SIGNAL MANAGEMENT. BC AND ASC OPERATING SYSTEMS SHALL MANAGE INPUT AND OUTPUT COMMUNICATION SIGNALS TO ALLOW DISTRIBUTED CONTROLLERS TO SHARE REAL AND VIRTUAL OBJECT INFORMATION AND TO ALLOW FOR CENTRAL MONITORING AND ALARMS.
-- DATA SHARING. EACH BC AND AAC SHALL SHARE DATA AS REQUIRED WITH EACH NETWORKED BC AND AAC.
-- STAND–ALONE OPERATION. EACH PIECE OF EQUIPMENT SHALL BE CONTROLLED BY A SINGLE CONTROLLER TO PROVIDE STAND–ALONE CONTROL IN THE EVENT OF COMMUNICATION FAILURE. ALL I/O POINTS SPECIFIED FOR A PIECE OF EQUIPMENT SHALL BE INTEGRAL TO ITS CONTROLLER. PROVIDE STABLE AND RELIABLE STAND–ALONE CONTROL USING DEFAULT VALUES OR OTHER METHOD FOR VALUES NORMALLY READ OVER THE NETWORK SUCH AS OUTDOOR AIR CONDITIONS, SUPPLY AIR OR WATER TEMPERATURE COMING FROM SOURCE EQUIPMENT, ETC.

- ENVIRONMENT: CONTROLLER HARDWARE SHALL BE SUITABLE FOR ANTICIPATED AMBIENT CONDITIONS.

-- CONTROLLERS USED OUTDOORS OR IN WET AMBIENT CONDITIONS SHALL BE MOUNTED IN WATERPROOF ENCLOSURES AND SHALL BE RATED FOR OPERATION AT –29°C TO 60°C (–20°F TO 140°F).
-- CONTROLLERS USED IN CONDITIONED SPACE SHALL BE MOUNTED IN DUST–PROTECTIVE ENCLOSURES AND SHALL BE RATED FOR OPERATION AT 0°C TO 50°C (32°F TO 120°F).

- SERVICEABILITY: PROVIDE DIAGNOSTIC LEDS FOR POWER, COMMUNICATION, AND PROCESSOR. ALL WIRING CONNECTIONS SHALL BE MADE TO A FIELD–REMOVABLE MODULAR TERMINAL STRIP OR TO A TERMINATION CARD CONNECTED BY A RIBBON CABLE. EACH BC AND AAC SHALL CONTINUALLY CHECK ITS PROCESSOR AND MEMORY CIRCUIT STATUS AND SHALL GENERATE AN ALARM ON ABNORMAL OPERATION. SYSTEM SHALL CONTINUOUSLY CHECK CONTROLLER NETWORK AND GENERATE ALARM FOR EACH CONTROLLER THAT FAILS TO RESPOND.

- REAL–TIME CLOCK: CONTROLLER SHALL HAVE A REAL–TIME CLOCK TO KEEP TRACK OF TIME IN THE EVENT OF A POWER FAILURE FOR UP TO THREE (3) DAYS.

- MEMORY:

-- CONTROLLER MEMORY SHALL SUPPORT OPERATING SYSTEM, DATABASE, AND PROGRAMMING REQUIREMENTS.
-- EACH CONTROLLER SHALL USE VOLATILE MEMORY WITH BATTERY BACKED UP MEMORY OR NONVOLATILE MEMORY AND SHALL RETAIN BIOS AND APPLICATION PROGRAMMING IN THE EVENT OF POWER LOSS. SYSTEM SHALL AUTOMATICALLY DOWNLOAD DYNAMIC CONTROL PARAMETERS FOLLOWING POWER LOSS.

–IMMUNITY TO POWER AND NOISE: CONTROLLERS SHALL BE ABLE TO OPERATE AT 90% TO 110% OF NOMINAL VOLTAGE RATING AND SHALL PERFORM AN ORDERLY SHUTDOWN BELOW 80% NOMINAL VOLTAGE.

- TRANSFORMER. POWER SUPPLY SHALL BE FUSED OR CURRENT LIMITING AND SHALL BE RATED AT A MINIMUM OF 125% OF CONTROLLER POWER CONSUMPTION.

2.6 INPUT AND OUTPUT INTERFACE:

- GENERAL. HARD–WIRE INPUT AND OUTPUT POINTS TO BCS, AACS, OR ASCS.
- PROTECTION. ALL INPUT POINTS AND OUTPUT POINTS SHALL BE PROTECTED SUCH THAT SHORTING OF THE POINT TO ITSELF, TO ANOTHER POINT, OR TO GROUND SHALL CAUSE NO DAMAGE TO THE CONTROLLER. ALL INPUT AND OUTPUT POINTS SHALL BE PROTECTED FROM VOLTAGE UP TO 24 V OF ANY DURATION, SUCH THAT CONTACT WITH THIS VOLTAGE WILL CAUSE NO CONTROLLER DAMAGE.
- BINARY INPUTS. BINARY INPUTS SHALL ALLOW THE MONITORING OF ON/OFF SIGNALS FROM REMOTE DEVICES. BINARY INPUTS SHALL SENSE DRY CONTACT CLOSURE WITHOUT APPLICATION OF POWER EXTERNAL TO THE CONTROLLER.
- PULSE ACCUMULATION INPUTS. PULSE ACCUMULATION INPUTS SHALL CONFORM TO BINARY INPUT REQUIREMENTS AND SHALL ALSO ACCUMULATE UP TO 10 PULSES PER SECOND.
- ANALOG INPUTS. ANALOG INPUTS SHALL MONITOR LOW–VOLTAGE (0–10 VDC), CURRENT (4–20 MA), OR RESISTANCE (THERMISTOR OR RTD) SIGNALS. ANALOG INPUTS SHALL BE COMPATIBLE WITH AND FIELD CONFIGURABLE TO COMMONLY AVAILABLE SENSING DEVICES.
- BINARY OUTPUTS. BINARY OUTPUTS SHALL PROVIDE FOR ON/OFF OPERATION OR A PULSED LOW–VOLTAGE SIGNAL FOR PULSE WIDTH MODULATION CONTROL. BINARY OUTPUTS ON BUILDING CONTROLLERS SHALL HAVE THREE–POSITION (ON–OFF–AUTO) OVERRIDE SWITCHES AND STATUS LIGHTS. OUTPUTS SHALL BE SELECTABLE FOR NORMALLY OPEN OR NORMALLY CLOSED OPERATION.
- ANALOG OUTPUTS. ANALOG OUTPUTS SHALL PROVIDE A MODULATING SIGNAL FOR THE CONTROL OF END DEVICES. OUTPUTS SHALL PROVIDE EITHER A 0–10 VDC OR A 4–20 MA SIGNAL AS REQUIRED TO PROPERLY CONTROL OUTPUT DEVICES. EACH BUILDING CONTROLLER ANALOG OUTPUT SHALL HAVE A TWO–POSITION (AUTO–MANUAL) SWITCH, A MANUALLY ADJUSTABLE POTENTIOMETER, AND STATUS LIGHTS. ANALOG OUTPUTS SHALL NOT DRIFT MORE THAN 0.4% OF RANGE ANNUALLY.
- TRI–STATE OUTPUTS. CONTROL THREE–POINT FLOATING ELECTRONIC ACTUATORS WITHOUT FEEDBACK WITH TRI–STATE OUTPUTS (TWO COORDINATED BINARY OUTPUTS). TRI–STATE OUTPUTS MAY BE USED TO PROVIDE ANALOG OUTPUT CONTROL IN ZONE CONTROL AND TERMINAL UNIT CONTROL APPLICATIONS SUCH AS VAV TERMINAL UNITS, DUCT–MOUNTED HEATING COILS, AND ZONE DAMPERS.
- UNIVERSAL INPUTS AND OUTPUTS. INPUTS AND OUTPUTS THAT CAN BE DESIGNATED AS EITHER BINARY OR ANALOG IN SOFTWARE SHALL CONFORM TO THE PROVISIONS OF THIS SECTION THAT ARE APPROPRIATE FOR THEIR DESIGNATED USE.

POWER SUPPLIES AND LINE FILTERING:

- POWER SUPPLIES: CONTROL TRANSFORMERS SHALL BE UL LISTED. FURNISH CLASS 2 CURRENT–LIMITING TYPE OR FURNISH OVER–CURRENT PROTECTION IN PRIMARY AND SECONDARY CIRCUITS FOR CLASS 2 SERVICE IN ACCORDANCE WITH NEC REQUIREMENTS. LIMIT CONNECTED LOADS TO 80% OF RATED CAPACITY.

-- DC POWER SUPPLY OUTPUT SHALL MATCH OUTPUT CURRENT AND VOLTAGE REQUIREMENTS. UNIT SHALL BE FULL–WAVE RECTIFIER TYPE WITH OUTPUT RIPPLE OF 5.0 MV MAXIMUM PEAK–TO–PEAK. REGULATION SHALL BE 1.0% LINE AND LOAD COMBINED, WITH 100–MICROSECOND RESPONSE TIME FOR 50% LOAD CHANGES. UNIT SHALL HAVE BUILT–IN OVER–VOLTAGE AND OVER–CURRENT PROTECTION AND SHALL BE ABLE TO WITHSTAND 150% CURRENT OVERLOAD FOR AT LEAST THREE SECONDS WITHOUT TRIP–OUT OR FAILURE.

UNIT SHALL OPERATE BETWEEN 0°C AND 50°C (32°F AND 120°F). EM/RF SHALL MEET FCC CLASS B AND VDE 0871 FOR CLASS B AND MILSTD 810C FOR SHOCK AND VIBRATION.

- LINE VOLTAGE UNITS SHALL BE UL RECOGNIZED AND CSA LISTED.
- POWER LINE FILTERING.

PROVIDE INTERNAL OR EXTERNAL TRANSIENT VOLTAGE AND SURGE SUPPRESSION FOR WORKSTATIONS AND CONTROLLERS. SURGE PROTECTION SHALL HAVE:

- DIELECTRIC STRENGTH OF 1000 V MINIMUM
- RESPONSE TIME OF 10 NANOSECONDS OR LESS
- TRANSVERSE MODE NOISE ATTENUATION OF 65 DB OR GREATER
- COMMON MODE NOISE ATTENUATION OF 150 DB OR GREATER AT 40–100 HZ

LOCAL CONTROL PANELS:

ALL INDOOR CONTROL CABINETS SHALL BE FULLY ENCLOSED NEMA 1 CONSTRUCTION WITH (HINGED DOOR) KEY–LOCK LATCH AND REMOVABLE SUBPANELS. A SINGLE KEY SHALL BE COMMON TO ALL FIELD PANELS AND SUBPANELS.

INTERCONNECTIONS BETWEEN INTERNAL AND FACE–MOUNTED DEVICES SHALL BE PREWIRED WITH COLOR–CODED STRANDED CONDUCTORS NEATLY INSTALLED IN PLASTIC TROUGHS AND/OR TIE–WRAPPED. TERMINALS FOR FIELD CONNECTIONS SHALL BE UL LISTED FOR 600 VOLT SERVICE. INDIVIDUALLY IDENTIFIED PER CONTROL/INTERLOCK DRAWINGS, WITH ADEQUATE CLEARANCE FOR FIELD WIRING. CONTROL TERMINATIONS FOR FIELD CONNECTION SHALL BE INDIVIDUALLY IDENTIFIED PER CONTROL DRAWINGS.

PROVIDE ON/OFF POWER SWITCH WITH OVERCURRENT PROTECTION FOR CONTROL POWER SOURCES TO EACH LOCAL PANEL.

WIRING AND RACEWAYS:

GENERAL. PROVIDE COPPER WIRING, PLENUM CABLE, AND RACEWAYS AS SPECIFIED IN APPLICABLE SECTIONS OF DIVISION 26.

INSULATED WIRE SHALL USE COPPER CONDUCTORS AND SHALL BE UL LISTED FOR 90°C (200°F) MINIMUM SERVICE.

EXECUTION

EXAMINATION:

THE PROJECT PLANS SHALL BE THOROUGHLY EXAMINED FOR CONTROL DEVICE AND EQUIPMENT LOCATIONS. ANY DISCREPANCIES, CONFLICTS, OR OMISSIONS SHALL BE REPORTED TO THE ARCHITECT/ENGINEER FOR RESOLUTION BEFORE ROUGH–IN WORK IS STARTED.

THE CONTRACTOR SHALL INSPECT THE SITE TO VERIFY THAT EQUIPMENT MAY BE INSTALLED AS SHOWN. ANY DISCREPANCIES, CONFLICTS, OR OMISSIONS SHALL BE REPORTED TO THE ENGINEER FOR RESOLUTION BEFORE ROUGH–IN WORK IS STARTED.

THE CONTRACTOR SHALL EXAMINE THE DRAWINGS AND SPECIFICATIONS FOR OTHER PARTS OF THE WORK. IF HEAD ROOM OR SPACE CONDITIONS APPEAR INADEQUATE—OR IF ANY DISCREPANCIES OCCUR BETWEEN THE PLANS AND THE CONTRACTOR'S WORK AND THE PLANS AND THE WORK OF OTHERS—THE CONTRACTOR SHALL REPORT THESE DISCREPANCIES TO THE ENGINEER AND SHALL OBTAIN WRITTEN INSTRUCTIONS FOR ANY CHANGES NECESSARY TO ACCOMMODATE THE CONTRACTOR'S WORK WITH THE WORK OF OTHERS. ANY CHANGES IN THE WORK COVERED BY THIS SPECIFICATION MADE NECESSARY BY THE FAILURE OR NEGLECT OF THE CONTRACTOR TO REPORT SUCH DISCREPANCIES SHALL BE MADE BY—AND AT THE EXPENSE OF—THIS CONTRACTOR.

PROTECTION:

THE CONTRACTOR SHALL PROTECT ALL WORK AND MATERIAL FROM DAMAGE BY HIS/HER WORK OR EMPLOYEES AND SHALL BE LIABLE FOR ALL DAMAGE THUS CAUSED.

THE CONTRACTOR SHALL BE RESPONSIBLE FOR HIS/HER WORK AND EQUIPMENT UNTIL FINALLY INSPECTED, TESTED, AND ACCEPTED. THE CONTRACTOR SHALL PROTECT ANY MATERIAL THAT IS NOT IMMEDIATELY INSTALLED. THE CONTRACTOR SHALL CLOSE ALL OPEN ENDS OF WORK WITH TEMPORARY COVERS OR PLUGS DURING STORAGE AND CONSTRUCTION TO PREVENT ENTRY OF FOREIGN OBJECTS.

COORDINATION:

SITE:

- WHERE THE MECHANICAL WORK WILL BE INSTALLED IN CLOSE PROXIMITY TO, OR WILL INTERFERE WITH, WORK OF OTHER TRADES, THE CONTRACTOR SHALL ASSIST IN WORKING OUT SPACE CONDITIONS TO MAKE A SATISFACTORY ADJUSTMENT. IF THE CONTRACTOR INSTALLS HIS/HER WORK BEFORE COORDINATING WITH OTHER TRADES, SO AS TO CAUSE ANY INTERFERENCE WITH WORK OF OTHER TRADES, THE CONTRACTOR SHALL MAKE THE NECESSARY CHANGES IN HIS/HER WORK TO CORRECT THE CONDITION WITHOUT EXTRA CHARGE.
- COORDINATE AND SCHEDULE WORK WITH OTHER WORK IN THE SAME AREA AND WITH WORK DEPENDENT UPON OTHER WORK TO FACILITATE MUTUAL PROGRESS.

TEST AND BALANCE:

- THE CONTRACTOR SHALL FURNISH A SINGLE SET OF ALL TOOLS NECESSARY TO INTERFACE TO THE CONTROL SYSTEM FOR TEST AND BALANCE PURPOSES.
- THE CONTRACTOR SHALL PROVIDE TRAINING IN THE USE OF THESE TOOLS. THIS TRAINING WILL BE PLANNED FOR A MINIMUM OF 4 HOURS.
- IN ADDITION, THE CONTRACTOR SHALL PROVIDE A QUALIFIED TECHNICIAN TO ASSIST IN THE TEST AND BALANCE PROCESS, UNTIL THE FIRST 20 TERMINAL UNITS ARE BALANCED.
- THE TOOLS USED DURING THE TEST AND BALANCE PROCESS WILL BE RETURNED AT THE COMPLETION OF THE TESTING AND BALANCING.

LIFE SAFETY:

- DUCT SMOKE DETECTORS REQUIRED FOR AIR HANDLER SHUTDOWN ARE PROVIDED UNDER DIVISION 28. INTERLOCK SMOKE DETECTORS TO AIR HANDLERS FOR SHUTDOWN AS SPECIFIED IN SEQUENCES OF OPERATION.
- SMOKE DAMPERS AND ACTUATORS REQUIRED FOR DUCT SMOKE ISOLATION ARE PROVIDED UNDER DIVISION 23. INTERLOCK SMOKE DAMPERS TO AIR HANDLERS AS SPECIFIED IN SEQUENCES OF OPERATION.
- FIRE AND SMOKE DAMPERS AND ACTUATORS REQUIRED FOR FIRE–RATED WALLS ARE PROVIDED UNDER DIVISION 23. FIRE AND SMOKE DAMPER CONTROL IS PROVIDED UNDER DIVISION 28.

COORDINATION WITH CONTROLS SPECIFIED IN OTHER SECTIONS OR DIVISIONS:

OTHER SECTIONS AND/OR DIVISIONS OF THIS SPECIFICATION INCLUDE CONTROLS AND CONTROL DEVICES THAT ARE TO BE PART OF OR INTERFACED TO THE CONTROL SYSTEM SPECIFIED IN THIS SECTION. THESE CONTROLS SHALL BE INTEGRATED INTO THE SYSTEM AND COORDINATED BY THE CONTRACTOR AS FOLLOWS:

- ALL COMMUNICATION MEDIA AND EQUIPMENT SHALL BE PROVIDED AS SPECIFIED IN SECTION 23 09 23 ARTICLE 2.2 (COMMUNICATION).
- EACH SUPPLIER OF A CONTROLS PRODUCT IS RESPONSIBLE FOR THE CONFIGURATION, PROGRAMMING, START UP, AND TESTING OF THAT PRODUCT TO MEET THE SEQUENCES OF OPERATION DESCRIBED IN SECTION 23 09 93.
- THE CONTRACTOR SHALL COORDINATE AND RESOLVE ANY INCOMPATIBILITY ISSUES THAT ARISE BETWEEN CONTROL PRODUCTS PROVIDED UNDER THIS SECTION AND THOSE PROVIDED UNDER OTHER SECTIONS OR DIVISIONS OF THIS SPECIFICATION.
- THE CONTRACTOR IS RESPONSIBLE FOR PROVIDING ALL CONTROLS DESCRIBED IN THE CONTRACT DOCUMENTS REGARDLESS OF WHERE WITHIN THE CONTRACT DOCUMENTS THESE CONTROLS ARE DESCRIBED.
- THE CONTRACTOR IS RESPONSIBLE FOR THE INTERFACE OF CONTROL PRODUCTS PROVIDED BY MULTIPLE SUPPLIERS REGARDLESS OF WHERE THIS INTERFACE IS DESCRIBED WITHIN THE CONTRACT DOCUMENTS.

GENERAL WORKMANSHIP:

INSTALL EQUIPMENT, PIPING, AND WIRING/RACEWAY PARALLEL TO BUILDING LINES (I.E. HORIZONTAL, VERTICAL, AND PARALLEL TO WALLS) WHEREVER POSSIBLE.

PROVIDE SUFFICIENT SLACK AND FLEXIBLE CONNECTIONS TO ALLOW FOR VIBRATION OF PIPING AND EQUIPMENT.

INSTALL EQUIPMENT IN READILY ACCESSIBLE LOCATIONS AS DEFINED BY CHAPTER 1 ARTICLE 100 PART A OF THE NATIONAL ELECTRICAL CODE (NEC).

VERIFY INTEGRITY OF ALL WIRING TO ENSURE CONTINUITY AND FREEDOM FROM SHORTS AND GROUNDS.

ALL EQUIPMENT, INSTALLATION, AND WIRING SHALL COMPLY WITH INDUSTRY SPECIFICATIONS AND STANDARDS FOR PERFORMANCE, RELIABILITY, AND COMPATIBILITY AND BE EXECUTED IN STRICT ADHERENCE TO LOCAL CODES AND STANDARD PRACTICES.

FIELD QUALITY CONTROL:

ALL WORK, MATERIALS, AND EQUIPMENT SHALL COMPLY WITH RULES AND REGULATIONS OF APPLICABLE LOCAL, STATE, AND FEDERAL CODES AND ORDINANCES.

CONTRACTOR SHALL CONTINUALLY MONITOR THE FIELD INSTALLATION FOR CODE COMPLIANCE AND QUALITY OF WORKMANSHIP.

CONTRACTOR SHALL HAVE WORK INSPECTION BY LOCAL AND/OR STATE AUTHORITIES HAVING JURISDICTION OVER THE WORK.

WIRING:

ALL CONTROL AND INTERLOCK WIRING SHALL COMPLY WITH NATIONAL AND LOCAL ELECTRICAL CODES, AND DIVISION 26 OF THIS SPECIFICATION, WHERE THE REQUIREMENTS OF THIS SECTION DIFFER FROM DIVISION 26, THE REQUIREMENTS OF THIS SECTION SHALL TAKE PRECEDENCE.

ALL NEC CLASS 1 (LINE VOLTAGE) WIRING SHALL BE UL LISTED IN APPROVED RACEWAY ACCORDING TO NEC AND DIVISION 26 REQUIREMENTS.

ALL LOW–VOLTAGE WIRING SHALL MEET NEC CLASS 2 REQUIREMENTS. LOW–VOLTAGE POWER CIRCUITS SHALL BE SUBFUSED WHEN REQUIRED TO MEET CLASS 2 CURRENT LIMIT.

WHERE NEC CLASS 2 (CURRENT–LIMITED) WIRES ARE IN CONCEALED AND ACCESSIBLE LOCATIONS, INCLUDING CEILING RETURN AIR PLENUMS, APPROVED CABLES NOT IN RACEWAY MAY BE USED PROVIDED THAT CABLES ARE UL LISTED FOR THE INTENDED APPLICATION.

ALL WIRING IN MECHANICAL, ELECTRICAL, OR SERVICE ROOMS – OR WHERE SUBJECT TO MECHANICAL DAMAGE – SHALL BE INSTALLED IN RACEWAY AT LEVELS BELOW 3 M (10FT).

DO NOT INSTALL CLASS 2 WIRING IN RACEWAYS CONTAINING CLASS 1 WIRING. BOXES AND PANELS CONTAINING HIGH–VOLTAGE WIRING AND EQUIPMENT MAY NOT BE USED FOR LOW–VOLTAGE WIRING EXCEPT FOR THE PURPOSE OF INTERFACING THE TWO (E.G. RELAYS AND TRANSFORMERS).

DO NOT INSTALL WIRING IN RACEWAY CONTAINING TUBING.

WHERE CLASS 2 WIRING IS RUN EXPOSED, WIRING IS TO BE RUN PARALLEL ALONG A SURFACE OR PERPENDICULAR TO IT AND NEATLY TIED AT 3 M (10 FT) INTERVALS.

WHERE PLENUM CABLES ARE USED WITHOUT RACEWAY, THEY SHALL BE SUPPORTED FROM OR ANCHORED TO STRUCTURAL MEMBERS. CABLES SHALL NOT BE SUPPORTED BY OR ANCHORED TO DUCTWORK, ELECTRICAL RACEWAYS, PIPING, OR CEILING SUSPENSION SYSTEMS.

ALL WIRE–TO–DEVICE CONNECTIONS SHALL BE MADE AT A TERMINAL BLOCK OR TERMINAL STRIP. ALL WIRE–TO–WIRE CONNECTIONS SHALL BE AT A TERMINAL BLOCK.

ALL WIRING WITHIN ENCLOSURES SHALL BE NEATLY BUNDLED AND ANCH

BUILDING AUTOMATION SYSTEM (CONTINUED)

ACTUATORS:

GENERAL: MOUNT AND LINK CONTROL DAMPER ACTUATORS ACCORDING TO MANUFACTURER'S INSTRUCTIONS.

- TO COMPRESS SEALS WHEN SPRING-RETURN ACTUATORS ARE USED ON NORMALLY CLOSED DAMPERS, POWER ACTUATOR TO APPROXIMATELY 5° OPEN POSITION, MANUALLY CLOSE THE DAMPER, AND THEN TIGHTEN THE LINKAGE.
- CHECK OPERATION OF DAMPER/ACTUATOR COMBINATION TO CONFIRM THAT ACTUATOR MODULATES DAMPER SMOOTHLY THROUGHOUT STROKE TO BOTH OPEN AND CLOSED POSITIONS.
- PROVIDE ALL MOUNTING HARDWARE AND LINKAGES FOR ACTUATOR INSTALLATION.

ELECTRIC/ELECTRONIC:
- DAMPERS: ACTUATORS SHALL BE DIRECT MOUNTED ON DAMPER SHAFT OR JACKSHAFT UNLESS SHOWN AS A LINKAGE INSTALLATION. FOR LOW-LEAKAGE DAMPERS WITH SEALS, THE ACTUATOR SHALL BE MOUNTED WITH A MINIMUM 5° TRAVEL AVAILABLE FOR TIGHTENING THE DAMPER SEAL. ACTUATORS SHALL BE MOUNTED FOLLOWING MANUFACTURER'S RECOMMENDATIONS.
- VALVES: ACTUATORS SHALL BE CONNECTED TO VALVES WITH ADAPTERS APPROVED BY THE ACTUATOR MANUFACTURER. ACTUATORS AND ADAPTERS SHALL BE MOUNTED FOLLOWING THE ACTUATOR MANUFACTURER'S RECOMMENDATIONS.

WARNING LABELS:

PERMANENT WARNING LABELS SHALL BE AFFIXED TO ALL EQUIPMENT THAT CAN BE AUTOMATICALLY STARTED BY THE CONTROL SYSTEM.

- LABELS SHALL USE WHITE LETTERING (12-POINT TYPE OR LARGER) ON A RED BACKGROUND.
- WARNING LABELS SHALL READ AS FOLLOWS.

-- C A U T I O N: THIS EQUIPMENT IS OPERATING UNDER AUTOMATIC CONTROL AND MAY START OR STOP AT ANY TIME WITHOUT WARNING. SWITCH DISCONNECT TO "OFF" POSITION BEFORE SERVICING.

PERMANENT WARNING LABELS SHALL BE AFFIXED TO ALL MOTOR STARTERS AND CONTROL PANELS THAT ARE CONNECTED TO MULTIPLE POWER SOURCES UTILIZING SEPARATE DISCONNECTS.

LABELS SHALL USE WHITE LETTERING (12-POINT TYPE OR LARGER) ON A RED BACKGROUND.

WARNING LABELS SHALL READ AS FOLLOWS:

- C A U T I O N: THIS EQUIPMENT IS FED FROM MORE THAN ONE POWER SOURCE WITH SEPARATE DISCONNECTS. DISCONNECT ALL POWER SOURCES BEFORE SERVICING.

IDENTIFICATION OF HARDWARE AND WIRING:

ALL WIRING AND CABLING, INCLUDING THAT WITHIN FACTORY-FABRICATED PANELS SHALL BE LABELED AT EACH END WITHIN 5 CM (2 IN.) OF TERMINATION WITH CONTROL SYSTEM ADDRESS OR TERMINATION NUMBER.

ALL PNEUMATIC TUBING SHALL BE LABELED AT EACH END WITHIN 5 CM (2 IN.) OF TERMINATION WITH A DESCRIPTIVE IDENTIFIER.

PERMANENTLY LABEL OR CODE EACH POINT OF FIELD TERMINAL STRIPS TO SHOW THE INSTRUMENT OR ITEM SERVED.

IDENTIFY CONTROL PANELS WITH MINIMUM 1 CM (? IN.) LETTERS ON LAMINATED PLASTIC NAMEPLATES.

IDENTIFY ALL OTHER CONTROL COMPONENTS WITH PERMANENT LABELS. ALL PLUG-IN COMPONENTS SHALL BE LABELED SUCH THAT LABEL REMOVAL OF THE COMPONENT DOES NOT REMOVE THE LABEL.

IDENTIFY ROOM SENSORS RELATED TO TERMINAL BOXES OR VALVES WITH NAMEPLATES.

MANUFACTURERS' NAMEPLATES AND UL OR CSA LABELS SHALL BE VISIBLE AND LEGIBLE AFTER EQUIPMENT IS INSTALLED.

IDENTIFIERS SHALL MATCH RECORD DOCUMENTS.

CONTROLLERS:
PROVIDE A SEPARATE CONTROLLER FOR EACH AHU OR OTHER HVAC SYSTEM. A DDC CONTROLLER MAY CONTROL MORE THAN ONE SYSTEM PROVIDED THAT ALL POINTS ASSOCIATED WITH THE SYSTEM ARE ASSIGNED TO THE SAME DDC CONTROLLER. POINTS USED FOR CONTROL LOOP RESET, SUCH AS OUTSIDE AIR OR SPACE TEMPERATURE, ARE EXEMPT FROM THIS REQUIREMENT.

BUILDING CONTROLLERS AND CUSTOM APPLICATION CONTROLLERS SHALL BE SELECTED TO PROVIDE THE REQUIRED I/O POINT CAPACITY REQUIRED TO MONITOR ALL OF THE HARDWARE POINTS LISTED IN SEQUENCES OF OPERATION.

PROGRAMMING:

PROVIDE SUFFICIENT INTERNAL MEMORY FOR THE SPECIFIED SEQUENCES OF OPERATION AND TREND LOGGING.

POINT NAMING: COORDINATE WITH OWNER FOR POINT NAMING CONVENTIONS. NAME POINTS AS SHOWN ON THE EQUIPMENT POINTS LIST PROVIDED WITH EACH SEQUENCE OF OPERATION OR AS DIRECTED BY OWNER. IF CHARACTER LIMITATIONS OR SPACE RESTRICTIONS MAKE IT ADVISABLE TO SHORTEN THE NAME, ABBREVIATIONS AS COORDINATED WITH OWNER MAY BE USED. WHERE MULTIPLE POINTS WITH THE SAME NAME RESIDE IN THE SAME CONTROLLER, EACH POINT NAME MAY BE CUSTOMIZED WITH ITS ASSOCIATED PROGRAM OBJECT NUMBER. FOR EXAMPLE, "ZONE TEMP 1" FOR ZONE 1, "ZONE TEMP 2" FOR ZONE 2.

SOFTWARE PROGRAMMING: PROVIDE PROGRAMMING FOR THE SYSTEM AND ADHERE TO THE SEQUENCES OF OPERATION PROVIDED. ALL OTHER SYSTEM PROGRAMMING NECESSARY FOR THE OPERATION OF THE SYSTEM, BUT NOT SPECIFIED IN THIS DOCUMENT, ALSO SHALL BE PROVIDED BY THE CONTRACTOR. EMBED INTO THE CONTROL PROGRAM SUFFICIENT COMMENT STATEMENTS TO CLEARLY DESCRIBE EACH SECTION OF THE PROGRAM. THE COMMENT STATEMENTS SHALL REFLECT THE LANGUAGE USED IN THE SEQUENCES OF OPERATION. USE THE APPROPRIATE TECHNIQUE BASED ON THE FOLLOWING PROGRAMMING TYPES:

- TEXT-BASED:

-- MUST PROVIDE ACTIONS FOR ALL POSSIBLE SITUATIONS
-- MUST BE MODULAR AND STRUCTURED
-- MUST BE COMMENTED

- GRAPHIC-BASED:

-- MUST PROVIDE ACTIONS FOR ALL POSSIBLE SITUATIONS
-- MUST BE DOCUMENTED

- PARAMETER-BASED:

-- MUST PROVIDE ACTIONS FOR ALL POSSIBLE SITUATIONS
-- MUST BE DOCUMENTED.

OPERATOR INTERFACE:

STANDARD GRAPHICS. PROVIDE GRAPHICS FOR ALL MECHANICAL SYSTEMS AND FLOOR PLANS OF THE BUILDING. THIS INCLUDES EACH CHILLED WATER SYSTEM, HOT WATER SYSTEM, CHILLER, BOILER, AIR HANDLER, AND ALL TERMINAL EQUIPMENT. POINT INFORMATION ON THE GRAPHIC DISPLAYS SHALL DYNAMICALLY UPDATE. SHOW ON EACH GRAPHIC ALL INPUT AND OUTPUT POINTS FOR THE SYSTEM. ALSO SHOW RELEVANT CALCULATED POINTS SUCH AS SETPOINTS. AS A MINIMUM, SHOW ON EACH EQUIPMENT GRAPHIC THE INPUT AND OUTPUT POINTS AND RELEVANT CALCULATED POINTS AS INDICATED ON THE APPLICABLE POINTS LIST OR SEQUENCE OF OPERATION.

THE CONTRACTOR SHALL PROVIDE ALL THE LABOR NECESSARY TO INSTALL, INITIALIZE, START UP, AND TROUBLESHOOT ALL OPERATOR INTERFACE SOFTWARE AND ITS FUNCTIONS AS DESCRIBED IN THIS SECTION. THIS INCLUDES ANY OPERATING SYSTEM SOFTWARE, THE OPERATOR INTERFACE DATABASE, AND ANY THIRD-PARTY SOFTWARE INSTALLATION AND INTEGRATION REQUIRED FOR SUCCESSFUL OPERATION OF THE OPERATOR INTERFACE.

CONTROL SYSTEM CHECKOUT AND TESTING:

STARTUP TESTING: ALL TESTING LISTED IN THIS ARTICLE SHALL BE PERFORMED BY THE CONTRACTOR AND SHALL MAKE UP PART OF THE NECESSARY VERIFICATION OF AN OPERATING CONTROL SYSTEM. THIS TESTING SHALL BE COMPLETED BEFORE THE OWNER'S REPRESENTATIVE IS NOTIFIED OF THE SYSTEM DEMONSTRATION.

- THE CONTRACTOR SHALL FURNISH ALL LABOR AND TEST APPARATUS REQUIRED TO CALIBRATE AND PREPARE FOR SERVICE OF ALL INSTRUMENTS, CONTROLS, AND ACCESSORY EQUIPMENT FURNISHED UNDER THIS SPECIFICATION.
- VERIFY THAT ALL CONTROL WIRING IS PROPERLY CONNECTED AND FREE OF ALL SHORTS AND GROUND FAULTS. VERIFY THAT TERMINATIONS ARE TIGHT.
- ENABLE THE CONTROL SYSTEMS AND VERIFY CALIBRATION OF ALL INPUT DEVICES INDIVIDUALLY. PERFORM CALIBRATION PROCEDURES ACCORDING TO MANUFACTURERS' RECOMMENDATIONS.
- VERIFY THAT ALL BINARY OUTPUT DEVICES (RELAYS, SOLENOID VALVES, TWO-POSITION ACTUATORS AND CONTROL VALVES, MAGNETIC STARTERS, ETC.) OPERATE PROPERLY AND THAT THE NORMAL POSITIONS ARE CORRECT.
- VERIFY THAT ALL ANALOG OUTPUT DEVICES (I/PS, ACTUATORS, ETC.) ARE FUNCTIONAL, THAT START AND SPAN ARE CORRECT, AND THAT DIRECTION AND NORMAL POSITIONS ARE CORRECT. THE CONTRACTOR SHALL CHECK ALL CONTROL VALVES AND AUTOMATIC DAMPERS TO ENSURE PROPER ACTION AND CLOSURE. THE CONTRACTOR SHALL MAKE ANY NECESSARY ADJUSTMENTS TO VALVE STEM AND DAMPER BLADE TRAVEL.
- VERIFY THAT THE SYSTEM OPERATION ADHERES TO THE SEQUENCES OF OPERATION. SIMULATE AND OBSERVE ALL MODES OF OPERATION BY OVERRIDING AND VARYING INPUTS AND SCHEDULES. TUNE ALL DDC LOOPS.
- ALARMS AND INTERLOCKS:

-- CHECK EACH ALARM SEPARATELY BY INCLUDING AN APPROPRIATE SIGNAL AT A VALUE THAT WILL TRIP THE ALARM.
-- INTERLOCKS SHALL BE TRIPPED USING FIELD CONTACTS TO CHECK THE LOGIC, AS WELL AS TO ENSURE THAT THE FAIL-SAFE CONDITION FOR ALL ACTUATORS IS IN THE PROPER DIRECTION.
-- INTERLOCK ACTIONS SHALL BE TESTED BY SIMULATING ALARM CONDITIONS TO CHECK THE INITIATING VALUE OF THE VARIABLE AND INTERLOCK ACTION.

CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE:

DEMONSTRATION:

- PRIOR TO ACCEPTANCE, THE CONTROL SYSTEM SHALL UNDERGO A SERIES OF PERFORMANCE TESTS TO VERIFY OPERATION AND COMPLIANCE WITH THIS SPECIFICATION. THESE TESTS SHALL OCCUR AFTER THE CONTRACTOR HAS COMPLETED THE INSTALLATION, STARTED UP THE SYSTEM, AND PERFORMED HIS/HER OWN TESTS.
- THE TESTS DESCRIBED IN THIS SECTION ARE TO BE PERFORMED IN ADDITION TO THE TESTS THAT THE CONTRACTOR PERFORMS AS A NECESSARY PART OF THE INSTALLATION, START-UP, AND DEBUGGING PROCESS AND AS SPECIFIED IN THE "CONTROL SYSTEM CHECKOUT AND TESTING" ARTICLE IN PART 3 OF THIS SPECIFICATION. THE ENGINEER WILL BE PRESENT TO OBSERVE AND REVIEW THESE TESTS. THE ENGINEER SHALL BE NOTIFIED AT LEAST 10 DAYS IN ADVANCE OF THE START OF THE TESTING PROCEDURES.
- THE DEMONSTRATION PROCESS SHALL FOLLOW THAT APPROVED IN PART 1, "SUBMITTALS." THE APPROVED CHECKLISTS AND FORMS SHALL BE COMPLETED FOR ALL SYSTEMS AS PART OF THE DEMONSTRATION.
- THE CONTRACTOR SHALL PROVIDE AT LEAST TWO PERSONS EQUIPPED WITH TWO-WAY COMMUNICATION AND SHALL DEMONSTRATE ACTUAL FIELD OPERATION OF EACH CONTROL AND SENSING POINT FOR ALL MODES OF OPERATION INCLUDING DAY, NIGHT, OCCUPIED, UNOCCUPIED, FIRE/SMOKE ALARM, SEASONAL CHANGEOVER, AND POWER FAILURE MODES. THE PURPOSE IS TO DEMONSTRATE THE CALIBRATION, RESPONSE, AND ACTION OF EVERY POINT AND SYSTEM. ANY TEST EQUIPMENT REQUIRED TO PROVE THE PROPER OPERATION SHALL BE PROVIDED BY AND OPERATED BY THE CONTRACTOR.
- AS EACH CONTROL INPUT AND OUTPUT IS CHECKED, A LOG SHALL BE COMPLETED SHOWING THE DATE, TECHNICIAN'S INITIALS, AND ANY CORRECTIVE ACTION TAKEN OR NEEDED.
- DEMONSTRATE COMPLIANCE WITH PART 1, "SYSTEM PERFORMANCE."
- DEMONSTRATE COMPLIANCE WITH SEQUENCES OF OPERATION THROUGH ALL MODES OF OPERATION.
- DEMONSTRATE COMPLETE OPERATION OF OPERATOR INTERFACE.
- ADDITIONALLY, THE FOLLOWING ITEMS SHALL BE DEMONSTRATED:

-- DDC LOOP RESPONSE: THE CONTRACTOR SHALL SUPPLY TREND DATA OUTPUT IN A GRAPHICAL FORM SHOWING THE STEP RESPONSE OF EACH DDC LOOP. THE TEST SHALL SHOW THE LOOP'S RESPONSE TO A CHANGE IN SET POINT, WHICH REPRESENTS A CHANGE OF ACTUATOR POSITION OF AT LEAST 25% OF ITS FULL RANGE. THE SAMPLING RATE OF THE TREND SHALL BE FROM 10 SECONDS TO 3 MINUTES, DEPENDING ON THE SPEED OF THE LOOP. THE TREND DATA SHALL SHOW FOR EACH SAMPLE THE SET POINT, ACTUATOR POSITION, AND CONTROLLED VARIABLE VALUES. ANY LOOP THAT YIELDS UNREASONABLY UNDER-DAMPED OR OVER-DAMPED CONTROL SHALL REQUIRE FURTHER TUNING BY THE CONTRACTOR.
-- DEMAND LIMITING. THE CONTRACTOR SHALL SUPPLY A TREND DATA OUTPUT SHOWING THE ACTION OF THE DEMAND LIMITING ALGORITHM. THE DATA SHALL DOCUMENT THE ACTION ON A MINUTE-BY-MINUTE BASIS OVER AT LEAST A 30-MINUTE PERIOD. INCLUDED IN THE TREND SHALL BE BUILDING KW, DEMAND LIMITING SET POINT, AND THE STATUS OF SHEDDABLE EQUIPMENT OUTPUTS.
-- OPTIMUM START/STOP. THE CONTRACTOR SHALL SUPPLY A TREND DATA OUTPUT SHOWING THE CAPABILITY OF THE ALGORITHM. THE CHANGE-OF-VALUE OR CHANGE-OF-STATE TRENDS SHALL INCLUDE THE OUTPUT STATUS OF ALL OPTIMALLY STARTED AND STOPPED EQUIPMENT, AS WELL AS TEMPERATURE SENSOR INPUTS OF AFFECTED AREAS.
-- INTERFACE TO THE BUILDING FIRE ALARM SYSTEM.
-- OPERATIONAL LOGS FOR EACH SYSTEM THAT INDICATE ALL SET POINTS, OPERATING POINTS, VALVE POSITIONS, MODE, AND EQUIPMENT STATUS SHALL BE SUBMITTED TO THE ARCHITECT/ENGINEER. THESE LOGS SHALL COVER THREE 48-HOUR PERIODS AND HAVE A SAMPLE FREQUENCY OF NOT MORE THAN 10 MINUTES. THE LOGS SHALL BE PROVIDED IN BOTH PRINTED AND DISK FORMATS.

- ANY TESTS THAT FAIL TO DEMONSTRATE THE OPERATION OF THE SYSTEM SHALL BE REPEATED AT A LATER DATE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY NECESSARY REPAIRS OR REVISIONS TO THE HARDWARE OR SOFTWARE TO SUCCESSFULLY COMPLETE ALL TESTS.

ACCEPTANCE:

- ALL TESTS DESCRIBED IN THIS SPECIFICATION SHALL HAVE BEEN PERFORMED TO THE SATISFACTION OF BOTH THE ENGINEER AND OWNER PRIOR TO THE ACCEPTANCE OF THE CONTROL SYSTEM AS MEETING THE REQUIREMENTS OF COMPLETION. ANY TESTS THAT CANNOT BE PERFORMED DUE TO CIRCUMSTANCES BEYOND THE CONTROL OF THE CONTRACTOR MAY BE EXEMPT FROM THE COMPLETION REQUIREMENTS IF STATED AS SUCH IN WRITING BY THE ENGINEER. SUCH TESTS SHALL THEN BE PERFORMED AS PART OF THE WARRANTY.
- THE SYSTEM SHALL NOT BE ACCEPTED UNTIL ALL FORMS AND CHECKLISTS COMPLETED AS PART OF THE DEMONSTRATION ARE SUBMITTED AND APPROVED AS REQUIRED IN PART 1, "SUBMITTALS."

CLEANING:

THE CONTRACTOR SHALL CLEAN UP ALL DEBRIS RESULTING FROM HIS/HER ACTIVITIES DAILY. THE CONTRACTOR SHALL REMOVE ALL CARTONS, CONTAINERS, CRATES, ETC., UNDER HIS/HER CONTROL AS SOON AS THEIR CONTENTS HAVE BEEN REMOVED. WASTE SHALL BE COLLECTED AND PLACED IN A DESIGNATED LOCATION.

AT THE COMPLETION OF WORK IN ANY AREA, THE CONTRACTOR SHALL CLEAN ALL WORK, EQUIPMENT, ETC., KEEPING IT FREE FROM DUST, DIRT, AND DEBRIS, ETC.

AT THE COMPLETION OF WORK, ALL EQUIPMENT FURNISHED UNDER THIS SECTION SHALL BE CHECKED FOR PAINT DAMAGE, AND ANY FACTORY-FINISHED PAINT THAT HAS BEEN DAMAGED SHALL BE REPAIRED TO MATCH THE ADJACENT AREAS. ANY CABINET OR ENCLOSURE THAT HAS BEEN DEFORMED SHALL BE REPLACED WITH NEW MATERIAL AND REPAINTED TO MATCH THE ADJACENT AREAS.

TRAINING:

PROVIDE TRAINING FOR A DESIGNATED STAFF OF OWNER'S REPRESENTATIVES. TRAINING SHALL BE PROVIDED VIA SELF-PACED TRAINING, WEB-BASED OR COMPUTER-BASED TRAINING, CLASSROOM TRAINING, OR A COMBINATION OF TRAINING METHOD.

TRAINING SHALL ENABLE STUDENTS TO ACCOMPLISH THE FOLLOWING OBJECTIVES:

- DAY-TO-DAY OPERATORS:

-- PROFICIENTLY OPERATE THE SYSTEM
-- UNDERSTAND CONTROL SYSTEM ARCHITECTURE AND CONFIGURATION
-- UNDERSTAND DDC SYSTEM COMPONENTS
-- UNDERSTAND SYSTEM OPERATION, INCLUDING DDC SYSTEM CONTROL AND OPTIMIZING ROUTINES (ALGORITHMS)
-- OPERATE THE WORKSTATION AND PERIPHERALS
-- LOG ON AND OFF THE SYSTEM
-- ACCESS GRAPHICS, POINT REPORTS, AND LOGS
-- ADJUST AND CHANGE SYSTEM SET POINTS, TIME SCHEDULES, AND HOLIDAY SCHEDULES
-- RECOGNIZE MALFUNCTIONS OF THE SYSTEM BY OBSERVATION OF THE PRINTED COPY AND GRAPHICAL VISUAL SIGNALS
-- UNDERSTAND SYSTEM DRAWINGS AND OPERATION AND MAINTENANCE MANUAL
-- UNDERSTAND THE JOB LAYOUT AND LOCATION OF CONTROL COMPONENTS
-- ACCESS DATA FROM DDC CONTROLLERS AND ASCS
-- OPERATE PORTABLE OPERATOR'S TERMINALS

- ADVANCED OPERATORS:

-- MAKE AND CHANGE GRAPHICS ON THE WORKSTATION
-- CREATE, DELETE, AND MODIFY ALARMS, INCLUDING ANNUNCIATION AND ROUTING OF THESE
-- CREATE, DELETE, AND MODIFY POINT TREND LOGS AND GRAPH OR PRINT THESE BOTH ON AN AD-HOC BASIS AND AT USER-DEFINABLE TIME INTERVALS
-- CREATE, DELETE, AND MODIFY REPORTS
-- ADD, REMOVE, AND MODIFY SYSTEM'S PHYSICAL POINTS
-- CREATE, MODIFY, AND DELETE PROGRAMMING
-- ADD PANELS WHEN REQUIRED
-- ADD OPERATOR INTERFACE STATIONS
-- CREATE, DELETE, AND MODIFY SYSTEM DISPLAYS, BOTH GRAPHICAL AND OTHERS
-- PERFORM DDC SYSTEM FIELD CHECKOUT PROCEDURES
-- PERFORM DDC CONTROLLER UNIT OPERATION AND MAINTENANCE PROCEDURES
-- PERFORM WORKSTATION AND PERIPHERAL OPERATION AND MAINTENANCE

PROCEDURES:

PERFORM DDC SYSTEM DIAGNOSTIC PROCEDURES.

CONFIGURE HARDWARE INCLUDING PC BOARDS, SWITCHES, COMMUNICATION, AND I/O POINTS.

MAINTAIN, CALIBRATE, TROUBLESHOOT, DIAGNOSE, AND REPAIR HARDWARE.

ADJUST, CALIBRATE, AND REPLACE SYSTEM COMPONENTS.

- SYSTEM MANAGERS/ADMINISTRATORS:

-- MAINTAIN SOFTWARE AND PREPARE BACKUPS
-- INTERFACE WITH JOB-SPECIFIC, THIRD-PARTY OPERATOR SOFTWARE
-- ADD NEW USERS AND UNDERSTAND PASSWORD SECURITY PROCEDURES

ORGANIZE THE TRAINING INTO SESSIONS OR MODULES FOR THE THREE LEVELS OF OPERATORS LISTED ABOVE. (DAY-TO-DAY OPERATORS, ADVANCED OPERATORS, SYSTEM MANAGERS AND ADMINISTRATORS). STUDENTS WILL RECEIVE ONE OR MORE OF THE TRAINING PACKAGES, DEPENDING ON KNOWLEDGE LEVEL REQUIRED.

PROVIDE COURSE OUTLINE AND MATERIALS ACCORDING TO THE "SUBMITTALS" ARTICLE IN PART 1 OF THIS SPECIFICATION. PROVIDE ONE COPY OF TRAINING MATERIAL PER STUDENT.

THE INSTRUCTOR(S) SHALL BE FACTORY-TRAINED AND EXPERIENCED IN PRESENTING THIS MATERIAL.

CLASSROOM TRAINING SHALL BE DONE USING A NETWORK OF WORKING CONTROLLERS REPRESENTATIVE OF INSTALLED HARDWARE.

SEQUENCES OF OPERATION:REFER TO DRAWINGS.

CONTROL VALVE INSTALLATION:

VALVE SUBMITTALS SHALL BE COORDINATED FOR TYPE, QUANTITY, SIZE, AND PIPING CONFIGURATION TO ENSURE COMPATIBILITY WITH PIPE DESIGN.

SLIP-STEM CONTROL VALVES SHALL BE INSTALLED SO THAT THE STEM POSITION IS NOT MORE THAN 60 DEGREES FROM THE VERTICAL UP POSITION. BALL TYPE CONTROL VALVES SHALL BE INSTALLED WITH THE STEM IN THE HORIZONTAL POSITION.

VALVES SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.

CONTROL VALVES SHALL BE INSTALLED SO THAT THEY ARE ACCESSIBLE AND SERVICEABLE AND SO THAT ACTUATORS MAY BE SERVICED AND REMOVED WITHOUT INTERFERENCE FROM STRUCTURE OR OTHER PIPES AND/OR EQUIPMENT.

ISOLATION VALVES SHALL BE INSTALLED SO THAT THE CONTROL VALVE BODY MAY BE SERVICED WITHOUT DRAINING THE SUPPLY/RETURN SIDE PIPING SYSTEM. UNIONS SHALL BE INSTALLED AT ALL CONNECTIONS TO SCREW-TYPE CONTROL VALVES.

PROVIDE TAGS FOR ALL CONTROL VALVES INDICATING SERVICE AND NUMBER. TAGS SHALL BE BRASS, 1.5 INCH IN DIAMETER, WITH ? INCH HIGH LETTERS. SECURELY FASTEN WITH CHAIN AND HOOK. MATCH IDENTIFICATION NUMBERS AS SHOWN ON APPROVED CONTROLS SHOP DRAWINGS.

CONTROL DAMPER INSTALLATION:

DAMPER SUBMITTALS SHALL BE COORDINATED FOR TYPE, QUANTITY, AND SIZE TO ENSURE COMPATIBILITY WITH SHEET METAL DESIGN.

DUCT OPENINGS SHALL BE FREE OF ANY OBSTRUCTION OR IRREGULARITIES THAT MIGHT INTERFERE WITH BLADE OR LINKAGE ROTATION OR ACTUATOR MOUNTING. DUCT OPENINGS SHALL MEASURE 2 IN. LARGER THAN DAMPER DIMENSIONS AND SHALL BE SQUARE, STRAIGHT, AND LEVEL.

INDIVIDUAL DAMPER SECTIONS, AS WELL AS ENTIRE MULTIPLE SECTION ASSEMBLIES, MUST BE COMPLETELY SQUARE AND FREE FROM RACKING, TWISTING, OR BENDING. MEASURE DIAGONALLY FROM UPPER CORNERS TO OPPOSITE LOWER CORNERS OF EACH DAMPER SECTION. BOTH DIMENSIONS MUST BE WITHIN 0.3 CM (1/8 IN.) OF EACH OTHER.

FOLLOW THE MANUFACTURER'S INSTRUCTIONS FOR FIELD INSTALLATION OF CONTROL DAMPERS. UNLESS SPECIFICALLY DESIGNED FOR VERTICAL BLADE APPLICATION, DAMPERS MUST BE MOUNTED WITH BLADE AXIS HORIZONTAL.

INSTALL EXTENDED SHAFT OR JACKSHAFT ACCORDING TO MANUFACTURER'S INSTRUCTIONS. (TYPICALLY, A STICKER ON THE DAMPER FACE SHOWS RECOMMENDED EXTENDED SHAFT LOCATION. ATTACH SHAFT ON LABELED SIDE OF DAMPER TO THAT BLADE.)

DAMPER BLADES, AXLES, AND LINKAGE MUST OPERATE WITHOUT BINDING. BEFORE SYSTEM OPERATION, CYCLE DAMPER AFTER INSTALLATION TO ENSURE PROPER OPERATION. ON MULTIPLE SECTION ASSEMBLIES, ALL SECTIONS MUST OPEN AND CLOSE SIMULTANEOUSLY.

PROVIDE A VISIBLE AND ACCESSIBLE INDICATION OF DAMPER POSITION ON THE DRIVE SHAFT END.

SUPPORT DUCTWORK IN AREA OF DAMPER WHEN REQUIRED TO PREVENT SAGGING DUE TO DAMPER WEIGHT.

AFTER INSTALLATION OF LOW-LEAKAGE DAMPERS WITH SEALS, CAULK BETWEEN FRAME AND DUCT OR OPENING TO PREVENT LEAKAGE AROUND PERIMETER OF DAMPER.

SMOKE DAMPER INSTALLATION:

THE CONTRACTOR SHALL COORDINATE ALL SMOKE AND SMOKE/FIRE DAMPER INSTALLATION, WIRING, AND CHECKOUT TO ENSURE THAT THESE DAMPERS FUNCTION PROPERLY AND THAT THEY RESPOND TO THE PROPER FIRE ALARM SYSTEM GENERAL, ZONE, AND/OR DETECTOR TRIPS. THE CONTRACTOR SHALL IMMEDIATELY REPORT ANY DISCREPANCIES TO THE ENGINEER NO LESS THAN TWO WEEKS PRIOR TO INSPECTION BY THE CODE AUTHORITY HAVING JURISDICTION.

PROVIDE COMPLETE SUBMITTAL DATA TO CONTROLS SYSTEM SUBCONTRACTOR FOR COORDINATION OF DUCT SMOKE DETECTOR INTERFACE TO HVAC SYSTEMS.

DUCT SMOKE DETECTION:

SUBMIT DATA FOR COORDINATION OF DUCT SMOKE DETECTOR INTERFACE TO HVAC SYSTEMS AS REQUIRED IN PART 1, "SUBMITTALS."

THIS CONTRACTOR SHALL PROVIDE A DRY-CONTACT ALARM OUTPUT IN THE SAME ROOM AS THE HVAC EQUIPMENT TO BE CONTROLLED.

START-UP AND CHECKOUT PROCEDURES:

START UP, CHECK OUT, AND TEST ALL HARDWARE AND SOFTWARE AND VERIFY COMMUNICATION BETWEEN ALL COMPONENTS:

- VERIFY THAT ALL CONTROL WIRING IS PROPERLY CONNECTED AND FREE OF ALL SHORTS AND GROUND FAULTS. VERIFY THAT TERMINATIONS ARE TIGHT.
- VERIFY THAT ALL ANALOG AND BINARY INPUT/OUTPUT POINTS READ PROPERLY.
- VERIFY ALARMS AND INTERLOCKS.
- VERIFY OPERATION OF THE INTEGRATED SYSTEM.

BAS CLOUD SERVER AND BMS PLATFORM SPECIFICATION

GENERAL:

PROVIDE A CLOUD-HOSTED BUILDING AUTOMATION SYSTEM (BAS) SERVER PLATFORM FOR CENTRALIZED MONITORING, CONTROL, TRENDING, ALARMING, SCHEDULING, AND DATA MANAGEMENT OF ALL BUILDING AUTOMATION CONTROLLERS.

THE BAS SERVER SHALL SUPPORT WEB-BASED THIN-CLIENT ARCHITECTURE ALLOWING OPERATORS TO ACCESS THE SYSTEM THROUGH STANDARD WEB BROWSERS WITHOUT INSTALLATION OF SPECIALIZED SOFTWARE.

THE BAS SERVER SHALL BE PROVIDED AS A SOFTWARE-AS-A-SERVICE (SAAS) PLATFORM HOSTED BY THE BAS VENDOR OR A QUALIFIED CLOUD SERVICE PROVIDER.

SYSTEM ARCHITECTURE:

THE BAS ARCHITECTURE SHALL CONSIST OF DISTRIBUTED DDC CONTROLLERS, BACNET COMMUNICATION NETWORKS, SECURE CLOUD-HOSTED BAS SERVER INFRASTRUCTURE, AND WEB-BASED OPERATOR INTERFACES.

CONTROLLERS SHALL MAINTAIN STAND-ALONE CONTROL CAPABILITY IN THE EVENT OF COMMUNICATION FAILURE WITH THE CLOUD SERVER.

CLOUD HOSTING REQUIREMENTS:

THE BAS SERVER SHALL BE HOSTED ON SECURE CLOUD INFRASTRUCTURE SUCH AS AMAZON WEB SERVICES (AWS) OR EQUIVALENT.
THE SYSTEM SHALL PROVIDE:

- HIGH AVAILABILITY SERVER ARCHITECTURE
- MULTIPLE DATA CENTER REDUNDANCY
- DAILY DATABASE BACKUPS
- AUTOMATIC SOFTWARE UPDATES
- CONTINUOUS MONITORING AND MAINTENANCE
- DISASTER RECOVERY CAPABILITY

COMMUNICATION PROTOCOLS:

THE BAS SHALL SUPPORT OPEN PROTOCOLS INCLUDING:

- BACNET/IP
- BACNET SECURE CONNECT (BACNET/SC)
- BACNET MS/TP & MODBUS INTEGRATION WHERE REQUIRED

THE BAS SERVER SHALL CONFORM TO BACNET ADVANCED OPERATOR WORKSTATION (B-AWS) PROFILE.

CLOUD CONNECTIVITY:

THE BAS CONTRACTOR SHALL PROVIDE SECURE CONNECTIVITY BETWEEN THE BAS BUILDING NETWORK AND THE CLOUD BAS PLATFORM.
CONNECTIVITY SHALL:

- USE ENCRYPTED COMMUNICATION (TLS 1.2 OR HIGHER)
- UTILIZE BACNET SECURE CONNECT (BACNET/SC)
- COMPLY WITH THE BAS CLOUD INFRASTRUCTURE SPECIFICATION
- COORDINATE WITH OWNER IT NETWORK POLICIES

CYBERSECURITY REQUIREMENTS:

THE BAS SHALL IMPLEMENT MODERN CYBERSECURITY PRACTICES INCLUDING:

- TLS ENCRYPTED COMMUNICATION
- ROLE-BASED ACCESS CONTROL (RBAC)
- MULTI-FACTOR AUTHENTICATION (MFA)
- SECURE AUTHENTICATION
- AUDIT LOGGING OF OPERATOR ACTIONS

ALL COMMUNICATIONS BETWEEN BAS DEVICES AND CLOUD SERVERS SHALL BE ENCRYPTED.

DATA RESIDENCY:

THE BAS VENDOR SHALL CLEARLY STATE THE COUNTRY AND REGION WHERE BAS DATA IS STORED AND PROCESSED.
PREFERENCE SHALL BE GIVEN TO SYSTEMS SUPPORTING CANADIAN DATA RESIDENCY WHERE APPLICABLE.

AVAILABILITY AND DISASTER RECOVERY:

THE BAS VENDOR SHALL PROVIDE A SERVICE LEVEL AGREEMENT INCLUDING:

- MINIMUM 99.5% UPTIME
- BACKUP FREQUENCY AND RETENTION POLICIES
- DISASTER RECOVERY PROCEDURES
- RECOVERY POINT OBJECTIVE (RPO)
- RECOVERY TIME OBJECTIVE (RTO)

LOCAL CONTROLLERS SHALL MAINTAIN SAFE LOCAL CONTROL DURING WAN OR INTERNET OUTAGES.

USER ACCESS:

THE BAS SERVER SHALL BE ACCESSIBLE VIA STANDARD WEB BROWSERS ON:
MOBILE DEVICES:

- ANDROID
- IOS

COMPUTERS:
- WINDOWS
- MACOS
- LINUX

SUPPORTED BROWSERS SHALL INCLUDE CHROME, EDGE, FIREFOX, AND SAFARI.

DATA TRENDING:

THE BAS SERVER SHALL SUPPORT CONFIGURABLE TREND LOGGING FOR OPERATIONAL AND ENERGY ANALYSIS.
TRENDING SHALL INCLUDE:

- SUPPLY AIR TEMPERATURE
- RETURN AIR TEMPERATURE
- MIXED AIR TEMPERATURE
- OUTSIDE AIR TEMPERATURE
- CO2 CONCENTRATION
- HEATING AND COOLING SETPOINTS
- FAN STATUS AND SPEED
- DAMPER AND VALVE POSITIONS
- EQUIPMENT RUNTIME

TREND LOGS SHALL BE EXPORTABLE TO SPREADSHEET FORMAT.

ECM MONITORING REQUIREMENTS:

THE BAS SHALL SUPPORT MONITORING AND VERIFICATION OF ENERGY SAVINGS ASSOCIATED WITH ENERGY CONSERVATION MEASURES (ECM) IMPLEMENTED FOR THE PROJECT.

TRENDING SHALL SUPPORT VERIFICATION OF OPERATIONAL PERFORMANCE AND ENERGY SAVINGS FOR UTILITY INCENTIVE PROGRAMS.

ENERGY MONITORING:

WHERE AVAILABLE, THE BAS SHALL RECORD:

- ELECTRICAL DEMAND (KW)
- ELECTRICAL ENER

GENERAL INSTRUCTIONS (ELECTRICAL)

CONDITIONS OF CONTRACT

1. THE OWNERS INSTRUCTIONS TO BIDDERS AND THE GENERAL CONDITIONS OF THE DESIGNERS SPECIFICATIONS ARE AN INTEGRAL PART OF THIS CONTRACT AND SHALL BE READ IN CONJUNCTION HEREWITH. THESE INSTRUCTIONS TO BIDDERS AND GENERAL CONDITIONS SHALL BE FULLY BINDING ON THE GENERAL CONTRACTOR AND HIS SUB-CONTRACTORS TO THE FULL SATISFACTION OF THE DESIGNER, ENGINEER AND OWNER.
2. THE RESPONSIBILITY AND SCOPE OF EACH SUB-TRADE RESTS SOLELY WITH THE CONTRACTOR. EXTRAS WILL NOT BE CONSIDERED BASED ON THE GROUNDS OF DIFFERENCE IN INTERPRETATION OF SPECIFICATIONS AND DRAWINGS AS TO WHICH TRADE INVOLVED SHALL PROVIDE CERTAIN SPECIALTIES OR MATERIALS.
3. IT IS A CONDITION OF THIS CONTRACT, THAT THE CONTRACTOR WILL IN THE PERFORMANCE OF THE SERVICES FOR THE OWNER AS DESCRIBED IN THIS CONTRACT, PERFORM WORK IN ACCORDANCE WITH ONTARIO BUILDING CODE LATEST EDITION, THE ONTARIO HYDRO ELECTRICAL SAFETY CODE, THE SEWAGE SYSTEMS ENVIRONMENTAL PROTECTION ACT ONTARIO, WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS), O.REG 644/88, THE ONTARIO GAS UTILIZATION CODE, AND ANY OTHER CODE OF PROVINCIAL OR LOCAL APPLICATION, INCLUDING HOURS OF WORK, RATES OF PAY, JOB SAFETY AND ALL OTHER MATTERS IN WHICH THE MUNICIPAL OR FEDERAL AUTHORITIES HAVE JURISDICTION, PROVIDED THAT IN ANY CASE OF CONFLICT OR DISCREPANCY, THE MORE STRINGENT REQUIREMENTS SHALL APPLY.
4. COMPLY WITH STANDARD FOR BUILDING CONSTRUCTION OPERATIONS, ISSUED BY THE ONTARIO FIRE MARSHALL'S OFFICE AND ALL APPLICABLE FIRE SAFETY CODES, LAWS, AND REGULATIONS.
5. IT IS INCUMBENT UPON THE CONTRACTOR TO INFORM ITSELF OF ANY SUCH LEGISLATION AND THE CONTRACTOR AGREES THAT IN THE EVENT OF NON-COMPLIANCE WITH THIS LEGISLATION, IT WILL INDEMNIFY AND HOLD HARMLESS THE OWNER FROM ANY COSTS AND DAMAGES RESULTING FROM SUCH NON-COMPLIANCE.
6. ALL WORK SHALL BE CARRIED OUT IN ACCORDANCE WITH STANDARDS OF GOOD PRACTICE SUCH AS, BUT NOT LIMITED TO, SMACNA AND ASHRAE, MEET OR EXCEED REQUIREMENTS OF CONTRACT DOCUMENTS, SPECIFIED STANDARDS, CODES AND REFERENCED DOCUMENTS DESCRIBED IN THESE INSTRUCTIONS.

EXAMINATION OF WORK

1. THIS PROJECT INVOLVES RENOVATIONS TO EXISTING BUILDING, THEREFORE EXAMINE THE SITE AND LOCAL CONDITIONS TO DETERMINE THE DIFFICULTIES IN CARRYING OUT THE WORK INDICATED AND SPECIFIED PRIOR TO SUBMITTING FINAL PRICE.

INTENT

1. IT IS THE INTENT OF THIS SPECIFICATION AND DRAWINGS TO PROVIDE FOR A COMPLETE AND FULLY OPERATING SYSTEM IN COMPLETE ACCORD WITH ALL APPLICABLE CODES. THESE DOCUMENTS MAY NOT SHOW OR DESCRIBE EACH AND EVERY ITEM REQUIRED FOR THE COMPLETE INSTALLATION;THEREFORE, THE CONTRACTOR SHALL MAKE PROVISIONS FOR ALL LABOUR, MATERIAL AND EQUIPMENT DEEMED NECESSARY TO COMPLETE THE WORK INDICATED OR REASONABLY IMPLIED ON ALL DRAWINGS.

LIABILITY

1. THIS CONTRACTOR SHALL ASSUME FULL RESPONSIBILITY FOR LAYING OUT HIS WORK AND FOR ANY DAMAGE OR EXTRA COSTS CAUSED TO THE OWNER OR OTHER CONTRACTORS BY IMPROPER LOCATION OR CARRYING OUT OF HIS WORK. CARRY ALL NECESSARY INSURANCE COVERAGE.

PERMITS, CERTIFICATES, FEES, ETC.

1. GIVE ALL NOTICES, OBTAIN ALL PERMITS AND PAY ALL FEES SO THAT THE WORK SPECIFIED HEREIN MAY BE CARRIED OUT, EXCEPT FOR OCCUPANCY PERMIT WHICH WILL BE OBTAINED BY THE OWNER. AT THE ENGINEER'S REQUEST, FURNISH ANY CERTIFICATES AS EVIDENCE THAT THE WORK INSTALLED CONFORMS WITH THE LAWS AND REGULATIONS OF ALL AUTHORITIES HAVING JURISDICTION.

GUARANTEE

1. THE CONTRACTOR, AS A CONDITION PRECEDENT TO FINAL PAYMENT AFTER COMPLETION OF THIS WORK, SHALL GIVE THE OWNER A WRITTEN GUARANTEE WARRANTING ALL APPARATUS FURNISHED UNDER THE CONTRACT TO REMAIN IN PERFECT SERVICEABLE CONDITION FOR A PERIOD OF ONE YEAR FROM THE DATE OF SUBSTANTIAL PERFORMANCE OF HIS WORK AS ESTABLISHED BY THE PROJECT MANAGER AND ENGINEER.

DOCUMENTS REQUIRED

1. MAINTAIN AT JOB SITE ONE COPY OF EACH OF THE FOLLOWING DOCUMENTS:
   - .1 DRAWINGS.
   - .2 SPECIFICATIONS.
   - .3 ADDENDA.
   - .4 CHANGE ORDERS.
   - .5 OTHER MODIFICATIONS TO CONTRACT.
   - .6 FIELD TEST REPORTS. .
   - .7 MANUFACTURERS' INSTALLATION AND APPLICATION INSTRUCTIONS.

EXTRA WORK

1. NO EXTRA WORK IS TO BE CARRIED OUT WITHOUT WRITTEN AUTHORIZATION FROM THE ENGINEER OR THE OWNER'S REPRESENTATIVE.
2. CONTRACTOR SHALL PROVIDE QUOTATIONS FOR EXTRA WORK AS DIRECTED UNDER CONTEMPLATED CHANGE NOTICES (CCN'S) ISSUED IN WRITING BY THE ENGINEER OR THE OWNER'S REPRESENTATIVE.
3. CONTRACTOR TO SUBMIT ITEMIZED BREAKDOWN FOR BOTH MATERIAL AND LABOUR FOR ALL CONTEMPLATED CHANGE NOTICES. CONTRACTOR WILL USE THE CCN FORMS PROVIDED WITH THE TENDER DOCUMENTS. ALL COLUMNS TO BE USED WHERE APPLICABLE AND EXTENSIONS MADE.
4. AT THE START OF THE PROJECT THE CONTRACTOR SHALL SUBMIT FOR REVIEW THE HOURLY LABOUR RATE THAT IS PROPOSED FOR PRICING ON ALL EXTRA WORK THAT MAY ARISE ON THE PROJECT.
5. LABOUR RATE TO INCLUDE ONLY:
   - .1 PAY AND VACATION PAY.
   - .2 WELFARE AS PER UNION COLLECTIVE AGREEMENT (ACCEPTED ONLY IF CONTRACTOR IS A UNION CONTRACTOR).
   - .3 E.I. OR C.P.P. AS PER FEDERAL GOVERNMENT REQUIREMENTS.
   - .4 W.C.B. PAYMENTS AS PER ONTARIO REGULATIONS.
   - .5 INSURANCE AS PER REQUIREMENTS OR REGULATING BODY.
6. MATERIAL WILL BE PRICES AT THE CONTRACTOR'S COST. COPIES OF SUPPLIER'S INVOICES MAY BE REQUIRED TO SUBSTANTIATE MATERIAL COSTS WHEN REQUESTED.
7. THE AMOUNT OF MARK-UP ALLOWED FOR PROFIT AND OVERHEAD WILL BE IN ACCORDANCE WITH THOSE IN THE CONTRACT DOCUMENTS WITH THE TENDER. TO BE MODIFIED TO REFLECT THE ALLOWED PROFIT AND OVERHEAD STATED IN THE CONTRACT DOCUMENTS.
8. THE MARK-UPS APPLY TO THE NET WHERE A CHANGE INCLUDES BOTH EXTRAS AND CREDITS.
9. COST OF WORK BY A SUB-TRADE TO THE DIVISION 26 CONTRACTOR WILL BE DETERMINED BY THE SUB-TRADE USING THE SAME ITEMIZED BREAKDOWN FORMAT AND THE SAME CCN FORM.
10. A MARK-UP OF 5% WILL BE PERMITTED BY THE DIVISION 26 CONTRACTOR FOR SUB-TRADE WORK.

PROGRESS BILLING

1. CONTRACTOR TO SUBMIT ITEMIZED BREAKDOWN FOR THE PROJECT BASED ON THE CONTRACT PRICE AGREED TO FOR THIS PROJECT. CONTEMPLATED CHANGE NOTICES ONCE AUTHORIZED BY THE OWNER WILL BE ADDED TO THE MONTHLY PROGRESS CLAIM.
2. CLAIMS FOR PAYMENT SHALL BE SUBMITTED FOR REVIEW PRIOR TO THE END OF THE PAY PERIOD TO ALLOW FOR A TIMELY REVIEW BY THE ENGINEER.
3. CONTRACTOR SHALL SUBMIT PROGRESS CLAIMS FOR REVIEW AND PAYMENT AUTHORIZATION IN ACCORDANCE WITH THE TERMS OF THE CONTRACT.

AS-BUILT AND RECORD DRAWINGS

1. OWNERS REPRESENTATIVE WILL PROVIDE TWO(2) SETS OF DRAWINGS AT THE START OF CONSTRUCTION TO ALLOW THE CONTRACTOR TO KEEP AND MAINTAIN ACCURATE AS-BUILT DRAWINGS.
2. ONE SET SHALL BE KEPT ON SITE TO RECORD THE INFORMATION REFLECTING CHANGES AND INSTALLATION ON A DAILY BASIS DURING CONSTRUCTION. AT THE END OF THE PROJECT ALL INFORMATION FROM THE CONSTRUCTION SET SHALL BE TRANSFERRED ONTO THE CLEAN SET AND SENT TO THE ENGINEER FOR THE FINAL REVIEW.
3. FAILURE TO KEEP UP TO DATE AS-BUILT DRAWING MAY JEOPARDIZE MONTHLY PROGRESS PAYMENTS. AS-BUILT DRAWING WILL BE REVIEWED AT THE SAME TIME AS MONTLY PROGRESS PAYMENT INSPECTIONS ARE CONDUCTED.

SHOP DRAWINGS

1. BEFORE FABRICATION OR DELIVERY OF ANY MATERIALS OR EQUIPMENT, SUBMIT ELECTRONIC COPIES OF SHOP DRAWINGS AND DATA SHEETS COVERING ALL ITEMS OF EQUIPMENT FURNISHED AND INTENDED FOR INSTALLATION UNDER THIS CONTRACT FOR APPROVAL BY THE ENGINEER.

TEMPORARY AND TRIAL USAGE

1. TEMPORARY OR TRIAL USAGE BY THE OWNER OF ANY MACHINERY, APPARATUS, EQUIPMENT OR ANY OTHER WORK OR MATERIALS SUPPLIED UNDER THE CONTRACT BEFORE FINAL WRITTEN ACCEPTANCE BY THE ENGINEER IS NOT TO BE CONSTRUED AS EVIDENCE OF THE ACCEPTANCE OF SAME BY THE OWNER. THE OWNER SHALL HAVE THE PRIVILEGE OF SUCH TEMPORARY AND TRIAL USAGE AS SOON AS THIS CONTRACTOR CLAIMS THAT SAID WORK IS COMPLETED. ANY DAMAGE CAUSED BY DEFECTIVE MATERIAL OR WORKMANSHIP THROUGH TEMPORARY OR TRIAL USAGE BY THE OWNER SHALL BE THE RESPONSIBILITY OF THIS CONTRACTOR.
2. ANY PERMANENT EQUIPMENT USED TEMPORARILY FOR TEMPORARY HEAT OR OTHERWISE WILL BE COMPLETELY REPAIRED, REPLACED, AND CLEANED TO THE FULL SATISFACTION OF THE OWNER.

EXPLOSIVES ACTUATED FASTENING DEVICES

1. DO NOT EMPLOY POWER GUNS USING EXPLOSIVES, UNLESS EXPRESSLY PERMITTED BY THE PROJECT MANAGER; COMPLY WITH REQUIREMENTS OF CSA Z-166 (SAFETY CODE FOR EXPLOSIVE ACTUATED TOOLS).

STORAGE

1. THE SECURITY OF THE CONTRACTOR'S EQUIPMENT AND MATERIALS SHALL BE HIS RESPONSIBILITY. CONTRACTOR SHALL LIAISE WITH THE BUILDING OPERATOR AS NECESSARY.

SIGNS

1. PROVIDE WARNING SIGNS IN LOCATIONS WHERE RENOVATIONS AND ALTERATION WORK IS ADJACENT TO AREAS AFFECTING THE PUBLIC.

EQUIPMENT AND SITE CLEANLINESS

1. DUCTS AND EQUIPMENT SHALL BE THOROUGHLY CLEANED OF DIRT, CUTTINGS AND OTHER FOREIGN SUBSTANCES. DISCONNECT, CLEAN AND RECONNECT WHENEVER NECESSARY FOR THE PURPOSE OF LOCATING AND REMOVING OBSTRUCTIONS. REPAIR WORK DAMAGED IN THE COURSE OF REMOVING OBSTRUCTIONS.
2. THE CONTRACTOR SHALL AT ALL TIMES KEEP THE PREMISES FREE FROM THE ACCUMULATION OF WASTE MATERIAL TO THE SATISFACTION OF THE PROJECT MANAGER. PLACE DUST PROTECTION IN THE FORM OF COVER SHEETS OVER EQUIPMENT AND FURNITURE TO ENSURE NO DUST INFILTRATION. CLEANING TO BE COMPLETED AT THE END OF EACH SHIFT TO THE SATISFACTION OF THE PROJECT MANAGER.

OPERATING AND MAINTENANCE DATA

1. FURNISH THREE (3) SETS OF OPERATING AND MAINTENANCE DATA FOR ALL NEW EQUIPMENT AND SYSTEMS. DATA SHALL BE ASSEMBLED IN BOOKLET FORM WITH HARD COVER AND INDEX. IDENTIFY FRONT COVER WITH NAME AND LOCATION OF THE PROJECT, CONSULTING ENGINEER AND CONTRACTOR. SUBMIT ONE COPY TO THE ENGINEER FOR APPROVAL.

MATERIALS

1. MATERIALS AND EQUIPMENT INSTALLED SHALL BE NEW, FULL WEIGHT AND OF BEST QUALITY SPECIFIED. USE SAME BRAND OF MANUFACTURER FOR EACH SPECIFIC APPLICATION. STATICALLY AND DYNAMICALLY BALANCE ROTATING EQUIPMENT FOR MINIMUM VIBRATION AND LOW OPERATING NOISE LEVEL. REPLACE MATERIAL OR WORKMANSHIP BELOW SPECIFIED QUALITY AND RELOCATE WORK WRONGLY PLACED TO THE SATISFACTION OF THE ENGINEER.

APPROVALS

1. THE PRICE SUBMITTED FOR THIS CONTRACT SHALL BE BASED ON THE USE OF MATERIALS AND EQUIPMENT AS SPECIFIED. IF THIS CONTRACTOR WISHES TO QUOTE ON EQUIVALENT MATERIALS AND EQUIPMENT, HE MUST QUOTE ON PRODUCTS APPROVED BY THE ENGINEER, IN WRITING, AS AN EQUIVALENT TO THE PRODUCT SPECIFIED. THIS CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR ANY ADDITIONAL WORK OR MATERIALS REQUIRED BY ALL OTHER CONTRACTORS TO ACCOMMODATE APPROVED EQUIVALENT MATERIALS OR EQUIPMENT. EXTRAS WILL NOT BE APPROVED TO COVER SUCH WORK.

CUTTING AND PATCHING

1. THE CONTRACTOR IS RESPONSIBLE FOR THIS WORK AND SHALL CO-ORDINATE LOCATIONS FOR ALL HOLES FOR PIPES, DUCTS THROUGH FLOORS AND ROOF, ETC., AND PROVIDE SLEEVES REQUIRED TO EXECUTE THE INSTALLATION. X-RAY FLOORS AND STRUCTURAL WALLS BEFORE CUTTING TO LOCATE EXISTING REBAR AND CONDUITS, AND MUST OBTAIN PROJECT MANAGER'S APPROVAL FOR PROPOSED CUTTING BEFORE PROCEEDING. PROVIDE ULC APPROVED FIRE STOPPING SYSTEM FOR ALL PENETRATIONS THROUGH RATED ASSEMBLIES.

SHUTDOWNS

1. ANY SHUTDOWN THAT MAY BE REQUIRED OF EXISTING EQUIPMENT MUST HAVE PRIOR APPROVAL FROM THE PROJECT MANAGER AND ENGINEER. PROVIDE A MINIMUM OF 48 HOURS NOTICE.

MATERIALS REMOVED

1. ALL MATERIALS REMOVED DURING DEMOLITION SHALL BECOME THE PROPERTY OF THE OWNER AND STOCKPILED AS DIRECTED ON SITE. MATERIAL REJECTED BY THE OWNER SHALL BE REMOVED FROM THE SITE BY THE CONTRACTOR.

ELECTRICAL SPECIFICATIONS

MINIMUM STANDARDS

1. ELECTRICAL INSTALLATION: TO CSA C22.1-LATEST EDITION
2. LIGHTING FIXTURES: TO CSA C22.2 No. 9-LATEST EDITION
3. FIXTURE BALLAST: TO CSA C22.2 No. 74-LATEST EDITION
4. ONTARIO BUILDING CODE-LATEST EDITION
5. ONTARIO ELECTRICAL SAFETY CODE-LATEST EDITION.

MOUNTING HEIGHTS

1. INSTALL ELECTRICAL EQUIPMENT AT FOLLOWING HEIGHTS UNLESS INDICATED OTHERWISE:
   - .1 LOCAL SWITCHES: 1100mm
   - .2 WALL RECEPTACLES:
     - .1 GENERAL: 400mm
     - .2 ABOVE COUNTERS: 175mm
   - .3 PANEL BOARDS: 1800mm FROM TOP
   - .4 TELECOMMUNICATION OUTLETS: 400mm

DEMOLITION

1. CONTRACTOR TO CO-ORDINATE WITH OTHER TRADES TO ENSURE THAT ELECTRICAL EQUIPMENT AND FEEDERS ASSOCIATED WITH MECHANICAL EQUIPMENT AND/OR IS LOCATED IN WALLS BEING DEMOLISHED IS ALSO BEING REMOVED.
2. EXISTING EQUIPMENT SHOWN AS RELOCATED TO BE CLEANED AND MADE OPERATIONAL BY THIS CONTRACTOR PRIOR TO ITS RELOCATION.
3. CONTRACTOR TO REPLACE BROKEN AND DISCOLOURED LIGHT FIXTURE ACRYLIC LENSES AS INDICATED BY THE ENGINEER.

EQUIPMENT SHUT-DOWN

1. ANY SHUTDOWN THAT MAY BE REQUIRED OF EXISTING EQUIPMENT, MUST HAVE PRIOR APPROVAL FROM THE ENGINEER.

IDENTIFICATION

1. IDENTIFY WITH LAMACOID NAMEPLATES ALL ELECTRICAL EQUIPMENT SHOWN ON THE DRAWINGS AND/OR MENTIONED IN THE SPECIFICATION SUCH AS MOTORS, SWITCHES, STARTERS, PANEL BOARDS, TRANSFORMERS, CONTROLS, AND SPECIAL RECEPTACLES, REGARDLESS OF WHETHER OR NOT THE ELECTRICAL EQUIPMENT WAS FURNISHED UNDER THIS SECTION OF THE SPECIFICATION. IDENTIFICATION REVIEWED BY ENGINEER.
2. UNLESS OTHERWISE SPECIFIED, NAMEPLATES SHALL BE RIGID LAMACOID, MINIMUM 1.5mm THICK WITH BLACK LETTERS ENGRAVED ON A WHITE BACKGROUND. NAMEPLATES TO BE NEATLY PLACED, AND SQUARE TO SURROUNDING BUILDING OR EQUIPMENT LINES, AND FASTENED IN PLACE WITH MECHANICAL FASTENERS (SCREWS OR POP RIVETS) AS REVIEWED BY ENGINEER.
3. PROVIDE NEATLY TYPED UPDATED CIRCUIT DIRECTORIES IN A PLASTIC HOLDER ON THE INSIDE DOOR OF PANEL BOARDS, WITH COPY IN MANUAL.
4. IDENTIFY ALL PULL AND JUNCTION BOXES, WITH P-TOUCH LABEL IDENTIFICATION, INDICATING SOURCE PANEL AND CIRCUIT NUMBERS.
5. IDENTIFY ALL RECEPTACLES AND SWITCHES WITH P-TOUCH LABELS, BLACK LETTERING ON TRANSPARENT TAPE, INDICATING SOURCE PANEL AND CIRCUIT NUMBER. LABELS TO BE LOCATED ON FRONT OF COVERPLATE.

LOCATION OF OUTLETS

1. LOCATE OUTLETS AS SHOWN ON DRAWINGS. REFER TO INTERIOR DESIGNER DRAWINGS FOR LOCATION OF OUTLETS WHICH ARE DIMENSIONED OR OTHERWISE LOCATED.
2. DO NOT INSTALL OUTLETS BACK-TO-BACK IN WALL; ALLOW MINIMUM 150mm HORIZONTAL CLEARANCE BETWEEN BOXES, AND LOCATE IN SEPARATE STUD CAVITIES WHEREVER POSSIBLE.
3. CHANGE LOCATION OF OUTLETS AT NO EXTRA COST OR CREDIT, PROVIDING DISTANCE DOES NOT EXCEED 3 METERS AND INFORMATION IS GIVEN BEFORE INSTALLATION.

ELECTRIC MOTORS AND WIRING

1. THE ELECTRICAL CONTRACTOR SHALL BE RESPONSIBLE TO SUPPLY ALL MOTOR STARTERS, EXCEPT ON PRE-WIRED PACKAGED EQUIPMENT, DISCONNECT SWITCHES FOR ALL MOTORS FOR THE PROJECT, AND ALL WIRING TO STARTERS AND MOTORS EXCEPT WHERE SHOWN OR NOTED OTHERWISE. EQUIPMENT REQUIRING CONNECTION TO AN ELECTRICAL POWER SOURCE SHALL BE CSA OR HYDRO APPROVED FOR USE AT LOCATION OF INSTALLATION. THE MECHANICAL CONTRACTOR SHALL SUPPLY AND INSTALL ALL LOW VOLTAGE CONTROL WIRING WITHIN 'EMT' CONDUIT FOR A COMPLETE AND OPERATING INSTALLATION UNLESS OTHERWISE SPECIFIED.

WIRING

1. ALL WIRING TO BE COPPER, R90 XLPE, STRANDED WITH 'BRADY LABEL' MAKING SLEEVES AT EACH END, UNLESS OTHERWISE NOTED ON DRAWINGS. WIRING TO BE COLOUR CODED AS PER CODE. MINIMUM WIRE SIZE TO BE No.12 AWG FOR POWER AND LIGHTING.
2. LEAVE ADEQUATE LENGTHS OF WIRE IN JUNCTION BOXES FOR CONNECTIONS TO EQUIPMENT.
3. '8x' WIRING IN WALLS ONLY.
4. RUN A GREEN INSULATED GROUND WIRE SIZED AS PER CODE IN ALL CONDUIT RUNS. DO NOT RELY ON CONDUIT AS GROUND.

CONDUITS

1. EACH LENGTH OF CONDUIT TO BE NEW AND BEAR CSA STAMP OF APPROVAL.
2. ALL CONDUITS RUN ABOVE THE SUSPENDED CEILING TO BE 'EMT'.
3. PROVIDE NYLON PULLROPES IN ALL EMPTY CONDUIT RUNS.
4. MODULAR TO MATCH EXISTING: NOCOM MODULAR WIRING CABLES SYSTEM FOR CONNECTION OF FLUORESCENT TROFFER LIGHT FIXTURES, CONSISTENT WITH BASE BUILDING
5. SMART-CONNECT CABLES: START, JOINER, DROP, SWITCH DROP CABLES AS REQUIRED.
6. CONNECTORS: MOULDED PVC RECEPTACLES AND ADAPTERS.
7. REMOVE AND RECONNECT AS REQUIRED TO OBTAIN LIGHTING CIRCUITS INDICATED AND ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.
8. TERMINATE STARTER AND DROP CABLES AT LIGHT SWITCHES AND LIGHT FIXTURES NOT OUTFITTED WITH NOCOM RECEPTACLES.
9. TURN OVER UNUSED CABLES TO BUILDING OWNER.

OUTLET BOXES

1. ELECTRO-GALVANIZED STEEL, COATING EQUAL TO THAT TO THE CONDUIT.
2. MINIMUM 37 mm DEEP 100 mm SQUARE OR OCTAGONAL AS REQUIRED.
3. EQUIP WITH PLASTER RINGS DEEP ENOUGH FOR WALL FINISH MATERIAL TO FIT OVER THE BOX AND WITHIN 6 mm OF THE COVER OPENING.

PULL BOXES

1. PROVIDE PULLBOXES WHERE RUNS EXCEED 30 METERS IN LENGTH AND HAVE MORE THAN 2-90° BENDS.

WIRING DEVICES

1. RECEPTACLES:
   - .1 DUPLEX RECEPTACLES, CSA TYPE 5-15R 125 VOLT, 15A 'U' GROUND WITH FOLLOWING WITH THE FOLLOWING FEATURES:
   - .2 RECEPTACLES OF SPECIFICATION GRADE.
   - .3 RECEPTACLES OF ONE MANUFACTURER THROUGHOUT PROJECT.
   - .4 IUNBREAKABLE NYLON FACE
   - .5 SUITABLE FOR No. 10 AWG FOR BACK AND SIDE WIRING. SIDE WIRING.
   - .6 BREAK-OFF LINKS FOR USE AS SPLIT RECEPTACLES.
   - .7 EIGHT (8) BACK WIRED ENTRANCES, FOUR(4) SIDE WIRING SCREWS.
   - .8 DOUBLE WIPE CONTACTS AND RIVETED GROUNDING CONTACTS.
   - .9 COLOUR: REFER TO ARCHITECTURAL FINISHES
   - .10 RECEPTACLE TO BE DECORA TYPE.
2. SWITCHES:
   - .1 TO CSA C22.2 NO. 111-M1986 (R1992)
   - .2 15A, 120 VOLT, SINGLE POLE, 3 WAY SWITCHES, AS INDICATED.
   - .3 MANUALLY OPERATED GENERAL PURPOSE AC SWITCHES WITH THE FOLLOWING FEATURES:
     - .1 TERMINAL HOLES APPROVED FOR NO. 10 AWG WIRE.
     - .2 SILVER ALLOY CONTACTS.
     - .3 UREA OR MELAMINE MOULDING FOR PARTS SUBJECT TO CARBON TRACKING
     - .4 SUITABLE FOR BACK AND SIDE WIRING.
     - .5 IVORY TOGGLE
   - .4 TOGGLE OPERATED LOCKING FULLY RATED FOR TUNGSTEN FILAMENT AND FLUORESCENT LAMPS, AND UP TO 80% OF RATED CAPACITY OF MOTOR LOADS.
   - .5 SWITCHES OF ONE MANUFACTURER THROUGH OUT.
   - .6 SWITCHES TO BE DECORA TYPE.
3. ISOLATED GROUND RECEPTACLES:
   - .1 DUPLEX RECEPTACLES, CSA TYPE 5-15R 125 VOLT, 15A, ISOLATED GROUND, WITH THE FOLLOWING FEATURES:
     - .1 ORANGE UREA MOULDED HOUSING.
     - .2 SUITABLE FOR No. 10 AWG FOR BACK AND SIDE WIRING.
     - .3 BREAK-OFF LINKS FOR USE AS SPLIT RECEPTACLES.
     - .4 EIGHT BACK WIRED ENTRANCES, FOUR(4) SIDE WIRING SCREWS.
     - .5 DOUBLE WIPE CONTACTS AND RIVETTED GROUNDING CONTACTS.
   - .2 RECEPTACLES OF SPECIFICATION GRADE.
   - .3 RUN ADDITIONAL GREEN ISOLATED GROUND WIRE PER CIRCUIT FROM PANEL TO EACH WIRING

PANEL BOARDS

1. TO CSA C22.2 No. 29-M1989
2. TO CSA C22.2 No. 5.1-M91
3. MINIMUM 125AMP, 120/208 VOLT, 3 PHASE, 4 WIRE PANEL BOARD RATED 10,000A (SYMMETRICAL) INTERRUPTING CAPACITY. OR AS INDICATED
4. COPPER BUS WITH COPPER NEUTRAL OF SAME AMPERE RATING AS MAINS.
5. MAINS: SUITABLE FOR BOLT ON BREAKERS
6. TRIM AND DOOR FINISH: BAKED GREY ENAMEL WITH TWO(2) KEYS FOR DOOR LOCK
7. PANEL BOARD MAINS, NUMBER OF CIRCUITS AND NUMBER OF BRANCH BREAKERS AS INDICATED.

CIRCUIT BREAKERS

1. PROVIDE CIRCUIT BREAKERS IN PANEL BOARD AS INDICATED.
2. BRANCH CIRCUIT BREAKERS QUICK MAKE, QUICK BREAK, AMBIENT COMPENSATED, COMMON TRIP ON ALL MULTIPOLE BREAKERS, TRIP INDICATING CLEARLY SHOWN BY BREAKER HANDLE TAKING POSITION MIDWAY BETWEEN ON AND OFF.
3. BREAKER INTERRUPTING CAPACITY:
   - .1 250V PANELBOARDS AND CDP PANELBOARDS: 10ka SYMMETRICAL (OR AS INDICATED)
   - .2 600V CDP PANELBOARDS: 25ka SYMMETRICAL (OR AS INDICATED)

TELEPHONE, DATA AND CABLEVISION

1. COMPLETE EMPTY RACEWAYS SYSTEM CONSISTS OF OUTLET BOXES, CONDUITS, FISH WIRES.
2. CONDUITS:
   - .1 21mm 'EMT' RISERS BETWEEN DOUBLE GANGED DEVICES BOXES AND CEILING PLENUM BY DIVISION 26. EXACT LOCATION TO BE DETERMINED ON SITE.(OR AS INDICATED)
3. FISH WIRE: POLYPROPYLENE TYPE.
4. COVERPLATES INSTALLED BY OTHERS.

COVERPLATES

1. POLISHED STAINLESS STEEL COVER PLATES, THICKNESS 1.0mm FOR WIRING DEVICES MOUNTED IN A FLUSH MOUNTED BOX.
2. INSTALL COVER PLATES ONLY AFTER PAINTING AND OTHER WORK IS FINISHED.
3. INSTALL SUITABLE COMMON COVER PLATES WHERE WIRING DEVICES ARE GROUPED.
4. COVER PLATES FOR WIRING DEVICES. COMMUNICATION OUTLET COVERLETS PROVIDED BY SYSTEM CONTRACTOR.
5. COVER PLATES FROM ONE MANUFACTURER THROUGHOUT PROJECT.

DISCONNECT SWITCH

1. DISCONNECT SWITCH TO BE RATED HORSEPOWER AND BE EQUIPPED WITH PROVISIONS FOR THREE(3) LOCKING DEVICES AND TO BE CEMA 1 UNLESS OTHERWISE INDICATED, AMPERAGE AS INDICATED ON DRAWINGS AND MOUNTED 1500mm ABOVE FINISHED FLOOR TO CENTRELINE OF HANDLE.

FUSES

1. FUSE TYPE REFERENCE J1, HAS BEEN ADOPTED FOR USE IN THIS SPECIFICATION.
2. FUSES: PRODUCT OF ONE MANUFACTURER.
3. HRCI-J FUSES.
4. TYPE J1, TIME DELAY, CAPABLE OF CARRYING 500% OF ITS RATED CURRENT FOR 10 SECOND MINIMUM.
5. INSTALL FUSES IN MOUNTING DEVICES IMMEDIATELY BEFORE ENERGIZING CIRCUIT.

TRANSFORMERS

1. ELECTRICAL CHARACTERISTICS:
   - .1 3 PHASE, 600 VOLT INPUT, 120/208 VOLT OUTPUT, 60Hz, kVA RATINGS AS INDICATED ON SINGLE LINE DIAGRAM/DRAWING
   - .2 VOLTAGE TAPS: STANDARD.
   - .3 CAPABILITY TO DELIVER FULL NAMEPLATE kVA
   - .4 NEUTRAL CONNECTION SHALL BE RATED AT TWICE THE CAPACITY OF THE SECONDARY PHASE CURRENT.
2. GENERAL CHARACTERISTICS:
   - .1 THREE PHASE COMMON CORE CONSTRUCTION.
   - .2 CONVECTION AIR COOLED, EEMAC 2R SPRINKLER-PROOF ENCLOSURE, REMOVABLE FRONT COVER.
   - .3 COPPER WINDINGS.
   - .4 INSULATION: CLASS 'H', 150°C TEMPERATURE RISE.
   - .5 BASIC IMPULSE LEVEL (BIL): 10kV.
   - .6 TYPE ANN.
   - .7 SOUND LEVEL: MAX. 45db AT 5 FEET.
   - .8 VOLTAGE CLASS: 1.2kV.
   - .9 ANTI-VIBRATION PADS SHALL BE USED BETWEEN CORE AND ENCLOSURE.
   - .10 FULL LOAD EFFICIENCY AT 170°C: 97%.
   - .11 MAGNETIZING INRUSH CURRENT: MAXIMUM 10 TIMES FULL LOAD RATING.

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No	DESCRIPTION	DATE
1	ISSUED FOR TENDER	APRIL 30, 2026
0	ISSUED FOR REVIEW	APRIL 28, 2026

REVISIONS

client:
TOWN OF CARLETON PLACE
175 BRIDGE STREET
CARLETON PLACE, ON K7C 2V8

project:
CARLETON PLACE ARENA – BUILDING AUTOMATION SYSTEM INSTALLATION
75 NEELIN STREET
CARLETON PLACE, ON K7C 4H1

drawing title:
ELECTRICAL SPECIFICATIONS

scale:	AS NOTED	drawn by:	P.P. / M.G.
designed by:	P.P. / M.G.	reviewed by:	JRP ENG.
approved by:	JRP ENG.	date:	APRIL 2026

project no.: 100-2608

drawing no.: ME-10 of 10