City of Mississauga

Master Specifications for Energy Management Control Systems (EMCS)

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Abstract of Revisions

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EMCS DESIGN GUIDELINES

Part 1 General Overview

1.1 General Overview of the CoM BAS Initiative (2020)

1.1.1 The City of Mississauga (CoM) is a progressive and leading-edge community in the GTA. Directed by the City's Climate Change Plan and Corporate Green Building Standard, energy management and sustainability are of high importance for the future city development. Recognizing this direction, the strategy of development and architecture of Building Automation Systems (BAS), as a crucial tool in controlling building HVAC, lighting, ice-making and other systems, is of the utmost importance. This document serves to provide a clear and concise strategy on the design of new BAS systems and their related inter-operability with other city-wide systems.

1.1.2 The CoM operates more than 350 buildings of various types including offices, ice rinks, pools, community centres, fire stations, libraries, parks, etc In 2020 the CoM set out to create a new BAS/EMCS standards for the purposes of insuring consistency in the design, installation and operation of BAS controls within those facilities with the intent of modernization and upgrading to meet the standards of the next generation of Smart Buildings and Internet of Things (IOT).

1.1.3 A pre-qualification of BAS/EMCS products and vendors to install and service them has been carried out and a CoM Master EMCS Upgrade Specifications has been created to outline the standards for both product an installation. All CoM Pre-Qualified BAS Vendors should be familiar with these CoM Master EMCS Upgrade Specifications and the Standards outlined within.

1.2 Basis of Design

1.2.1 The basis of design for CoM EMCS Upgrades incorporates a dedicated CoM Enterprise server (or virtual server) complete with operating system, all necessary software tools, and an EMCS Enterprise Server Software (ESS) package that has a fully open and accessible licensing structure. The design also includes a second back-up server for storage of all system database parameters including back-up of all BAS Vendor specific field controller programming, trend data, and color graphics. Both servers are located in a CoM designated server room and be connected to the CoM wide area network ("WAN") for communication to multiple sites and multiple EMCS products.

1.2.2 The new system architecture utilizes Tridium Niagara Framework N4 as the pre-selected EMCS ESS package. Vendors shall coordinate with the CoM prior to the start of any project to determine the current Revision of Software in use and to be applied to SRPDC.

1.2.3 The anticipated EMCS upgrade work involved at each facility including new construction projects shall comprise the supply and installation of a new supervisory remote digital controller ("SRPDC"), remote programable digital controllers ("RPDC"), terminal equipment controllers ("TEC") and connection to other original equipment manufacturer application specific controllers ("OEMASC") over EMCS vendor supplied communication network(s).

1.2.4 The EMCS vendor supplied SRPDC shall be a Tridium Niagara JACE 8000 Series controllers connected to EMCS/BAS vendor specific RPDC, TEC, and OEMASC over a field network utilizing BAC-net communication protocol in an open, able to exchange information system. (Where direction has been provided from CoM to connect to existing LON based controllers, LON Communication may be used).

1.2.5 Refer to Part 1.8 of this section for System Architecture and Communication Protocols.

1.2.6 All SRPDC, RPDC, TEC, EMCS Routers/Switches, etc. to be in lockable NEMA rated enclosures (except where otherwise indicated – i.e. VAV Box TEC may be mounted directly on the VAV Box). If in doubt, seek clarification from CoM before submitting a quotation on any project.

1.2.7 All graphics, EMCS programming, trend data, security settings, access level priorities, etc. shall be uploaded by the EMCS vendor(s) and stored on the Server for each project (without need for the involvement of others). This shall be repeated at the start of commissioning and again upon completion of deficiency clean-up and as-builts. Remote access will be provided in accordance with current City of Mississauga IT policies, procedures, and processes.

1.3 Original Equipment Manufacturer Application Specific Controllers (OEMASC).

1.3.1 The use of dedicated equipment controls supplied by others shall be pre-approved by the City of Mississauga Facilities Management prior to design and specification.

1.3.2 All equipment of this nature shall come with a BAC-net compliant communications interface communicating via BAC-net IP (or approved equivalent that is supported by the Pre-Qualified DDC Vendor Hardware interface modules – i.e. LON/Modbus/etc.). The use of Non-BAC-net communication protocols shall only be considered if Bac-Net IP is not available.

1.3.3 Design consultant shall fully identify and indicate the relationship between the EMCS and the dedicated controls for specific HVAC equipment as supplied by others, spelling out the points to be monitored, points to be modified, how and where to display on the graphics, responsibility of HVAC equipment representative and EMCS vendor for programming, graphics and interface, etc.

1.3.4 Connection to the OEM supplied controls shall be via a dedicated Sub-Net communication BUS running from the SNC to the OEMASC's. Please refer to the City of Mississauga System Architecture Diagrams (Appendix A4)

1.3.5 The OEMASC are mentioned in the CoM Master EMCS Upgrade Specifications, Section 253001-EMCS: Building Controllers, are to be stand-alone microprocessor-based controllers that handle the staging, sequencing, control and coordination of specific HVAC equipment and related systems components (Example Chillers/Boilers AHU's/ Other) or a dedicated application specific control system (example, Lighting Control, Power Monitoring, etc). This provides a sole source of responsibility for the equipment's performance to avoid damage to the equipment, to increase safety, and to increase vendor and manufacturer responsiveness during problem solving.

1.3.6 All OEMASC shall be a fully BAC-net compliant devices in order to facilitate interoperability between OEM electrical/mechanical sub-systems and BAC-net EMCS. The use of a gateway/protocol translator shall not be allowed.

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1.3.7 The OEM shall provide any software or hardware required to access or modify any electrical/mechanical subsystems *i.e. RTUs, VSD's, Chillers, Lighting controls and /or Electrical Monitoring & metering.

1.3.8 All submittals for both EMCS and OEM supplied equipment shall identify the interface between EMCS and OEM supplied controller including available points to read/write between systems.

1.3.9 Set up, testing and commissioning of the interface between OEMASC and the EMCS control system shall be carried out with both parties (OEM Programmer and EMCS Programmer) present on site to ensure the proper communication set up and establishing control priority levels and parameters. The cost of these services shall be included in the price from both vendors.

1.3.10 Specifying Consultant shall ensure to include for provision of any necessary OEM Configuration Tools and Licenses as required to connect and setup the OEM controllers and the interface to base EMCS system.

1.4 Purpose of the Guideline

1.4.1 The purpose of this Guideline is to provide the Project Manager, Specifying Design Engineer/Consultant, and other CoM staff involved with evaluation of BAS related projects, with an overview of the CoM EMCS design philosophy.

1.4.2 The Guideline outlines the design requirements for; point naming conventions, typical points and standard sequences of operation, alarming, alarm routing, training needs, commissioning, and the project turn-over process. It also details the CoM approval process (to be followed by Consultant and Contractor) from concept design through to final commissioning and turn-over.

1.5 Role of Consultant and the Use of the CoM Master EMCS Upgrade Specifications

1.5.1 The Master EMCS Upgrade Specifications shall be used as the basis of all EMCS design work for the City of Mississauga facilities.

1.5.2 Design Engineers/Consultants working for the CoM shall create their own project specific EMCS specifications to the extent necessary to meet the needs of the specific project and incorporating the elements and design principals of these Master Specifications. The project specifications shall make clear reference to the sections of these **City of Mississauga Master EMCS Upgrade Specifications** (*Most Current Revision*) within their own design document (in Division 25) .

1.5.3 Project based EMCS specifications issued by Design Engineers/Consultants for the design and specification of HVAC controls shall not deviate from the basic concepts and requirements set forth in the **CoM Master EMCS Upgrade Specifications**. The Master specifications provide details of the CoM expectations an requirements for:

- Removal of Existing
- Hardware/Devices Standards
- Wiring/Network Standards

- Installation Standards
- Alarms and Alarm Routing
- Trend setup
- Active Directory and User Access Levels

1.5.4 The Design Engineer/Consultant should also clearly identify that it is the **City of Mississauga Pre-Qualified EMCS Vendor's** responsibility to make note of any deviations between the Project Specific Specifications and **City of Mississauga Master Specifications for EMCS Upgrades Rev # (Current Revision)**. Such deviations shall be brought to the attention of the City of Mississauga project manager prior to tender closing.

1.5.5 The Design Engineer/Consultant's primary input for new EMCS installations and modifications will be as follows;

- Summary Point Matrix including an indication of points/equipment to be controlled, and locations on the drawings.
- The Sequence of Operation for Equipment to be controlled
- Control System Schematic Drawings
- EMCS Design Consultant shall make use of the material provided in the **Appendices** of the Master Specifications and attached to this Guideline including:
  - A1- CoM Point Naming Convention
  - A2- CoM Building ID and Type List
  - A3- CoM EMCS Cabinet Installation Standard
  - A4- CoM System Architectures
  - A5- CoM Graphical Standard
  - A6- CoM Points List and Typical Sequences of Operation
  - B1 – CoM Points List Template
  - B2 – CoM Sample Points List
  - B3 – CoM Pre-Commissioning Checklist Form
  - B4 – CoM Project Acceptance Form
  - B5 – CoM Training Sign-Off Form
  - B6 – CoM Sample Project Specification EMCS Section
- Electronic versions will be made available to the Consultant and shall be modified/completed to meet the particular project needs of individual projects.

1.5.6 **Note to Contractors:** The **CoM Master EMCS Upgrade Specifications** document should be read in conjunction with the Project Specific Design and Specifications for any New and/or Replacement Energy Management Control System (EMCS), and EMCS upgrade projects designed for the City of Mississauga, Ontario.

1.5.7 Because the **CoM Master EMCS Upgrade Specifications** are periodically updated, the current and ***most recent version of this document should be obtained directly from the City of Mississauga, Ontario Project Manager at the start of each project.***

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1.6 Creation of Points List and Point Naming Convention

1.6.1 Consultants must adhere to CoM Standards for points list and point naming convention, please refer to attached **Appendices A1 and A6**. Preliminary Point Names are to be review and approved by the City of Mississauga Energy Management Team Member

1.7 Application of Building ID and Type

1.7.1 Each CoM has a unique **Building ID** tag which shall form a part of the point name and is to be used in the future integration of other software applications (Room Booking, Asset Planning, etc) with the EMCS. The application of sequences applies different operational modes and control settings based on **Building Type**. Refer to Appendix A2 for a list of Building ID tags and Type of facility. Refer to Appendix A6 for the application of different control modes.

1.8 System Architecture and Communication Protocols

1.8.1 The System Architecture is dependent on the size of facility, type of project, and the availability of CoM IT infrastructure **refer to Appendix A4**. Design Engineer/Consultant should discuss the different system topologies and obtain approvals from the City of Mississauga Project Manager for the final selection of appropriate System Architecture design.

1.8.2 The intended design of all specified system Architectures requires an SRPDC, set-up and programmed to manage and monitor communication between SNC and/or all field level controllers (RPDC, TEC, OEMASC). All EMCS field level controllers shall be capable of standalone operation on loss of communication with the SRPDC and/or SNC. No physical control points shall reside on the either the SRPDC or SNC.

1.8.3 All system graphics, EMCS programming, trend data, security settings, access level priorities, etc shall be uploaded by the EMCS/BAS vendor(s) and stored on the Server (without need for the involvement of the other contractors).

1.9 Application of Typical System Points List and Standard Sequences

1.9.1 In order to maintain consistency in both the design and operation of BAS control systems, the CoM has developed a list of Typical Points and Standard Sequence of Operation to be applied to each typical system.

1.9.2 The standard sequences are generic in nature and are meant to form the basis of design for all CoM BAS control projects. The sequences shall be used as the initial starting point for each project, customized by the specifying Design Engineer/Consultant and tailored for the specifics of individual project and system requirements. Refer to **Appendix A6** for typical points and standard sequences.

1.9.3 All project specific sequences are to be submitted to the CoM for review and approval prior to Tenders (refer to Guideline Part 1.13 **BAS Design and Construction Approval Process).**

1.9.4 Final schedules, set-points, limits, dead bands, etc shall be determined during commissioning and then documented in the as-built drawings and final project close out documentation.

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1.9.5 Where new HVAC systems/design concepts are not listed in the Appendices, the Design Engineer/Consultant shall follow the same naming convention format and broader BAS design principles as outlined in the **CoM Master EMCS Upgrade Specifications** to create a new Points List and Typical Sequence of Operation for integration and use in the subsequent revisions of **CoM Master EMCS Upgrade Specifications**. Once created by Design Engineer/Consultant, the points list and sequences will be presented to the CoM Project Manager for distribution to Stakeholders, review and approval.

1.10 CoM Graphical Standards

1.10.1 The CoM uses a common graphical interface for all sites, set-up and designed specifically to the CoM organizational structure and user access requirements. Each project shall conform to the Graphical Standard and shall seek approval of system graphics before deploying them on site.

1.10.2 Each project will require the full development of **NEW** site-specific customized graphics in accordance with the CoM Graphical Standard as outlined **Appendix A5**. The contractor shall utilize the CoM Graphical Standard in conjunction with existing completed graphical workstation(s) as the starting point of development of new graphics. BAS Vendor shall work closely with the CoM assigned approver and Design Engineer/Consultant to create project/site specific custom graphics.

1.10.3 To accomplish the above, the BAS Vendor shall meet with the Owner and Design Engineer/Consultant within 2 weeks of the Project Start-Up meeting to specifically discuss the requirements for new system graphics and associated plan of execution.

1.10.4 The BAS Vendor and Design Engineer/Consultant shall anticipate a reiterative process whereby the graphics will be submitted multiple times for review and comment, followed by revision(s) until both the Owner is satisfied with the end result (and graphics approval is granted).

1.11 CoM Alarming & Guideline

1.11.1 Refer to **Appendix A6, Part 1.4 Alarm Management** and subsequent Typical Sequence of operation.

1.12 CoM Commissioning Standards

1.12.1 The commissioning agent (CxA) may be a third party service, design consultant, or CoM employee as designated and outline in the Consultant’s project specifications.

1.12.2 Anticipated commissioning process and the role of the EMCS vendor are referenced in these Master Specifications Section 25 01 11

1.13 BAS Design and Construction Approval Process

1.13.1 All new EMCS designs shall be submitted to the City of Mississauga Facilities Management for review prior to tendering of any projects

1.13.2 Preliminary Design Review:

- Assigned CoM Approver to review:
- The use of Correct Point Naming convention

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- The specification of required points and application of correct sequences (Refer **to Appendix A1 and A6** for Point Naming Convention, Points Lists and Standard Sequence of Operation)

1.13.3 Final Design Review (prior to tender):

- Assigned CoM Approver to review:
- Specification uses correct references to **CoM Master EMCS Upgrade Specifications for EMCS Upgrade** (of latest revision)
- Correct use of (or reference to) CoM BAS Forms and Standards (Refer to **Appendix A and B**)
- Proper description of system Architecture and the Pre-Approved Products/ Pre-Qualified Vendors (Refer to **Appendix A4** and **CoM List of Pre-Approved Vendors/Products**)
- Proper reference to additional CoM Submittal and Close-Out Documentation approval process
- Inclusion of CoM Forms for Commissioning/Closeout/Training Approval (Refer to **Appendix B3, B4 and B5)**

1.13.4 Pre-Construction /Submittal Review

- Following the Design/Tender phase the next review by CoM Assigned Approver shall occur during the Pre-Construction Phase. Specifying project Design Engineer/Consultant shall also be responsible to conduct their OWN engineering review concurrently with the CoM review, and shall incorporate the CoM Assigned Approver's comments on the returned shop drawings.
- Assigned CoM Approver to review submittals to confirm:
- Conformance to the specified products and installation standards detailed in the CoM Master EMCS Upgrade Specifications (Refer to **CoM Master EMCS Upgrade Specifications Section 25 30 01 EMCS Building Controllers Family of Controllers, and Section 25 30 02 EMCS Field Control Devices**)
- Shop drawing submittal package has all necessary information (Refer to CoM Master EMCS Upgrade Specifications Section 25 05 02 EMCS Submittals and Review Process)
- Design has correct System Architecture and the Use of Pre-Qualified Products
- Application of Correct Sequences and Points/System
- Use of proper point naming convention

1.13.5 Construction Phase Review:

- Assigned CoM Approver to review close-out submittals to confirm:
- System graphics have been reviewed by CoM Facility Operations to ensure conformance with CoM Graphical Standard (Refer to **Appendix A5**)
- Graphics have been tested by CoM Facility Operations and/or Commissioning Agent to confirm that:
- Links are operational and correct,

- PDF of As-Builts and written sequences are properly linked to the graphics and are up to date with final settings,
- active directory and user access levels are correct and functional
- specified database integration (ie room booking software) is functional and correctly linked to proper systems
- Activity Modes have been set-up and programmed including display of active operational mode on system graphics,
- All alarms (Environmental, Maintenance, Critical, Energy) are set up and alarm routing is correct.
- All systems graphics have an associated settings page with all adjustable control variables, alarm settings and time delays.
- Verification of Trend Data Set-Up, Auto Back-up of Files & software
- Site Verification that CoM Demolition & Installation standards have been met.
- Review of Closeout Data (CoM Forms – Provisional Acceptance, Commissioning Reports, Final Acceptance, Training Acknowledgement, etc). Refer to **Appendix B**

END OF SECTION

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SUBMITTAL PROCEDURES

Part 1 General

1.1 RELATED REQUIREMENTS

1.1.1 Section 25 05 01 EMCS General Requirements.

1.1.2 Section 25 05 02 EMCS Submittals and Review Process

1.2 REFERENCES

1.2.1 None

1.3 ADMINISTRATIVE

1.3.1 Submit to Consultant submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered a sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

1.3.2 Do not proceed with Work affected by submittal until review is complete.

1.3.3 Present shop drawings, product data, samples and mock-ups in SI Metric units.

1.3.4 Where items or information is not produced in SI Metric units converted values are acceptable.

1.3.5 Review submittals prior to submission to Consultant. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.

1.3.6 Notify Consultant, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

1.3.7 Verify field measurements and affected adjacent Work are co-ordinated.

1.3.8 Contractor's responsibility for errors and omissions in submission is not relieved by Consultant's review of submittals.

1.3.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved Consultant review.

1.3.10 Keep one reviewed copy of each submission on site.

1.4 SHOP DRAWINGS AND PRODUCT DATA

1.4.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

1.4.2 Where applicable as indicated elsewhere, submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

1.4.3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for

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completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

1.4.4 Allow 10 days for Consultant's review of each submission.

1.4.5 Adjustments made on shop drawings by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant prior to proceeding with Work.

1.4.6 Make changes in shop drawings as Consultant may require, consistent with Contract Documents. When resubmitting, notify Consultant in writing of revisions other than those requested.

1.4.7 Accompany submissions with transmittal letter containing:

- 1.4.7.1 Date
- 1.4.7.2 Project title and number
- 1.4.7.3 Contractor's name and address
- 1.4.7.4 Identification and quantity of each shop drawing, product data and sample
- 1.4.7.5 Other pertinent data

1.4.8 Submissions include:

- 1.4.8.1 Date and revision dates
- 1.4.8.2 Project title and number
- 1.4.8.3 Name and address of:
  - 1.4.8.3.1 Subcontractor
  - 1.4.8.3.2 Supplier
  - 1.4.8.3.3 Manufacturer
- 1.4.8.4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
- 1.4.8.5 Details of appropriate portions of Work as applicable:
  - 1.4.8.5.1 Fabrication.
  - 1.4.8.5.2 Layout, showing dimensions, including identified field dimensions, and clearances.
  - 1.4.8.5.3 Setting or erection details.
  - 1.4.8.5.4 Capacities.
  - 1.4.8.5.5 Performance characteristics.
  - 1.4.8.5.6 Standards.
  - 1.4.8.5.7 Operating weight.
  - 1.4.8.5.8 Wiring diagrams.
  - 1.4.8.5.9 Single line and schematic diagrams.
  - 1.4.8.5.10 Relationship to adjacent work.

1.4.9 After Consultant's review, distribute copies.

1.4.10 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Consultant may reasonably request.

1.4.11 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Consultant where shop drawings will not be prepared due to standardized manufacture of product.

1.4.12 Submit electronic copies of test reports for requirements requested in specification Sections and as requested by Consultant.

1.4.12.1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.

1.4.12.2 Testing must have been within 3 years of date of contract award for project.

1.4.13 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Consultant.

1.4.13.1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.

1.4.13.2 Certificates must be dated after award of project contract complete with project name.

1.4.14 Submit electronic copies of manufacturer’s instructions for requirements requested in specification Sections and as requested by Consultant.

1.4.14.1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.

1.4.15 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Consultant.

1.4.16 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

1.4.17 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Consultant.

1.4.18 Delete information not applicable to project.

1.4.19 Supplement standard information to provide details applicable to project.

1.4.20 If upon review by Consultant, no errors or omissions are discovered or if only minor corrections are made, copies will be returned, and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

1.5 SAMPLES

1.5.1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.

1.5.2 Deliver samples prepaid to Consultant's business address.

1.5.3 Notify Consultant in writing, at time of submission of deviations in samples from requirements of Contract Documents.

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

1.5.5 Adjustments made on samples by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant prior to proceeding with Work.

1.5.6 Make changes in samples which Consultant may require, consistent with Contract Documents.

1.5.7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.6 MOCK-UPS

1.6.1 N/A

1.7 CERTIFICATES AND TRANSCRIPTS

1.7.1 Immediately after award of Contract, submit Workers' Compensation Board status.

1.7.2 Submit transcription of insurance immediately after award of Contract.

Part 2 Products

2.1 NOT USED

2.1.1 Not Used.

Part 3 Execution

3.1 NOT USED

3.1.1 Not Used.

END OF SECTION 01 33 00

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REGULATORY REQUIREMENTS

Part 1 General

1.1 REFERENCES

1.1.1 Ontario Building Code (Latest Edition)

1.2 RELATED SECTIONS

1.2.1 All

1.3 CODES, BY-LAWS, REGULATIONS, ORDINANCES

1.3.1 Carry out work in accordance with requirements of the latest edition of the applicable provincial building code, including all amendments and revisions.

1.3.2 Comply with requirements, regulations and ordinances of other authorities having jurisdiction.

1.3.3 Where it is necessary to carry out work outside property lines, such as sidewalks, paving, concrete curbs, service connections, comply with applicable requirements of municipal authorities having jurisdiction. Any permits and fees associated with this work shall be included in the Contract price.

1.3.4 Codes, by-laws, regulations, ordinances referred to in these Contract Documents are the latest published edition including published revisions and amendment, at time of Tender Submission.

1.3.5 In case of conflict between codes, by-laws, regulations, ordinances, specifications, follow most stringent requirements.

1.4 FIRE PROTECTION REQUIREMENTS

1.4.1 Refer to technical section of specifications and drawings for specific fire protection requirements.

1.4.2 Test methods used to determine fire hazard classification and fire endurance rating shall be as required by The Building Code.

1.4.3 Upon request, furnish the Owner with evidence of compliance with project fire protection requirements.

1.4.4 Materials and components used to construct fire rated assemblies and materials requiring fire hazard classification shall be listed and labelled, or otherwise approved, by fire rating authority. Labelled materials and their packaging shall bear fire rating authorities label showing product classification.

1.4.5 Materials having a fire hazard classification shall be applied/installed in accordance with manufacturer’s directions.

1.4.6 Fire rated assemblies shall be constructed in strict accordance with applicable assembly design report. Deviation will not be allowed.

1.4.7 Construct fire rated assemblies as continuous, uninterrupted elements except for permitted openings. Extend fire rated walls and partitions from floor to underside of structural deck above.

1.4.8 Fill and patch voids and gaps around opening and penetrations in and at perimeter of fire rated assemblies to maintain continuity and integrity of fire separation and smoke seal to the requirements of jurisdictional authorities.

Part 2 Products

2.1 NOT USED

2.1.1 Not Used.

Part 3 Execution

3.1 NOT USED

3.1.1 Not Used.

END OF SECTION 01 41 00

QUALITY CONTROL

Part 1 General 2
1.1 RELATED SECTION 2
1.2 REFERENCES 2
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QUALITY CONTROL

Part 1 General

1.1 RELATED SECTION

1.1.1 All

1.2 REFERENCES

1.2.1 Canadian Construction Association

1.2.1.1 CCA-1 Stipulated Price Subcontract

1.3 INSPECTION OF WORK

1.3.1 The Owner, Consultant, and Commissioning Agent are to have access to the work for inspection purposes. Co-operate and provide such access.

1.3.2 Give timely notice requesting inspection if work is designated for special tests, inspections or approvals or if work is to be covered up.

1.3.3 Any work which is covered or permitted to be covered that is subject to inspection or before any special tests and approvals are completed is to be uncovered and have the inspections satisfactorily completed. Pay costs of such remedial work.

1.3.4 Arrange for and be responsible for all required inspections of the Work including mechanical and electrical inspections.

1.3.5 Make all payments required for inspection permits.

1.3.6 Inform all inspection agencies of need for inspections.

1.3.7 Request that Consultant conduct all inspections concerning changes in the Work and requests for payment.

1.4 REJECTED WORK

1.4.1 Defective work, whether the result of poor workmanship, use of defective materials or damage through carelessness or other act, and whether incorporated in the work or not, which has been rejected by the owner as failing to conform to the Contract documents, is to be removed promptly and replaced in accordance with the Contract documents at the Contractor’s expense.

1.4.2 If in the opinion of Consultant, it is not expedient to correct defective work, or work not done in accordance with the Contract documents, Consultant may deduct from the Contract price the difference in value between the work done and that called for in the Contract documents, the amount of which is to be determined by Consultant.

1.5 STANDARDS

1.5.1 Within the text of these specifications, reference is made to the following standards:

1.5.1.1 ASTM - American Society for Testing and Materials

1.5.1.2 CAN/CGSB - Canadian General Standards Board

1.5.1.3 CSA - Canadian Standards Association

1.5.1.4 FM - Factory Mutual Engineering Corporation

1.5.1.5 ULC - Underwriters’ Laboratories of Canada

1.5.1.6 CGA - Canadian Gas Association

QUALITY CONTROL

1.5.2 The testing of materials not elsewhere specified, or normally carried out as a matter of standard construction practice, may be requested by Consultant to prove conformance with Standards, and will be paid for by Consultant. Materials that fail are to be replaced and re-tested at the Contractor's expense and costs incurred by the Owner for the original test(s) shall be deducted from the Contract value.

1.5.3 The referenced standards and any amendments on the day of receipt of tenders shall be applicable to the work during the duration of the Contract, unless otherwise specified.

1.6 CONTRACTOR'S RESPONSIBILITIES *(IF TESTING IS REQUIRED)*

1.6.1 Contractor shall be responsible for all of the following:

1.6.1.1 Notify the Owner and testing agency minimum 48 hours in advance of operations to allow for assignment of personnel and scheduling of tests without causing delay in work.

1.6.1.2 Provide testing agency with access to work at all time.

1.6.1.3 Supply casual labour and other incidental services required by testing agency.

1.6.2 When initial inspection and testing indicates non-compliance with Contract documents, any subsequent re-inspection and re-testing occasioned by non-compliance shall be performed by same testing agency at the Contractor's cost.

1.6.3 When initial inspection and testing indicates non-compliance with Contract documents, costs of that initial inspection and testing shall be charged to the Contractor.

1.7 TOLERANCES FOR INSTALLATION OF WORK

1.7.1.1 Unless acceptable tolerances are otherwise specified in a Section or are otherwise required for proper functioning of equipment, tolerances for site services, and mechanical and electrical systems are defined as follows:

1.7.1.2 "Plumb and Level" shall mean plumb or level within 1 mm in 1 metre.

1.7.1.3 "Square" shall mean not in excess of 10 seconds lesser or greater than 90 degrees.

1.7.1.4 "Straight" shall mean within 1 mm under or over a 1 Metre long straightedge

1.7.2 All work must be installed in accordance with the tolerances specified in Paragraph 1.7 above.

Part 2 Products

2.1 Not Used

Part 3 Execution

3.1 Not Used

END OF SECTION 01 45 00

CLOSEOUT PROCEDURES

Part 1 General ... 2
1.1 RELATED REQUIREMENTS ... 2
1.2 REFERENCES ... 2
1.3 DEFINITIONS OF ACCEPTANCE TERMS ... 2
1.4 TAKE OVER PROCEDURE ... 3
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Part 3 Execution ... 5
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CLOSEOUT PROCEDURES

Part 1 General

1.1 RELATED REQUIREMENTS

1.1.1 01 33 00 Submittal Procedures

1.1.2 01 78 00 Closeout Submittals

1.1.3 25 01 11 EMCS Start-Up, Verification and Commissioning.

1.2 REFERENCES

1.2.1 None

1.3 DEFINITIONS OF ACCEPTANCE TERMS

1.3.1 Real End of the Work

1.3.1.1 The work shall be considered finished when the deficiencies are completed in accordance to Consultant's evaluation.

1.3.2 Contractor's Inspection

1.3.2.1 The Contractor and his subcontractors shall conduct an initial inspection of the work prior to Pre-Commissioning Activities (functional testing, performance testing, etc.) and shall attempt to correct all noted deficiencies. Contractor is to provide a written list of deficiencies to the Owner and Consultant using the City of Mississauga Project Close Out Provisional Acceptance Forms.

1.3.3 Provisional Acceptance

1.3.3.1 The provisional acceptance shall follow the end of work on site as necessary to obtain substantial completion and shall signal the start of the warranty.

1.3.3.2 The Contractor shall make a request for the provisional acceptance by completing City of Mississauga ***Project Close Out Provisional Acceptance Form*** and related functional testing. This shall occur only when the system has been completely installed, calibrated, tested and is operational

1.3.3.3 Provisional Acceptance forms must be signed off by Contractor/Owner/Consultant, marking the mutual agreement of Substantial Completion of the system.

1.3.3.4 If Consultant judges that the tests are not adequately done by the Contractor prior to his request for provisional acceptance, the charges incurred by the Consultant and/or commissioning agent for an additional visit shall be charged to the Contractor.

1.3.4 Final Inspection:

1.3.4.1 Consultant, Contractor, and Owner to inspect Work and identify defects and deficiencies.

1.3.4.2 Contractor to correct Work as directed prior to Commissioning.

1.3.5 Commissioning

1.3.5.1 Commissioning shall be carried out by the contractor and Owner's designate commissioning agent only after Provisional acceptance has been granted.

1.3.5.2 As a part of the new control system installation, the contractor shall first fully test and commission the entire system. All pre-commissioning activities and testing shall be fully documented and submitted with the Provisional Acceptance Forms. This includes a full point-to point check-out (functional test) of the system, provide completed Pre-commissioning (Functional Test) Check List to Owner's designate Commissioning Agent.

1.3.5.3 Contractor shall assistance, staff and materials to support the Owner's designate Commissioning Agent activities.

1.3.5.4 Contractor's designate programmer/control technician to carry out the operator commands and adjustments to software parameters as directed by the Owners designated Commissioning Agent.

1.3.5.5 Owners designate commissioning agent to prepare commissioning report outlining results of functional and performance testing including a list of any outstanding deficiencies to be completed by the contractor to obtain Final Acceptance.

1.3.6 Final Acceptance

1.3.6.1 Application for final acceptance shall follow within a maximum of ten (10) working days from receipt of Commissioning report. Contractor shall complete all outstanding deficiencies, submitted as built and O&M documentation and completed training to receive Final Acceptance.

1.3.6.2 Final Acceptance forms must be signed off by Contractor/Owner/Consultant, marking the mutual agreement of acceptance of the system.

1.4 TAKE OVER PROCEDURE

1.4.1 Substantial Completion

1.4.1.1 Refer to Part 1 above for definition of terms for acceptance. All Forms must be completed by the Contractor, Submitted and Signed by all parties (Contractor/Consultant/Owner) for a stage to be considered Complete

1.4.1.2 Substantial Completion cannot be granted without completed and signed City of Mississauga ***Project Close Out Provisional Acceptance Forms***.

1.4.1.3 When the Contractor is satisfied that all deficiencies have been corrected, the Contractor shall request, in writing, a Substantial Completion Inspection along with the submission of the ***Project Close Out Provisional Acceptance Form***. Once forms are submitted there will be a Final Inspection to confirm completion, the inspection team shall consist of the Owner, Consultant and Contractor.

1.4.1.4 **Final Inspection**: Contractor to complete the ***Project Close Out Provisional Acceptance Forms*** and Submit to the Owner and Consultant indicating satisfactory completion of the "Contractor's Inspection" and signifying readiness for Final Inspection. Commissioning shall be scheduled but cannot take place until the Final Inspection is complete. Inspection Team shall conduct a final inspection of the system installation and create a list of any noted additional deficiencies.

1.4.1.5 **Deficiencies**: Following final inspection, a list of all noted deficiencies to date shall be drawn up and include with the deficiencies previously listed on the back pages of ***Project Close Out Provisional Acceptance Form***. The Contractor shall correct all deficiencies in a satisfactory manner and within agreed upon timelines.

1.4.1.6 **Declaration of Completion:** (Signed Project Close Out Provisional Acceptance Form): When it is mutually agreed upon by the inspection team that the work needed for Provisional Acceptance is complete, and the value of outstanding work is less than the contractual obligations required for Substantial Completion (per contract documents) all parities shall sign the "***Project Close Out Provisional Acceptance Form***" and shall agree upon the date to be noted for Substantial Completion.

1.4.1.7 **Certificate of Substantial Completion**: The Owner or Payment Certifier will state in writing, upon agreement with the above declaration, their approval of the inspected work, as "Substantially Complete." The Contractor shall publish this Certificate of Substantial Completion in a recognized industry trade journal (e.g. Daily Commercial News) to establish the date for commencement of the lien period.

1.4.1.8 **Commencement of Lien and Guarantee Period**: The date of publication of the Owner's certificate of substantial completion, as above, shall mean immediate commencement of the lien period as specified by Provincial lien laws, and commencement periods. Neither the Contractor, the subcontractors nor any supplier shall carry out any work except for repairs or replacements under guarantee on the project during the lien period.

1.5 TOTAL PERFORMANCE

1.5.1 Final Acceptance

1.5.1.1 Prior to requesting a final acceptance do the following:

1.5.1.1.1 Complete commissioning with Owner's designate Commissioning Agent.

1.5.1.1.2 Schedule and completed all outstanding deficiencies

1.5.1.1.3 Submit As-Built Documentation and where EMCS has been upgraded, update System Graphics to include Links to updated PDF's of As-Builts

1.5.1.1.4 Submit all Project Close-Out Documentation

1.5.1.1.5 Complete all Training

1.5.1.1.6 Submit a final request for payment in accordance with Contract requirements and incorporating all approved changes to the Contract price.

1.5.1.1.7 Submit completed and signed City of Mississauga ***Project Close Out Final Acceptance Forms*** to the Owner and Consultant signifying a request for a Final Acceptance. Final Acceptance Form to include a copy of all previous deficiencies noting dates corrected and indicating that the work is totally performed, and the project is ready for Final Acceptance. A final inspection will be required to verify completion and shall be carried out by the same parties involved in the Provisional Acceptance Stage.

CLOSEOUT PROCEDURES

1.5.1.2 If all deficiencies have not been corrected, in the opinion of the Owner and/or Consultant a final deficiency list shall be prepared and sent to the Contractor in the same manner as specified herein for the Substantial Completion and the inspection procedure repeated until all items have been completed to the satisfaction of the Owner and/or Consultant.

1.5.1.3 The Owner and Consultant will conduct one Total Performance inspection and maximum one follow-up inspection. Subsequent inspections due to the Contractor's failure to complete work as required shall be paid for by the Contractor.

1.5.1.4 Failure of the Contractor to correct the listed deficiencies within the 40-day lien period will result in direct action being taken by the Owner to correct the deficiencies outside of the Contract.

1.5.1.5 On the 40th day of the lien period final inspection shall be made to ascertain that Contractor progresses with deficiencies and to invoke the above clause should it be required.

1.5.1.6 Once all deficiencies are complete and all parties are satisfied that the conditions are met for "Final Acceptance". The Owner, Contractor, and Consultant will all sign the ***Project Close Out Final Acceptance Form***.

1.6 DEMONSTRATION AND TRAINING

1.6.1 The Owner's facility staff, shall receive orientation and training on features, systems and equipment in each facility requisite with the complexity and criticality of the system and the OWNER's needs.

1.6.2 Additional training requirements may be found in specific sections of Division 25.

1.7 FINAL CLEANING

1.7.1 Clean all workspace in accordance in anticipation of final turn-over

1.7.2 Remove surplus materials, excess materials, rubbish, tools and equipment.

1.7.3 Waste Management: separate waste materials for recycling

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION 01 77 00

CLOSEOUT SUBMITTALS

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1.1 RELATED REQUIREMENTS ... 2
1.2 REFERENCES ... 2
1.3 ADMINISTRATIVE REQUIREMENTS ... 2
1.4 ACTION AND INFORMATIONAL SUBMITTALS ... 2
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1.9 EQUIPMENT AND SYSTEMS ... 4
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Part 3 Execution ... 8
3.1 NOT USED ... 8

CLOSEOUT SUBMITTALS

Part 1 General

1.1 RELATED REQUIREMENTS

1.1.1 Section 01 33 00 - Submittal Procedures

1.1.2 Section 01 77 00 - Close-Out Procedures

1.1.3 Section 01 79 00 - Demonstration and Training.

1.2 REFERENCES

1.2.1 None

1.3 ADMINISTRATIVE REQUIREMENTS

1.3.1 Pre-warranty Meeting:

1.3.1.1 Convene meeting one week prior to contract completion with contractor's representative and Owner’s Authorized Representative to:

1.3.1.1.1 Verify Project requirements.

1.3.1.1.2 Review manufacturer's O&M instructions and warranty requirements.

1.3.1.2 Owner’s Authorized Representative to establish communication procedures for:

1.3.1.2.1 Notifying of any construction warranty defects.

1.3.1.2.2 Determine priorities for type of defects.

1.3.1.2.3 Determine reasonable response time.

1.3.1.3 Contact information for bonded and licensed company for warranty work action: provide name, telephone number and address of company authorized for construction warranty work action.

1.3.1.4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

1.4.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.4.2 Two weeks prior to Substantial Performance of the Work, submit to the Consultant, four (4) final copies of operating and maintenance manuals in English.

1.4.3 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.

1.4.4 Provide evidence, if requested, for type, source and quality of products supplied.

1.5 FORMAT

1.5.1 Organize data as instructional manual.

1.5.2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.

1.5.3 When multiple binders are used correlate data into related consistent groupings.

1.5.3.1 Identify contents of each binder on spine.

1.5.4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.

1.5.5 Arrange content by systems, under Section numbers and sequence of Table of Contents.

1.5.6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

1.5.7 Text: manufacturer's printed data, or typewritten data.

1.5.8 Drawings: provide with reinforced punched binder tab.

1.5.8.1 Bind in with text; fold larger drawings to size of text pages.

1.5.9 Provide scaled CAD files in dwg format on CD.

1.6 CONTENTS - PROJECT RECORD DOCUMENTS

1.6.1 Table of Contents for Each Volume: provide title of project;

1.6.1.1 Date of submission; List names and Date.

1.6.1.2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.

1.6.1.3 Schedule of products and systems indexed to content of volume.

1.6.2 For each product or system:

1.6.2.1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

1.6.3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.

1.6.4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

1.6.5 Typewritten Text: as required to supplement product data.

1.6.5.1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.

1.6.6 Training: refer to Section 01 79 00 - Demonstration and Training.

1.7 AS -BUILT DOCUMENTS AND SAMPLES

1.7.1 Maintain, at site for Consultant and Owner one record copy of:

1.7.1.1 Contract Drawings.

1.7.1.2 Specifications.

1.7.1.3 Addenda.

1.7.1.4 Change Orders and other modifications to Contract.

1.7.1.5 Reviewed shop drawings, product data, and samples.

1.7.1.6 Field test records.

1.7.1.7 Inspection certificates.

1.7.1.8 Manufacturer's certificates.

1.7.2 Store record documents and samples in field office apart from documents used for construction.

1.7.2.1 Provide files, racks, and secure storage.

1.7.3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.

1.7.3.1 Label each document "PROJECT RECORD" in neat, large, printed letters.

1.7.4 Maintain record documents in clean, dry and legible condition.

1.7.4.1 Do not use record documents for construction purposes.

1.7.5 Keep record documents and samples available for inspection by Consultant.

1.8 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

1.8.1 Record information on set black line opaque drawings, and in copy of Project Manual, provided by Consultant.

1.8.2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.

1.8.3 Record information concurrently with construction progress.

1.8.3.1 Do not conceal Work until required information is recorded.

1.8.4 Contract Drawings and shop drawings: mark each item to record actual construction, including:

1.8.4.1 Measured depths of elements of foundation in relation to finish first floor datum.

1.8.4.2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

1.8.4.3 Measured locations of internal utilities and appurtenances referenced to visible and accessible features of construction.

1.8.4.4 Field changes of dimension and detail.

1.8.4.5 Changes made by change orders.

1.8.4.6 Details not on original Contract Drawings.

1.8.4.7 References to related shop drawings and modifications.

1.8.5 Specifications: mark each item to record actual construction, including:

1.8.5.1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.

1.8.5.2 Changes made by Addenda and change orders.

1.8.6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.

1.8.7 Provide digital photos, if requested, for site records.

1.9 EQUIPMENT AND SYSTEMS

1.9.1 For each item of equipment and each system include description of unit or system, and component parts.

1.9.1.1 Give function, normal operation characteristics and limiting conditions.

1.9.1.2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

1.9.2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.

1.9.3 Include installed colour coded wiring diagrams.

1.9.4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.

1.9.4.1 Include regulation, control, stopping, shut-down, and emergency instructions.

1.9.4.2 Include summer, winter, and any special operating instructions.

1.9.5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

1.9.6 Provide servicing and lubrication schedule, and list of lubricants required.

1.9.7 Include manufacturer's printed operation and maintenance instructions.

1.9.8 Include sequence of operation by controls manufacturer.

1.9.9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

1.9.10 Provide installed control diagrams by controls manufacturer.

1.9.11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.

1.9.12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

1.9.13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

1.9.14 Additional requirements: as specified in individual specification sections.

1.10 MATERIALS AND FINISHES

1.10.1 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations.

1.10.1.1 Provide information for re-ordering custom manufactured products.

1.10.2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

1.10.3 Moisture-protection and weather-exposed products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

1.10.4 Additional requirements: as specified in individual specifications sections.

1.11 MAINTENANCE MATERIALS

1.11.1 Spare Parts:

1.11.1.1 Provide spare parts, in quantities specified in individual specification sections.

1.11.1.2 Provide items of same manufacture and quality as items in Work.

1.11.1.3 Deliver to site; place and store.

1.11.1.4 Receive and catalogue items.

1.11.1.5 Submit inventory listing to Owner’s Authorized Representative.

1.11.1.6 Include approved listings in Maintenance Manual.

1.11.1.7 Obtain receipt for delivered products and submit prior to final payment.

1.11.2 Extra Stock Materials:

1.11.2.1 Provide maintenance and extra materials, in quantities specified in individual specification sections.

1.11.2.2 Provide items of same manufacture and quality as items in Work.

1.11.2.3 Deliver to site; place and store.

1.11.2.4 Receive and catalogue items.

1.11.2.5 Submit inventory listing to Owner's Authorized Representative.

1.11.2.6 Include approved listings in Maintenance Manual.

1.11.2.7 Obtain receipt for delivered products and submit prior to final payment.

1.11.3 Special Tools:

1.11.3.1 Provide special tools, in quantities specified in individual specification section.

1.11.3.2 Provide items with tags identifying their associated function and equipment.

1.11.3.3 Deliver to site; place and store.

1.11.3.4 Receive and catalogue items.

1.11.3.5 Submit inventory listing to Owner's Authorized Representative.

1.11.3.6 Include approved listings in Maintenance Manual.

1.12 DELIVERY, STORAGE AND HANDLING

1.12.1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.

1.12.2 Store in original and undamaged condition with manufacturer's seal and labels intact.

1.12.3 Store components subject to damage from weather in weatherproof enclosures.

1.12.4 Store paints and freezable materials in a heated and ventilated room.

1.12.5 Remove and replace damaged products at own expense and for review by Consultant.

1.13 WARRANTIES AND BONDS

1.13.1 Develop warranty management plan to contain information relevant to Warranties.

1.13.2 Submit warranty management plan, 30 days before planned pre-warranty conference, to Owner's Authorized Representative approval.

1.13.3 Warranty management plan to include required actions and documents to assure that Owner's Authorized Representative receives warranties to which it is entitled.

1.13.4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.

1.13.5 Submit, warranty information made available during construction phase, to Owner's Authorized Representative for approval prior to each monthly pay estimate.

1.13.6 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:

1.13.6.1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.

1.13.6.2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principals.

1.13.6.3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.

1.13.6.4 Verify that documents are in proper form, contain full information, and are notarized.

1.13.6.5 Co-execute submittals when required.

1.13.6.6 Retain warranties and bonds until time specified for submittal.

1.13.7 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.

1.13.8 Conduct joint 4 month and 9-month warranty inspection, measured from time of acceptance, by Owner’s Authorized Representative.

1.13.9 Include information contained in warranty management plan as follows:

1.13.9.1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.

1.13.9.2 Provide list for each warranted equipment, item, feature of construction or system indicating:

1.13.9.2.1 Name of item.

1.13.9.2.2 Model and serial numbers.

1.13.9.2.3 Location where installed.

1.13.9.2.4 Name and phone numbers of manufacturers or suppliers.

1.13.9.2.5 Names, addresses and telephone numbers of sources of spare parts.

1.13.9.2.6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.

1.13.9.2.7 Cross-reference to warranty certificates as applicable.

1.13.9.2.8 Starting point and duration of warranty period.

1.13.9.2.9 Summary of maintenance procedures required to continue warranty in force.

1.13.9.2.10 Cross-Reference to specific pertinent Operation and Maintenance manuals.

1.13.9.2.11 Organization, names and phone numbers of persons to call for warranty service.

1.13.9.2.12 Typical response time and repair time expected for various warranted equipment.

1.13.9.3 Contractor's plans for attendance at 4- and 9-month post-construction warranty inspections.

1.13.9.4 Procedure and status of tagging of equipment covered by extended warranties.

1.13.9.5 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

1.13.10 Respond in timely manner to oral or written notification of required construction warranty repair work.

1.13.11 Written verification to follow oral instructions.

1.13.11.1 Failure to respond will be cause for the Owner’s Authorized Representative to proceed with action against Contractor.

1.14 WARRANTY TAGS

1.14.1 Tag, at time of installation, each warranted item. Provide durable, oil and water-resistant tag approved by Owner’s Authorized Representative.

1.14.2 Attach tags with copper wire and spray with waterproof silicone coating.

1.14.3 Leave date of acceptance until project is accepted for occupancy.

1.14.4 Indicate following information on tag:

1.14.4.1 Type of product/material.

1.14.4.2 Model number.

1.14.4.3 Serial number.

1.14.4.4 Contract number.

1.14.4.5 Warranty period.

1.14.4.6 Inspector's signature.

1.14.4.7 Construction Contractor.

Part 2 Products

2.1 NOT USED

2.1.1 Not Used.

Part 3 Execution

3.1 NOT USED

3.1.1 Not Used.

END OF SECTION 01 78 00

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DEMONSTRATION AND TRAINING

Part 1 General

1.1 RELATED REQUIREMENTS

1.1.1 25 01 11 EMCS Start-Up, Verification and Commissioning

1.1.2 25 01 12 EMCS Training.

1.2 ADMINISTRATIVE REQUIREMENTS

1.2.1 Demonstrate the operation and maintenance of equipment and systems to Owner's personnel in accordance with sections 25 01 11 and 25 01 12.

1.2.2 Owner: provide list of personnel to receive instructions, and co-ordinate their attendance at agreed-upon times.

1.2.3 Preparation:

1.2.3.1 Verify conditions for demonstration and instructions comply with requirements.

1.2.3.2 Verify designated personnel are present.

1.2.3.3 Ensure equipment has been inspected and put into operation in accordance with Section 25 01 11.

1.2.3.4 Ensure testing, adjusting, and balancing has been performed and equipment and systems are fully operational.

1.2.4 Demonstration and Instructions:

1.2.4.1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at agreed upon times, at the designated location.

1.2.4.2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.

1.2.4.3 Review contents of manual in detail to explain aspects of operation and maintenance.

1.2.4.4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.

1.2.5 Time Allocated for Instructions: ensure amount of time required for instruction of each item of equipment or system as follows:

1.2.5.1 Section 25 01 12 - EMCS Training: refer to part 1.4 of Section 25 01 12 for details.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

1.3.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.3.2 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for Owner's approval.

1.3.3 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.

1.3.4 Give time and date of each demonstration, with list of persons present.

1.3.5 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.4 QUALITY ASSURANCE

1.4.1 When specified in individual Sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:

1.4.1.1 Instruct Owner's personnel.

1.4.1.2 Provide written report that demonstration and instructions have been completed.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION 01 79 00

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2.1 Not Used 5

Part 3 Execution 5

3.1 Not Used 5

GENERAL COMMISSIONING REQUIREMENTS

Part 1 General

1.1 SUMMARY

1.1.1 Section Includes:

1.1.2 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.

1.2 ACRONYMS:

1.2.1 BMM - Building Management Manual.

1.2.2 Cx - Commissioning.

1.2.3 CxA – Commissioning Agent

1.2.4 EMCS - Energy Monitoring and Control Systems.

1.2.5 O&M - Operation and Maintenance.

1.2.6 PI - Product Information.

1.2.7 PV - Performance Verification.

1.2.8 TAB - Testing, Adjusting and Balancing.

1.3 RELATED SECTION

1.3.1 Section 25 01 11 EMCS Start-Up, Verification and Commissioning

1.3.2 Section 25 01 12 EMCS Training

1.3.3 Section 25 90 01 EMCS Site Requirements Applications and System Sequences of Operation

1.4 GENERAL

1.4.1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed by the Owner’s designate CxA only after equipment, systems and integrated systems are completely installed, functional and the Contractor's Performance Verification responsibilities (**Pre Commissioning Activities**) have been completed and approved.

1.4.2 Objectives:

1.4.2.1 Verify installed equipment, systems and integrated systems operate in accordance with Contract Documents and design criteria and intent.

1.4.2.2 Ensure appropriate documentation is compiled into the BMM.

1.4.2.3 Effectively train O&M staff.

1.4.3 Contractor to assist the CxA in the Cx process, operating equipment, and systems, troubleshooting and adjusting as required.

1.4.3.1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.

1.4.3.2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.

1.4.4 Design Criteria: as per client's requirements or determined by designer and/or the CxA. To meet Project functional and operational requirements.

1.5 SCOPE OF WORK

1.5.1 Provide all material, tools, labour, and supervision necessary to assist the commissioning agent (CxA) in the verification of commissioning of the equipment and systems as outlined in the drawings, specifications, and final commissioning plan.

1.5.2 Contractors and Manufacturer Representatives for each piece of installed equipment are to participate in the commissioning process and cooperate fully with the CxA.

1.5.3 Once the contractor’s **Pre-Commissioning Activities** are completed as outlined in the project specific Contract Documents, provide material, tools, labour and supervision to verify in detail with the CxA that the equipment and systems have been commissioned in accordance with this and related Sections.

1.6 OBJECTIVES

1.6.1 Verify installed equipment, systems and integrated systems operate in accordance with the owner`s project requirements, the contract documents and design criteria and intent.

1.6.2 A commissioning agent (CxA) will be assigned by the Owner to perform commissioning verification of the new equipment and control sequences. This will include both functional testing and performance testing activities as outlined in the Final Commissioning Plan.

1.6.3 Contractor participates in the commissioning process, operating equipment and systems, troubleshooting and making adjustments as required.

1.6.4 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be operated interactively with each other as intended in accordance with contract documents and design criteria.

1.6.5 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.

1.6.6 A Final Commissioning Plan, including functional performance test forms, will be provided by the commissioning agent for completion by the contractor. The functional performance test forms will be based on the sequence of operations outlined in Section 25 90 01 EMCS Site Requirements Applications and System Sequences of Operation.

1.7 COMMISSIONING (CX) OVERVIEW

1.7.1 Complete commissioning scope to be defined by consultant/BAS Designer in project specific specifications (refer to Section 01 91 13.13 Commissioning Plan of project specifications).

1.7.2 Cx activities supplement field quality and testing procedures described in relevant technical sections.

1.7.3 Refer to drawings and specifications for overview of the equipment and systems to be commissioned. Final equipment and systems list will be provided in Final Commissioning Plan.

1.7.4 Cx activities supplement field quality and testing procedures described in relevant technical sections of the Contract Documents. Cx activities do not relieve the Contractor from the contractual requirements outlined in other specification sections of the Contract Documents. Cx activities do not circumvent or relieve the Contractor from warranty requirements, responsibilities, or obligations.

1.7.5 Ensure all systems have been started, adjusted to design criteria, and are functionally operational, ready for independent testing. The CxA will not begin Functional Performance Testing until satisfied that all requirements have been met. The CxA reserves right to request inspection reports and sign-off from Contractor or Consultant that equipment and systems are ready for Functional Performance Testing.

1.7.6 Employ experienced personnel for equipment start up and commissioning, who are able to interpret results of readings and tests and report the system status in a clear and concise manner.

1.7.7 Provide all equipment required to perform testing, balancing, and commissioning of systems. Calibrate instruments used in start-up; provide calibration certificates if requested by the CxA.

1.7.8 Utilize equipment check certificates and other commissioning documents required by the CxA.

1.7.9 Verify that equipment is installed in accordance with Contract Documents, and reviewed shop drawings.

1.7.10 Commissioning will be considered complete once:

1.7.10.1 Require start-up documentation and checklists, as outlined in Contract Documents, have been submitted for review by the CxA.

1.7.10.2 Completed Cx documentation has been received, reviewed for suitability and approved by the CxA and the Owner.

1.7.10.3 Equipment, components, and systems have been commissioned and all issues have been addressed to the satisfaction of the Owner.

1.8 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

1.8.1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the non-functional system, including related systems as deemed required by the CxA to ensure effective performance.

1.8.2 Costs for corrective work, additional tests and inspections to determine acceptability and proper performance of such items to be borne by the Contractor. Above costs to be in the form of progress payment reductions or hold-back assessments.

1.9 PRE-CX REVIEW

1.9.1 Before Construction:

1.9.1.1 Review contract documents confirm by writing to Consultant.

1.9.1.1.1 Adequacy of provisions for Cx.

1.9.1.1.2 Aspects of design and installation pertinent to success of Cx.

1.9.2 During Construction:

1.9.2.1 Co-ordinate provision, location, and installation of provisions for Cx.

1.9.3 Before start of Cx:

1.9.3.1 Have completed Cx Plan up to date.

1.9.3.2 Ensure installation of related components, equipment, sub-systems, systems is complete.

1.9.3.3 Fully understand Cx requirements and procedures.

1.9.3.4 Understand completely design criteria and intent and special features.

1.9.3.5 All related equipment has been started up and start-up reports and pre-functional checklists are submitted and approved ready for functional testing.

1.9.3.6 All control system functions for this and all interlocking systems are programmed and operable per contract documents, including final setpoints and schedules with debugging, loop tuning, and sensor calibrations completed.

1.9.3.7 Piping system flushing complete, water treatment system complete and operational.

1.9.3.8 Vibration control report approved (if required).

1.9.3.9 Test and balance (TAB) complete and approved for the air and hydronic systems.

1.9.3.10 All A/E deficiency list items for the equipment specified are corrected.

1.9.3.11 Functional test procedures have been reviewed and approved by installing contractor.

1.9.3.12 Safeties and operating ranges reviewed by the CxA and the Contractor.

1.9.3.13 Test requirements and sequences of operation provided.

1.9.3.14 Schedules and setpoints provided.

1.9.3.15 False loading equipment, system, and procedures ready.

1.9.3.16 Crankcase heaters have been on long enough for start-up.

1.9.3.17 Sufficient clearance around equipment for servicing.

1.9.3.18 Record of all values for pre-test setpoints changed to accommodate testing has been made and a check box provided to verify return to original values (control parameters, limits, delays, lockouts, schedules, etc.)

1.9.3.19 Other miscellaneous checks of the pre-functional checklist and start-up reports completed successfully.

1.9.3.20 Points verification report from Control Contractor has been provided.

1.9.4 Inform Consultant in writing of discrepancies and deficiencies on finished works.

Part 2 Products

2.1 Not Used

Part 3 Execution

3.1 Not Used

END OF SECTION 01 45 00

DEMOLITION FOR MINOR WORKS

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DEMOLITION FOR MINOR WORKS

Part 1 General

1.1 RELATED REQUIREMENTS

1.1.1 N/A

1.2 REFERENCES

1.2.1 CSA International

1.2.1.1 CSA S350, Code of Practice for Safety in Demolition of Structures.

1.2.2 U.S. Environmental Protection Agency (EPA)/Office of Water

1.2.2.1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

1.3.1 N/A

1.4 SITE CONDITIONS

1.4.1 Review "Designated Substance Report" and take precautions to protect environment.

1.4.2 If material resembling spray or trowel-applied asbestos or other designated substance listed as hazardous be encountered, stop work, take preventative measures, and notify Owner & Consultant immediately.

1.4.2.1 Proceed only after receipt of written instructions have been received from Consultant.

1.4.3 Notify Owner and Consultant before disrupting building access or services including Power, Water, Life Safety, and Environmental Controls.

Part 2 Products

2.1 NOT USED

2.1.1 Not used.

Part 3 Execution

3.1 EXAMINATION

3.1.1 Inspect building with Owner’s Authorized Representative (OAR) and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.

3.1.2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.

3.1.3 Notify and obtain approval of utility companies before starting demolition.

3.1.4 Disconnect, cap, plug or divert, as required, existing public utilities within the property where they interfere with the execution of the work, in conformity with the requirements of the authorities having jurisdiction. Mark the location of these and previously capped or plugged services on the site and indicate location (horizontal and vertical) on the record drawings. Support, shore up, and maintain pipes and conduits encountered.

3.1.4.1 Immediately notify OAR, Consultant and utility company concerned in case of damage to any utility or service, designated to remain in place.

3.1.4.2 Immediately notify the OAR and Consultant should uncharted utility or service be encountered and await instruction in writing regarding remedial action.

3.2 PREPARATION

3.2.1 Protection of In-Place Conditions:

3.2.1.1 Keep noise, dust, and inconvenience to occupants to minimum.

3.2.1.2 Protect building systems, services and equipment.

3.2.1.3 Provide temporary dust screens, covers, railings, supports and other protection as required.

3.2.2 Demolition/Removal:

3.2.2.1 Remove all existing redundant controls and control devices and other items as indicated. Where specifically identified in specifications or points list, return to owner. If not specified, dispose of in environmentally friendly manner.

3.2.2.2 Remove/relocate existing services as required to permit new construction.

3.3 CLEANING

3.3.1 Progress Cleaning:

3.3.1.1 Leave Work area clean at end of each day.

3.3.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment from site.

3.3.3 Refer to demolition drawings and project specifications for items to be salvaged for reuse.

END OF SECTION 02 41 99

FIRE STOPPING

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FIRE STOPPING

Part 1 General

1.1 RELATED SECTIONS

1.1.1 Section 25 05 01 EMCS General Requirements

1.1.2 Section 25 30 02 EMCS Field Control Devices

1.1.3 Section 26 05 00 Common Work Results Electrical.

1.2 REFERENCES

1.2.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

1.2.2 Material Safety Data Sheets (MSDS).

1.2.3 Underwriter's Laboratories of Canada (ULC)

1.2.4 ULC-S115, Fire Tests of Fire stop Systems.

1.3 DEFINITIONS

1.3.1 Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.

1.3.2 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.

1.3.3 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.

1.3.4 Tightly Fitted; (ref: NBC Part 3.1.9.1.1 and 9.10.9.6.1): penetrating items that are cast in place in buildings of non-combustible construction or have "0" annular space in buildings of combustible construction.

1.3.4.1 Words "tightly fitted" should ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation.

1.4 SUBMITTALS

1.4.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.4.2 Product Data:

1.4.2.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.4.2.2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets.

1.4.3 Shop Drawings:

1.4.3.1 Submit shop drawings to show proposed material, reinforcement, anchorage, fastenings and method of installation.

1.4.3.2 Construction details should accurately reflect actual job conditions.

1.4.4 Samples:

1.4.4.1 Submit duplicate 300 x 300 mm samples showing actual fire stop material proposed for project.

1.4.5 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.

1.4.5.1 Test reports: in accordance with CAN-ULC-S101 for fire endurance and CAN-ULC-S102 for surface burning characteristics.

1.4.5.1.1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping with specifications for specified performance characteristics and physical properties.

1.4.5.2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4.5.3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.

1.4.5.4 Manufacturer's Field Reports: Where requested by consultant, submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.5 QUALITY ASSURANCE

1.5.1 Qualifications:

1.5.1.1 Installer: person specializing in fire stopping installations with [2] years documented experience or approved by manufacturer (in writing).

1.5.2 Pre-Installation Meetings: convene pre-installation meeting prior to beginning work of this Section, with EMCS contractor's representative to:

1.5.2.1 Verify project requirements.

1.5.2.2 Review installation and substrate conditions.

1.5.2.3 Co-ordination with other building subtrades.

1.5.2.4 Review manufacturer's installation instructions and warranty requirements.

1.5.3 Site Meetings: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.

1.5.3.1 After delivery and storage of products, and when preparatory Work is complete, but before installation begins.

1.5.3.2 Once during progress of Work at 25%.

1.5.3.3 Upon completion of Work, after cleaning is carried out.

1.6 DELIVERY, STORAGE AND HANDLING

1.6.1 Packing, shipping, handling and unloading:

1.6.1.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6.1.2 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, ULC markings.

1.6.2 Storage and Protection:

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

1.6.2.2 Replace defective or damaged materials with new.

1.6.3 Waste Management and Disposal:

1.6.3.1 Separate waste materials for recycling where applicable.

Part 2 Products

2.1 MATERIALS

2.1.1 Fire stopping and smoke seal systems: in accordance with CAN-ULC-S115.

2.1.1.1 Asbestos-free materials and systems capable of maintaining effective barrier against flame, smoke and gases in compliance with requirements of CAN-ULC-S115 and not to exceed opening sizes for which they are intended [and conforming to specified special requirements described in PART 3.

2.1.1.2 Fire stop system rating: Min 1 hr (or match existing where greater).

2.1.2 Service penetration assemblies: systems tested to CAN-ULC-S115.

2.1.3 Service penetration fire stop components: certified by test laboratory to CAN-ULC-S115.

2.1.4 Fire-resistance rating of installed fire stopping assembly in accordance with NBC.

2.1.5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.

2.1.6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.

2.1.7 Primers: to manufacturer's recommendation for specific material, substrate, and end use.

2.1.8 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.

2.1.9 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.

2.1.10 Sealants for vertical joints: non-sagging.

FIRE STOPPING

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PREPARATION

3.2.1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.

3.2.1.1 Ensure that substrates and surfaces are clean, dry and frost free.

3.2.2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.

3.2.3 Maintain insulation around pipes and ducts penetrating fire separation [without interruption to vapour barrier.

3.2.4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.3 INSTALLATION

3.3.1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.

3.3.2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.

3.3.3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.

3.3.4 Tool or trowel exposed surfaces to neat finish.

3.3.5 Remove excess compound promptly as work progresses and upon completion.

3.4 SEQUENCES OF OPERATION

3.4.1 Proceed with installation only when submittals have been reviewed and approved by Consultant.

3.4.2 Install floor fire stopping before interior partition erections.

3.4.3 Metal deck bonding: fire stopping to precede spray applied fireproofing to ensure required bonding.

3.4.4 Mechanical pipe insulation: certified fire stop system component.

3.4.4.1 Ensure pipe insulation installation precedes fire stopping.

3.5 FIELD QUALITY CONTROL

3.5.1 Inspections: notify Authority of Jurisdiction and Consultant when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.

3.5.2 Manufacturer's Field Services:

3.5.2.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

3.5.2.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.5.2.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.6 CLEANING

3.6.1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.6.2 Remove temporary dams after initial set of fire stopping and smoke seal materials.

3.7 SCHEDULE

3.7.1 Fire stop and smoke seal at:

3.7.1.1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.

3.7.1.2 Edge of floor slabs at curtain wall and precast concrete panels.

3.7.1.3 Top of fire-resistance rated masonry and gypsum board partitions.

3.7.1.4 Intersection of fire-resistance rated masonry and gypsum board partitions.

3.7.1.5 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.

3.7.1.6 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.

3.7.1.7 Openings and sleeves installed for future use through fire separations.

3.7.1.8 Around mechanical and electrical assemblies penetrating fire separations.

3.7.1.9 Rigid ducts: greater than 129 cm^2: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

END OF SECTION 07 84 00

EMCS: START-UP, VERIFICATION AND COMMISSIONING

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EMCS: START-UP, VERIFICATION AND COMMISSIONING

Part 1 General

1.1 SUMMARY

1.1.1 Section Includes.

1.1.1.1 Methods and procedures for start-up, verification and commissioning, for building Energy Management Control System (EMCS) and includes:

1.1.1.1.1 Start-up testing and verification of systems.

1.1.1.1.2 Check out demonstration or proper operation of components.

1.1.1.1.3 On-site operational tests.

1.1.2 Related Sections.

1.1.2.1 Section 01 33 00 - Submittal Procedures.

1.1.2.2 Section 01 78 00 - Closeout Submittals.

1.1.2.3 Section 01 91 12 – General Commissioning Requirements

1.1.2.4 Section 01 79 00 – Demonstration and Training

1.1.2.5 Section 25 01 12 - EMCS: Training.

1.1.2.6 Section 25 05 01 - EMCS: General Requirements.

1.2 ACRONYMS AND DEFINITIONS

1.2.1 For additional acronyms and definitions refer to Section 25 05 01 - General Requirements.

1.2.2 **AEL**: ratio between total test period less any system downtime accumulated within that period and test period.

1.2.3 **Cx:** Commissioning

1.2.4 **CxA**: Commissioning Authority

1.2.5 **Downtime**: results whenever EMCS is unable to fulfill required functions due to malfunction of equipment defined under responsibility of EMCS vendor. Downtime is measured by duration, in time, between time that Vendor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:

1.2.5.1 Outage of main power supply in excess of back-up power sources provided that:

1.2.5.1.1 Automatic initiation of back-up was accomplished.

1.2.5.1.2 Automatic shut-down and re-start of components was as specified.

1.2.5.2 Failure of communications link, provided that:

1.2.5.2.1 Controller automatically and correctly operated in stand-alone mode.

1.2.5.2.2 Failure was not due to failure of any specified EMCS equipment.

1.2.5.3 Functional failure resulting from individual sensor inputs or output devices provided that:

1.2.5.3.1 System recorded said fault.

1.2.5.3.2 Equipment defaulted to fail-safe mode.

1.2.5.3.3 AEL of total of all input sensors and output devices is at lest 99% during test period.

1.2.6 **FT**: Functional Testing

1.2.7 **PV:** Performance Verification

1.2.8 **Start-up:** New controller and associated control devices have been fully installed, preliminary programming is complete and sufficient to operate the controlled equipment. Pre-commissioning activities and commissioning (Cx) have not yet taken place and are a separate and distinct stage of readiness.

1.3 SUBMITTALS

1.3.1 Functional Testing (FT) Check List (refer to Appendix B): Complete and submit to Commissioning Agent (CxA), Consultant and Owner. See 1.6.2.

1.3.1.1 Include measurements, final settings and certified test results.

1.3.1.2 Bear signature of control technician responsible for completing verification

1.3.2 Preliminary As-Built Drawings

1.3.2.1 Revise shop drawings to reflect changes, adjustments, and modifications made to the EMCS during construction and submit “preliminary as-built” to CA, Consultant and/or Owner in accordance with Section 01 78 00 - Closeout Submittals and Section 25 05 02 EMCS Submittals and Review Process.

1.3.2.2 Add notation to “preliminary as-built” documentation recommending any additional changes and/or modifications deemed advisable by the BAS vendor to improve performance, environmental conditions, or energy consumption.

1.4 CLOSEOUT SUBMITTALS

1.4.1 Provide documentation, O&M Manuals, and training of O&M personnel for review of Consultant and Owner before interim acceptance in accordance with Section 01 78 00 Closeout Submittals.

1.4.2 Revise the “preliminary as-built" documentation to final AS-BUILT documentation. Final AS-BUILT to reflect changes made during commissioning including but not limited to sequences, set-point and limit adjustments, and alarm settings.

1.5 DESIGN REQUIREMENTS(CxA)

1.5.1 The CxA shall Confirm with Consultant and/or Owners Authorized Representative that Design Criteria and Design Intents are still applicable.

1.5.2 CxA to be fully aware of, and qualified to interpret Design Criteria and Design Intents.

1.6 START-UP ACTIVITIES

1.6.1 New controls shall be installed and programmed sufficient to operate equipment while the remainder of the EMCS installation continues.

1.6.2 New controllers shall be connected to the new EMCS sub-network and linked to related system graphics.

1.6.3 Critical alarms shall be established and set-up to notify Owner/Facility Operator and EMCS vendor of alarm conditions.

1.6.4 All trends shall be set-up and configured in the N4 Engine.

1.6.5 Existing controls shall taken off line and disconnected from the system.

1.7 PRE-COMMISSIONING ACTIVITES

1.7.1 As a part of the EMCS installation, the vendor shall fully test and pre-commission the entire EMCS. <u>***Pre-commissioning activities shall take place after start-up is complete and the system is fully programmed and ready for testing.***</u>

1.7.2 All pre-commissioning activates shall be fully documented on the Functional Testing Check List (refer to Appendix B) and shall be submitted with the City of Mississauga <u>**Project Close Out Provisional Acceptance Forms**</u> <u>***prior***</u> to Demonstration and acceptance testing.

1.7.3 Pre- Commissioning Activities shall include a point-to point verification of the following at the minimum:

1.7.3.1 Verify that all Panel Enclosures, EMCS equipment, building and field controllers, end devices and sensors, are installed and operational according to the specifications, submittals and manufacturer's installation and application instructions.

1.7.3.2 Test, calibrate and bring on-line every control device.

1.7.3.3 Calibrate all inputs by comparing the actual site condition with the Graphical Interface point display.

1.7.3.4 Verify all outputs from Graphical Interface command to observed response of controlled device.

1.7.3.5 Verify failure response and fail-safe conditions of all devices and safeties.

1.7.3.6 Each control program shall be fully commissioned and tested for complete design intent compliance and functionality.

1.7.3.7 Verify overall network performance of EMCS for complete design intent compliance and functionality with all devices on-line, communicating and fully operational.

1.7.3.8 Subsystems not directly controlled by the EMCS but associated with the OEM Application Specific Controllers (OEMASC) shall also be fully tested and commissioned as to design intent compliance and functionality.

1.7.4 Refer to 3.6 for additional details.

1.8 COMMISSIONING

1.8.1 Upon completion of the Pre-Commissioning activities and sign-off on the Provisional Acceptance Form (by Owner and CxA), the EMCS vendor shall provide full assistance, staff, and materials to support the commissioning activities. This includes:

1.8.1.1 Provision of all testing apparatus in use by the vendor to test and calibrate or verify calibration of control system and all other apparatus for which the vendor has control or calibration responsibility.

1.8.1.2 Assistance includes but is not limited to reviewing test procedures and providing software enhancements to accommodate testing methods.

1.8.1.3 On-site programmer/control technician to carry out the operator commands and adjustments to software parameters as directed by the Owners designated CxA. This may include but is not limited to; physical inspection of all hardware installed, point-to point functional testing (also referred to as Owner-Witnessed Testing), and system Performance Verification Testing.

1.9 COMPLETION OF COMMISSIONING

1.9.1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by CxA, Consultant, and Owner's Project Manager or Designated Representative.

1.9.2 Vendor shall rectify any outstanding deficiencies and then fill out the City of Mississauga **Project Closeout Final Acceptance Form** (refer to Appendix B) and submit for approval.

1.10 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

1.10.1 When Commissioning is complete the CxA will issue a Commissioning Report documenting the results of the Owner/CxA witnessed FT and PV that occurred and outstanding deficiencies. The deficiencies will then be added to those previously attached to the Provisional Acceptance Form. The contractor will work to complete all outstanding deficiencies in accordance to the timeline agreed upon with the Owner and CxA, and shall then document their completion and attach it to a signed copy of the **Project Closeout Final Acceptance Form** (refer to Appendix B). Once Accepted, the Consultant will issue Final Certificate of Completion. Refer to Part 3.12 for Acceptance Procedures.

Part 2 Products

2.1 EQUIPMENT

2.1.1 Not applicable

Part 3 Execution

3.1 PROCEDURES

3.1.1 Test each system independently and then in unison with other related systems.

3.1.2 Commission integrated systems using procedures prescribed by Consultant and or as specified within. It is the EMCS vendor's responsibility to coordinate with others to ensure a Control representative familiar with the programming and set-up of the integrated system being present to ensure all BACnet communication points are properly configured and visible to the EMCS including Read/Write privileges and that the specified sequence and integration is operating as intended.

3.1.3 Debug system software.

3.1.4 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.

3.2 START-UP TRIALS

3.2.1 The Consultant may at any time be able to either, on his own, or demand from the Vendor a check of all the apparatus, system or installation.

3.2.2 This test does not constitute in any manner an acceptance and may not give way to any claim for compensation due to accident, damage or rupture as a result of any deficiency in the apparatus, equipment or installation.

3.3 FACTORY TESTING

3.3.1 All computers and controls shall have passed a verification test in the factory before delivery to the site.

3.3.2 Every circuit in the SRPDC RPDC & DDC shall have been tested and operated for a minimum period of at least 96 hours.

3.4 PRE-COMMISSIONING ACTIVITES (EMCS CONTRACTOR)

3.4.1 Complete all pre-commissioning activities including the functional testing (FT) of the entire system and performance Verification (PV) prior to submitting for Provisional Acceptance.

3.4.2 Complete and submit Functional Testing Check List (refer to Appendix B).

3.4.3 Test and verify all alarms, graphical links, user group access levels (refer to Provisional Acceptance Form Check List).

3.4.4 Complete site set-up and configuration, prepare and download all back-up file and communicate the location of these files to the CoM

3.4.5 Prepare and submit the Provisional Acceptance Form including documentation of any know deficiencies.

3.4.6 Complete work to resolve known deficiencies prior to start of Commissioning (Cx).

3.5 COMMISSIONING – Cx (OWNER-WITNESSED TESTING)

3.5.1 Commissioning may only begin after completion of Start-Up, and Pre-Commissioning Activities. The contractor must submit and obtain sign-off by the Owner and CxA on the Provisional Acceptance Form.

3.5.2 After receiving the Provisional Acceptance Form, the Owner and/or CxA shall visit the site and connect remotely to the new EMCS to verify system readiness for commissioning. Should it be determined that the system is not ready for commissioning, the contractor shall return to site and complete any necessary work as directed. Back charges for additional time spent by the CxA may apply.

3.5.3 Testing the actual system installed on site shall be done in order to demonstrate the full functionality of the EMCS to the Owner's, Consultant's and/or Owner's Commissioning Agent's satisfaction. The Vendor shall supply the instruments, specialized tools and labour for the necessary adjustments in order to obtain the specified system performance.

3.5.4 Commissioning activities shall include both Owner/Cx witnessed point-to-point **Functional Testing** (**FT**) and control sequence verification (**Performance Verification - PV**).

3.5.5 A local operator workstation (LOWS), including all necessary software shall be made available and utilized to support the point-to point **FT** and **PV** activities. As the installed system is intended to be accessible from any Owner designated workstation, the location of the LOWS will be defined by the Owner and/or Owner's Authorized Representative prior to the start of commissioning activities.

3.5.5.1 Any LOWS connected upstream of the City of Mississauga demarcation point must meet all City of Mississauga ITS requirements and be approved for use by ITS.

3.5.6 After receipt of all system documentation (as supplied by this vendor) by the Owner and/or Owner's Authorized Representative, notify the Owner 10 working days before testing begins.

3.5.7 Testing shall be performed by the vendor, witnessed by the Owner or his appointed representative.

3.5.8 The vendor must fill out and complete the formatted **Functional Testing Check List** documentation (refer to Appendix B) for witnessing the results, comments, vendor repair activity, vendor's initials, and re-test witnessing. Vendor shall submit these **Functional Testing Check List** with one line for each physical point on the system, and columns to record the results, dates, and initials witnesses for both pre-tests and witness tests.

3.5.9 The Vendor shall perform pre-commissioning point-to-point verification (Functional Testing) before the witnessed tests and shall fill in the **Functional Testing Check List** to demonstrate successful performance prior to witness tests (refer to Appendix B for a sample copy of **Functional Testing Check List**). Electronic version of the check list shall be provided to the vendor at the start of the project with all intended/specified points listed by others during the design phase. The vendor shall complete remaining fields including point names, device ID, etc. as job progresses.

3.6 FUNCTIONAL TESTING (FT)

3.6.1 All items listed within this Section 3.5 shall be considered the minimum standard for functional testing to be completed.

3.6.2 Verify operation, location and proper identification of all power sources, including circuit breakers and control equipment power transformers.

3.6.3 Start/stop points:

3.6.3.1 Issue start and stop commands from the local operator workstation (LOWS). Verify that controlled equipment responds appropriately and that the stat/stop status is accurately reflected at the (LOWS).

3.6.4 Analog points:

3.6.4.1 Analog inputs and outputs shall be verified at both extremes of their ranges and at the midpoint. Verify tight shutoff and full opening of the dampers and valves.

3.6.5 Digital points:

3.6.5.1 Verify that both commanded conditions (on/off, open/closed, etc.) and device status are accurately reflected at the LOWS.

3.6.6 Fan and pump failure alarms:

3.6.6.1 Test by turning off the motor at the Hand/Off/Auto (HOA) switch and observing the run-state indication at the operator station.

3.6.7 Temperature points:

3.6.7.1 Verify accuracy of sensors by comparing temperature values with the reading of an independent measuring device located in the same space or flow. Test liquid temperature sensors as installed in piping thermo wells to verify effectiveness of heat conducting compound.

3.6.8 Pressure points:

3.6.8.1 Verify accuracy of sensors by comparing displayed pressure with the reading of an independent measuring device located in the same flow stream. Retain the services of the balancer as required to confirm reading.

3.6.9 Control valves:

3.6.9.1 Verify tight shutoff by comparing water or air temperature entering and leaving the heat transfer device.

3.6.10 Operator response and sequencing:

3.6.10.1 Demonstrate that sequenced or modulated valves and dampers position accurately in response to changed conditions. Ensure that the positioned response accurately follows anticipated and specified control behavior. Ensure that the petition of multiple operators provides simultaneous modulation of damper or valve assemblies.

3.6.11 Control signal stability (general):

3.6.11.1 Demonstrate the control loops are tuned so that the output does not change until the controlled system has time to respond to the last output signal.

3.6.12 Control signal stability (response to step input):

3.6.12.1 Demonstrate that control loops are tuned so that they are stable without excessive hunting following a step input of not less than 20% of the operating/reset range of the controlled variable.

3.6.13 Control signal stability (floating point devices):

3.6.13.1 Verify that minimum pulse output duration is no less than the value required to assure repositioning to the controlled device.

3.6.14 Demonstrate the capability of the controls system to execute the complete sequence of operation as given in the mechanical controls design documents.

3.6.15 Verify tight shut-off of all actuated control valves (for 3-way valves, demonstrate capacity for 100% by-pass of coil).

3.6.16 Failure modes

3.6.16.1 Verify all stand-alone operation by disconnecting communication lines between stand-alone control units and verifying continued operation.

3.6.16.2 Disconnect and reapply 120 VAC Local Operation Station (LOWS) power to confirm proper power recovery from power failure.

3.6.16.3 Disconnect and reconnect DDC controller power to confirm proper power recovery from power failure.

3.7 PERFORMANCE VERIFICATION (PV)

3.7.1 Using the graphical interface at Local operator workstation (LOWS), and in conjunction with CA, verify the operation and functionality of the following:

3.7.2 Override test: Verify manual override capability for start/stop and modulated points types.

3.7.3 Control logic

3.7.3.1 Exercise all control logic packages.

3.7.3.2 Check response to change in set-point and/or key control parameters.

3.7.4 Supervisory functions

3.7.4.1 Verify content of time clock schedules.

3.7.4.2 Verify all alarms including; establishing alarm limits, alarm priorities (i.e. – Critical, Maintenance, Energy, Out of Range, etc.), routing priorities.

3.7.4.3 Demonstrate alarm routing functionality by triggering each different type of alarm and verifying that the system properly routed the alarm to the appropriate email and recorded in historical files, etc.

3.7.4.4 Set-up and verify user access levels for each user type.

3.7.4.5 Set-up and demonstrate trending and verify the location of data storage for historical trending.

3.7.4.6 Verify Global commands.

3.7.4.7 Establish links from server graphics (EMCS Access Page) to the individual site.

3.7.4.8 Establish links from site alarms to server based graphics site and verify their operation.

3.7.4.9 Set-up and verify the automatic download of back-up files and communicate file location to the Owner.

3.8 CONTROLLER / CONTROLLER SYSTEM FAILURE MODE TESTING

3.8.1 Verify all stand-alone operation by disconnecting communication lines between stand-alone control units and verifying continued operation.

3.8.2 Disconnect and reapply 120 VAC Local Operation Station (LOWS) power to confirm proper power recovery from power failure.

3.8.3 Disconnect and reconnect controller power (to each controller) to confirm proper power recovery from power failure.

3.9 PARTIAL START-UP

3.9.1 The Vendor shall be ready for a partial start-up. The system may be started-up and functioning even though all the components are not yet installed. For example, the system may be started-up with only one SRPDC and one point and subsequently the rest of the points and other SRPDC can be added to the system and started-up.

3.9.2 Start-up of a system(s) shall be considered as a separate and distinct activity from Pre-Commissioning and Commissioning.

3.10 SWITCH OVER OF EXISTING TO NEW SYSTEM (CONTROL SYSTEM REPLACEMENTS AND UPGRADES)

3.10.1 Once the immediate work is completed, the new system shall operate and replace the old control system. The Vendor shall remove all pneumatic and electric controllers, relays, piping, switches, and panels etc. that are no longer required and shall hand them to the Owner. The pneumatic tubing connected to the existing pneumatic actuators may be reused if it is clean and not pierced.

3.10.2 The Vendor shall clean the site of all equipment that the Owner does not desire to keep. Equipment that the Owner wishes to keep will be identified and a list turned over to the vendor prior to the start of any demolition.

3.10.3 The existing equipment that allows starting and stopping the system locally with a key shall be conserved for added safety measures during maintenance work. These locks shall be transferred to the new panels if necessary. The whole shall be kept in good working order.

3.10.4 The existing local analog gauges shall not be retained, except for the differential static pressure gauge (D.S.P.G) inside the mechanical system that shall remain functional. These gauges (D.S.P.G.) shall be installed properly.

3.10.5 The sequences of operation for the fire alarm shall be respected and the vendor shall transfer to the new system all the necessary information from the existing panel. All transfers shall be done in parallel with the implementation of the system. The switchover from the old to the new system shall be done in a minimum downtime, subject to the Owner’s approval. A temporary control system shall be provided by the Vendor during the power transfer.

3.11 DEMONSTRATION

3.11.1 Demonstration is not a part of Start-Up/Commissioning or training and shall be done independently and only after completion of both tasks.

3.11.2 Demonstrate to Consultant and Owner the operation of systems including a thorough review of the sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lockouts in accordance with Section 01 79 00 - Demonstration and Training.

3.12 ACCEPTANCE OF WORK

3.12.1 Real End of the Work

3.12.1.1 The real end of work shall occur when all demolition, installations, programming and graphics are complete, and the Contractor has completed (their own) initial Functional and Performance Based testing and made arrangements with the Commissioning Agent to establish a date for commissioning. Any know deficiencies to that point of the project shall be documented by the contractor (on Provisional Acceptance Form) and then scheduled for completion prior to the start of Commissioning. To mark the real end of work, the contractor shall complete (and submit) a signed copy of the City of Mississauga **Project Close Out Provisional Acceptance Form** (and all closeout documentation) to signify that they are ready for a final inspection (and commissioning)

3.12.2 Provisional Acceptance

3.12.2.1 The provisional acceptance shall follow the real end of the work and shall signal the contractor’s readiness for the start of Commissioning.

3.12.2.2 The Vendor shall complete and submit a signed copy of the **Project Close Out Provisional Acceptance Form** as their request for the provisional acceptance. This shall occur only when the system is completely installed, calibrated, tested and operational. The Owner’s representative and Consultant will then conduct a final inspection of the installation and review all submitted close-out documentation, pre-commissioning forms, and provisional acceptance form. If the Consultant and/or Owner judges that the installation is not complete, or tests are not adequately done by the contractor – the Provisional Acceptance Forms will not be signed back and the contractor shall return to site to complete the work before re-submission. Any charges incurred by the Consultant and or CA for additional visits shall be charged back to the Vendor.

3.12.2.3 If the at the end of the final inspection, the City representative and Consultant deem the project ready for commissioning, they will sign back the Provisional Acceptance Form indicating the project is ready to be commissioned and the job will be considered **Substantially Complete.**

3.12.2.4 The Consultant shall add any noted deficiencies add to the list of previously identified deficiencies within the **Project Close Out Provisional Acceptance Form**

3.12.3 Commissioning (Cx)

3.12.3.1 A request for commissioning shall be made by the contractor after the Real End of Work and shall take place only once the Provisional Acceptance Forms have been accepted and signed back by the Owner and Consultant.

3.12.3.2 Refer to Section 3.4 above

3.12.4 Final Acceptance

3.12.4.1 The final acceptance shall follow within forty (40) working days from the start of the warranty.

3.12.5 Reference to the Specifications

3.12.5.1 All inspections, meetings, tests, etc. associated with the work acceptance shall be done by comparing the work with the specifications and the concordance and discordance documents. If there is ambiguity in the specifications or in the concordance and discordance document, the provisions in the specifications and the Consultant's opinion shall prevail. It is the Vendor's responsibility to detect any difference between the specification and the system to be supplied.

3.13 ACCEPTANCE PROCEDURES

3.13.1 General Clauses

3.13.1.1 Notwithstanding the brief definitions of acceptance mentioned in the previous sub-sections, the definitions given in the general clauses are more detailed and these shall prevail in case of any interpretation.

3.13.2 Required Interpretation

3.13.2.1 The Vendor shall supply the Consultant with all the information concerning the identification of points, the functions, the limits, the sequence of operations, the locking devices, the boot-up of the system after a power failure, the readings, the programs, the parameters and all the information associated to the system and the control points.

3.13.3 Software

3.13.3.1 The Vendor shall download to the central server all software and graphics for the installation and shall activate the system. In addition, he shall be responsible for updating and verifying the database. A computer demonstration, in real time, of the monitoring capacities and commands of the system shall be presented to the Owner before the start-up of the definitive operation of the system. If this demonstration is in conformity with the specifications requirements and Consultant's representative, he shall authorize the start-up of the system.

3.13.4 Start-Up

3.13.4.1 Once the start-up is finalized, the Owner's representative shall inspect and verify the good functioning of the system, the sub-system and its accessories. He shall establish a deficiency list for correction, if necessary.

3.13.5 Repair

3.13.5.1 After receiving the deficiency list, the Vendor shall clear all identified deficiencies and then submit a City of Mississauga **Project Closeout Provisional Acceptance Form** indicating that each component on the deficiency list has been corrected and is functional (refer to Appendix B).

3.13.5.2 When all components detailed in this report have been verified and adjusted to the Owner's satisfaction, a second request for the system acceptance shall be submitted to the Owner. The Owner shall proceed with the provisional acceptance if he finds that the whole is in conformity with the requirements of the specifications.

3.13.5.3 If the Vendor must isolate some system components for verification and/or correction, and for this reason must modify, change, add or remove some hardware, software or accessories to enable the system to function partially out of service, the Vendor shall do the necessary verification for the execution of the changes until the Consultant determines that the system may function normally.

3.13.5.4 All hardware or software defects shall be covered by the warranty and the Vendor shall repair all the deficiencies within reasonable delays (as agreed upon with the Owner when deficiency and/or repair item is first noted). The loggings of the work schedules and deficiency correction reports shall be submitted to the Owner for identifying the defects and repairs being made.

END OF SECTION 25 01 11

EMCS: TRAINING

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EMCS: TRAINING

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Requirements and procedures for training program, instructors and training materials, for building Energy Management Control System (EMCS) Work.

.2 Related Sections.

.1	Section 01 33 00	Submittal Procedures.
.2	Section 01 78 00	Closeout Submittals.
.3	Section 01 79 00	Demonstration and Training
.4	Section 25 05 01	EMCS: General Requirements.

1.2 DEFINITIONS

.1 CDL - Control Description Logic.

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

1.3 SUBMITTALS

.1 Not Applicable

1.4 TRAINING

.1 General

.1 The supplier shall offer training in the factory and on the site. This training shall be given by the Vendor, during the start-up of the new control system and before the provisional acceptance.

.2 Quality Assurance

.1 Provide a list of the proposed trainer. Trainer must be a competent instructor thoroughly familiar with specific aspects of EMCS installed in facility.

.2 Consultant and/or Owner reserves right to approve instructors.

.3 Instructions

.1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of EMCS installed.

.2 Training to be project-specific.

.4 Training Documentation

.1 Submit training documentation for review 30 days minimum before training. Documentation shall include an agenda for each training day, objectives, a synopsis of each lesson, and instructor's background and project specific qualifications (see 1.4.6).

.2 The training documentation can be submitted at the same time as the project's Controls System Operators Manual.

.5 Training in the Factory

.1 Upon request, provide a list of the courses available and the associated costs.

.6 Training on Site (Operator Training)

.1 TRAINING ON SITE shall be based on instruction for 3 different user groups, with 2 sessions per group and 4 hours of training per session. Each user groups will require a custom user-group specific level of training based on their designated user access level and functional interaction with the EMCS.

.2 Training to be provided for each EMCS installation (unless otherwise noted in the tender documents).

.3 Training shall be delivered by a qualified representative of the supplier who was directly involved in the installation of the system for which the operators are being trained.

.4 Prior to the start of training the Vendor shall ensure the manuals are submitted, approved, and available to hand out to the trainees before the start of the first training session.

.5 Commissioning and demonstration of the system are an independent task and ***shall not*** be considered as part of the TRAINING ON SITE.

.6 Upon completion of the training, each trainee should fully understand the project's DDC system fundamentals. The TRAINING ON SITE shall be given in two (2) parts, but not limited, as follows:

.1 PART ONE: System Overview and Fundamentals

- *Review of As-Built documentation including:*
    - *Overview of systems controlled and related components.*
    - *Overview of project's list of points and objects.*
    - *Overview of project's device network communication architecture.*
    - *Overview or project's specified sequence of control for each system.*
    - *Overview of Alarms Types, Alarm Limits, and Routing.*
    - *Overview Trending Capabilities and Data Storage*

.2 PART TWO: System Access and Operation

- *The second session of training shall be conducted at the Local Operators Workstation Connected to the EMCS in the field via the Enterprise Server. Upon completion of the session, each trainee should fully understand the project's EMCS site specific installed operation.*
- *The training session shall include the following:*
- *A walk-through tour of the mechanical systems and the installed BAS components.*
- *A discussion of the components and functions at each BAS panel.*
- *Logging-in and navigating at operator interface type.*
- *Modifying set-points.*

- *Creating, editing, and viewing trends.*
- *Creating, editing, and viewing alarms.*
- *Creating, editing, and viewing operating schedules and events.*
- *Trouble shooting hardware errors.*

1.5 CONTINUOUS TRAINING

.1 Concerning the training, the dominant role of the Vendor is to supply Consultant with all the information regarding the changes, the modifications, and the upgrading of the system or its components. In particular, the Vendor shall immediately advise Consultant of all the changes in the methods of operation of the system.

1.6 ADDITIONAL TRAINING

.1 Upon request, list courses offered by name, duration and approximate cost per person per week. Note courses recommended for training supervisory personnel.

1.7 MONITORING OF TRAINING

.1 Submit preliminary training schedule for review by Owner and consultant. Owner and/or Owner may modify the training schedule and content to conform to site specific requirements.

.2 Owner may choose to video tape the training session for future use.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION 25 01 12

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EMCS: GENERAL REQUIREMENTS

Part 1 General

1.1 SUMMARY

1.1.1 Section Includes:

1.1.1.1 General requirements and General Profile of the Work for building Energy Monitoring and Control System (EMCS) that are common to Master Specification for Direct Digital Control System Installations City of Mississauga, Ontario.

1.1.2 Related Sections:

1.1.2.1 Section 01 33 00 - Submittal Procedures.

1.1.2.2 Section 01 77 00 – Closeout Procedures

1.1.2.3 Section 01 78 00 – Closeout Submittals

1.1.2.4 Section 01 79 00 – Demonstration and Training

1.1.2.5 Section 25 01 11 – EMCS: Start-up, Verification and Commissioning

1.1.2.6 Section 25 01 12 – EMCS: Training

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

1.1.2.8 Section 25 05 54 - EMCS: Identification.

1.1.2.9 Section 25 08 20 – EMCS: Warranty and Maintenance

1.1.2.10 Section 25 30 01 – EMCS: Location Area Network

1.1.2.11 Section 25 30 02 – EMCS: Building Family of Controllers

1.1.2.12 Section 25 30 02 – EMCS: Field Control Devices

1.1.2.13 Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

1.1.2.14 Appendix A: City of Mississauga Standards and Guidelines

1.1.2.15 Appendix B: City of Mississauga Forms and Templates

1.1.2.16 Appendix C: ~~City of Mississauga IT Services Cabling Specifications~~

1.2 REFERENCES

1.2.1 American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).

1.2.1.1 ANSI/ISA 5.5 1985, Graphic Symbols for Process Display

1.2.1.2 ANSI/IEEE 260.1-1993, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).

1.2.2 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

1.2.2.1 ASHRAE STD 135, BACNET - Data Communication Protocol for Building Automation and Control Network.

1.2.3 Canadian Standards Association (CSA International).

1.2.3.1 CAN/CSA-Z234.1, Canadian Metric Practice Guide.

1.2.4 Consumer Electronics Association (CEA).

1.2.4.1 CEA-709.1, Control Network Protocol Specification.

1.2.5 Department of Justice Canada (Jus).

1.2.5.1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.

1.2.5.2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

1.2.6 Electrical and Electronic Manufacturers Association (EEMAC).

1.2.6.1 EEMAC 2Y 1, Light Gray Colour for Indoor Switch Gear.

1.2.7 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

1.2.7.1 Material Safety Data Sheets (MSDS).

1.3 DEFINITIONS

1.3.1 ACRONYMS AND ABBREVIATIONS used in EMCS

- AEL - Average Effectiveness Level.
- AIT - Agreement on International Trade.
- AO - Analog Output.
- BAC-net - Building Automation and Control Network.
- CDL - Control Description Logic.
- CoM – City of Mississauga
- CDS - Control Design Schematic.
- COSV - Change of State or Value.
- CPU - Central Processing Unit.
- Cx – Commissioning
- CxA – Commissioning Agent
- DI - Digital Input.
- DO - Digital Output.
- DP - Differential Pressure.
- EMCS - Energy Management Control System.
- FT – Functional Testing
- GUI – Graphical User Interface
- HVAC - Heating, Ventilation, Air Conditioning.
- IDE - Interface Device Equipment.
- I/O - Input/Output.
- ISA - Industry Standard Architecture.
- LAN - Local Area Network.
- LON - Local Operating Network
- NC - Normally Closed.
- NO - Normally Open.
- OEMASC – Original Equipment Manufacturer Application Specific Controllers
- OWS – Operator’s Workstation.
- PCMCIA - Personal Computer Micro-Card Interface Adapter.
- PV – Performance Verification

EMCS: GENERAL REQUIREMENTS

- PID - Proportional, Integral and Derivative.
- RAM - Random Access Memory.
- RPDC – Remote Programable Digital Controllers
- SRPDC – Supervisory Remote Programable Digital Controllers
- SP - Static Pressure.
- ROM - Read Only Memory.
- TEC - Terminal Equipment Controller.
- USB - Universal Serial Bus.
- UPS - Uninterruptible Power Supply.
- VAV - Variable Air Volume.

1.3.2 Point: may be logical or physical.

1.3.2.1 Logical points: values calculated by system such as set points, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.

1.3.2.2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.

1.3.3 Point Name: All points shall be named in accordance with the **City of Mississauga, Point Naming Convention** – Refer to Appendix A and Section 25 05 54 EMCS: Identification

1.4 SUBMITTALS

1.4.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and 25 05 02 - EMCS: Submittals and Review Process.

1.5 DESIGN REQUIREMENT

1.5.1 This document shall be read in conjunction with the design documents and specifications of any New and/or Replacement Energy Management Control System (EMCS), and EMCS upgrade projects designed for the City of Mississauga, Ontario.

1.5.2 Because these Master specifications are periodically updated, the current and most recent version of the Master Specifications should be requested and obtained directly from the City of Mississauga Project Manager prior to submitting a Tender for each project. **The current version of the Master Specifications referenced shall be documented in, and read in conjunction with, the project specific specifications.** Where the requirements of the two documents are in conflict, the more stringent interpretation shall apply. **Refer to appendix B6 for a Sample Project Specification.**

1.5.3 The basis of design for all EMCS Upgrades incorporates the following system architecture:

1.5.3.1 A dedicated EMCS Enterprise server (complete with operating system, software tools, licenses, etc.) and Tridium Niagara 4 EMCS Enterprise Server Software (ESS) package that has a fully open and accessible licensing structure.

1.5.3.2 The EMCS Server and Tridium Niagara 4 ESS is already in place. It shall be the responsibility of the contractor to communicate with CoM Facilities Department to determine the current reversion Niagara 4 Supervisor operating and required revision of JACE to be used at the start of each project.

1.5.3.3 Databases shall be Microsoft SQL-based in accordance with the City of Mississauga ITS standard.

1.5.3.4 Secondary back-up server(s) with database software as required for all storage of all system database parameters including; back-up of all field panel programming, trend data, and site-specific color graphics

1.5.3.5 Both servers are existing and reside in a CoM designated server room, connected to the CoM local area network (LAN) and wide area network (“WAN”) for communication to multiple sites and multiple pre-qualified EMCS products.

1.5.3.6 EMCS upgrades and installation for each facility shall comprise the supply and installation of a new supervisory remote digital controller (“SRPDC”) connected to remote programable digital controllers (“RPDC”), terminal equipment controllers (“TEC”) and original equipment manufacturer application specific controllers (“OEMASC”) over a EMCS vendor supplied BACNet communication network(s).

1.5.3.7 The EMCS vendor supplied SRPDC shall be a Tridium Niagara JACE 8000 Series controller(s) of sufficient number and capacity to manage the number of field controllers and points as specified for the specific installation.

1.5.3.8 All JACE panels shall come with Open NiCS statements and shall be installed with the most recent version of Niagara 4 at the time of purchase (ie – v4.8). EMCS Vendor shall confirm the version with CoM before ordering.

1.5.3.9 The SRPDC shall communicate to the EMCS server over the COM WAN using TCP/IP communications protocol. Only one (1) network drop and IP address shall be provided by COM at a given site. EMCS and SRPDC solutions must support LAN-, WAN-, and cellular-connected facility installations based on network availability that will be specified for each location.

1.5.3.10 The EMCS Vendor shall be responsible to supply and install all necessary routers, switches, cabling, conduits and enclosures to create any necessary sub-networks for extension of TCP/IP Communication network to accommodate multiple SRPDC on one site (or IP based controllers where approved by City of Mississauga).

1.5.3.11 All communication cabling for EMCS sub-networks shall be in EMT conduit where exposed and in plenum rated cable above ceiling systems. Plenum rated cabling outside of conduit shall be properly supported by cable hangers at intervals as outlined in Section 251001.

1.5.3.12 The new EMCS system architecture and controller type utilized shall allow for Full Access to each controller (RPDC/TEC) directly from the server utilizing the Tridium Niagara Workbench tool and database previously saved on server. Full access shall be defined as the ability to upload/download programing, modify programming and control parameters (PID loops, time delays, etc).

1.5.3.13 At the start of each new project (prior to full submittals), the successful EMCS vendor shall identify the proposed system architecture and type of controller(s) to be used. Upon request of the Owner, the EMCS shall demonstrate how the proposed system meets the requirements of 1.5.3.12 (above).

1.5.3.14 If the proposed system does not meet with the requirements of 1.5.3.12, the Owner reserves the right to stop the project until the EMCS vendor can provide a workable solution at no extra cost to the City of Mississauga

1.5.3.15 All SRPDC, RPDC, TEC, switches, routers, etc. to be in NEW lockable NEMA rated enclosures (except where otherwise – i.e. VAV Box TEC may be mounted directly on the VAV Box). If in doubt, seek clarification from COM before submitting a quotation on any project.

1.5.3.16 The system architecture requires that the SRPDC be set-up and programmed to manage and monitor communication between all field level controllers (RPDC, TEC, OEMASC), and communicate all EMCS activity to the ESS over the City's Ethernet based WAN using TCP/IP communication protocol. All EMCS field controllers shall be capable of standalone operation on loss of communication with the SRPDC. ***No physical control points shall reside on the SRPDC.***

1.5.3.17 All graphics, EMCS programming, trend data, security settings, access level priorities, etc. shall be uploaded by the EMCS vendor(s) and stored on the Server for each project (without need for the involvement of others). This shall be repeated at the start of commissioning and again upon completion of deficiency clean-up and as-built. Remote access will be provided in accordance with current City of Mississauga ITS policies, procedures and processes.

1.5.4 Coordinate with Original Equipment Manufacturer (OEM) regarding dedicated application specific controllers as supplied by Others (OEMASC).

1.5.4.1 The use of dedicated equipment controls supplied by others shall be pre-approved by the City of Mississauga, Ontario Facilities Management prior to design and specification.

1.5.4.2 These shall include but not be limited to the following:

- Chillers,
- Heat pumps,
- Gas fired furnaces,
- Boilers
- VFD's
- Rooftop Units
- VRF's
- Refrigeration Systems
- Generators

- Utility Meters/Sub Meters
- Lighting Controls
- Other equipment that come with OEM Installed On-board micro-processor controls.

1.5.4.3 All equipment of this nature shall come with a BACNet compliant communications interface communicating via BACNet IP or MS/TP (as indicated in the specified project specific system architecture) or approved equivalent communication protocol that is supported by the Pre-Qualified BAS Vendor Hardware interface modules – i.e. LON/Modbus/etc.). **The use of Non-BACNet communication protocols must be PREAPPROVED by CoM and shall only be considered if Bac-Net is not available.**

1.5.4.4 EMCS Design consultant shall fully identify and indicate the relationship between the EMCS and the dedicated OEM controls for specific HVAC equipment as supplied by others, spelling out the points to be monitored, points to be modified, how and where to display on the graphics, responsibility of HVAC equipment representative and EMCS vendor for programming, graphics and interface, etc.

1.5.4.5 Connection to the OEM supplied controls shall be via a dedicated Sub-Net communication BUS running from the Supervisory Remote Programmable Digital Controller (SRPDC) to the OEMASC's. The SRPDC should communicate to OEMASC using BAC-net (IP) communication protocol. Please refer to the City of Mississauga System Architecture Diagram

1.5.4.6 The OEMASC as mentioned in Section 253001-EMCS: Building Controllers, are to be stand-alone microprocessor-based controllers that handle the staging, sequencing, control and coordination of specific HVAC equipment and related systems components (Example Chillers/Boilers AHU's/ Other). This provides a sole source of responsibility for the equipment's performance to avoid damage to the equipment, to increase safety, and to increase vendor and manufacturer responsiveness during problem solving.

1.5.4.7 OEMASC shall be a fully BAC-net compliant device to facilitate interoperability between OEM electrical/mechanical sub-systems and BAC-net EMCS or provide the necessary gateway to integrate into the web-based BAC-net EMCS using the BAC-net communication protocol.

1.5.4.8 The OEM shall provide any software or hardware required to access or modify any electrical/mechanical subsystems *i.e. RTUs, VSD's, Chillers, Lighting controls and /or Electrical Monitoring & metering.

1.5.4.9 Typical gateway requirements for projects include but not be limited: A BAC-net interface to the chillers' manufacturers, a BAC-net interface to the VSD manufacturers' product(s), a BAC-net interface to the electrical monitoring manufacturers product(s).

1.5.4.10 A Modbus interface may be used only when a BAC-net interface is not available from the equipment OEM. If the equipment manufacturer does not have this capability, they shall contact the authorized representative of Construction Specification of Canada (CSC) for assistance and shall include in their equipment price any necessary hardware and/or software obtained from the CSC to comply with this section. Cost alone is not an acceptable reason for not providing a BAC-net interface.

1.5.4.11 OEM Configuration Tools and licences required to configure all OEMASC installed on this project, shall be provided by the equipment EMCS Vendor.

1.5.4.12 All submittals for both EMCS and OEM supplied equipment shall identify the interface between EMCS and OEM supplied controller including available points to read/write between systems.

1.5.4.13 Set up, testing and commissioning of the interface between OEMASC and the EMCS control system shall be carried out with both parties (OEM Programmer and EMCS Programmer) present on site to ensure the proper communication set up and establishing control priority levels and parameters. The cost of these services shall be included in the price from both vendors.

1.5.4.14 Specifying Consultant shall ensure to include for provision of any necessary OEM Configuration Tools and Licenses as required to connect and setup the OEM controllers and the interface to base EMCS system.

1.5.5 Fire and Emergency Power

1.5.5.1 Only the Dedicated Fire Alarm system should control life safety equipment such as smoke evacuation and make-up air fans serving; atriums, elevator shafts, stairwells, etc. Likewise, only the Dedicated Fire Alarm system should control the smoke control dampers and related systems.

1.5.5.2 Fire and smoke damper position may be monitored by the EMCS but shall not be used for the purposes of control. The Dedicated Fire Alarm system alone should provide the functional control of these dampers and necessary fan commands during alarm conditions.

1.5.5.3 The Dedicated Fire Alarm system should directly shut down all air handling units as required by Code through a hardwired signal. That shut down authority should be effective for all positions of the local Hand-Off-Auto (H-O-A) selector switch and/or variable speed drive (VSD) controls.

1.5.5.4 The EMCS system shall not control air handling units after activation of shutdown sequence by the fire alarm panel. The EMCS shall resume control only after confirmed reset of the fire alarm system.

1.5.5.5 The EMCS system shall monitor the Dedicated Fire Alarm panel to determine when the building is under a fire alarm condition. In cases where the EMCS system is interfaced to the Alarm Panel through a direct communications interface (i.e. BACNet), the EMCS functions shall be distinct and separate from the Fire Alarm.

1.5.5.6 Smoke/fire dampers and smoke/fire damper actuators are to be specified under the air distribution system, not under Master EMCS specifications.

1.5.5.7 In buildings where mechanical systems operate under EMCS control during *emergency power conditions*, the EMCS system shall monitor the appropriate emergency power transfer switch to determine when there is loss of normal power and also the restoration of normal power.

1.5.5.8 The EMCS shall follow specified sequences for Emergency Power Operation during a power failure including but not limited to the restart of equipment based on specified equipment start-up priority.

1.5.6 Use of Colour Graphics & Graphical User Interface

1.5.6.1 The use of dynamic colour graphics to their maximum extent, are required to improve the presentation and the interpretation of data.

1.5.6.2 The Graphic displays shall have full-screen resolution when viewed on user interfaces (i.e. laptop or PC) through the Owner's Enterprise server. Real-time values displayed on a Web page shall update automatically without requiring a manual "refresh".

1.5.6.3 The Graphical User Interface shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing, of, and access to, the hierarchical structure of the database. In addition, menu pull-downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line that displays the location and the selected object identification.

1.5.6.4 The contractor shall provide all software necessary to permit the owner's designate super user to create, modify, delete, file and recall all graphics. The software package shall encompass graphical presentation of the geographical territory of the site, floor plans and equipment locations, c/w all graphics required, and sufficient expansion for the ultimate system.

1.5.6.5 The system shall be capable of generating any graphic in conjunction with any alarm of change-of-state reported.

1.5.6.6 Command software shall be provided to:

- Create a new graphic picture
- Modify a portion of a graphic picture
- Delete a graphic picture
- Call up and cancel the display of a graphic picture

1.5.6.7 The graphic package shall contain a library of HVAC related standard graphics and graphic symbols.

1.5.6.8 In the development of a graphic picture, the graphic software shall support all operator actions necessary to:

- Define the background
- Establish colours
- Define and locate symbols
- Position and edit alpha-numeric descriptors of any height
- Establish sources of real-time data and the location of their readouts

1.5.6.9 The graphics operating values and data, such as set-points, process values, alarms and parameters should be dynamically updated.

1.5.6.10 Creation of graphics must be possible using a mouse or equivalent screen point's device.

1.5.6.11 The package should be equipped with point trend graphical presentation of historical logged data, time schedule editor and alarms. The operator should read alarms from the graphics and acknowledge.

1.5.6.12 Vendors shall provide new graphics and programming both on site and in a vendor specific dedicated server (customer supplied) Located on the City Control and monitoring Centre.

1.5.6.13 The graphics generated for each site and project shall be consistent in nature from building to building, and system to system, etc. All Graphics shall conform to the ***City of Mississauga Graphical Standard.*** The Standard is under continuous development by the City and the successful bidder of each individual project will be given access to view a live **Template Workstation** representing the most recent updated version of the Graphic Standard.

1.5.6.14 Access to the template workstation shall be granted to all vendors at the start of each new project for purposes of determining the basis and layout of COM system graphics, along with specific objectives/instruction on graphical needs of the project from COM. EMCS vendor shall use the Template Station graphics as starting point to create NEW customized, site specific project graphics. The new graphics are to match the outlined template look, layout, and colour scheme while displaying the building and system specific information for that site and the direction of COM.

1.5.6.15 Graphics shall be submitted for review and approval by COM before acceptance and their application on site. Contractor shall make all necessary changes to satisfy the City and should anticipate a reiterative process with multiple submissions before the Graphics are finalized. **NO WORK ON SITE SHALL BEGIN** until the graphics have been submitted, reviewed and approved.

1.5.6.16 Graphical Interface shall be programmed to have multiple levels of user access via Active Director (Refer to Appendix A City of Mississauga Standards and Guidelines).

1.5.6.17 The Graphical Interface shall be to the City of Mississauga Graphical Standard (Refer to Appendix A5)

1.5.7 Equipment Standardization

1.5.7.1 Whenever possible, the system shall use standard and readily available components and installation techniques to minimize the risks that may arise for "specialized" equipment and devices. Proven materials, software, techniques, etc. are preferred.

1.5.8 Training

1.5.8.1 The EMCS Vendor shall be responsible to provide training. (Refer to Section 25 01 12 EMCS Training).

1.5.9 Communications

1.5.9.1 The Communication Network from the SRPDC to the Server shall utilize the Owner's existing ETHERNET TCP/IP network protocol. Communication between SRPDC and RPDC panels and field controllers and devices shall be via BAC-net Communication Network in accordance with **ANSI/ASHRAE 135 2004**. The Contactor shall provide a peer-to-peer networked, fully distributed control system for the buildings electrical and mechanical systems.

1.5.10 Reliability/Security

1.5.10.1 The system shall include protective measures in order to minimize the interruption risks and non-authorized operation of the system. These measures include but not limited to the following:

- Equipment/device address duplication
- Protection against atmospheric conditions
- High power electrical protection
- Distributed intelligence
- Analogue and digital control
- Limited access to the system
- Proven software
- Spare parts
- Remote software down and up loading
- Maintained Memory and Programming on power failure
- Physical spacing between components
- Locking panels
- "Fail safe" programming
- Protection from radio wave interference (ex: use of walkie-talkies near the DDC.)
- TLS Encryption and Security Certificates

1.5.10.2 Provide and maintain independent validation by a reputable application security assessor of implementation of OWASP ASVS v3.0.x Level 2 application security controls. Any exceptions to Level 2 controls, or acceptance of an alternative control framework (and exceptions thereto), must be managed and approved through standard City of Mississauga Information Technology Services (information security risk management) and Records Management (privacy management) processes.

1.5.10.3 Ensure that re-validation is performed on an annual basis at a minimum, or upon any significant changes to website/application functionality

1.5.11 Back-up Databases

1.5.11.1 Back-up copies of all SRPDC,RPDC & TEC system controller databases shall be stored in the Owner's dedicated EMCS Server. In addition, the vendor shall store a copy of all back-up programming for each controller and site and shall furnish to the owner upon request at no additional charge.

1.5.11.2 Continuous supervision of the integrity of all SRPDS,RPDC & TEC system controller databases shall be provided. In the event that any SRPDC,RPDC & TEC system controller on the network experiences a loss of its database for any reason, the system shall automatically download a new copy of the respective database to restore proper operation.

1.5.11.3 Database back-up/download shall occur over the local area network without operator intervention and again over the COM WAN at a frequency set-up by the installing contractor in coordination with CoM Facilities department. Users shall also have the ability to manually execute downloads of any or all portions of a SRPDC, RPDC & TEC system controller database.

1.6 OBJECTIVES

1.6.1 General Objectives

1.6.1.1 The Controls Contractor shall supply and install a complete new BAC-net based (DDC) direct digital control Energy Management Control System (EMCS) system as required to achieve the Sequences of control for HVAC systems, heating & cooling plants, etc. and/or to replace the existing control systems used by the Owner.

1.6.1.2 No Gateways, communication bridges, protocol Translators or any other electronic devices that translate other communication protocols to the BAC-net communication protocol shall be permitted for the EMCS installation. Gateways may only be used as required for interfacing to major HVAC equipment and other building systems as specified elsewhere (i.e. – Chillers, Boilers, Power Meters, lighting, etc.)

1.6.1.3 The new EMCS control system shall consist of a high-speed Ethernet, peer-to-peer (through a BAC-net) network using TCP/IP protocol and DDC controllers interfacing with the Owner’s dedicated EMCS enterprise server through the **SPRDC**. The EMCS server shall allow facility operators and other City of Mississauga Staff to interface with the control network via dynamic color graphics.

1.6.1.4 The new EMCS shall be provided with a complete Web enabled graphical user interface (GUI). The Web enabled GUI shall operate on industry standard PC hardware. The new EMCS system graphics shall be HTML 5 based vector scalable graphics and must be able to be viewed from any computer or hand held device (i.e. smart phone, tablet, etc.) on the owner supplied network or any computer on the internet (via a VPN) using no special software other than browsers (Microsoft internet explorer, Safari, or equivalent). Any black boxes or proprietary server hardware will not be acceptable.

1.6.1.5 The new EMCS shall be flexible in nature and shall permit expansion of both capacity and functionality through the addition of EMCS controllers, sensors, actuators and operator devices.

1.6.1.6 The new system Architecture design shall eliminate dependence upon any single device for alarm, event reporting and control functionality. Each EMCS controller shall operate independently by performing its own specified control programs and routines, operator I/O, Alarm management, data collection and sequences of operations. The failure of any single device, component or network connection shall not interrupt the execution of any control strategy, routines, reporting, or any operator interface device. Refer to Appendix A for System Architecture Diagram.

1.6.1.7 The EMCS Controllers shall be able to access data from, or send control commands and alarm reports directly to, any other controller or combination of controllers on the local area network without dependence upon a central processing device. EMCS controllers shall also be able to send alarm reports to unlimited email devices such as cell phones, pagers, or standard alarm terminals via Supervisory Remote Digital Controller (**SRPDC)** and the Owner's EMCS Server using remote alarm software.

1.6.1.8 All products used in the project installation shall be new and currently under manufacturer warranty and shall have been applied in similar installations of a minimum of two years. Spare parts shall be available for at least five years after completion of this contract. Security certifications must be maintained throughout the expected life of any/all components

1.6.1.9 All controllers supplied for control of HVAC equipment shall be of One Manufacturer throughout.

1.6.1.10 For replacement of existing systems, contractor to remove existing direct digital control panel(s) and ***return to Owner upon request or dispose of if not required by owner***. Existing sensors (pneumatic/digital/electronic) made redundant or unnecessary by this work shall be removed.

1.6.1.11 Unless otherwise noted, all existing pneumatically operated control valves shall be replaced with new electronically actuated control valves. Where indicated to remain, pneumatically actuated devices shall be interfaced with new electro-pneumatic transducers. Contractor shall run new main air pneumatic tubing from the air compressor system to transducers and again to devices.

1.6.1.12 Where noted on drawings and/or points list, existing control valves shall be replaced with new electronic control valves operating on a 0-10Vdc or 4-20 mA signal. Contractor shall be responsible for complete supply and installation (mechanical/electrical/controls) of valves and actuators.

1.6.1.13 Remove all existing pneumatic damper actuators. Supply and install replacement electronic actuators operating on a 0-10Vdc or 4-20mA signal

1.6.2 Global Scope

1.6.2.1 The City of Mississauga owns, operates, and maintains facilities across the greater area and is comprised of several buildings of different size and use (Museum, libraries, Administrative, Community Center, Fire Halls Nursing Home etc.). The City is in the process of upgrading and standardizing the controls to achieve energy efficiency goals and improved thermal comfort. As part of the process the City will be tendering a number of requests to solicit stipulated price contract Bids for the installation of the New EMCS including connection of these installations to the City's Host EMCS Enterprise Server

1.6.2.2 The scope of work shall include remote programmable BACNet Certified Supervisory Remote Digital Controllers (SRPDC) and associated controllers c/w control and sensor devices, installed in each building and connected to a host server in another building on campus.

1.6.2.3 City of Mississauga Pre-Qualified EMCS Vendors and Products are:

Company Name	Branch Location	Contact Person	EMCS Family of Products
Facio Corporation	145 West Beaver Creek Rd, Richmond Hill, ON L4B 1C6	Gary MacMillan gmacmillan@facio.ca 416-391-5581 ext. 102	Honeywell Spyder BacNet IP series (programmable via Niagara Workbench) and Ciper series controller. Distech Eclypse BacNet IP series controllers
Automated Controls and Energy Solutions Group Inc.	5285 Solar Dr Unit 103, Mississauga, ON L4W 5B8	Murat Kinaci estimates@acesolutionsgroup.ca 416-635-0678 ext. 103	Honeywell Spyder BacNet IP series (programmable via Niagara Workbench) and Ciper series controller
Airon HVAC and Control Ltd.	5150 Fairview St, Burlington, ON L7L 6B7	Tanya Mead tanyam@airongroup.ca 905-331-6555 ext. 128	Honeywell Spyder BacNet IP series (programmable via Niagara Workbench) and Ciper series controller
Ainsworth Inc.	131 Bermondsey Rd, North York, ON M4A 1X4	Albert Galit agalit@escautomation.com 416-895-6850	Schneider Smart X BacNet IP series, with Niagara module (programmable

			via Niagara Workbench)
Accu-Temp Systems Inc.	226 St Leger St, Kitchener, ON N2H 4M5	Scott Ward Scottw@accutempsystems.com 519-896-7027 ext. 224	Honeywell Spyder BacNet IP series (programmable via Niagara Workbench) and Ciper series controller
Modern Niagara Toronto Inc	8125 Hwy 50 Vaughan, Ontario L4L 1A5	Jason Baycroft jbaycroft@modernniagara.com 647-541-1503	Distech – Eclypse – Bacnet IP series controllers

1.6.3 Owner's Needs and Rights

1.6.3.1 The Owner demands equipment using Direct Digital Control (DDC) and distributed intelligence that is proven and shall be currently under manufacturer warranty. The operator interfaces, Building Controllers, System Controllers, and Application Specific Controllers shall be connected directly through a BAC-net communication internetwork. It is essential that all proposed systems strictly meet the Owner's needs.

1.6.3.2 The Owner has a full ownership of all products including hardware, software, graphic files, dominations, etc.

1.6.4 General Prescriptions and Concerns

1.6.4.1 Conform to all general sections of these specifications (General Conditions, General Requirements, etc.) The present section is an integral part of the Pre-Approved Direct Digital Control Vendor's scope of work and deliverables under contract with the Owner, as well as the specific scope of work for detailed for individual installations within each facility.

1.6.5 Description of Work

1.6.5.1 Supply, install and render operational an Energy Management Control system, including communications interfaces, to the Owner's proprietary communication network. The connections to the proprietary communications network shall be provided by the Owner. ***Contractor shall be responsible for communicating and coordinating IP drop locations with Owner's designated IT representative)***

1.6.5.2 The new EMCS system shall incorporate a ***<u>Supervisory Remote Programmable Digital Controller</u>*** (SRPDC). The SRPDC to is be located in the owner's designate main mechanical room or other owner designated location, complete with necessary interface hardware/software to allow communication over the City of Mississauga intranet using TCP/IP BAC-net standard protocol. ***<u>A UPS shall be provided by the EMCS Vendor</u>*** for the SRPDC to condition power and provide 20 minutes of uninterrupted power to avoid loss of communication during temporary power outage.

1.6.5.3 The SRPDC shall communicate to third party OEM controllers through separate vendor supplied dedicated Sub-Network. Sub-Network shall also be BAC-net based Local Area Network (LAN).

1.6.5.4 The City of Mississauga intends to install Wi-Fi communications throughout each of its facilities including coverage in mechanical rooms. Vendor shall set up HTML 5 scalable graphics that can be viewed and operated via mobile devices (i.e. Smart Phone and/or tablets) accessible through the Public or Owner’s Wi-Fi network. The purpose of these graphics is to facilitate the service and maintenance of the systems by the Owner’s technicians. Access to the Graphics via this method shall be through the EMCS Enterprise Server Software. Also, at each site the graphics shall reside on the SRPDC and shall be accessible by a laptop or operator’s workstation. Security Access Levels as outlined in these specifications shall be consistent and maintained when accessing controls through any or all PC/Laptop/Handheld Devices.

1.6.5.5 The installation of all the necessary equipment, complete with programming, should be in accordance with the control plans, system sequences of operation, the specific scope of work for each building and any other information in these and/or other specifications associated with the specific project. The specific scope of work is an integral part of these and other specifications, where other specifications are in contradiction to these specifications it is the contractor’s responsibility to bring it to the attention of the Owner prior to submitting a bid.

1.6.5.6 The contractor shall install an adequate quantity of controls in order to respond to the requirements of each facility.

1.6.5.7 Furnish and install all necessary elements in order to execute the described sequences of operations.

1.6.5.8 The Control contractor shall be responsible for having the required electrical work executed by a qualified electrician and include the associated costs in his tender.

1.6.5.9 All electrical installation shall be made in conformity with the Electrician Safety Authority (ESA) and according to the applicable codes and regulations in force.

1.6.5.10 Provide all necessary power supplies from dedicated circuits in new/existing power panels.

1.6.5.11 Provide all the necessary wiring for the remote start/stop of equipment.

1.6.5.12 Install all conduits for power, control, and communication wiring in accordance with these specifications

1.6.5.13 Install a BACNet based communication bus between SRPDC, RPDC and the field communication devices of the building.

Part 2 **Products**

2.1 EQUIPMENT

2.1.1 Control Network Protocol and Data Communication Protocol: to ASHRAE STD 135.

2.1.2 Complete list of equipment and materials to be used on project and forming part of tender documents by adding manufacturer's name, model number and details of materials, and submit for approval.

Part 3 Execution

3.1 INSTALLATION

3.1.1 The EMCS Vendor shall furnish and install all apparatus, accessories, wires and instrumentation piping necessary to the completion and good functioning of the system.

3.1.2 The system shall be installed by electricians, technicians and mechanics trained and qualified for this type of work.

3.1.3 The supervision and start-up of the automation system shall be done on the dates stipulated by the Owner.

3.1.4 The system shall be installed in accordance with these specifications.

3.1.5 Electrical Wiring

- Submit shop drawings and product data in accordance with the requirements as detailed in these specifications.
- All wiring shall comply with local and national electrical codes and the requirements of Division 16.
- All control and sensor wiring shall be colour coded in compliance with Section 25 05 54.
- All wiring shall be plenum rated Beldon or equivalent, #18, #20 or #22-gauge, non-shielded wiring when in conduit, shielded where exposed. Lengths for specific gauge and applications shall comply with the controls' manufacturer's guidelines. Exposed low voltage wiring shall be in EMT conduit, plenum rated cable above ceilings (neatly secured with Tie-Wraps to building elements), and wire mould in finished areas where noted. All power wiring (120V) shall be in EMT conduit. The final 18" of wiring into mechanical equipment shall be in liquid tight, mounted to ensure vibration is not transmitted from equipment to conduit.
- Size 24 VAC wiring according to length refer to manufacturer's voltage drop table and size wire to achieve a minimum of 22 VAC at the control being powered.
- The use of wire-nuts for connections on communication bus is prohibited. Use "Scothlok" 3M terminals or other similar terminal block type product.
- All new controls shall have an independent power supply with dedicated breaker. The contractor shall be responsible for finding available power and labelling panel(s) for new control circuits.
- All controllers and field devices shall be identified in accordance with Section 25 05 54

3.2 NEW SYSTEMS

3.2.1 Supply and install a BAC-net based Supervisory remote programmable digital control panel (SRPDC) in the designated main Mechanical room or other location as indicated on the drawings or designated by the Owner.

3.2.2 The SRPDC shall be powered by a dedicated circuit from the nearest power panel and conditioned through a UPS before powering the panel. This UPS will also serve to back-up power for the SRPDC so that it may maintain communication with the Owner's designated Enterprise Server during power failure at individual buildings and ensure systematic re-start of equipment upon restoration of commercial power (through Restart Programming).

3.2.3 Install all necessary equipment (sensors, wiring, relays, etc.) and complete programming of the installation (alarm messages, graphics, communications, application programs, etc.) in accordance with the sequences of operations and the control plans as specified.

3.2.4 The running status of equipment such as fans, pumps, compressors, etc. shall be detected by a current sensing relay. These relays shall be calibrated consequently on site. Auxiliary contacts or airflow switches are not accepted as a proof of run unless specified elsewhere.

3.2.5 The power supply (120V) to the control devices, which controls the mechanical systems should be from a dedicated power circuit and connected to the nearest electrical panel with the circuit identified at the power panel, on the drawings and at the control device.

3.2.6 The control equipment locations shown on the plans is approximate only and final locations shall be coordinated with the Owner and/or Consultant during the work execution. The plans are not to scale, and they indicate approximate location only.

3.2.7 All the new wiring and piping of the new control system shall be the contractor's responsibility, including the power and control wiring, electrical conduit, control devices, etc. Communication wiring between the SRPDC and the Owner's Ethernet Switch shall be done by others but coordinated by this contractor.

3.2.8 The Contractor shall coordinate the test of the fire alarm system with the Owner's fire alarm company to verify that the interlocks with the ventilation system have been properly maintained and are functional.

3.2.9 The Contractor shall coordinate a power failure test run done with the Owner in order to verify the SRPDC reactions to this test. This test shall take place after the switchover and start-up of the SRPDC, RPDC and TEC controllers.

3.2.10 The Contractor shall acquire, at his own expense, all information on manufacturer's equipment such as: boilers, rooftop HVAC systems, chillers, fire panels, VSD's etc. in order to identify the necessary electric wiring required for the proper functioning of the new system. Any relays and/or interface modules for the control panel shall be supplied by the Contractor at his own expense.

3.2.11 All controllers including but not limited to SRPD, RPDC, TEC and OEMASC shall comply with all aforementioned EMCS system requirements and shall comply with the BACNet Protocol in accordance with the latest version of **ANSI/ASHRAE Standard 135**.-**2004.** All controllers (other than OEMASC) shall be of one manufacturer.

3.2.12 Remote Programmable Digital Controllers (RPDC) shall be furnished by the EMCS vendor as necessary to control large point count of major mechanical equipment, and the implementation of EMCS global control strategies.

3.2.13 Every mechanical system and/or large piece of mechanical equipment (i.e., Heating Plant, Chiller Water Plant, Large AHU, etc.) shall have one (1) dedicated RPDC with sufficient point capacity and memory such that it shall be connected to ALL field devices and terminal components (devices & sensors) associated with that system and/or piece of equipment. Distributed control of one (1) single piece of large equipment shall not be performed by multiple controllers.

3.2.14 The SRPDC shall be microprocessor based and shall execute many functions completely without the help of the central system. For example, they shall:

- Interrogate inputs and outputs
- Calculate by using real time data and other parameters
- Execute the Enterprise Server Software instructions
- Report information to the Enterprise Server Software
- Facilitate communicate between other field controllers (RPDC, TEC, and OEMASC) allowing interrogation and operation modification without the need to connect to the Server.

3.2.15 Function of the New System

3.2.15.1 Collection of Data Base

- The system shall collect different data from the mechanical and electrical systems of the automated buildings.

3.2.15.2 Control Capacity

- The system shall permit the automatic and manual control of the data and the equipment.

3.2.15.3 Programmability

- The system shall be fully programmable in order to perform basic operations automatically and certain calculations frequently used (i.e. reset schedules and calculated system set points, etc.).

3.2.15.4 Report Printing and Generation

- The system shall produce certain reports and/or graphics as detailed in these specifications through the use of external devices such as a printer.

3.2.15.5 Database Management

- It shall be possible for the operator to view and/or print out any portion of the database including, as a minimum:
  - Point configuration
  - Alarm limits
  - Schedules (Note: The system shall permit different schedules: weekly, Holiday, Alternate schedule and Temporary schedule for special events and work orders)
  - Report configuration
  - Graphic configuration
  - Global program configuration
  - SRPDC & DDC software

3.3 REPLACEMENT OF EXISTING SYSTEMS:

3.3.1 Where the specified EMCS is intended for the replacement of existing control systems, remove **all components** of the existing control system which are not required including but not limited to:

3.3.1.1 Electric and/or pneumatic controllers

3.3.1.2 Instrumentation supports and instrument panels

3.3.1.3 Existing control panel enclosures

3.3.1.4 Pneumatic Thermostats and all pneumatic tubing (in their entirety)

3.3.1.5 All existing control transformers, relays, wiring, timers, conduits, switches, thermostats, humidistats, control piping, etc. made redundant as a result of this scope of work. Where existing control and/or power wiring is unmarked and un-know, vendor shall trace and remove.

3.3.2 It is preferable that all new control panel(s) be installed where existing control panels have been removed or in close proximity.

3.3.3 If the contractor wished to re-use any existing control components (conduit, wires, cabinets) this shall be clearly communicated to the owner and submitted for approval prior to closing. It shall also be clearly identified in the bid submission as an Optional Price Deduction and the contractor shall warranty any re-used control components for a period of one (1) year from date of final acceptance

3.3.4 Prior to the start of the project, the contract is responsible for conducting a Survey and functional test of the existing system components including but not limited to, panel and device locations, condition and functionality of any equipment to remain and be connected to the new controls (ie – Dampers, Damper Actuators, VFD's, Sensors identified as "to remain", freeze stats, high limits, etc). The contractor shall submit the survey to the Owner along with cost estimates for any repair/replacement.

3.3.5 Prior to removal of the existing control panel, the contractor shall be responsible for downloading all existing programming and databases including present control variables. This information may be used at a later stage as reference in the new installation (ie - Flow values, alarm limits, etc).

3.3.6 Where approval is given for equipment is to be re-used, contractor shall carry out all necessary tests to ensure that the equipment will perform satisfactorily in its final duty as specified. All Testing shall be carried out prior to re-use. If after testing any items cannot perform as specified, the contractor shall be responsible for providing new to make the system perform as specified. The Owner takes no responsibility for the suitability and operation of existing equipment.

3.3.7 Supply and install all necessary accessories for the remote start-up of a pump or a fan, etc. These shall include relays, H.O.A. selectors, magnetic conductors interlock wiring, etc. All safety interlocks of the existing starters shall remain functional in both hand and auto positions. Where existing starters do not have H.O.A. selectors, contractor shall be responsible to retrofit/replace the starters and provide new.

3.3.8 Supply, install and render operational, primary control panel (SRPDC) and communications interface first. This shall be done to maintain the control and communication of the existing systems during the transfer from the existing DDC to the new control system.

3.3.9 All modifications to starters wiring are to be rewired while keeping only necessary interlocks. All redundant interlocks or relays shall be removed in their entirety (i.e. pneumatic fire heads where replaced with electrical/mechanical high limits controls, etc.).

3.3.10 Pneumatic Devices

3.3.10.1 The owner does not intend to use any pneumatic devices within mechanical rooms (i.e. Damper and Valve Actuators). In some cases (where identified) field devices such as Thermostats/Valves in other areas of the building may remain as designated by the Owner/Consultant**.**

3.3.10.2 In cases where the Owner/Consultant has designated to re-use pneumatic actuators and control devices, a pressure gauge (0-30 psi) shall be installed in the pneumatic line at the output of each electro-pneumatic transducer (EPT) and in the main compressed air line to the controller(s).

3.3.10.3 An in-line oil filter shall be installed in the main airline to each controller**.**

3.3.11 For replacement systems, the contractor shall provide a priority list at the start of the project indicating systems that are to be transferred first (from the old to the new control system) so that the building controls can be updated in a systematic and organized fashion. Consultant/Owner will review the list and provide any necessary input/changes.

3.3.12 The EMCS Contractor shall have all necessary thermo-wells for piping installed by a qualified mechanical contractor. Where existing thermometers are installed, the existing thermometer wells shall not be reused for DDC sensors. Strap-On sensors shall not be acceptable except where previously identified by the Consultant and/or Owner's representative. When new thermo-wells are to be installed in existing piping that is insulated, a length of one (1) foot of insulation shall be removed and redone adequately with new insulation of the same thickness and finish.

3.3.13 The Contractor shall be responsible for all the necessary patching and painting to make good the existing finish due to the removal of the existing equipment or the new installation.

3.3.14 Sequences of Operations

3.3.14.1 The sequences of operations for all systems furnished in these specifications are generic in nature and are the expected sequence end results. (Refer **25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation**)

3.3.14.2 The Contractor shall make sure that the programming of the sequences of operations for the systems shall be such to prevent cycling at system start-up as well as cycling of the control actuators for the mixing dampers, cooling valves, heating valves, or other devices, etc.

3.3.14.3 The Contractor shall foresee and include in his programming all necessary control loops, control modes, proportional bands, integration time, time delays for start-up, ramping, control loop reset and all other necessary details for the proper functioning of the system and in order to produce a stable control of the equipment.

3.4 QUALITY ASSURANCE

3.4.1 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.

3.4.2 Health and Safety:

3.4.2.1 Do construction occupational health and safety in accordance with Province of Ontario Occupation Health and Safety Act and city of Mississauga Health and Safety Requirements as a minimum.

3.4.3 Quality Control:

3.4.3.1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.

3.4.3.2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.

3.4.3.3 Submit proof of compliance to specified standards with shop drawings and product data. Label or listing of specified organization is acceptable evidence.

3.4.3.4 In lieu of such evidence, submit certificate from testing organization, approved by Engineer/ Consultant and/or Owner, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.

3.4.3.5 For materials whose compliance with organizational standards/codes/specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.

3.4.3.6 Permits and fees: in accordance with general conditions of contract.

3.4.3.7 Submit certificate of acceptance from authority having jurisdiction to Engineer/ Consultant and/or Owner.

3.4.3.8 Existing devices intended for re-use (where specified): submit test report.

3.5 DELIVERY, STORAGE AND HANDLING

3.5.1 Material Delivery Schedule: provide schedule to Owner and/or Consultant/Engineer within 2 weeks after award of Contract.

3.5.2 Waste Management and Disposal:

3.5.2.1 Separate waste materials for recycling in accordance with Specifications.

3.5.2.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

3.5.2.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material for recycling in accordance with Waste Management Plan.

3.5.2.4 Separate for recycling and place in designated containers; Steel, Metal, Plastic, Paper waste in accordance with Waste Management Plan.

3.5.2.5 Place materials defined as hazardous or toxic in designated containers.

3.5.2.6 Handle and dispose of hazardous materials in accordance with Regional and Municipal, regulations.

3.5.2.7 Label location of salvaged material's storage areas and provide barriers and security devices.

3.5.2.8 Ensure emptied containers are sealed and stored safely.

3.5.2.9 Divert unused materials from landfill to appropriate recycling facility as approved by Owner and/or Consulting/Engineer.

3.5.2.10 Fold up metal and plastic banding, flatten and place in designated area for recycling.

3.6 MANUFACTURER'S RECOMMENDATIONS

3.6.1 Installation: to manufacturer's recommendations.

3.7 PAINTING

3.7.1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.

3.7.2 Restore to new condition, finished surfaces too extensively damaged to be primed and touched up to make good.

3.7.3 Clean and prime exposed hangers, racks, fastenings, and other support components.

END OF SECTION 25 01 11

EMCS: SUBMITTALS AND REVIEW PROCESS

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EMCS: SUBMITTALS AND REVIEW PROCESS

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Methods and procedures for shop drawings submittals, preliminary and detailed review process including review meetings, for building Energy Management Control System (EMCS).

.2 Related Sections.

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 25 05 01 - EMCS: General Requirements

.3 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.2 DEFINITIONS

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

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures and coordinate with requirements of this Section.

.2 Graphics submittal shall consist of PDF screen shots for each graphic (Floor Plans, Systems, submitted to the City of Mississauga for review and comment. This shall be followed by an on-line interactive demonstration of the graphics for the contractor to clarify comments and expectations prior to beginning the work on re-submissions.

.3 Shop Drawing submittals to consist of 3 hard copies and 1 soft copy of design documents, shop drawings, product data and software.

.1 Hard copy to be completely indexed and coordinated package to assure compliance with contract requirements and arranged in same sequence as specification and cross-referenced to specification section and paragraph number.

.2 Soft copy to be in PDF and/or EXEL format in accordance with owner’s request, structured using menu format for easy loading and retrieval.

.4 Receive from Owner and/or Consultant the job specific electronic version of the **City of Mississauga Points Matrix Form** as provided during project Tender. Vendor to populate all relevant columns and fields with necessary data including but not limited to; Point Names (in accordance with city of Mississauga Point Naming Convention), Point Type, Device Type, Controller Location and Power Source, etc. Refer to Appendix A

1.4 PROJECT SPECIFIC POINT NAME REVIEW

.1 Prior to submission of shop drawings, prepare and submit the populated **CoM Point Matrix Form** (see 1.3.4 above) utilizing the CoM Point Naming Convention for review and approval.

.2 Points list shall include all hardwired and virtual points to be utilized by the contractor in the programming and installation of new/upgraded EMCS installations.

.3 Contractor to revise point names and re-submit as directed until the final point names are approved by the City of Mississauga and/or Consultant.

1.5 DEVICE NETWORK NUMBERING REVIEW

.1 Prepare a complete list of network numbers for all devices connected to the system and submit to the City of Mississauga for review (Refer to Appendix A, City of Mississauga Standards and Guidelines).

1.6 SHOP DRAWING REVIEW

.1 Submit shop drawings within 15 working days of award of contract and include, but not limited, following:

.1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.

.2 Detailed system architecture showing all points associated with each controller including, signal levels, pressures where new EMCS ties into existing control equipment (where applicable)

.3 Spare point capacity of each controller by number and type.

.4 Controller locations.

.5 Location of Power supplies to each panel and control transformer including Panel Name, Location, Circuit Numbers, etc.

.6 Auxiliary control cabinet locations.

.7 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.

.8 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).

.9 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.

.10 Flow measuring stations: complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at design flow rate, manufacturer, model and range of velocity transmitter.

.11 Wiring diagrams

.12 Piping diagrams and hook-ups

.13 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others

.14 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including

- Sensing element type and location.
- Transmitter type and range.

- Associated field wiring schematics, schedules and terminations.
- Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
- Software and programming details associated with each point.
- Manufacturer's recommended installation instructions and procedures.
- Input and output signal levels or pressures where new system ties into existing control equipment.
- Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.
- Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs (in Accordance with City of Mississauga format).

1.7 GRAPHICS REVIEW

.1 Contractor to develop site-specific custom graphics for each installation and submit to CoM for review and approval.

.2 Graphics review will be a re-iterative process, contractor should anticipate multiple submissions before final approval.

.3 CoM and CxA to also review graphics and performance of graphical links, etc during the Cx phase. Contractor shall make any additional changes as necessary to the CoM satisfaction without additional charge.

1.8 DEVICE AND PANEL LABEL REVIEW

.1 All labels to be submitted to CoM for review (panels, devices, equipment, wire tags, etc)

.2 All devices shall be labelled in accordance with CoM standards and guidelines, refer to Appendix A3.1.

.3 Contractor shall make all necessary changes to the satisfaction of CoM prior to installation in the field.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION 25 05 02

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EMCS PROJECT RECORD DOCUMENTS

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Requirements and procedures for final control diagrams and operation and maintenance (O&M) manual, for building Energy Management Control System (EMCS) Work.

.2 Related Sections.

.1 Section 01 78 00 - Closeout Submittals.

.2 Section 25 05 01 - EMCS: General Requirements.

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

.4 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

.5 Appendix A – City of Mississauga Forms and BAS Installation Guidelines

1.2 DEFINITIONS

.1 OWS - Operator Workstation.

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

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 78 00 - Closeout Procedures, supplemented and modified by requirements of this Section.

.2 Submit Acceptance Forms, Record Documents, As-built drawings, and Operation and Maintenance Manuals to Engineer and Owner in English.

.3 Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders.

.1 Binders to be 2/3 maximum full.

.2 Provide index to full volume in each binder.

.3 Identify contents of each manual on cover and spine.

.4 Provide Table of Contents in each manual.

.5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

1.4 AS-BUILTS

.1 Provide 1 copy of detailed shop drawings generated in Section 25 05 02 - EMCS: Submittals and Review Process and include:

.1 Changes to contract documents as well as addenda and contract extras.

.2 Changes to interface wiring.

.3 Routing of conduit, wiring and EMCS Subnetworks, control panel locations, power panel, and powers supply locations associated with EMCS installation.

.4 Locations of obscure devices to be indicated on drawings.

.5 Printed verification copy of received Critical alarm messages.

.6 Panel/circuit breaker number for sources of normal/emergency power.

.7 Names, addresses, telephone numbers of each sub-contractor having installed equipment, local representative for each item of equipment, each system.

.8 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports as specified in Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

.9 Basic system design and full documentation on system configuration.

.2 Submit for final review by Engineer and Owner.

.3 Provide before acceptance 3 Hard and 1 soft copy incorporating changes made during final review. Final approved AS-BUILTS shall be linked to the graphics through each individual systems page and the entire AS-BUILTS through the Left Side Navigation Bar – refer to CoM Graphical Standards Appendix A5

1.5 O&M MANUALS

.1 Custom design O&M Manuals (both hard and soft copy) to contain material pertinent to this project only, and to provide full and complete coverage of subjects referred to in this Section.

.2 Provide 3 complete sets of hard and soft copies prior to system or equipment tests

.3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.

.4 Functional description to include:

.1 Functional description of theory of operation.

.2 Design philosophy.

.3 Specific functions of design philosophy and system.

.4 Full details of data communications, including IP port and protocols required/in use, data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.

.5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.

.6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented for implementation in automatic mode.

.5 System operation to include:

.1 Complete step-by-step procedures for operation of system including required actions at OWS.

.2 Operation of computer peripherals, input and output formats.

.3 Emergency, alarm and failure recovery.

.4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including keystrokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.

.6 Software to include:

  .1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.

  .2 Detailed descriptions of program requirements and capabilities.

  .3 Data necessary to permit modification, relocation, reprogramming and to permit new and existing software modules to respond to changing system functional requirements without disrupting normal operation.

  .4 Software modules, fully annotated source code listings, error free object code files ready for loading via peripheral device

  .5 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, program execution.

  .6 Software for each Controller and single section referencing Controller common parameters and functions.

  .7 Up-to-date security certifications.

.7 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including calibration, maintenance, repair of sensors, transmitters, transducers, controller and interface firmware's, plus diagnostics and repair/replacement of system hardware.

.8 System configuration document:

  .1 Information regarding IP port and protocols required/in use

  .2 Provisions and procedures for planning, implementing and recording hardware and software modifications required during operating lifetime of system.

  .3 Information to ensure co-ordination of hardware and software changes, data link or message format/content changes, sensor or control changes in event that system modifications are required.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION 25 05 03

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EMCS IDENTIFICATION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Requirements and procedures for identification of devices, sensors, wiring tubing, conduit and equipment, for building Energy Monitoring and Control System (EMCS) Work and nameplates materials, colours and lettering sizes.

.2 Related Sections.

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 25 05 01 - EMCS: General Requirements.

.3 Appendix A - City of Mississauga Standards and Guidelines

.4 Appendix B – City of Mississauga Forms and Templates

.3 References

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

1.2 DEFINITIONS

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

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit to Consultant and City of Mississauga for approval

.1 Complete Points List using City of Mississauga Point Naming Convention (including all virtual points and hardwired points) to be used for Shop Drawings.

.2 Device Name and Numbering

.3 Wire Labels

.4 Field device tag names,

.5 Cabinet and Controller name/numbering and enclosure Layout Diagrams

.6 Floor plans with proposed network routing, power supply locations, router/switch locations, controller locations

.3 All point names, point descriptors, numbering, lables, etc shall follow the **City of Mississauga Standards and Guidelines** (refer to Appendix A) .

Part 2 Products

2.1 NAMEPLATES FOR CONTROLLER PANELS

.1 Identify by Plastic laminate (Lamacoid), 3 mm thick Melamine, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.

.2 Sizes: 25 x 67 mm minimum.

.3 Lettering: minimum 7 mm high, black.

.4 Inscriptions: machine engraved to identify the following information

- Panel #
- RPDC #(s)
- Equipment Served by Panel

.5 See EMCS Labeling Requirements for Examples

2.2 NAMEPLATES FOR CONTROLLER PANELS

.1 Identify by Plastic laminate, 3 mm thick Melamine, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.

.2 Sizes: 25 x 67 mm minimum.

.3 Lettering: minimum 7 mm high, black.

.4 Inscriptions: machine engraved to identify the following information

- Panel #
- Devices in Panel
- Power Supply (if electrical Panel)
- EMCS Sticker

.5 See EMCS Labeling Requirements for Examples

2.3 NAMEPLATES FOR FIELD DEVICES

.1 Identify by plastic encased cards attached by plastic tie.

.2 Sizes: 50 x 100 mm minimum.

.3 Lettering: minimum 5 mm high in Black.

.4 Data to include:

- Point name
- Controller #
- IO Port

.5 For points located in MCC, Starter, Boiler etc. include all points being used within the conduit entering the equipment.

.6 See EMCS Labeling Requirements for Examples

2.4 NAMEPLATES FOR ROOM SENSORS

.1 Identify by stick-on labels using point name identifier.

- Example: RM205RMT_T (TEC5411)

.2 Location: On bottom portion of Room Sensor (as directed by Consultant and/or Owner).

.3 Letter size: to suit, clearly legible.

2.5 WARNING SIGNS

.1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.

.2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS".

2.6 WIRING

.1 Supply and install markings on wiring at panels, junction boxes, splitters, cabinets, field devices and outlet boxes.

.2 Colour coding: Use colour coded wiring throughout. Communications cables shall be of one color throughout system.

.3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

- .1 Example: 120V Power – Fed from Panel LP-1, CCT – 10

.4 Controller to Terminal Block Wiring

- .1 All wires connecting a controller to a terminal block shall be orange in colour for I/O (blue for signal common) and display the following info on a sticker wrapped around the wire:
  - .1 IO Port Connected to on the controller
  - .2 Terminal Number on Terminal Strip

.5 Terminal Block to Device

- .1 All wires connecting a terminal block to a BAS control device shall be Grey in Colour and display the following info on a sticker wrapped around the wire at both ends:
  - .1 Controller #
  - .2 IO Port connected to on controller
  - .3 Point Name

.6 Controller to BAS Switch

- .1 All communication wire connecting controllers to a BAS Switch shall be Blue in colour and display the following info on a sticker wrapped around the wire at both ends:
  - .1 Near the Controller – "To Switch #"
  - .2 Near the Switch – "To RPDC #"

.7 See EMCS Labeling Requirements for Examples

2.7 CONDUIT

.1 Colour code EMCS conduit.

.2 Mark all EMCS junction box covers and conduit fittings with Orange "EMCS" Stickers

.3 In Mechanical Rooms: Mark conduit at 1.5m intervals with Orange Fluorescent tape. Also mark at point of entry and exit of each wall/partition.

2.8 PANEL ENCLOSURES

.1 A professional printed/typed input/output layout sheet shall be mounted within each controller. This sheet shall be laminated and shall include:

- .1 A panel layout diagram showing termination points of each controller and all devices within the panel (i.e. relays, expansion panels, transformers, etc.)

.2 The descriptor name of the points connected to each controller channel together with the revision number and date.

.3 Designation of power source panel location and circuit number

.2 All controllers and associated devices shall be identified with symbols relating directly to the control diagram.

2.9 CONCEALED CONTROL DEVICES

.1 Label all control devices (i.e. Heat Pumps, VAV Boxes, Fan Coils, room thermostats, relays, transformers, panels, etc.) in the field with proper descriptors and where concealed above ceilings, etc. - identify on the ceiling grid below where the devices are located with Lamacoid Label

Part 3 Execution

3.1 NAMEPLATES AND LABELS

.1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

3.2 EXISTING PANELS

.1 Correct/replace existing nameplates and legends to reflect changes made during Work.

END OF SECTION 25 05 54

EMCS WARRANTY AND MAINTENANCE

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EMCS WARRANTY AND MAINTENANCE

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Requirements and procedures for warranty and activities during warranty period and service contracts, for building Energy Management Control System (EMCS).

.2 Related Sections.

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 78 00 - Closeout Submittals.

.3 Section 25 05 01 - EMCS: General Requirements.

.4 Appendix A – City of Mississauga Forms and BAS Guidelines

.3 References.

.1 Canada Labour Code (R.S. 1985, c. L-2)/Part I - Industrial Relations.

.2 Canadian Standards Association (CSA International).

.1 CSA Z204-Latest Addition, Guidelines for Managing Indoor Air Quality in Office Buildings.

1.2 DEFINITIONS

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

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit detailed preventative maintenance schedule for system components to Owner's Representative.

.3 Submit detailed EMCS inspection reports to Owner's Representative.

.4 Submit dated, maintenance task lists to Owner's Representative and include the following sensor and output point detail, as proof of system verification:

.1 Point name and location.

.2 Device type and range.

.3 Measured value.

.4 System displayed value.

.5 Calibration detail

.6 Indication if adjustment required,

.7 Other action taken or recommended

.5 Complete and submit a full network analysis report. Report shall identify results of analysis with detailed recommendations to correct any problems found.

.6 Records and logs

.1 Maintain records and logs of each maintenance task on site.

.2 Organize cumulative records for each major component and for entire EMCS chronologically.

.3 Submit records to Owner's Representative, after inspection indicating that planned and systematic maintenance have been accomplished

.4 Revise and submit to Owner's Representative in accordance with Section 01 78 00 - Closeout Submittals "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period

1.4 MAINTENANCE SERVICE DURING WARRANTY PERIOD

.1 Provide services, materials, and equipment to maintain EMCS for specified warranty period.

.2 Emergency Service Calls:

.1 Initiate service calls when EMCS is not functioning correctly.

.2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.

.3 Furnish Owner with telephone number where service personnel may be reached at any time.

.4 Service personnel to be on site ready to service EMCS within 2 hours after receiving request for service (refer to 1.5.1 of this Section)

.5 Perform Work continuously until EMCS restored to reliable operating condition.

.3 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.

.4 Work requests: record each service call request, when received separately on City of Mississauga approved form and include:

.1 Serial number identifying component involved.

.2 Location, date and time call received.

.3 Nature of trouble.

.4 Names of personnel assigned.

.5 Instructions of work to be done.

.6 Amount and nature of materials used.

.7 Time and date work started.

.8 Time and date of completion.

.5 Provide system modifications in writing.

.6 No system permanent modification, including operating parameters and control settings, to be made without approval of Engineer/Consultant and/or Owner.

1.5 WARRANTY

.1 **Scope of Warranty**: The Contractor shall guarantee the proper functioning of all the work and the installation regarding his contract for a period of one year, effective as the provisional acceptance of the work of the Owner. The Contractor shall replace or repair, at his discretion, both immediately and free of charge and all the devices, pieces of equipment or material found defective during this period. This warranty covers material and labour including but not limited to:

.1 All expenses generated from the imperfect execution of the work, poor maintenance, repair or replacement.

.2 Emergency service calls during the warranty period (available 24 hours/day, 7 days/week, and 52 weeks/year) within a 2-hour response time.

.3 Replacement of all defective pieces and components.

.4 Correction to any and all programming where the performances are not in conformity with the rules of the trades.

.2 Warranty of Perfect Execution of the Work

.1 Owner shall hold an equivalent amount of 5% of the cost of the work without interest for a period of six (6) months following the provisional acceptance date of the work, as a warranty of perfect execution of the work.

.2 Neither the holdback nor its payment shall free the Contractor from the legal responsibilities he is incumbent upon. Consultant shall use this amount of money to execute the repair that the Contractor neglects or refuses to do within five (5) days following a written notice from the Owner to this concern.

.3 Intermittent Defects

.1 If during the warranty period, intermittent defects or abnormal phenomena are detected, that fail under the Contractor's responsibility, the period of the warranty shall be extended for a period equivalent to the time loss of system functionality caused by these defects or phenomena.

.4 The Contractor's Responsibility

.1 Any operational defect which may appear in any of the work and occurring during the period and according to the judgement of Council is not due to a misuse of the Owner and/or an ordinary wear and tear but a deficiency in the material or in the installation work and /or programming shall be repaired by the Contractor without any additional expenses to Owner or Consultant. The Contractor shall also assume any costs to compensate for any injuries or other work that the defect may have caused. All repairs done by the Contractor, during the warranty period, shall be done after peak working hours in the concerned areas and causing minimum inconveniences to the Owner.

.2 Inspection and acceptance of the work and materials, the payments made and the use of equipment by the users shall not diminish the Contractors' responsibilities. The general warranty shall not exempt, in any case, any particular warranty, otherwise stipulated and shall not affect any warranty provided in terms of the established laws.

.5 Renewal of Software

.1 If the Contractor makes any upgrade to their represented EMCS system and/or the EMCS software, it shall be made available to Owner and installed on the server and/or system controllers. The new editions of software updates which can be incorporated to the existing installed equipment shall be supplied and installed **free of charge** to the Owner for a period of five (5) years from date of initial installation. Contractor shall notify owner in writing 12 months prior to the end of the five (5) year software service period and offer a re-subscription with a stipulated price. (This applies to both JACE and Field Controllers)

.2 Maintenance of security certifications is required during both the original and extended warranty periods as described above.

.6 Preventive Maintenance

.1 Preventive maintenance is not considered as part of the warranty.

.2 Preventive maintenance forms part of Service Contracts which is an optional decision by the Owner.

1.6 WARRANTY EXTENSION

.1 The Contractor may be asked during individual tender to submit a separate price for an additional warranty contract (for services, pieces, repair/replacement offered to the Owner), for a period of twelve (12) months, effective at the end of the warranty of the present contract.

.1 Maintenance of security certifications is required during any extended warranty periods

1.7 SERVICE CONTRACTS

.1 Provide in-depth technical expertise and assistance to Owner's Representative and Commissioning Agent in preparation and implementation of service contracts and in-house preventive maintenance procedures. Service contracts duration is for the warranty period.

.2 Service Contracts (as provided by the installing EMCS contractor and included in the base bid) to include:

.1 Annual verification of field points for operation and calibration.

.2 Four (4) service visits per year.

.3 Two (2) hour response to all daytime emergency calls.

.4 Two (2) hour response to all emergency calls during silent hours.

.5 Silent hours defined as 1630 h – 0800 h and on weekends and statutory holidays.

.6 Complete inventory of installed system.

1.8 CHANGES, ADJUSTMENTS AND MODIFICATIONS

.1 During the Warranty Period the Owner's Representative and/or Commissioning Agent will perform a quarterly review of the new EMCS performance. The installing EMCS contractor shall make minor adjustments and programming changes to improve the performance of the system at the direction of the OAR. These may include but shall not be limited to:

- PID loop tuning
- Sensor recalibration
- Modification of programming to redefine control parameter (ie – Switch from Space Sensor Control to Return Air Control)
- Graphical changes and updates to database

.2 Any of these minor adjustments, programming, and graphical changes made during the warranty period shall be done at no additional charge to the City of Mississauga.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 FIELD QUALITY CONTROL

.1 Work must be approved by a City of Mississauga staff and receive a proper work order number at least 3 days prior to the inspections. Any work without a proper work order number shall be considered as a free of charge service.

.2 Perform as minimum (3) three minor inspections and one major inspection (more often if required by manufacturer) per year. Provide detailed written report to Owner's Representative as described in Submittal article.

.3 Perform inspections during regular working hours, 0800 to 1630 h, Monday through Friday, excluding statutory holidays.

.4 Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:

- .1 Perform calibrations using test equipment having traceable, certifiable accuracy at minimum 50% greater than accuracy of system displaying or logging value.
- .2 Check and calibrate random sample of 10% field input/output devices in accordance with Canada Labour Code - Part I and CSA Z204.
- .3 Provide dated, maintenance task lists, as proof of execution of complete system verification

.5 Minor inspections to include, but not limited to:

- .1 Perform visual, operational checks to Control Panels, peripheral equipment, interface equipment and other panels.
- .2 Check equipment cooling fans as required.
- .3 Visually check for mechanical faults, air leaks and proper pressure settings on pneumatic components.
- .4 Review system performance with Operations Supervisor and/or Owner's Representative to discuss suggested or required changes.

.6 Major inspections to include, but not limited to:

- .1 Minor inspection.
- .2 Clean OWS(s) peripheral equipment, Control Panels, interface and other panels, micro-processor interior and exterior surfaces.
- .3 Check signal, voltage and system isolation of Control Panels, peripherals, interface and other panels.
- .4 Verify calibration/accuracy of each input and output device and recalibrate or replace as required (as per 3.1. 4.2).
- .5 Run system software diagnostics as required.
- .6 Install all software and firmware enhancements (including those required by the EMCS LAN equipment) to ensure components are operating at most current revision for maximum capability and reliability.

.7 Perform network analysis and provide report as described in Submittal article.

.8 Rectify deficiencies revealed by maintenance inspections and environmental checks.

.9 Continue system debugging and optimization.

.10 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.

.11 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

END OF SECTION 25 08 20

EMCS LOCAL AREA NETWORK

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EMCS LOCAL AREA NETWORK

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 System requirements for Local Area Network (LAN) for Building Energy Management Control System (EMCS).

.2 Related Sections:

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

.3 References

.1 Canadian Standards Association (CSA International).

.1 CSA T529 Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/TIA/EIA-568-A with modifications).

.2 CSA T530 , Commercial Building Standard for Telecommunications Pathways and Spaces (Adopted ANSI/TIA/EIA-569-A with modifications).

.2 Institute of Electrical and Electronics Engineers (IEEE)/Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements.

.1 IEEE Std 802.3™, Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.

.3 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)

.1 TIA/EIA-568-, Commercial Building Telecommunications Cabling Standards Set, Part 1 General Requirements Part 2 Balanced Twisted-Pair Cabling Components Part 3 Optical Fiber Cabling Components Standard.

.2 TIA/EIA-569-A, Commercial Building Standard for Telecommunications Pathways and Spaces

1.2 DEFINITIONS

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

1.3 SYSTEM DESCRIPTION

.1 Data communication network to link Supervisory Remote Digital Control Panel (SRPDC) to Remote Digital Control Panels (RPDC), Terminal Equipment Controllers (TEC) and OEM Application Specific Controllers (OEMASC) in accordance with CSA T529 and CSA T530.

.1 Provide reliable and secure connectivity of adequate performance between different sections (segments) of network.

.2 Allow for future expansion of network, with selection of networking technology and communication protocols.

.2 Data communication network to include, but not limited to:

.1 EMCS-LAN.

.2 Network interface cards.

.3 Network management hardware and software.

EMCS LOCAL AREA NETWORK

.4 Network components necessary for complete network.

1.4 DESIGN REQUIREMENTS

.1 EMCS Local Area Network (EMCS-LAN).

.1 High speed, high performance, local area network over which SRPDC, and RPDC communicate with other directly on peer to peer basis in accordance with CSA T529 and T530.

.2 EMCS-LAN (RPDC to RPDC and/or SPRDC): BACNet IP Communication Protocol

.3 EMCS-SUBLAN (RPDC to TEC): BACnet IP Communication Protocol and/or BACnet MS/TP Communication Protocol as indicated in project specific specifications.

.4 Each EMCS-SUB LAN to be capable of supporting at minimum of 100 devices.

.5 High speed data transfer rates for alarm reporting, quick report generation from multiple controllers, upload/download information between network devices. Bit rate to be 10 Megabits per second minimum.

.6 Detection and accommodation of single or multiple failures of either SRPDC, RPDC, TEC, OEMASC or network media. Operational equipment to continue to perform designated functions effectively in event of single or multiple failures.

.7 Commonly available, multiple sourced, networking components and protocols to allow system to co-exist with other networking applications including office automation.

.2 Dynamic Data Access.

.1 LAN to provide capabilities for OWSs, either network resident or connected remotely, to access point status and application report data or execute control functions for other devices via LAN.

.2 Access to data to be based upon logical identification of building equipment.

.3 Network Medium.

.1 Network Medium (EMCS LAN): Ethernet Cable (IP) CAT 5,6,6E

.2 Network Medium (EMCS SUBLAN): Ethernet Cable (IP) CAT 5,6,6E or shielded twisted cable, compatible with network protocol to be used within buildings (as indicated in Project specifications).

.4 EMCS Switch/Router

.1 Vendor is to supply and install all necessary Switches/Routers for a complete EMCS network separate and distinct from the building's IT LAN.

.2 Switches/Routers are to be installed in a lockable Cabinet Enclosure Marked EMCS with dedicated power supplies.

.3 System architecture shall be designed to limit the number of sub-network switches to four (4) per router (Refer to System Architecture Appendix A4).Each sub-network shall have a maximum of twenty-five (25) IP based controllers.

.5 Network Security

.1 Security protocols of the EMCS LAN shall meet or exceed the requirements of the City of Mississauga Information Technology Services department

EMCS LOCAL AREA NETWORK

Part 2 Products

2.1 COMMUNICATION WIRING HANGERS

.1 Provide Communication system wiring hangers to supplement existing hangers such that communications cable maximum span is 4m for change in direction of greater than 45 degrees or 9m for a straight run

.2 Hangers are to be suitable for supporting up to 80 4-pair UTO low voltage cables with 50mm diameter loop. Provide multiple hangers on single support bracket as shown on detail drawing. Erico No. CAT32.

.3 Provide all required 10mm threaded hangers, rods, bolts, wall anchors, beam clamps and fittings as required for proper installation and support.

.4 Manufacturers: Caddy, B-Line, Approved Equal.

Part 3 Execution

3.1 NETWORK/COMMUNICATION CABLING

.1 EMCS communication BUS (between SRPDC and all field panels) shall be in EMT Conduit where exposed, and in plenum rated cable (FT 6) above rated ceiling plenums. Where EMCS network is run outside of conduit it must be neatly run with new communication hangers (where they are pre-existing, communication hangers be re-used).

.2 All Communication cable shall be of the same color with label at extremities indicating LAN identification, termination point and where applicable Switch and Port. **EMCS Ethernet cable shall be Orange.**

.3 Where there are insufficient hangers or structure existing, contractor shall install hangers to accommodate a maximum distance between strapping points of 4m (for change in direction of greater than 45 degrees) or 9m for a straight run.

.4 Ethernet communications for EMCS networks/sub-network shall be in conduit throughout (where exposed) and plenum rated cable above rated ceiling systems. EMCS Vendor shall supply designated EMCS Switches/Routers and assign all sub-network addresses needed to communicate to controllers and OEMASC. Refer to Appendix A City of Mississauga Standards and Guidelines for device naming and system architecture.

.5 EMCS Switch/Router shall be installed in a latched NEMA Rated cabinet within mechanical/electrical rooms.

.6 Communications conduits to be minimum 21mm EMT maximum 50% full.

.7 In general, the following table shall be used for conduit sizing:

Conduit Size:	21mm	27mm	35mm	41mm
Max UTP	2	3	6	7

.8 Cables shall not be attached to pipe, conduit or ductwork, etc.

.9 Conduit ends shall be provided with non-metallic bushing to provide a round edge which will not abrade the cable jacket.

END OF SECTION 25 10 01

EMCS BUILDING CONTROLLERS, FAMILY OF CONTROLLERS

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EMCS BUILDING CONTROLLERS, FAMILY OF CONTROLLERS

Part 1 General

1.1 SUMMARY

1.1.1 Section Includes:

1.1.1.1 Materials and installation for building automation controllers including:

1.1.1.1.1 Supervisory Remote Programmable Digital Controller (SRPDC).

1.1.1.1.2 Remote Programmable Digital Controller (RPDC)

1.1.1.1.3 Terminal Equipment Controllers (TEC)

1.1.1.1.4 Original Equipment Manufacturer Application Specific Controllers (OEMASC)

1.1.2 Related Sections:

1.1.2.1 Section 25 05 01 - EMCS: General Requirements.

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

1.1.2.3 Section 25 05 54 – EMCS: Identification

1.1.2.4 Section 25 05 03 - EMCS: Project Record Documents.

1.1.2.5 Section 25 30 02 - EMCS: Field Control Devices.

1.1.2.6 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

1.1.3 References

1.1.3.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE)

1.1.3.1.1 ASHRAE, Applications Handbook, SI Edition.

1.1.3.2 Canadian Standards Association (CSA International)

1.1.3.2.1 C22.2 No.205-M1983(R1999), Signal Equipment.

1.1.3.3 Institute of Electrical and Electronics Engineers (IEEE)

1.1.3.3.1 IEEE C37.90.1-02, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.

1.2 DEFINITIONS

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

1.3 SYSTEM DESCRIPTION

1.3.1 General: Network of controllers comprising of SRPDC, RPDC, TEC, OEMASC to be provided as indicated in System Architecture and Standard Wiring Diagram to support building systems and associated sequence(s) of operations as detailed in these specifications.

1.3.1.1 Provide sufficient controllers to meet intents and requirements of this section.

1.3.1.2 Controller quantity, and point contents to be approved by Consultant at time of preliminary design review.

1.3.2 Controllers: stand-alone intelligent Control Units.

1.3.2.1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.

1.3.2.2 Incorporate communication interface ports for communication to LANs to exchange information with other Controllers.

1.3.2.3 Capable of interfacing with operator interface device.

1.3.2.4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controllers

1.3.2.4.1 Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

1.4 SUBMITTALS

1.4.1 Provide submittals in accordance with Section 01 33 00 Submittal Procedures and Section 25 05 02 - EMCS: Submittals and Review Process.

1.4.2 Submit product data sheets for each product item proposed for this project.

1.5 DESIGN REQUIREMENTS

1.5.1 To include:

1.5.1.1 Scanning of AI and DI connected inputs for detection of change of value and processing detection of alarm conditions.

1.5.1.2 Perform On-Off digital control of connected points, including resulting required states generated through programmable logic output.

1.5.1.3 Perform Analog control using programmable logic, (including PID) with adjustable dead bands and deviation alarms.

1.5.1.4 Control of systems as described in sequence of operations.

1.5.1.5 Execution of optimization routines as listed in this section.

1.5.2 Total spare capacity for RPDC: at least 25 % of each point type (distributed throughout the RPDC's within each mechanical/electrical room) unless directed otherwise during tender.

1.5.3 Field Termination and Interface Devices:

1.5.3.1 To: CSA C22.2 No.205.

1.5.3.2 Electronically interface sensors and control devices to processor unit.

1.5.3.3 Include, but not be limited to, following:

1.5.3.3.1 Programmed firmware or logic circuits to meet functional and technical requirements.

1.5.3.3.2 Power supplies for operation of logics devices and associated field equipment.

1.5.3.3.3 Lockable wall cabinet.

1.5.3.3.4 Required communications equipment and wiring (if remote units).

1.5.3.3.5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.

1.5.3.3.6 Input Output interface to accept as minimum AI, AO, DI, DO functions as specified.

1.5.3.3.7 Wiring terminations: use conveniently located screw type or spade lug terminals.

1.5.3.4 AI interface equipment to:

1.5.3.4.1 Convert analog signals to digital format with 10 bit analog-to-digital resolution.

1.5.3.4.2 Provide for following input signal types and ranges:

- 4 - 20 mA;
- 0 - 10 V DC;
- 100/1000-ohm RTD input;

1.5.3.4.3 Meet IEEE C37.90.1 surge withstand capability.

1.5.3.4.4 Have common mode signal rejection greater than 60 dB to 60 Hz.

1.5.3.4.5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.

1.5.3.5 AO interface equipment:

1.5.3.5.1 Convert digital data from controller processor to acceptable analog output signals using 8-bit digital-to-analog resolution.

1.5.3.5.2 Provide for following output signal types and ranges:

- 4 - 20 mA.
- 0 - 10 V DC.

1.5.3.5.3 Meet IEEE C37.90.1 surge withstand capability.

1.5.3.6 DI interface equipment:

1.5.3.6.1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.

1.5.3.6.2 Meet IEEE C37.90.1 surge withstand capability.

1.5.3.6.3 Accept pulsed inputs up to 2 kHz.

1.5.3.7 DO interface equipment:

1.5.3.7.1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 V AC.

1.5.3.7.2 Switch up to 5 amps at 220 V AC using optional interface relay.

1.5.4 Controllers and associated hardware and software: operate in conditions of 0ºC to 44ºC and 20 % to 90 % non-condensing RH.

1.5.5 Controllers (SRPDC & RPDC): mount in **NEW** NEMA 1 wall mounted cabinet with hinged, keyed-alike locked door.

1.5.5.1 Provide for conduit entrance from top, bottom or sides of panel.

1.5.5.2 Except were otherwise noted, TEC's to be mounted inside a separate NEMA rated enclosure in nearest designated mechanical/electrical room. Wiring from enclosure to terminal equipment shall be in EMT conduit (including the portion above ceiling system) with liquid tight conduit for the last 24-30" only.

1.5.5.3 All the controllers and panels to be installed eye level height, to be accessed without using ladder or stool, not behind doors or any mechanical equipment, in a way that panel door can be fully opened without restriction. With some exception for direct mounting controller (such as VAV box) unless otherwise approve by COM.

1.5.6 Cabinets to provide protection from dust water dripping from above, while allowing sufficient airflow to prevent internal overheating. For installations in dusty areas (ie – Transit Garage), cabinet enclosure will accommodate air filtration for cabinet venting.

1.5.7 Provide surge and low voltage protection for interconnecting wiring connections.

1.6 MAINTENANCE PROCEDURES

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

Part 2 Products

2.1 SUPERVISORY REMOTE PROGRAMMABLE DIGITAL CONTROLLER (SRPDC)

2.1.1 The SRPDC is BAC-Net Compliant, stand-alone and fully user- programmable supervisory controller. The SRPDC shall comply with all mentioned EMCS System requirements and shall monitor the network of distributed application specific remote digital controllers (RPDC). The SRPDC shall communicate on a peer–to-peer basis across the Owners Ethernet network with the other SRPDC Controllers and to a Central Enterprise Server.

2.1.2 The SRPDC shall use one (or several) micro-computer(s) with sufficient memory to:

2.1.2.1 Acquire, process, and transfer data to the Owner's Enterprise Server OR OTHER SRPDC.

2.1.2.2 Accept, process, and execute orders coming from the Enterprise Server or other input devices;

2.1.2.3 Record, analyze, and signal the change of state or value that appears among the connected RPDC controllers to the SRPDC;

2.1.2.4 Access to any one SRPDC shall allow the user to gain access any other SRPDC on the owner's network without need to go through the Owner's server.

2.1.2.5 The SRPDC shall have the capability of generating and storing HTML5 Scalable Vector Graphics. NOTE: System Graphics for each Site shall reside on the server with secondary copies downloaded to the SRPDC on Site. A secondary back-up copy of all graphics shall also be automatically updated with each change and stored on the Owner's designate Enterprise Server.

2.1.3 Every SRPDC shall execute continuous diagnostics and all function failures shall be enunciated at one or more designated operator's workstations. Failure of an SRPDC shall not affect the function of the Server or any other SRPDC on the network.

2.1.4 If the EMCS Enterprise Server or network transmission fails, the SRPDC shall continue to control all the changes of state and/or value and shall have sufficient memory to store the readings of all analog inputs and the calculated values of the SRPDC for a minimum of 12 hours. After the failure, the SRPDC shall send the stored readings to the EMCS Enterprise Server.

2.1.5 Intervals between each reading shall depend on the type of reading and shall be determined by the Owner designated user(s) through commands established in the EMCS Enterprise Server Software.

2.1.6 These time intervals shall be adjustable and defined by the user and shall be selected based on the real capacities of the SRPDC provided by the supplier.

2.1.7 Each SRPDC shall function on a common communication bus line between different RPDC's 's on a peer-to-peer basis and shall provide real-time clock functions for scheduling and network time synchronization. The SRPDC shall be able to communicate with the Server in a selective manner and in a way to maintain stand-alone operation of the SRPDC.

2.1.7.1 The SRPDC shall be able to communicate with the COM network for network time synchronization

2.1.8 If there is a power failure, the SRPDC shall have sufficient memory to support its operating system, database, programming requirements. Battery shall maintain the static RAM memory and clock functions for minimum of 72 hours.

2.1.9 The SRPDC operating system, field database, and application programs shall reside in EEPROM.

2.1.10 The run time field data and values shall reside in battery backed-up on board memory or RAM.

2.1.11 SRPDC shall be **Tridium JACE 8000 Series controller**. Contractor shall provide required number of SPRDC(s) designed to manage the number of points and controllers on the specific site.

2.1.12 All data including programming and graphics shall be backed up by the contractor at the EMCS Enterprise Server upon completion of every change to the system.

2.2 REMOTE PROGRAMMABLE DIGITAL CONTROLLERS (RPDC)

2.2.1 Each RPDC shall be fully user-programmable, digital controller that communicates via MS/TP Bus supporting BAC-net Standard protocol ANSI/ASHRAE 135 2004.

2.2.2 The RPDC shall be factory programed with a continuous adaptive tuning algorithm that detects changes in the physical environment and continually adjusts loop tuning parameters suitably. Controllers that require manual tuning of loops or perform tuning on command only shall not be acceptable.

2.2.3 The RPDC shall provide a remote annunciation of any detected component failure, low battery conditions or repeated failure to establish communication.

2.2.4 Each RPDC shall incorporate direct digital control and shall operate as an independent control unit capable of distributed processing functions as described hereafter. It shall furnish real direct digital control replacing the transmitters and the existing analog controllers.

2.2.5 Each RPDC shall work as an independent unit and shall continue to operate independently even if the other parts of the system including the SRPDC and/or Enterprise Server are not operational.

2.2.6 RPDC shall have the following characteristics:

2.2.6.1 Automatic start-up after a power failure

2.2.6.2 Controller set-point reset, locally or remotely through the EMCS Enterprise Server and position readjustment of the controlled devices

2.2.6.3 The RPDC shall include troubleshooting LED indicators to identify conditions i.e. Power ON/OFF, Device fault, No fault, normal operation etc.

2.2.6.4 User capacity to define all the operational characteristics of each control loop by means of keyboard commands of a man-machine interface (MMI)

2.2.6.5 User capacity to define the control modes such as: proportional, integral, derivative, square error, and adaptive functions in response to the network needs;

2.2.6.6 Clear communication language oriented toward process control and not done in computer jargon

2.2.6.7 User capacity to define the operation logic such as: and/or equal to/unequal to, and greater than/less than

2.2.6.8 Self-diagnostics

2.2.6.9 Energy management functions (ex: optimal star/stop, enthalpy control, electric load shedding control, etc.

2.2.6.10 Library of control routines and program logic to perform the sequence of operation.

2.2.6.11 Contain sufficient memory to support its own operating system, database and have at least 25% of the memory available for future use.

2.2.6.12 In the event of the loss of normal power, there shall be an orderly shutdown of all digital controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for minimum of 72 hours.

2.2.6.13 Upon restoration of normal power, the RPDC shall automatically resume full operation without manual intervention.

2.2.6.14 Controllers shall include all point inputs and outputs necessary to perform the specified control sequences. Analog outputs shall be industry standard signals such as 24 Volts floating control,3-15 psi pneumatic, 0-10VDC or 20 mA, allowing for interface to a variety of modulating actuators.

2.2.6.15 All controller sequences and operation shall provide closed loop control of the intended application. Controlling by another upstream RPDC over the local field network is not acceptable.

2.3 TERMINAL EQUIPMENT CONTROLLERS (TEC)

2.3.1 TEC shall be utilized for control of each piece of terminal equipment including but not limited to the following:

- Variable Air Volume (VAV) boxes
- Constant Air Volume (CAV) boxes with reheat
- Dual Duct Terminal Boxes
- Unit Air conditioners
- Heat Pumps
- Unit Ventilators
- Fan Coils
- Room and or Laboratory Pressurization

2.3.2 TEC’s shall include all point inputs and outputs necessary to perform the specified control sequences for associated terminal equipment. Analog outputs shall be industry standard signals such as 24 Volts floating point control, 0-10VDC or 4-20 mA, allowing for interface to a variety of modulating actuators.

2.3.3 All TEC sequences and operation shall provide closed loop control of the intended application.

2.3.4 Controlling terminal equipment by another upstream RPDC controller over the local field network is not acceptable.

2.4 ORIGINAL EQUIPMENT MANUFACTURER APPLICATION SPECIFIC CONTROLLERS (OEMASC)

2.4.1 The EMCS shall extend communication and operation through the integration of OEM Application Specific Controllers (OEMASC) via a dedicated BACNet Field BUS connected to the SRPDC.

2.4.2 Each OEMASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of all other controllers in the network. Each OEMASC shall include a microprocessor-based, multi-tasking, and real time digital control processor.

2.4.3 As listed in 2.4.1, the OEMASC are to reside on a dedicated EMCS Subnetwork, connected directly to the SRPDC and only communicating to OEMASC (i.e. – no other field controllers to reside on this network).

2.4.4 Equipment supplied with OEMASC may include:

- Chillers,
- Heat pumps,
- Gas fired furnaces,
- Boilers
- VFD’s
- Rooftop Units

- Utility Meters/Sub Meters
- Lighting Controls
- Variable Refrigerant Flow (VRF) systems
- Heat Recovery Ventilators
- Chemical/Gas detector
- Air/Refrigeration Compressors
- Dehumidifiers
- Generators
- Humidifiers
- Overhead Doors
- Spray Pads
- Other equipment that come with OEM Installed On-board micro-processor controls.

2.4.5 The OEMASC shall include all points (inputs and outputs) necessary to perform the specified control sequences and shall be the responsibility of the Equipment supplier. Integration of the OEMASC to the EMCS shall require programming representatives of both systems to be present on site at the time of set-up to ensure all BACNet and/or other communication protocols are set up and mapped to the EMCS with proper priority to ensure specified sequence of operation is met.

2.5 HARDWARE CONFIGURATION AND CONSTRUCTION

2.5.1 Each SRPDC and associated RPDC’s shall include a lockable cabinet, power supply, electronic cards, and termination modules, all CSA and ULC approved.

2.5.2 Each SRPDC and RPDC shall operate in an ambient environment of -10 °C to 35°C and 10% to 90% relative humidity.

2.5.3 Each SRPDC, RPDC and TEC shall be protected to eliminate transitory high voltage, electromagnetic noises, radio frequency interference (ex.: interferences caused by walkie-talkies).

2.5.4 The SRPDC, RPDC and TEC shall have integral power switch. If the device manufacturer does not provide an on-board power switch, then the System Contractor shall provide a separate dedicated transformer and switch within each enclosure for each controller.

2.5.5 The SRPDC, RPDC and TEC shall provide diagnostic LEDs for power, communications and microprocessor status i.e. device fault, normal data transmission, Download or start up in progress & not ready for normal operation. All programming sequences shall be stored in non-volatile memory.

2.5.6 Each RPDC and TEC shall contain both software and firmware to perform full DDC PID control loops.

2.5.7 Each controller type shall be able to support various types of zone temperature sensors, such as temperature sensor only, temperature sensor with built-in local override switch, with set point adjustment switch, temperature sensor with CO2 monitor or temperature sensor with occupancy switch.

2.5.8 Each TEC controller for VAV/CAV application shall have a built-in air flow transducer for accurate air flow measurements in order to provide the pressure independent VAV operation. If the transducer is not internal to the controller, the controller/transducer assembly shall be factory tested and approved for the intended use.

2.5.9 Astronomical Time: Astronomical capability shall allow the system to calculate sunrise and sunset times based on geographical location, and incorporate Daylight Savings Time, for dusk-to dawn control or dusk-to time control. This is required in any DDC controller with I/O for exterior lighting circuit(s) .The DDC controller may receive this value from SRPDC or RPDC and fail to a “safe” position (i.e., lights fail on) upon a loss of communication from the SEPDC or RPDC.

2.5.10 Type of Points

2.5.10.1 Each controller shall have the following types of points:

- Binary inputs and pulse accumulation;
- Universal inputs shall be capable of 0-20mA,dry contact, and 0-5VDC,2-10 VDC or 0-10 VDC;
- Binary outputs to command apparatus of 2 to 3 statuses;
- Analog inputs to measure real-time variables;
- Analog outputs (e.g. Current mode 4-20 mA, Voltage mode 0-10VDC, 2-10 VDC) to read and adjust the set-points and positions and for the direct digital control of apparatus.

2.5.10.2 The system shall allow the user to change the characteristics of the individual points on each function card. This characterization shall be made possible by means of a keyboard procedure where the user shall transfer specific parameters from the Server that are destined to the RPDC, or from a portable keyboard or one integrated in the RPDC. The user shall be able to modify these parameters from these keyboards.

2.5.10.3 If the controller uses multi-point type function cards for control and monitoring, each function card shall have an integrated capacity of auto-control and shall visually indicate its operational status. The failure of a function card in a controller shall not prevent the controller from controlling the other function cards and shall not affect the other controllers.

2.5.11 Termination Board

2.5.11.1 Each controller shall have a termination board to which the wiring or piping shall be connected. The controller shall be isolated from the command circuits or sensors either by **double voltage relays or optic couplers or** equivalent. All input/output signals shall be terminated on the board using screws or compression spring type terminals. Each analog input shall have the capacity to adapt standard inputs of the industry such as 4 to 20 mill-amperes or 1 to 5 volts DC, or 0 to 10 volts DC without physically modifying the control panel.

2.5.11.2 The Contractor shall identify all the wiring connected to the different elements of the system. The numbered auto-adhesive stickers are not acceptable. The Contractor shall use plastic mold (PVC) type reference marks, to identify the wiring terminated to the board inside the control panel and at the end device. All wiring shall be identified using full and proper point descriptors.

2.5.12 Telecommunication Interface

2.5.12.1 Communication Network Use

2.5.12.1.1 The system shall supervise remote buildings. It shall be possible for the Enterprise Server to communicate with the Supervisory Remote Programmable Digital Controllers (SRPDC) by the ETHERNET communication network furnished by the Owner.

2.5.12.2 Remote Interfaces and Access to Installations on the Owner's Intranet

2.5.12.2.1 The communication interfaces such as the ETHERNET, communication cards, computers, and software etc. shall be included with the SRPDC (supervisory panel) for all sites. These interfaces shall be supplied by the Contractor.

2.5.12.2.2 The Owner shall provide one (1) network drop and IP address at a given site. EMCS and SRPDC solutions must support LAN-, WAN-, and cellular-connected facility installations based on network availability that will be specified for each location. The Control vendor shall be responsible for coordinating with the Owner's IT department designated personnel.

2.5.12.2.3 Each pre-qualified EMCS vendor may be granted Internet access to the Owner's Intranet system through an Owner supplied VPN (or other secure methodology in accordance with COM ITS policies and procedures). This access will be arranged for by the control vendor in coordination with the Owner's designated representative and shall be restricted to a specific duration of time. Each time the vendor accesses the system the date and time and name of person accessing the system shall be recorded and stored within the database. ***NO UNAUTHORIZED ACCESS to the Owner's Intranet and EMCS control systems will be permitted***.

2.5.12.3 Communication Modes

2.5.12.3.1 The only communication mode to the SRPDC shall be via the owner's ETHERNET network. All necessary accessories to establish communication shall be supplied by the Contractor. Communication modes such as dedicated or dial-up telephone lines or cable modems shall not be accepted.

2.5.13 Communication Protocol

2.5.13.1 The system shall be capable of high-speed ETHERNET communication using TCP/IP Protocol though the primary SRPDC (supervisory panel) and the Enterprise Server. The SRPDC at each site shall be assigned an IP address. Communication between SRPDC and RPDC shall be by BACNet IP only. The use of BacNet MS/TP or other communication protocols shall be by exception and only where specifically identified in the details project specifications and/or approved by the CoM.

2.5.13.2 Where BACNet over IP communication between SRPDC and RPDC is specified, EMCS vendor shall supply a dedicated EMCS Ethernet Managed Switch(es) to manage all sub-network communications between SRPDC and RPDC. All IP and MAC addresses shall be set up by and are the responsibility of the EMCS Vendor. The make/model of the Ethernet Managed Switch shall be discussed with and approved by the Owner.

2.5.14 Computer Interfaces

2.5.14.1 The computer interfaces shall communicate commands and access the SRPDC in each building using the Owner's ETHERNET network via the central Enterprise Server.

2.5.14.2 Communication Interfaces

2.5.14.2.1 The communication interfaces that allow the connection to the computer communication system are those mentioned in sub-section 2.

2.5.14.2.2 Each controller shall have a communication port for connection to the network and also available for a direct connection to an operator interface.

2.5.14.2.3 The operator interface connected to any controller shall allow the operator to interface with each inter-networked controller on the system as if directly connected. Controller information such as data, status, reports, system software, and custom programs shall be viewable and editable from each inter-networked controller.

2.6 SOFTWARE SPECIFICATIONS

2.6.1 General Principles

2.6.1.1 Interface at the EMCS Enterprise Server (SERVER)

2.6.1.1.1 The owner has purchased and installed Tridium Niagara 4 software of the latest revision. This EMCS Enterprise Server Software (ESS) package resides on a dedicated City of Mississauga EMCS Enterprise Server. The owner also maintains a secondary back-up server for the storage of all program files, graphics, trend data, alarms, and reports for the support of connection and monitoring of up to 350 buildings

2.6.1.1.2 The Contractor shall program completely the Owner's EMCS ESS of all described points in the points list of building(s) shown on the plans. The data base shall include the definitions and descriptions (key names) of each point connected to the SRPDC installed in the various buildings.

2.6.1.2 Software Furnished by the Contractor

2.6.1.2.1 The Contractor shall furnish all necessary software and software tools for programming and modification of field panels and for the communication and functional operation of the systems as specified. This software shall be "Open" in nature and licensed to allow for use and modification by the Owner or Owner designated service contractor(s).

2.6.1.2.2 The EMCS ESS shall be installed and operational prior to the delivery of any field based EMCS. The software described in this section of the specifications shall be applicable to all new SRPDC, RPDC, TEC, OEMASC, and as they relate to the new EMCS ESS and Back-up Server.

2.6.1.3 Proven Software

2.6.1.3.1 Only proven software shall be accepted.

2.6.1.4 Security Requirements

2.6.1.4.1 Only software with the minimum version of an un-deprecated TLS encryption subject to further requirements as specified in Section 250501 paragraph 1.5.10.2 and 1.5.10.3 shall be permitted.

2.6.1.4.2 Software shall utilize Active Directory Log-In and shall come with **False Log-in Protection**

2.6.1.5 Type of Points

2.6.1.5.1 The system shall have two (2) types of points: the first type shall derive from a physical measure. A physical point denotes a point physically connected to the system, for example, pressure temperature and relative humidity. These points are defined as “Real”.

2.6.1.5.2 The second type of point is identified as an information point by the operator but is not necessarily a number of a data corresponding to their physical point, for example, a prediction, or a calculation of energy or cost estimates. These points are defined as “Virtual”.

2.6.2 Real Time System Management

2.6.2.1 Power Failure and Automatic RE-start

2.6.2.1.1 In case of power failure, the system shall stop in an organized method and a routine procedure shall provide an automatic re-start of the system once the power is restored.

2.6.3 Acquisition of Data and Control Software

2.6.3.1 Binary (Digital) Inputs

2.6.3.1.1 The system shall monitor the binary inputs. The actual condition of a two-status device shall continually be saved in memory and represented by a pair of binary statuses. The indications at the SERVER operator and the binary statuses shall be described by the following abbreviations called “Descriptor” such as “OP-CL” for open-closed.

2.6.3.1.2 The system can record the number of changes of state of a binary input in order to measure the variables such as flow indicated by pulses.

2.6.3.1.3 Minimum requirements are to comply with the BAC-net standard for data sharing. The user must be able to specify either input condition for alarming. This Binary Input must also include the capability to record equipment run-time by counting the amount of time the hardware input is in an “on” condition. The user must be able to specify either input condition as the “on” condition.

2.6.3.2 Analog Inputs

2.6.3.2.1 Minimum requirements are to comply with the BAC-net standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.

2.6.3.2.2 The system shall read, convert, transmit and display the analog values of all the required points.

2.6.3.2.3 All displays and readings shall display analog point’s value in a numerical form with appropriate units and the negative sign if necessary. The displayed values shall contain the necessary number of figures plus a decimal point if required.

2.6.3.2.4 The Owner shall define the units of measure to describe the changes of state and the information requests. Examples of units of measure: KPA for kilo Pascal, ºC for degree Celsius.

2.6.3.2.5 The system shall be capable of using the English system of measure as well as the International system without modifying the equipment. The Owner may define up to 50 analog ranges. Each range may define as linear, square root extract or whatever functions dependent on the results of a calculation.

2.6.3.2.6 The operator may assign specific limits to each analog point (2 high and 2 low). The system shall compare the analog readings with the predetermined limits and shall advise the operator every time a point goes into alarm or returns to normal conditions.

2.6.3.2.7 A simple differential shall be associated to every specific limit. This differential shall precisely determine the gap necessary for a return to normal indication when a point returns within its normal operation range.

2.6.3.2.8 The user shall enter all the limits and the entire differential directly with the same units of the measured variables. The system shall react on an analog point update when an analog point passes from a normal condition to a high or a low limit condition as well as a return to the normal condition, when stopping or starting the equipment, when displaying a graphic or message, when printing a report or a message, or when readjusting the setpoint of a controller according to the established interlock sequence.

2.6.3.2.9 The Owner shall be able to create a summary of the analog limits and differentials with the high and low limits and differentials for all the specified analog points.

2.6.3.3 Binary (Digital) Outputs

2.6.3.3.1 Minimum requirements are to comply with the BAC-net standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as inter-start delay must be provided.

2.6.3.3.2 The system shall control local devices having 2 or 3 statuses. The operator shall be able to control the local devices. Descriptors defining the commands that the operator wishes to execute shall be used.

2.6.3.3.3 The commands shall be grouped, and one command is given per status. Each binary output shall be programmed to respond to only one group of commands. These command groups shall be for example: OP-AUTO-CL for Open-Auto-Closed or STR-STO for Start-Stop.

2.6.3.3.4 The operator shall be able to issue global commands including but not limited to:

- Time of day scheduling
- Weekly schedules
- Event/Holiday Schedules
- A positive feedback response shall be used for all the command points to make sure that the monitored device, motor, controller, etc. has in fact received and executed the command issued by the operator or the system.
- All commands not executed as requested, shall emit a message to the operator.

2.6.3.4 Analog Outputs

2.6.3.4.1 Minimum requirements are to comply with the BAC-net standard for data sharing.

2.6.3.4.2 The remote reset of controller setpoints and/or valves shall be possible for all the specified reset points. The reset values shall use units that correspond to the controlled variable such as degrees Fahrenheit, degrees Celsius, kilo Pascal’s, etc.

2.6.3.4.3 The operator data entries shall be the same as the output data of the reset points. For example, to change a pressure controller setpoint from 10 KPA to 110KPA, the operator shall simply enter the reset value of 110KPA.

2.6.3.4.4 A power supply failure at the existing SERVER or at the local SRPDC shall not affect the setpoints. These setpoints shall maintain the last ordered value.

2.6.3.4.5 The operator shall be able to issue global zone temperature setup including occupied/unoccupied mode temperature set points.

2.6.3.5 Change of State

2.6.3.5.1 The system shall detect all changes of state of a point as specified hereafter and shall report these changes of state to the operator. Any change of state specified as such shall set off an audible alarm. Acknowledgement shall cancel the audible alarm.

2.6.3.5.2 Any change of state of a point shall include a descriptor, identification, data units, date and hour. The printout of a binary monitor point shall include binary status identification, indications relative to an abnormal condition or an alarm point condition, an indication that the point equipment is out of service, the date and the hour.

2.6.3.5.3 For an analog change of state, the system shall print the point identification, its analog value with its units, an indication identifying whether the value is high or low, the date and the hour.

2.6.3.5.4 For each alarm point, the system shall print a message, custom predefined by the User, which shall be printed immediately following the point display.

2.6.3.5.5 The system shall communicate the information of a change of state of a point towards a particular desk. The reception of the change of state shall not be interrupted by the display summary asked by the operator.

2.6.3.5.6 The display of the changes of state on the colour screen shall be done in priority as defined by the User. In addition, the User shall decide the change of colour related to the acquisition of the change of state.

2.6.3.5.7 Upon receiving changes of state, they shall be printed in chronological order. The print outs of acquisitions of change of states shall be done simultaneously as the acquisition itself.

2.6.3.5.8 The system shall report the multiple changes of state according to the established priority levels when generating the database. The Owner shall decide if a change of state necessitates an acknowledgement.

2.6.3.6 Access Control

2.6.3.6.1 Provide a minimum of 6 levels of command security**. Individual operators shall be able to be assigned to security level**. Assignment to a security level shall allow the operator to use commands that have been assigned to that level of security or below only. It shall be possible to re-assign security levels to operators, and commands online, through an operator's terminal (by the owner's system manager).

2.6.3.6.2 City of Mississauga Access Levels shall be as follows:

2.6.3.6.2.1 Level 1 – Read Only

2.6.3.6.2.2 Level 2 – Temporary Override of Setpoints and Schedule

2.6.3.6.2.3 Level 3 – Permanent Change of Setpoints and Schedule Adjustments

2.6.3.6.2.4 Level 4 – Admin (Access to the server and programming)Full access

2.6.3.6.3 Access to SRPDC shall be set up by Vendor with user ID and Password as per COM instruction. All other access to EMCS shall be routed through the Enterprise Server.

2.6.3.6.4 As outlined in part 2.6.1.4.2, operators shall log-in using Active Directory and the system shall prohibit False Login. A log of the time and date of each log-on/log-off (both a regular log-off and an accidental log-off by closing the browser) and activity of users shall be recorded on the server and accessible for print off by the Owner's system manager.

2.6.3.6.5 Multiple operators shall be able to be logged on different terminals, under different security levels, simultaneously. The fact that multiple operators are signed on concurrently shall be transparent to the individual operators. A minimum of 25 users/operators shall be able to access the system concurrently.

2.6.3.7 Reports Logs & Records

2.6.3.7.1 Provide a reporting package that allows operators with properly designated user access level(s) to select, modify, or create reports. Each report shall be definable as to data content, format, interval, and date. Provide the ability for the operator to obtain real-time logs of all objects by type or status (i.e. alarms, lockout, normal). Reports and logs shall be stored on the central enterprise server memory in a format that is readily accessible by other standard software applications, including spreadsheets and word processing.

2.6.3.7.2 The report generator shall include time, day, month, year, report title, operator's initials, and shall produce as a minimum the following reports:

- All points in allocation
- All points of a point type
- All points in an individual system
- All points (SRPDC, RPDC, & TEC)
- Acronym summary
- Alarm summary
- Alarm Messages
- Lockout summary
- Disable "Locked –out" points summary: including point name, whether disable by system or by operator.
- Override summary
- Generate and format reports for graphical and numerical display from real time and store data.
- Print and store reports as selected by the operator.
- Summary of sensor spans and bases
- Summary of analog alarm limits and differentials
- Summary of point parameters
- Summary of RPDC loop parameters
- Run time summary: summary of accumulated time of selected equipment. Include point name, run, and time to date, alarm limit setting. Run time to accumulate until reset individually by the operator.

- Trend logs
- Historical profiles

2.6.3.7.3 Point Identifiers

2.6.3.7.3.1 The EMCS shall locate a point to be monitored or controlled with unique point identifier.

2.6.3.7.3.2 The EMCS shall be able to identify group's points in at least the following manners:

2.6.3.7.3.2.1 Points that are geographically in, for example, a penthouse, or building.

2.6.3.7.3.2.2 Points that are part of a closed system, for example, a fan system or a water system.

2.6.3.7.3.2.3 Points that perform similar functions, for example, all fans supply air temperatures or leaving chilled water temperatures.

2.6.3.7.4 Alarm Reports & Records

2.6.3.7.4.1 The alarm summary shall include the time and date of occurrence, the operator's username who acknowledge the alarm, the location, system and point descriptor, value or status at the time of alarm and alarm condition(i.e. high, low, return to normal etc.) The recording of alarms on specific points shall be able to be enabled or disabled on command. A summary of points disable for alarm recording shall be provided.

2.6.3.7.5 Alarm Scan

2.6.3.7.5.1 The EMCS system shall continuously scan all points connected to it and update the data base on binary changes of state and significance of analog changes. The system shall compare any change of state or analog update to establish parameters and determine if the point is in an alarm condition.

2.6.3.7.5.2 Alarms shall be queued for reporting and under NO circumstances shall any alarm go undetected due multiple alarms.

2.6.3.7.6 Alarm Messages

2.6.3.7.6.1 Provide capability to create and assign to any point a message to be printed or to be sent to a pager or other handheld device such as a smart phone, tablet, etc. at the time of alarm. Summaries of message content and points assigned to messages shall be displayed on the operator's terminal or printed on the assigned device on command.

2.6.3.7.7 Alarm Acknowledgement

2.6.3.7.7.1 Provide capability to display alarms on the operator's terminal and update these alarms once a minute. Alarms shall be acknowledged when displayed by prompting for operator's username. The operator's username shall be recorded with the alarm.

2.6.3.7.8 Alarm Management

2.6.3.7.8.1 Establish and provide alarm management programming using the server software and provide any additional software as necessary to accomplish the following:

- **Critical Alarms** – Critical alarms are defined as those that require the immediate attention and action of Facility Operations. Examples – VSD Failure, low & high water temperature, over/under pressure, loss of outside air sensor, loss of power, computer room cooling high temperature, etc.
- These alarms shall provide both indication at the operator workstations through the EMCS server and shall be sent to nominated Building and/or Security Services Department staff (or other locations as defined by the owner) for immediate action. Alarms shall be sent via SMS and/or Email etc. indicating the Building ID, Alarm Indication and Alarm Parameter, Time of Alarm, etc.
- All alarm settings shall be super user adjustable through the Alarm Settings graphic page.
- Critical alarms indication on the graphics shall appear as a Flashing Red background with the Word ALARM (under Alarm condition) and Green Background with the Work Normal when not in alarm.
- Critical Alarms shall also be recorded and stored on the EMCS Server
- **Environmental Alarms –** Environmental Alarms are defined as Non-Critical (HVAC related) alarms and as indicated on site specific points list and sequences. Environmental alarms typically include but are not limited to the following:
    - Temperature/humidity out of specified range etc.
    - Mixed air low limit

  - Command vs Status
- Environmental alarms shall provide indication on the graphics (Flashing Yellow) both the EMCS ESS operator workstation(s) and workstations connected through the SRPDC and shall remain until the alarm condition is corrected.
- **Maintenance Alarms** – Maintenance alarms as defined as important operational alarms that require the attention and action of Maintenance personnel and as indicated on the site-specific points list and sequences.
- Examples include equipment run-times, pressure drop across filters, etc. These alarms shall be generated by the EMCS and stored in a database at the central EMCS server until acknowledged or removed by system operations. They shall also send out an Email indicating building, required maintenance, etc.
- **Utility Alarms** – Example – Peak Demand Exceeded, daily consumption exceeded. These alarm limits shall be set-up and established during commissioning. The alarms shall provide indication both at the operator workstation and shall send out an email to various email accounts indicating that anticipated parameters have been exceeded.
- All alarms shall be stored in a database under various file headings (i.e. critical, environmental, maintenance, energy), date and time stamped including the date of acknowledgement of the alarm parameter, until cleared by the system administrator.
- Alarms shall be set-up to be functional during the appropriate seasons and inactive when outside of the related season (i.e. – low water temperature alarms shall not be active during summer, chilled water alarms shall not be active after the central chilled water has been shut off to the building).

2.6.3.7.9 Scheduled Events/Modes

2.6.3.7.9.1 Any command point in the system shall be able to be assigned to a time of day and calendar operating schedule as well as temporary overrides, programmed events (though 3rd party database application), and temperature based operating parameters through any operator's terminal (based on assigned user authority level).

2.6.3.7.9.2 The number of starts and stops per point, per day, shall not be limited. Points shall be assigned "time windows" in which they shall either be ON or OFF during the time of the window. Points shall be able to be assigned different time windows each day of the week plus holiday schedule.

2.6.3.7.9.3 The operator shall be able to list summaries of the time schedules on the operator's terminal. The summary shall indicate the point and the various time windows assigned for that particular day. The summary shall be able to be restricted to a particular location, system or point as well as those days of the week desired.

2.6.3.7.9.4 The system shall be capable of and set-up by the Vendor to access other 3rd party database programs to obtain data necessary for the scheduling of "EVENTS" that occur outside of the established Occupied Schedules. (Ex: Community Use Programming).

2.6.3.7.10 Overrides

2.6.3.7.10.1 Owner's designated administrator shall be able to override all point types, schedules, etc. until releasing from Manual to Auto.

2.6.3.7.10.2 Operators with specified security access level(s) shall be able to override analogue and digital output points with a Timed Override period not to exceed 24 hours. When timed override expires, the system shall revert to "Auto" mode.

2.6.3.7.10.3 The EMCS shall keep track of all override activities and store information on Enterprise Server indicating the Date/Time of override and Username who initiated.

2.6.3.7.10.4 When any point or schedule is overridden, the Graphical User Interface shall display a distinctive color indicating the system is not in Auto Mode and shall return to normal display once the override is removed.

2.6.3.7.11 Trending

2.6.3.7.11.1 The EMCS trending shall be set-up by the EMCS Vendor using the N4 Engine during each installation and shall store data at the SRPDC and then be automatically uploaded to the EMCS ESS. This shall include all inputs/outputs points.

2.6.3.7.11.2 The SRPDC shall communicate (upload) trend data to the ESS at regular intervals for long term storage and shall be capable of storing all site Trend Data for a minimum period of one (1) months without manual data handling.

2.6.3.7.11.3 As a minimum, provide capacity for set up of up to 150 trend logs per SRPDC at one time. Storage duration and data capture intervals shall be user adjustable. Provide data for review in both graphical and tabular format accessible through the EMCS server on operator workstations.

2.6.3.8 Auto-Diagnostic Message

2.6.3.8.1 The system shall continuously query itself to detect any failure or malfunction of the circuits and shall be able to report to the operator any change of state of any equipment. The diagnostic shall include at least the following messages:

- The system can/cannot communicate with a point.
- The system can/cannot communicate with the SRPDC & other RPDC.
- The system can/cannot communicate with an operator terminal.
- The SRPDC & other RPDC are operational/non-operational.
- A power failure was detected on such a day, and such an hour.

2.6.3.8.2 Summaries and readings, when used, shall indicate with special indications or references the state of the communication material of each point. These indicators shall be continuously updated.

2.6.3.9 Locking

2.6.3.9.1 There are two modes of locking. When the Owner locks the change of state report of a point, this point shall execute all addressed commands but shall not report its change of state as a normal or abnormal condition.

2.6.3.9.2 When the Owner locks the capacity of executing a command of a point, the point shall report all changes of its state without executing any addressed command except the unlock command.

2.6.3.9.3 In addition, the Owner can lock a point simultaneously in the two modes. The execution of the locking command shall clear all inhibition of change of state or command.

2.6.3.9.4 Upon the Owner's demand, the system shall supply a summary of locking showing the locked points and their mode of locking.

2.6.3.9.5 All requested reports and summaries shall display a locking indication for the locked points.

2.6.3.9.6 Reports and summaries shall indicate the locking/unlocking status of each point by means of special indications or reference marks.

2.6.3.10 Interlocks

2.6.3.10.1 The User may define the interlock sequences that connect two or more points. The User may assign different priorities for the interlock sequences in such a manner that a point used in multiple sequences shall respond to those of a higher level.

2.6.3.11 Totalization

2.6.3.11.1 This program shall allow totalizing of all binary or analog points.

2.6.3.11.2 The User may:

- Determine the state of an open-closed, normal-abnormal point that must be totalized.
- Designate the basic totalization units and the consumption units.
- Interrupt and resume the totalization of a point as required.
- Modify the total value of the day or the current period and define a warning limit. When the total exceeds the warning limit, it shall produce a change of state and the count shall be reset to zero. When the total exceeds the maximum physical limit of the computer, it shall produce another change of state and the count shall be reset to zero.

2.6.3.11.3 The Totalization Summary shall include:

- Point identification
- Appropriate indication
- Last sample value
- State of the totalization program: active or non-active
- Totalization basic units
- Totalization parameters
- Totalled value of the day with appropriate units of measure
- Total value for the current period with appropriate units of measure
- Total value for the last period
- Warning limit
- Reset to zero limit
- Associated optimal point to stop totalization

2.6.3.11.4 The summary of a point or a group of points may be requested as described by the User.

2.6.3.12 Precision

2.6.3.12.1 The system shall have a minimum precision of input to the SRPDC to the display or print out of + /- 0.5% of the displayed or printed value.

2.6.3.13 Point Segregation

2.6.3.13.1 The User may define segregation of the points as a function of his needs. For example, the points in a building or in a region may be referred to a specific terminal during the day, and for the evening or at night they may be referred automatically to another terminal without any operator intervention. Also, a point in one RPDC may be referred to one or many different terminals independently from the other points in the same RPDC.

2.6.3.14 SERVER-SRPDC & SRPDC-SERVER (Server) Communication

2.6.3.14.1 Every building shall have a stand-alone program and installation that shall render it independent from the SERVER and the other buildings. The data transfer between the SRPDC of the same building shall not be done through the SERVER when this data is necessary for a control sequence.

2.6.3.15 Remote Control

2.6.3.15.1 Remote control shall allow the verification of all digital, analog and calculated points. Setpoints may be changed and the position of the controlled devices may be fixed. All analog and calculated points, function of controlled elements and the status of the digital points may be displayed.

2.6.3.15.2 The SERVER may also simulate the operation of a terminal to be connected to a SRPDC. This terminal mode shall permit communication to the SRPDC in real time to change setpoints, schedules, take temperature readings and reprogram the SRPDC. All modifications shall be automatically updated on the hard disc.

2.6.3.16 Project Management

2.6.3.16.1 At the beginning of the project, the Contractor shall present to the Owner all the documentations and required forms for point definition and for programming.

2.6.3.16.2 All associated details regarding the segregation, the penetration and the communication of each point shall be established and communicated at the beginning of the project.

2.6.4 Owner’s Programming Capacities

2.6.4.1 Programming Definition

2.6.4.1.1 The system shall be programmable at two levels.

2.6.4.1.1.1 The first level is the programming in the conversational English language. This kind of programming is used by the Owner to create his own graphs, his own displays and messages, etc. as explained in the following paragraphs.

2.6.4.1.1.2 The second level shall allow to modify the software furnished by the supplier and shall be used for example to add new symbols in the library of software to create graphics.

2.6.4.2 GUI Creation and Modification

2.6.4.2.1 Creation and Modification to the Database

2.6.4.2.1.1 By using the first level programming, the Owner may affect all the changes to the database with the system on-line and operational.

2.6.4.2.1.2 The Owner may at the very least do the following operations:

- Add and delete points
- Modify all point parameters
- Change, add, and delete point descriptions
- Change, add, and delete units
- Change, add, and delete points in various programs
- Choose the analog alarm limits and their differentials
- Define each function card or module to accept the different analog inputs or the different binary inputs
- Create custom links between points
- Write the program of the SRPDC & RPDC from the SERVER. Load this program in the SRPDC & RPDC while maintaining the capacity to receive alarms and coloured graphics.
- Modify the penetration menu
- Modify the point segregation
- Modify the communication parameters and the input/output ports

2.6.4.2.2 The owner shall be able to modify all points in the database. This modification shall include the addition, elimination and modification of the unit scales or operation modes. The addition of a new point on site shall be accomplished completed by the means of a keyboard once all the material is installed in its place.

2.6.4.2.3 Once the function cards or module of the SRPDC & RPDC are modified, a change of function can be executed consequently by entering a keyboard command. For example, an analog input point which is presently used by a temperature sensor can be modified to operate with a pressure sensor.

2.6.4.2.4 When new points are to be added on site, they may either be grouped in a new display system or may be substituted by existing points in the existing system or may simply be added to the existing systems.

2.6.4.3 Custom Made Equations and Links between Points

2.6.4.3.1 The system shall allow the Owner to develop custom made sequences of operation, unique control algorithms and interactive links between the points, custom made calculations, etc. This program shall directly use the dynamic data of the system.

2.6.4.3.2 The system shall at the very least perform the following operations:

- Addition/subtraction
- Multiplication/division
- Square root/exponential
- Linear equations/quadratic equations

2.6.4.3.3 And can execute the following programming instructions:

- And/or
- Equal/unequal to
- Less than/more than

2.6.4.3.4 All connected points to the system such as temperature, pressure, flow, status, alarm points etc. shall be used in real time in these equations. Also, the Inputs shall include the real time, day of the week, date, constants, and results of other calculations.

2.6.4.3.5 As an equation result of any combination of mathematical or logical function of dynamic data of the system, the system shall, as a minimum, perform the following changes:

- Start-stop command or open/close
- Increase/decrease setpoints in the system
- Initiate reports and displays
- Activate the application programs
- Start/stop alarm functions
- Change the analog output for direct digital control

2.6.4.3.6 The Owner's entries for equation processing shall be made with a keyboard command using the first level programming. A step-by-step interactive routine shall be furnished to guide the User's entries. Systems that demand binary input, decimals, machine languages or digital codes shall not be accepted.

2.6.4.3.7 The computer shall be able, by using equations, to make all calculations and operations, as follows:

- Flows
- Predictions
- Comparison of forecasts and historical data

- Display or printout of a message or a graphic
- When an analog point in the system exceeds a certain limit, change of setpoint of a controller
- Display of instructions for actions to be taken by the operator when the value exceeds a certain limit
- Degree-days for heating and cooling

2.6.4.4 New Programming

2.6.4.4.1 The Owner, by using the second level language, may program the system to support all the following programs for the development, the compilation, the loading and the execution by the Owner.

2.6.4.5 Copy of the Software

2.6.4.5.1 The Contractor shall give the Owner a copy of the block diagram of programming logic included with 'As-Built'.

2.6.4.5.2 The Contractor shall furnish to the Owner any software/hardware and software tools necessary to edit, modify, add or delete a point from the system and the graphics. This applied to the Enterprise Server, SRPDC and RPDC.

2.6.4.6 Software and SRPDC, RPDC Programming

2.6.4.6.1 The SRPDC & RPDC shall have its own BAC-net standard software that shall allow it to function totally independent from the SERVER. In addition to the standard software already included in the existing SERVER, the SRPDC & associated RPDC controls shall have its own energy management software that includes but is not limited to the following software:

- Start/stop time schedule (weekly, holidays and alternative)
- Run-time
- Load shedding
- Duty cycling
- Run-time optimization
- Outdoor air quality optimization
- Inter-lock
- PID Control Loop (Each individual property must be adjustable as well as able to be disabled to allow proportional control only, or proportional with integral control, as well as proportional, integral and derivative control).
- Chiller and boiler optimization
- Optimization of water temperature or air supply
- Power failure/auto restart feature (when power is restarted the RPDC & RPDC controls shall automatically restart in an orderly

fashion including all appropriate delay without the necessity for operator intervention)

- Point summary reports, alarms summary reports, trending

2.6.4.6.2 Load reset control; parameters shall include the following:

- Analog limits for heating and/or cooling as appropriate.
- Analog differential limits.
- Magnitude of set point increment.
- Program frequency.
- Communication between SRPDC and SERVER through a dedicated communication network or LAN/WEB technologies and network service providers.
- Communication between SRPDC and RPDC through a local bus communication line.

Part 3 Execution

3.1 LOCATION

3.1.1 Location of SRPDC and RPDC to be in dedicated mechanical/electrical rooms or as approved by Consultant and/or Owner.

3.1.2 Location of TEC shall be dictated by the placement of terminal equipment to be controlled (i.e. VAV Box, Heat Pump, etc.). Except where otherwise noted, TEC shall be located in a NEMA 1 enclosure within five (5) feet of terminal equipment being controlled and shall have liquid Tight flexible conduit between the Controller enclosure and Terminal equipment neatly installed and secure to structure (as close as possible to point of final termination).

3.1.3 Any controllers, control devices, sensors, etc. located in public space shall not have an accessible communication port for connecting to the controller/device and accessing the EMCS. If a communication port is present, the controller/device must be enclosed in a lockable cabinet prohibiting access to the communication port by un-authorized personnel.

3.2 HARDWARE INSTALLATION

3.2.1 Install Controllers in secure locking enclosures or as directed by Engineer/Consultant.

3.2.2 Terminal Equipment controllers above ceiling system may be unit mounted (i.e. VAV, Heat pumps, etc.).

3.2.3 Provide necessary power from local 120V branch circuit panel for equipment.

3.2.4 Install tamper locks on breakers of circuit breaker panel.

3.2.5 Use uninterruptible Power Supply (UPS) and emergency power when equipment must operate in emergency and co-ordinating mode.

3.3 SOFTWARE/PROGRAMMING INSTALLATION

3.3.1 Software shall be installed, and system programmed and run-tested prior to installation on site. Any adjustments and/or changes to programming as identified during the commissioning process shall be implemented by the contractor at no additional cost to the project and then re-tested with Commissioning Agent. Further adjustments may also be identified during seasonal commissioning process and shall be carried out by the contractor at no additional charge.

3.3.2 Custom site-specific graphics shall be generated using City of Mississauga (CoM) template workstations as guideline. Preliminary, site specific graphics shall be created and delivered to CoM (and Consultant) for review and comment, followed by multiple rounds of modification before final approval (and prior to uploading to site). Contractor shall make all necessary changes and updates as identified during shop drawing phase and again during commissioning phase. Final sequences and As-Built Documentation shall be updated each time there is a change and shall be included for both manual and PDF links through graphical Interface.

3.3.3 The system programmer shall be present during the commissioning process to ensure continuity throughout the project.

3.3.4 All changes shall be uploaded to Enterprise Server immediately prior to leaving the site.

END OF SECTION 25 30 01

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EMCS: FIELD CONTROL DEVICES

Part 1 General

1.1 SUMMARY

.1 Section Includes:

  .1 Control devices integral to the Building Energy Monitoring and Control System (EMCS):

    .1 Transmitters, sensors, controls, meters, switches, transducers, dampers, damper operators, valves, valve actuators, and low voltage current transformers.

.2 Related Sections:

  .1 Section 07 84 00 – Fire stopping.

  .2 Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning.

  .3 Section 25 05 01 - EMCS: General Requirements.

  .4 Section 25 05 02 - EMCS: Submittal and Review Process

  .5 Section 25 05 54 - EMCS: Identification.

.3 REFERENCES

  .1 American National Standards Institute (ANSI).

    .1 ANSI C12.7-1993 (R1999), Requirements for Watthour Meter Sockets.

    .2 ANSI/IEEE C57.13-1993, Standard Requirements for Instrument Transformers.

  .2 American Society for Testing and Materials International, (ASTM).

    .1 ASTM B148-97(03), Standard Specification for Aluminum-Bronze Sand Castings.

  .3 National Electrical Manufacturer's Association (NEMA).

    .1 NEMA 250-03, Enclosures for Electrical Equipment (1000 Volts Maximum).

  .4 Air Movement and Control Association, Inc. (AMCA).

    .1 AMCA Standard 500-D-98, Laboratory Method of Testing Dampers for Rating.

  .5 Canadian Standards Association (CSA International).

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

  .6 City of Mississauga Communication Cabling Specification Standard

1.2 DEFINITIONS

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

1.3 SUBMITTALS

.1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 02 - EMCS: Submittals and Review Process.

.2 Pre-Installation Tests.

  .1 Submit samples at random from equipment shipped, as requested by Consultant/Engineer, for testing before installation. Replace devices not meeting specified performance and accuracy.

.3 Manufacturer's Instructions:

  .1 Submit manufacturer's installation instructions for specified equipment and devices.

1.4 EXISTING CONDITIONS

.1 Cutting and Patching: in accordance with Specifications supplemented as specified herein.

.2 Repair surfaces damaged during execution of Work.

.3 One (1) week after project kick-off meeting, Owner to review and identify any materials designated to be turned over for re-use (after removal by EMCS contractor). EMCS contractor shall dispose of all other redundant materials in an environmentally friendly manner.

.4 Two (2) weeks after project kick-off meeting, EMCS contractor to conduct a complete survey of the existing EMCS and associated systems to be controlled including download of existing controller database and programming, a functional test of HVAC/Lighting devices to remain (ie - dampers, valves, VFD's, Lighting contactors – as identified in the project specifications), identification of power sources for EMCS, and existing sensor locations. A report shall be given to the owner identifying the as-found condition of any devices to remain and quotations for replacement where they are found to be defective.

Part 2 Products

2.1 GENERAL

.1 Control devices of each category to be of same type and manufacturer.

.2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, assembly.

.3 Operating conditions: 0 - 32°C with 10 - 90% RH (non-condensing) unless otherwise specified.

.4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.

.5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.

.6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

.7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.

.8 Devices installed in user occupied space not to exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.

.9 Range: including temperature, humidity, pressure, as indicated in project specific I/O summary (Points List).

2.2 TEMPERATURE SENSOR/TRANSMITTER

.1 Temperature sensors and transmitters shall be either "NTC" thermistor-type or "RTD" platinum element. Each project must utilize one sensor type unless approved by consultant during tendering.

.2 NTC Sensors shall be 10K or 20K ohm at 0 degrees C, with a 304 Stainless Steel Probe having accuracies as follows:

.1 Coefficient of resistivity: 0.001 ohms/ohm*oC

.2 Accuracy 0.2oC over a range of 0-70oC

.3 Stability 0.02oC drift per year

.3 RTD Sensors shall be Platinum Element type, 100 or 1000 ohm at 0 degrees C (plus or minus 0.2 ohms), thin film type or equivalent, having accuracies as follows:

.1 Coefficient of resistivity: (0.00385) ohms/ohm oC.

.2 Accuracy 0.2oC over range of 0 to 70 oC.

.3 Stability 0.02oC drift per year.

.4 Sensors shall have a time constant response of less than four (4) seconds to a temperature change of 10°C.

.5 Sensors shall be manually calibrated on site so that the wiring length does not detract from the sensor accuracy specified.

.6 Temperature sensors shall be of the following types:

.1 **Room sensor-** suitable for all walls mounting, with metal protective guard. Element length of 0.4" to 2" (10 – 50mm) with ceramic tube protection or equivalent.

.2 **General purpose duct sensor** - suitable for insertion into air ducts. Element length of 18" (457 mm) or 30" (760 mm),junction box wiring connections and gasket to prevent air leakage or vibration noise.

.3 **Averaging sensor duct type** - continuous filament with immersion length of 18' (5486 mm) minimum, junction box wiring connections and gasket to prevent air leakage or vibration noise. For duct greater in any dimension that 48 inches (1219mm) and or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used. Capillary supports at the sides of the duct shall be provided to support the sensing string.

.4 **Outside air sensor** - shall consist of a single device sensor, ventilated non-metallic sun shield designed to minimize solar and wind effect, utility box terminations, and watertight gasket to prevent water seepage.

.5 **High Limit sensor** - shall be manual reset type. Sensing element shall be bimetal

.6 **Terminal Unit space temperature sensors** - shall be provided in accordance with the drawing at the locations indicated with the following options:

- Standard Wall-mount Space sensor
- Set-point Adjustment Buttons ("+" & "-")
- Override/Bypass

- Occupancy
- RH
- NO Network Jack

.7 Thermostats shall provide flexibility to adjust the following Parameters:

.1 Adjustable Temporary Occupancy Over-ride (from 0 to 24 hours)

.2 Adjustable heating, cooling dead-band from 2ºC to 4ºC

.3 Adjustable set-point limits (i.e. +/- 2°C)

.8 In all public areas as such as Arenas, Cafeterias, Hallways and corridors where additional security is required the sensor shall be a blank stainless steel wall plate temperature sensor equal to Greystone type model #TE200AS (PT 1000-1000 Ohms, Platinum)

.9 The Network Thermostat shall employ non-volatile electrical erasable programmable read-only memory (EEPROM) for all adjustable parameters.

.10 The Power supply shall be 24 VDC with effect less than 0.01 oC per volt change.

.11 The output signal: 4-20 mA or 0-10VDC into (500) ohm maximum load. Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5% of full-scale output.

.12 Transmitter ranges: Select narrowest range to suit application from the following:

.1 - 50oC to + 50oC, plus or minus 0.5odegrees C

.2 - 0oC to + 100oC, plus or minus 0.5odegrees C

.3 - 0oC to + 50oC, plus or minus 0.25odegrees C

.4 - 0oC to + 25oC, plus or minus 0.1o degrees C

.5 -10oC to + 35oC, plus or minus 0.25o degrees C

2.3 LOW LIMIT CONTROLS (FREEZE STAT)

.1 Provide one (1) Low Limit sensor for each 20 sq. ft. (1.86 sq. m) of coil face. Low limit thermostats shall be of the vapor pressure remote element, manual reset type with adjustable set point. The device shall respond to the lowest temperature to which 1 foot of the element is exposed.

.2 Capillary sensing tubing serpentine vertically across the air flow entering the face of the coil and be supported firmly by mechanical clips.

.3 The Low Limit sensor shall be DPDT with a minimum of (1) NO contact and one (1) NC contact. One set of contacts shall be wired directly to controlled mechanical equipment contactor/VSD in order to affect both automatic and manual (HOA) switch positions. The second set of contacts will be wired to a digital input for annunciation of freeze protection alarm condition. Manual reset type is required.

2.4 HIGH LIMIT CONTROLS

.1 Provide High Limit Controls where indicated. Connect thermostat controllers that are capable of stopping fans in event of excessive temperatures in fan circuits. Provide thermostats with fixed or adjustable settings to operate at not less than 32ºC above normal maximum temperature at their location in the air handling system.

.2 The High Limit sensor shall be DPDT with a minimum of (1) NO contact and one (1) NC contact. One set of contacts shall be wired directly to controlled mechanical equipment contactor/VSD in order to affect both automatic and manual (HOA) switch positions. The second set of contacts will be wired to a digital input for annunciation of high limit alarm condition. Manual reset type is required.

2.5 IMMERSION WELLS

.1 Immersion wells shall be stainless steel or may be copper only if the medium being controlled is treated with appropriate chemicals products that inhibit corrosion and heat transfer compound to be compatible with sensors.

.2 Contractor shall be responsible for filling wells with suitable fluid for proper thermal conductivity transmittance.

2.6 RELATIVE HUMIDITY SENSORS/TRANSMITTERS

.1 Relative humidity transmitters and/or sensors shall have electronic circuits to compensate for element variations. The sensors shall have an operating range of 5 to 90% RH minimum, with a ($\pm$) 5% RH accuracy.

.2 Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with neoprene grommet, bushing, and a mounting bracket.

.3 Transmitters shall be shipped factory pre-calibrated.

.4 Outdoor Humidity sensor requirements:

- Range 0-100% RH minimum
- Operating temperature range: -40 to 50ºC
- Absolute accuracy: plus or minus 2%
- Temperature coefficient: plus or minus 0.03% RH/°C over 0 to 50 degrees.
- Must be unaffected by condensation or 100% saturation.
- No routine maintenance or calibration is required.

.5 The humidity station shall be suitable for duct or outside mounting and consist of sensors, ventilated non-metallic sun shield, utility box for terminations, and watertight gasket to prevent water seepage.

.6 The Humidity transmitters shall have the following requirements:

- Output signal of 4-20 mA into (500) ohm maximum load. or equivalent.
- Output variations: not to exceed 0.2% of full-scale output for supply voltage variations of plus or minus 10%.
- Output linearity error: plus or minus 1.0% maximum of full scale output.
- Shall have output short circuit and open circuit protection.
- Integral zero and span adjustments.

2.7 CO2 SENSORS

.1 CO2 sensors shall be a photo –acoustic type CO2 sensor with integral transducers and linear output. The devices shall read CO2 concentrations between 0 and 2000 ppm with full scale accuracy of at least plus or minus 100 ppm. The sensor shall have multiple outputs (0 -10 VDC or 4- 20 ma), annual zero drift + /- 10 ppm and automatic self-diagnostics.

2.8 AIR QUALITY SENSORS

.1 The Air Quality sensor shall monitor a wide range of gaseous volatile organic component common in indoor air contaminants like paint fumes, solvents, cigarette smoke, and vehicle exhaust. The sensor shall automatically compensate for temperature and humidity, have span and calibration potentiometers, operate on 24 VDC power with output of 0-10 VDC, and have service rating of 0 to 80ºC or 32 to 140ºF and 5 to 95% relative humidity.

2.9 STATIC PRESSURE TRANSMITTERS

.1 Static pressure transmitters shall have a multipoint sensing element with self-averaging manifold.

.2 Requirements:

- Maximum pressure loss shall be 0.75” w.g. at 2000 CFM with an accuracy of 1% of total duct static.
- Output signal of 4-20 mA into 500-ohm maximum load or equivalent.
- Accuracy:0.4% of span
- Repeatability: within .5% of output
- Linearity: within 1.5% of output
- Dead-band or hysteresis:0.1% of span
- Output short circuit protection.
- Calibrated span: not to exceed 150% of duct static pressure at maximum flow
- Pressure +/- 2% of the transmitter span.

2.10 FLOW (AIR FLOW & WATER)

.1 Electronic Air Flow Monitoring System shall be solid state electronic device comprised of a thermistor-based sensing grid and microprocessor-based electronics panel for flow averaging temperature compensation and signal transmission.

.2 Water flow In –Line Type: for Pipe Sizes up to 1.5 inches (38mm) in line type flow sensor shall have a nonmagnetic spinning impeller.

.3 Water flow Insertion Type: for Pipe 1.5 to 10 inches (38 to 254mm) provide a probe mounted insertion type turbine sensor.

2.11 VELOCITY PRESSURE SENSORS

.1 Sensors Requirements:

.1 Multipoint static and total pressure sensing element with self-averaging manifold with integral air equalizer and straightener section.

.2 Maximum pressure loss: 37 Pa at 1000 m/s
.3 Accuracy: plus or minus 1% of actual duct velocity.

2.12 VELOCITY PRESSURE TRANSMITTERS

.1 Transmitters Requirements:
- Output signal: 4-20 mA linear into 500-ohm maximum load.
- Calibrated span: not to exceed 125% of duct velocity pressure at maximum flow.
- Accuracy: 4% of span.
- Repeatability: within 0.1% of output.
- Linearity: within .5% of span.
- Dead-band or hysteresis: 0.1% of span.

2.13 LIQUID AND STEAM FLOW METERS

.1 Requirements: In accordance with CITY OF MISSISSAUGA Master Metering Specifications. Request copy from CITY OF MISSISSAUGA Facilities Project Manager when quoting a new project.

2.14 DIFFERENTIAL PRESSURE TRANSMITTERS & TRANSDUCERS

.1 Differential pressure transmitters shall be made of suitable materials for continuous contact with the process materials such as: compressed air water, glycol or steam etc.

.2 Output signal of 4-20 mA or equivalent, output short circuit and open circuit protection.

.3 Output variations: less than .2% full scale for supply voltage variations of plus or minus 10%.

.4 The controller shall determine airflow by dynamic pressure measurement using an integral dead-end differential pressure transducer. The transducer shall be maintenance-free and shall not require air filters

.5 The controller shall have the ability to automatically calibrate the flow sensor to eliminate pressure transducer offset error due to ambient temperature, humidity effects.

2.15 ELECTRIC/PNEUMATIC TRANSDUCERS (EPT) OR ELECTRIC/RESISTANCE TRANSDUCERS (ERT)

.1 Provide electric pneumatic transducers and/or electric resistance transducers that apply to the operation characteristics required in the specifications.

.2 The EPT shall have a nominal output 1 to 20 PSI, an adjustment span of 2 to 20 SPI, 5% span, and zero adjustment from 1 to 18 PSI.

.3 The ETR shall have a minimum of 3 linear rheostats, having a 5% tolerance.

.4 Each transducer shall have analog input adjustment point.

.5 Supply with each EPT a positive feedback system (pneumatic electric transducer PET) allowing a feedback of the demand from the pneumatic control signal to the controlled devices.

.6 Each pneumatic and/or electric control adjustment shall allow DDC to maintain the last output command during a malfunction or a power control failure of the control panel.

2.16 CURRENT SENSING RELAYS

.1 Current sensing relays shall be Carlo Gavazzi, 120 VAC, plug in type with remote sensor (donut). Relays shall be properly secured to cabinet/device enclosure using DIN rail or other manufacturer approved method

2.17 ELECTRIC RELAYS

.1 Electric control relays shall be double pole double throw with 24V or 120 V nominal (DPDT) coils. Contacts rated 10 amps at 120 VAC, plug-in type with sub-base, and wiring terminal blocks.

.2 Contacts shall be rated for 10 amps at 120 AC

.3 Relays shall have an integral indicator light and check button.

2.18 FRACTIONAL HORSEPOWER MOTOR CONTROL

.1 For fractional HP motors (i.e. Exhaust Fans) to be controlled by the EMCS, new starters shall be Veris Hawkeye H548.

.2 Shall be used for monitoring motor status and providing Hand/Off/Auto control of the FHP motor.

2.19 PRESSURE SWITCHES

.1 Pressure switches shall have Bourdon tube, bellows or diaphragm type sensing element. Pressure switches shall be snap action type, voltage rated at 120 VAC, 15 AMPS or 24 volts DC, with adjustable setpoint and differential.

.2 Sensing element shall be isolated between the sensor and the pressure source (steam, high temperature how water, etc.)

.3 Pressure switch range shall be according to their application and shall be commercial building industry standard.

2.20 CURRENT ELECTRIC TRANSDUCERS

.1 Current electric transducers shall measure line current and produce a proportional signal with the following range:

- 4 – 20 Ma
- 0 – 1 VDC
- 0 – 10 VDC
- 0 – 20 VDC
- 2 – 10 VDC

.2 Frequency insensitive from 10-80 Hz

.3 Accuracy to 0.5% full scale.

.4 Zero and span adjustments. Field adjustable range to suit motor applications.

.5 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

2.21 ELECTRONIC SIGNAL ISOLATION TRANSDUCERS

.1 The signal isolation transducer shall be provided whenever an analog output signal from BAS is to be connected to an external control system as an input or is to receive as input signal from remote system.

2.22 SUMP LEVEL SWITCHES

.1 Requirements:

- Indicate high/low water level and to alarm.
- Maximum operating temperature: 120ºC.
- Snap action contacts rated (15 amp at 120 V)
- Adjustable set-point and differential.

2.23 TANK LEVEL SWITCHES

.1 Switches shall be sealed mercury tube type in waterproof and shockproof enclosure. Contacts shall be rated 15 amps at 120 VAC.

2.24 WIND VELOCITY TRANSMITTERS

.1 Requirements:

.1 3-cup anemometer and airfoil vane mounted on common vertical axis, designed for mast mounting.

.2 Anemometer:

- Range: 0-160 km/h.
- Threshold: 3.0 km/h.
- Accuracy: +/- 2%.

.3 Airfoil vane

- Range: 0-360 degrees with infinite resolution potentiometer with no loss of reading at transition point.
- Starting threshold: 1.1 M/s.
- Accuracy: +/- 0.5%.
- Output signals: 4 to 20 Ma into 500-ohm load.
- Provide two output signals: velocity, direction.
- Mast: aluminum, size and height as indicated.
    - Provide at least 3 stainless steel guys, turnbuckles, anchor bolts. Follow manufacturer's installation guidelines.
    - Lightning protection as indicated on electrical drawings.

2.25 SOLAR SENSORS

.1 Monitor solar radiation as indicated.

.2 Pyranometer, black and white, producing proportional 0-50 mV signal. Include converter for 4-20 mA signal.

2.26 PLC MULTIPOINT DAYLIGHT HARVESTING PHOTOSENSOR

.1 Monitor lighting levels for control of lighting systems as indicated.

.2 Kele Model: MK7-B-CR (0-10Vdc or 4-20ma)

.3 Supply Voltage:12-24 VDC, 20 mA max

.4 Analog Output:(model specific) 4-20 mA @ 850Ω, or 0-10VDC @ 5KΩ min

.5 Range Adjust & Response Time: Field adjustable

.6 Operating Conditions:-40° to 140°F (-40° to 60°C); 10% to 95% RH Non-condensing

.7 Wiring Terminations: 3 wire 18 AWG pigtails

.8 Mounting:
- Indoor (-CCF):Smooth back for ceiling down mounting w/double stick tape
- Outdoor (-CR):1/2″ MNPT for Horizontal mount
- Skylight (-CS):1/2″ MNPT for Vertical-up mount

.9 Enclosure Rating: NEMA 1-Indoor (-CCF) and Skylight (-CS), NEMA 3R Outdoor (-CS)

.10 Warranty:2 year

2.27 SURFACE WATER DETECTORS

.1 Requirements:
- Provide alarm on presence of water on floor.
- Expendable cartridge sensor.
- Internal waterproof switch.
- One set of dry contacts 2 amps at 24 V.
- Unaffected by moisture in air.
- Self-powered.

2.28 ELECTRONIC DAMPER ACTUATORS

.1 Electronic damper actuators shall be direct shaft mount. The actuator shall be direct couple over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The fastening clamp assembly shall be of a ‘V’ bolt design with associated ‘V’ shaped toothed cradle attaching to the shaft for maximum strength and eliminating slippage. Spring return actuators shall have a ‘V’ clamp assembly of sufficient size to be directly mounted to an integral jackshaft of up to 1.05 inches. Single bolt or screw type fasteners are not acceptable.

.2 Modulating and two-position actuators shall be provided as required by the sequence of operations.

.3 The actuator mounting arrangement and spring return `` fail-safe` `feature shall permit normally open or normally closed positions of the dampers, as required.

.4 The actuator shall be size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.

.5 All actuators (except terminal units i.e. VAV boxes etc.) shall be furnished with mechanical spring return unless otherwise specified in the sequence of operations.

.6 All actuators shall have external adjustable stops to limit the travel in either direction, or gear release to allow manual positioning.

.7 Power requirements: Modulating actuators shall accept 24 VAC or VDC power supply, consume no more 15 VA. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator provide position feedback signal of 2-10 VDC.

.8 The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication.

.9 For VAV box applications floating control type actuators may be used.

.10 Damper actuators shall drive damper from fully open to fully closed, in less than 120 seconds.

.11 Actuators shall be designed for a minimum of 100,000 full stroke cycles and 1,000,000 part cycles at the actuator’s rated torque and shall have a 2-year manufacturer’s warranty, starting from the date of start-up.

2.29 ELECTRONIC / ELECTRIC VALVE ACTUATORS

.1 Each actuator shall be equipped with current limiting circuitry incorporated in its design to prevent damage to the actuator.

.2 Modulating and two-position actuators shall be provided as required by the sequence of operations.

.3 The actuators shall provide the minimum torque required for proper valve close-off against system pressure for the required application.

.4 All actuators shall fail in the last position unless specified with mechanical spring return in the sequence of operations.

.5 The spring return feature shall permit normally open or closed positions of the valves a, specified.

.6 All direct shaft mount rotational actuators shall have external adjustable stops to limit the travel in either direction.

.7 Scale or dial indication of actual control valve position.

.8 Size actuator to meet requirements (CV`s) and performance of the control valve specifications.

.9 For interior and perimeter heating and cooling applications floating control actuators are acceptable.

.10 Power requirements: Modulating actuators shall accept 120 VAC or 24 VDC power supply, consume no more 15 VA. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator provide position feedback signal of 2-10 VDC.

.11 The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication.

.12 Two- position or open/ closed actuators shall accept 24Vdc or 120 VAC power supply.

.13 Butterfly isolation and other valves, as specified in the sequence of operations, shall furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop the associated heating /cooling pump or chiller.

2.30 POWER AND ELECTRIC CONSUMPTION TRANSDUCER

.1 Power transducers shall measure the electric power in Kilowatts (proportional signal) with ranges of 4 to 20 mA, 0 TO 5 VDC, 2-10 VDC, 0 to 20 VDC and shall measure electric consumption in KWH (pulsed signal).

.2 Power transducers shall have a local LCD display on the unit of instantaneous power (kW) and shall be VERIS model #H6004.

2.31 POWER SUPPLIES

.1 General

.1 DC power supplies shall be sized for the connected device load. Total rated load shall not exceed 75% of the rated capacity of the power supply.

- Input: 120 VAC +10% line change.
- Output: 24 VDC.
- Load Regulation: +0.05% for 50% load change.
- An appropriately sized fuse and fuse block shall be provided and located next to power supply.

.2 A lockable power disconnect switch shall be provided next to the power supply or as an integral component of the power supply.

.3 The 120-Volt circuits used for the BAS shall be dedicated to the BAS and shall not be used for any other purposes.

.4 Each BAS Control Panel (including the Building Controller) shall have a “packaged” Power Supply in a separate enclosure, such that the BAS Control Panel door can be opened without exposure to the 120-Volt wiring connections (Arc-Flash hazard) (see 2.33.5)

.2 Uninterrupted Power Supply (UPS)

.1 The UPS unit shall be supplied by a 120 VAC source and shall have enough capacity (VA) to support the associated SRPDC. The UPS shall be continuous operation type with battery reserve of 30 minutes minimum (at full charge) during a power failure. The UPS shall have internal fuse protection. The UPS shall supply the Communication Interface as well (if applicable). The primary role of the UPS shall be to maintain the primary RPDC microprocessor function as well as the modules for input/output points. This will allow the reading of data from the SRPDC in continuous mode and at the central computer via the communication network during the delay of the generator start-up.

.2 In absence of power failure, the internal rectifier and sine wave circuit of the UPS allows the UPS to regulate the power supply to the CNP ex. Frequency, voltage variation, etc.

.3 The UPS shall be supplied and installed by the EMCS contractor and shall be of the following type: Power Ware Model BE850M2 or approved equivalent. The UPS shall be a true UPS meaning the inverter shall be active at all times, not just on a loss on input power. The UPS (and all DDC equipment) shall powered through dedicated circuit(s) from the nearest power panel. The UPS shall be monitored and signal an alarm to the DDC system when the UPS batteries are dead

.3 Other Primary Elements
All other primary elements shall be of the highest quality for commercial building industry. The precision shall be (+/-) 1% of the normal reading for the application.

2.32 PANELS – ADD REFERENCE TO APPENDIX

.1 Wall mounted NEMA 1 enamelled steel cabinets with hinged and key-locked front door.

.2 Multiple panels as required to handle requirements with additional space to accommodate 25% additional capacity as without adding additional cabinets.

.3 Panels shall have DIN Rail mounting for controllers, relays, and other control devices.

.4 Panel shall have separate color coded terminal strip for termination of end devices (sensors, relays, etc) entering panel, and then from terminal strip to the termination point on controller. End devices shall not be wired directly to controller.

.5 Panels shall have external 120Vac to 24Vdc transformer. There shall be no 120V wiring inside of panel enclosure.

.6 Panels shall have plastic raceway/cable tray system for routing of wires into/out of panel.

.7 All panels shall be installed with Termination diagram showing the proper point names or each wire into panel, where it terminates on the terminal strip and where the wiring from terminal strip terminates at controller.

.8 Panels to be lockable with same key.

.9 Color Grey

Part 3 Execution

3.1 INSTALLATION

.1 The contractor shall inform the owner and receive a written approval for the installation location of all field control devices, before any installation

.2 The contractor should examine projects plans for control devices and equipment locations, and report any discrepancies, conflicts, or omissions to the project manager for resolution before proceeding for installation. The contractor should examine projects plans for control devices and equipment locations, and report any discrepancies, conflicts, or omissions to the project manager for resolution before proceeding for installation.

.3 The Contractor shall supply all primary elements as indicated on the drawings and as described in the sequences of operation. It includes all sensors, contacts for the analog and binary inputs and includes all controllers, relays and controlled devices necessary for the analog and binary outputs.

.4 The Contractor shall make all the final connections to the new elements to render a complete and operational control system.

.5 All sensors, transmitters, instruments, etc. which are to be replaced to permit the installation of the new system, shall be replaced with corresponding ones according to the new specifications. The Contractor shall present shop drawings for approval to the Owner before ordering the equipment.

.6 All holes made in ducts for the installation of primary elements shall be sealed properly in order not to affect the readings due to ambient air aspirating through these holes.

.7 Install all equipment and piping in readily accessible locations. Do not run tubing and conduit concealed under insulation or inside ducts.

.8 Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

.9 Install equipment, piping, cables, wiring/conduit parallel to or right angles to building lines. Refer to Category 6 Structured Cabling specification in Appendix C for additional requirements.

.10 Fabricated control panels built to support auxiliary devices such power supplies, relays, controllers, and control devices.

.11 Install all sensors and instrumentation according to manufacturer's instructions. Temperature sensor locations shall be readily accessible, permitting quick replacement and servicing of them without special skills and tools.

.12 Install room sensors prenatally supported on wall frame. They shall be mounted at 1.5 meter (5.0 feet) above finished floor.

.13 The blank stainless steel wall plate sensors shall be flush mounted directly to a single gang electrical box or directly to a wall. Insulating foam is adhered to the back of the wall plate in order to provide a thermal barrier from internal wall temperatures.

.14 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

.15 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.

.16 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.

.17 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.

.18 Fire stopping: provide space for fire stopping in accordance with Section 07 84 00 - Firestopping. Maintain fire rating integrity.

.19 Electrical:

   .1 Complete installation in accordance with Local, Provincial and National Electrical Codes

   .2 Modify existing starters to provide for EMCS as indicated in points list.

   .3 Refer to electrical control schematics as supplied by equipment manufacturer's installation manual. Trace any existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by Consultant before beginning Work.

.4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

.5 Where exposed install communication wiring in conduit. Above rated ceiling, contractor may run plenum rated cable neatly tie wrapped to existing structure.

  .1 Provide complete conduit system to link all Controllers and field devices.
  .2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
  .3 Maximum conduit fill not to exceed 40%.
  .4 Design drawings do not show conduit layout.

3.2 IDENTIFICATION

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

3.3 AIR FLOW MEASURING STATIONS

.1 Protect air flow measuring assembly until cleaning of ducts is completed.

3.4 TESTING AND COMMISSIONING

.1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

END OF SECTION 25 30 01

EMCS: SITE REQUIREMENTS, APPLICATIONS AND SYSTEMS SEQUENCES OF OPERATION

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EMCS: SITE REQUIREMENTS, APPLICATIONS AND SYSTEMS SEQUENCES OF OPERATION

Part 1 General

1.1 SUMMARY

1.1.1 Section Includes:

1.1.1.1 Generic Sequence of Operation that are common to City of Mississauga Energy Management Control System (EMCS) Installations.

1.1.2 Related Sections:

1.1.2.1 Section 01 33 00 – Submittal Procedures

1.1.2.2 Section 01 77 00 – Closeout Procedures

1.1.2.3 Section 25 05 01 - EMCS: General Requirements

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

1.1.2.5 Appendix A – CoM Standards and Guidelines

1.1.3 References:

1.1.3.1 Not Used

1.2 SUBMITTALS

1.2.1 Provide Submittal drawings in accordance with Section 01 33 00 Submittal Procedures and Section 25 05 02 EMCS Submittals and Review Process.

1.2.2 Submittals information shall include:

1.2.2.1 A detailed narrative description of Sequence of Operation of each system including initial ramping periods and reset schedules.

1.2.2.2 Control Description Logic (CDL) for each system.

1.2.2.3 Completed Input/Output Point Matrix Summary Tables populated with COM point naming conventions for each system and related equipment/device fields.

1.2.2.4 System Diagrams consisting of the following; EMCS System architectural diagram, Control Design Schematic for each system (as viewed on OWS), System flow diagram for each system with electrical ladder diagram for MCC starter interface.

1.2.2.5 Final As-Built submittals shall be updated to reflect the final conditions upon completion of installation and commissioning process. A link to PDF version of as-builts shall be provided on all pages of graphical user interface, specific to the system on that graphical page (i.e. – RTU1 shall have link to Sequence and Wiring Diagrams for RTU1, RTU2…)

1.3 SEQUENCES OF OPERATION

1.3.1 Application of Specified Sequences

1.3.1.1 The CoM Typical Points List and Standard Sequence of Operation can be found in Appendix A CoM Standards and Guidelines. The sequences are generic in nature and are meant to form the basis of design for all CoM EMCS Projects

1.3.1.2 The sequences shall be used as the initial starting point for each project, customized by the specifying Consultant and tailored for the specifics of individual project and system requirements.

1.3.1.3 All project specific sequences to be submitted to the CoM for review and approval prior to Tender. – Refer to **EMCS Design Guidelines**, Approval Process.

1.3.2 HVAC Operating Schedules & Modes

1.3.2.1 Refer to **CoM Typical Points List and Standard Sequence of Operation**, in Appendix A

1.3.3 System Sequences

1.3.3.1 Refer to **CoM Typical Points List and Standard Sequence of Operation**, in Appendix A

Part 2 Products

2.1 NOT USED

2.1.1 Not Used.

Part 3 Execution

3.1 NOT USED

3.1.1 Not Used.

END OF SECTION 25 90 01

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Part 1 General

1.1 RELATED SECTIONS

1.1.1 Section 25 05 01 EMCS General Requirements

1.1.2 Section 25 30 01 EMCS Building Family of Controllers

1.1.3 Section 25 30 02 EMCS Field Control Devices

1.2 REFERENCES

1.2.1 Canadian Standards Association (CSA International)

1.2.1.1 CSA C22.1, Canadian Electrical Code, Part 1 (20th Edition), Safety Standard for Electrical Installations.

1.2.1.2 CSA C22.2.

1.2.2 CAN/CSA-C22.3 No. 1, Overhead Systems.

1.2.3 CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

1.2.4 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)

1.2.5 EEMAC 2Y-1 , Light Gray Colour for Indoor Switch Gear.

1.2.6 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)

1.2.7 IEEE SP1122, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.3 DEFINITIONS

1.3.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.3.2 This section covers items common to Sections of Division 26. This section supplements requirements of General Conditions, Supplemental General Conditions and the General Requirements of these specifications.

1.3.3 This Contractor shall be responsible for all cutting and patching required for the removal of existing and installation of new electrical services associated with mechanical systems as indicated and/or specified within.

1.3.4 Where there is a discrepancy between these specifications on those on the drawings, the drawing shall be taken as correct.

Part 2 Codes and Standards

2.1 GENERAL

2.1.1 Do complete installation in accordance with CSA C22.1-1990 and Ontario Hydro code requirements except where specified otherwise.

2.1.2 Do overhead and underground systems in accordance with CSA C22.3No.1-M1979 except where specified otherwise.

2.1.3 Abbreviations for electrical terms: to CSA Z85-1983.

2.1.4 Comply with most recent electrical, building and other applicable codes and authorities having jurisdiction. All new equipment must be CSA approved or approved by special Ontario Hydro inspection.

Part 3 Execution

3.1 CARE, OPERATION AND START-UP

3.1.1 Instruct Consultant and operating personnel in the operation, care and maintenance of equipment.

3.1.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components.

3.1.3 Provide these services for such period, and for as many visits as necessary, to put equipment in operation and ensure that operating personnel are conversant with all aspects of its care and operation.

3.2 VOLTAGE RATINGS

3.2.1 Operating voltages: to CAN3-C235-83.

3.2.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

3.2.3 Voltage drop: voltage drop on new systems wired under this contract shall not exceed 3%. Provide calculations at the request of consultant.

3.3 PERMITS, FEES AND INSPECTION

3.3.1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.

3.3.2 Pay associated fees. Apply for, obtain and pay for all permits, licences, inspections, examinations and fees required.

3.3.3 Ameresco will provide drawings and specifications required by Electrical Inspection Department and Supply Authority at no cost.

3.3.4 Notify Ameresco of changes required by Electrical Inspection Department prior to making changes. Comply with any changes requested prior to making changes.

3.3.5 On completion of work, furnish to the Owner **Certificates of Acceptance** from authorities having jurisdiction.

3.4 MATERIALS AND EQUIPMENT

3.4.1 Provide materials and equipment in accordance with these specifications and associated drawings.

3.4.2 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment that is not CSA certified, obtain special approval from Electrical Inspection

Department of governing authority. Should any dispute arise as to quality or fitness of products, decision rests strictly with Ameresco based on requirements of Contract Documents.

3.4.3 Factory-assemble control panel and component assemblies.

3.5 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

3.5.1 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections for direct digital controls, which are related to control systems specified in Division 25 (**<u>All other controls, interlocks, etc shall be by Division 26</u>**).

3.6 FINISHES

3.6.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two (2) coats of finish enamel.

3.6.2 Clean and touch-up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

3.6.3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

3.7 EQUIPMENT IDENTIFICATION

3.7.1 Identify electrical equipment with nameplates in accordance with existing building nomenclature.

3.7.2 Nameplates

3.7.2.1 Lamacoid 3 mm thick plastic engraving sheet, black face, white core.

Nameplate Sizes:

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

3.7.3 Labels

3.7.3.1 Embossed plastic labels with 6 mm high letters unless specified otherwise.

3.7.3.2 Wording on nameplates to be approved by Consultant prior to manufacture.

3.7.3.3 Allow for average of 25 letters per nameplate.

3.7.3.4 Identification to be English.

3.7.3.5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

3.7.3.6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

3.7.3.7 Terminal cabinets and pull boxes: indicate system and voltage.

3.7.3.8 Transformers: indicate capacity, primary and secondary voltages.

3.8 WIRING IDENTIFICATION

3.8.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

3.8.2 Maintain phase sequence and colour coding throughout.

3.8.3 Colour code: to CSA C22.1-1990.

3.8.4 Use colour coded wires in communication cables, matched throughout system.

3.9 CONDUIT AND CABLE IDENTIFICATION

3.9.1 Colour code conduits, boxes and metallic sheathed cables.

3.9.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals

3.9.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
up to 250 V	yellow	
up to 600 V	yellow	green
up to 5 kV	yellow	blue
up to 15 kV	yellow	red
Telephone	green	
Other communication systems	green	blue
Fire alarm	red	
Emergency voice	red	blue
Other security systems	red	yellow

3.10 WIRING TERMINATIONS

3.10.1 Lugs, terminals, and screws used for termination of wiring to be as specified on drawings.

3.11 MANUFACTURER'S AND CSA LABELS

3.11.1 Must be visible and legible after equipment is installed.

3.12 WARNING SIGNS

3.12.1 As specified and to meet requirements of Electrical Inspection Department and Consultant.

3.12.2 Decal signs, minimum size 175 x 250 mm.

3.13 MOUNTING HEIGHTS

3.13.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

3.13.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

3.13.3 Install electrical equipment at following heights unless indicated otherwise.

3.13.3.1 Local switches: 1,400 mm

3.13.3.2 Wall receptacles:

3.13.3.3 General: 300 mm.

3.13.3.4 Above top of continuous baseboard heater: 200 mm.

3.13.3.5 Above top of counters or counter splash backs: 175 mm

3.13.3.6 In mechanical rooms: 1,200 mm.

3.13.3.7 Panelboards: as required by Code or as indicated.

3.13.3.8 Telephone and interphone outlets: 300 mm.

3.13.3.9 Wall-mounted telephone and interphone outlets: 1,500 mm.

3.13.3.10 Fire alarm stations: 1,500 mm.

3.13.3.11 Fire alarm bells: 2,100 mm.

3.13.3.12 Television outlets: 300 mm.

3.13.3.13 Wall-mounted speakers: 2,100 mm

3.13.3.14 Clocks: 2,100 mm

3.13.3.15 Doorbell pushbuttons: 1,500 mm

3.14 LOAD BALANCE

3.14.1 Measure phase current to panelboards with normal loads operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

3.14.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

3.14.3 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

3.15 CONDUIT AND CABLE INSTALLATION

3.15.1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.

3.15.2 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

Part 4 Field Quality Control

4.1 TESTING

4.1.1 Conduct and pay for following tests:

4.1.1.1 Power distribution system including phasing, voltage, grounding and load balancing.

4.1.1.2 Circuits originating from branch distribution panels.

4.1.1.3 Lighting and its control.

4.1.1.4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

4.1.2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.

4.2 INSULATION RESISTANCE TESTING.

4.2.1.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

4.2.1.2 Megger 350-600 V circuits, feeders and equipment with a 1,000 V instrument.

4.2.1.3 Check resistance to ground before energizing.

4.2.2 Carry out tests in presence of Consultant.

4.2.3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

4.2.4 Submit test results for Consultant to review.

4.3 CO-ORDINATION OF PROTECTIVE DEVICES

4.3.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

END OF SECTION 26 05 00

Appendix A: City of Mississauga Standards & Guidelines

Appendix A
City of Mississauga Standards and Guidelines

A1- CoM Master Point Naming List
A2- CoM Site ID and Naming
A3 CoM Labelling Requirements
A4- CoM System Architectures and Communication Protocols
A5- CoM Graphical Template
A6- CoM Typical Points and Sequences

Point	Name
# LIGHT LEVEL	LTG#
1ST FLOOR OFFICE	1FLROFFICE
2ND FLOOR OFFICE	2FLROFFICE
ACTIVE	ACTIVE
ACTIVE PUMP	ACTPMP
ACTIVE(CALCULATED)	ACTIVESP
ACTIVITY	ACTIVITY
ACTUATOR	ACTUATOR
ADMIN	ADMIN
AEROBICS	AEROBICS
AIR COMPRESSOR	ACMP
AIR COOLED CONDENSER	CND
AIR CURTAIN	ACURT
AIR FLOW	AFLOW
AIR FLOW SET POINT	ALSPT
AIR HANDLING UNIT	AHU
ALARM	ALM
AMMONIA	NH3
AMONIA LEAK ALARM	NH3_ALM
AMP	AMP
ARENA	ARENA
ART GALLERY	ART GALLERY
ATRIUM	ATRIUM
AUTO MODE	AUTOMODE
AVERAGE	AVG
AVERAGE SURFACE TEMPERATURE	AVGSRFT
AVERAGE TEMPERATURE	AVGT
BAC NET	BAC
BACK	BACK
BACK STAGE	BACKSTAGE
BACK UP	BA
BANQUET	BANQUET
BASEBOARD HEATER	BBH
BASEBOARD VALVE	BASEBOARDVLV
BASKETBALL	BSKTBALL
BEACON	BEACON
BILLARDS	BILLARDS
BILLIARDS	BILLIARDS
BOILER	BLR
BOOTH	BOOTH
BOXING	BOXING
BRINE	B
BRINE PUMP	BPMP
BRINE RETURN TEMP	BRT
BRINE SUPPLY TEMP	BST

BRINE SYSTEM	BS
BUILDING	BLDG
BURNER	BUR
BURNER ALARM	BUR_ALM
BUS	BUS
BYPASS DAMPER	BPDPR
CAPACITY	CAP
CAPACTICITY CONTROL	CAPCNTRL
CARBON DIOXIDE	CO2
CARBON MONOXIDE	CO
CEILING FAN	CFAN
CHAMGE OVER	CHNGOVR
CHANGE ROOM	CHNGRM
CHILLED WATER	CHW
CHILLED WATER RETURN	CHWR
CHILLED WATER SUPPLY	CHWS
CHILLER	CHLR
CHLORINE	CHLORINE
CHLORINE LEVEL	CHLORINELVL
CHLORINE PUMP	CHLORINEPMP
CIRCLE DESK	CIRCLEDESK
CITY WATER	CITYW
CITY WATER VALVE	CTYWTRVLV
CLOSED	CL
CO2 LEVEL	CO2LVL
COIL	COIL
COIN ROOM	COINRM
COLD BRINE	CB
COLD BRINE PUMP	CBPMP
COLD BRINE RETURN TEMP	CBRT
COLD BRINE SUPPLY TEMP	CBST
COLD DECK	CLDDECK
COLD WATER	CW
COLD WATER TEMP	CWT
COMMAND	CMD
COMMON	COM
COMMON COLD BRINE	COMCB
COMMUNICATION	COMM
COMMUNICATION PROTOCAL	VP
COMMUNITY	COMMUNITY
COMPRESSOR	CMP
COMPRESSOR AMPS	CMPRAMP
COMPRESSOR FAIL	CMPRFAIL
COMPRESSOR JACKET PUMP	CJPMP
COMPRESSOR RUN FAILED	CMPRUNFAIL
COMPRESSOR RUNTIME	CMPRRUN
COMPRESSOR STAGE	CMPRSTAGE

COMPRSSOR SLIDE VLV	CMPRSLIDEVLV
CONDENSATE PUMP	CONPMP
CONDENSER	CND
CONDENSER FAN	CNDFAN
CONDENSER FAN RUNTIME	CNDFANRUN
CONDENSER FAN VFD	CNDFANVFD
CONDENSER PUMP	CNDPMP
CONDENSER STAGE	CNDSTG
CONDENSER TANK	CNDTANK
CONDENSER VALVE	CNDVLV
CONDENSER WATER PUMP	CNDWTRPMP
CONDENSING WATER	CDW
CONDENSING WATER RETURN	CDWR
CONDENSING WATER SUPPLY	CDWS
CONTROL	CNTRL
CONTROL SCHEDULE	CNTRLSCH
CONTROL TEMP SET POINT	CNTRL_SPT
CONTROLLER	CONTROLLER
COOLING	CLG
COOLING COIL	CLGCOIL
COOLING COIL LEAVING TEMP	CLGCOILT
COOLING CONTROL	CLGCNTRL
COOLING DAY	CLGDAY
COOLING EFFECTIVE	CLGEFF
COOLING ENABLE	CLGENABLE
COOLING MODE	CLGMODE
COOLING NIGHT	CLGNIGHT
COOLING OVERIDE	CLGOVRD
COOLING PUMP	CLGPMP
COOLING SET POINT	CLGSPT
COOLING STAGE	CLGSTG
COOLING SYSTEM	CLG
COOLING TOWER	CT
COOLING VALVE	CLGVLV
CORRIDOR	CORRIDOR
COUNCIL	COUNCIL
COURTROOM	COURTRM
CRAFT	CRAFT
CURRENT	CRNT
CYCLE COUNT	CYCLECOUNT
CYCLE OFF TIME PERIOD	CYCLEOFF
CYCLE ON TIME PERIOD	CYCLEON
DAMPER	DPR
DAMPER MAXIMUM POSITION	DPRMAX
DAMPER MINIMUM POSITION	DPRMIN
DAY	DAY
DAYLIGHT	DAYLTG

DAYLIGHT CONTROLS	DAYLTGCNTL
DC LINK	DCLINK
DEADBAND	DEADBAND
DEHUMIDIFICATION MODE	DHMODE
DEHUMIDIFICATION UNIT	DH
DEHUMIDIFIER	DHU
DELAY	DELAY
DESICANT WHEEL	DWHEEL
DESICANT WHEEL FAULT	DWHEELFAULT_ALM
DETECTION/DETECTOR	DETECT
DEW	DEW
DEW SET POINT	DEWSPT
DEWPOINT	DEWP
DEWPOINT HIGH LIMIT	DEWHILIMIT
DEWPOINT OCCUPIED	DEWOCC
DEWPOINT TEMPERATURE	DEWT
DEWPOINT UNOCCUPIED	DEWUNOCC
DIESEL	DISEL
DIFFERENCE	DIFF
DIFFERENTIAL	DT
DIFFERENTIAL PRESSURE	DP
DIFFERENTIAL PRESSURE VALVE	DPVLV
DINING ROOM	DININGRM
DISCHARGE	DIS
DISCHARGE PRESSURE	DISPRS
DISCHARGE TEMPERATURE	DIST
DOMESTIC COLD WATER	DCW
DOMESTIC HOT WATER	DHW
DOMESTIC WATER BOSSTER PUMP	DWBPMP
DOMESTIC WATER RECIRC PUMP	DWRPMP
DOOR	DOOR
DRAIN	DRAIN
DRAIN OVERRIDE	DRAINOVRD
DRAIN VALVE	DRVLV
DRESSING RM	DRESSINGRM
DRESSING ROOM	DRESSRM
DRY BULB	DB
DUCT	DUCT
DUCT HEATER	DHTER
DUCT INLET	DUCTINLET
DUCT STATIC PRESSURE	DUCTSTATICPRS
EAST	EAST
ECONOMIZER	ECO
EFFECTIVE	EFF
EFFECTIVE COOLING	EFFCLG
EFFECTIVE HEATING	EFFHTG
EFFECTIVE SETPOPINT	EFFSPT

ELECTRIC HEATER	EH
ELECTRIC UNIT HEATER	EUH
ELECTRICAL ROOM	ELECRM
ELECTRICAL SYSTEM	ELECSYS
ELECVATOR SUMP PUMP	ESUMP
ELEVATOR	ELV
EMERGENCY	EMERGENCY
ENABLE	ENABLE
END SWITCH	ES
ENERGY RECOVERY VENTILATOR	ERV
ENGINE	ENGINE
ENTRANCE HEATER	HAC
EVAPORATOR CONDENSER	ECND
EVAPORATOR CONDENSER PUMP	ECNDPMP
EVAPORATOR CONDENSING VALVE	ECNDVLV
EXHAUST	EXH
EXHAUST AIR DAMPER	EADPR
EXHAUST AIR TEMPERATURE	EAT
EXHAUST FAN	EF
EXTERIOR	EXT
FACILITY	FACILITY
FAMILY CHANGE ROOM	FAMCHNGRM
FAN	FAN
FAN COIL	FC
FAN FAST	FANFAST
FAN MODE	FANMODE
FAN OFF CYCLE	FANOFFCYCLE
FAN OFF CYCLE DELAY	FANOFFCYCLEDELAY
FAN OPERATION	FANOP
FAN SLOW	FANSLOW
FAN VFD	FANVFD
FAST	FAST
FEEDBACK	FBK
FIGURE	FIGURE
FILE ROOM	FILERM
FILTER	FLT
FIRE ALARM	FIRALM
FIRE OVERIDE	FIROVRD
FIRE PANEL	FIRPNL
FIRE STAT	FIRZ
FIRE SYSTEM	FIRSYS
FIRING	FIRE
FIRST AID ROOM	1STAIDRM
FITNESS	FITNESS
FIXED SET POINT	FIXEDSP
FLOOR	FLR
FLOW	FLOW

FLUID COOLER	FCL
FORCE FLOW HEATER	FFH
FOUNTAIN	FOUNTAIN
FPM	FPM
FREE COOLING	FREECLG
FREEZE STAT	FRZ
FREQUENCY	FREQ
FRONT	FRONT
FUEL SYSTEM	FUEL
GALLERIA	GALLERIA
GAME	GAME
GARDEN	GARDEN
GAS	GAS
GAS DETECTION SYSTEM	GASD
GAS METER	GASMTR
GAS ZONE	GZN
GENERAL	GENERAL
GENERATOR	GEN
GLASS BLOWING	GLASSBLOW
GLYCOL	GL
GLYCOL PUMP	GLPMP
GLYCOL RETURN TEMP	GLRT
GLYCOL SUPPLY TEMP	GLST
GREY WATER SYSTEM	GWS
GROUND	GRND
GYM	GYM
GYMNASTIC	GYMNASTIC
HALL	HALL
HAND AUTO	HANDAUTO
HAND AUTO MODE	AUTOMODE
HEADER	HEADER
HEAT EXCHANGE SUPPLY WATER TEMPERATURE	HXSWT
HEAT EXCHANGER	HX
HEAT EXCHANGER TEMPERATURE	HXT
HEAT EXCHANGER VALVE	HXVLV
HEAT PIPE	HEATEPIPE
HEAT PLANT CONDENSER	HPCND
HEAT PUMP	HP
HEAT RECOVER SYSTEM	HRS
HEAT RECOVER WHEEL	HRWHEEL
HEAT RECOVERY	HR
HEAT RECOVERY UNIT	HRU
HEAT RECOVERY VENTILATOR	HRV
HEAT RECOVERY WHEEL	HRW
HEAT RECOVERY WHEEL IN TEMP	HRWINT
HEAT RECOVERY WHEEL OUT TEMP	HRWOUTT
HEAT RECOVERY WHEEL OVERIDE	HRWOVRD

HEAT RECOVERY WHEEL SUPPLY AIR TEMP	HRWSAT
HEAT RECOVERY WHEEL TEMP	HRWT
HEAT SINK	HEATSINK
HEAT SINK TEMPERATURE	HEATSINKT
HEATER	HTER
HEATING	HTG
HEATING	HTG
HEATING COIL	HTGCOIL
HEATING DAY	HTGDAY
HEATING EFFECTIVE	HTGEFF
HEATING ENABLE	HTGENABLE
HEATING LOOP	HTGL
HEATING MODE	HTGMODE
HEATING NIGHT	HTGNIGHT
HEATING PUMP	HTGPMP
HEATING PUMP LOOP	HPL
HEATING SET POINT	HTG_SPT
HEATING SETPOINT	HTGSPT
HEATING STAGE	HTGSTG
HEATING STAGES	HTGSTG
HEATING SYSTEM	HTG
HEATING VALVE	HTGVLV
HEATING VENTILATOR	HV
HEATSINK	SINK
HIGH	HI
HIGH DELAY	HIDELAY
HIGH DISCHARGE	HIDIS
HIGH DISCHARGE PRESSURE	HIDISPRS
HIGH DISCHARGE TEMPERATURE	HIDIST
HIGH LEVEL	HILVL
HIGH LIGHT LEVEL	HILTGLVL
HIGH LIGHT LEVEL DELAY	HILTGLVLDELAY
HIGH LIMIT SHUT DOWN ALARM	HILIMIT_ALM
HIGH LOAD SHUTDOWN ALARM	HILOADSHUT_ALM
HIGH OIL TEMP	HIOIL
HIGH OIL TEMPERATURE	HIOILT
HIGH PRESSURE	HIPRS
HIGH SPEED	HISPEED
HIGH SUCTION PRESSURE	HISUCPRS
HIGH TEMPERATURE ALARM	HIT_ALM
HONEYWELL	HONEYWELL
HOT BRINE RETURN TEMP	WBRT
HOT BRINE SUPPLY TEMP	WBST
HOT DECK	HTDECK
HOT WATER PLANT	HWP
HOT WATER RETURN TEMPERATURE	HWRT
HOT WATER TANK	HWT

HOT WATER VALVE	HOTWTRVLV
HOT WATER VLAVE	HWVLV
HOUR	HR
HOURS	HR
HUMIDIFIER	HUM
HVAC	HVAC
HYDRO METER	ELECMTR
ICE	ICE
ICE MELT	ICEMELT
ICE PLANT	ICEP
ICE PLANT COMPRESSOR	CMPR
ICE PLANT DEHUMIDIFICATION UNIT	ICEDH
ICE RESURFACING	ICER
ICE TEMP MODE	ICETEMPMODE
ICE TEMPERATURE	ICET
ICE TEMPERATURE MODE EFFECTIVE	ICETEMPMODEEFF
IDLE	IDLE
IN	IN
IN LET	INLET
INFARED CONTROL	INFAREDCNTL
INFARED SENSOR	INFAREDSENSOR
INFRARED	IR
INFRARED HEATER	IRHTER
INTERIOR	INT
INTERVIEW ROOM	INTERVIEWRM
INVERTER	INVERTER
INVERTER THERMAL	INVTTHERMAL
JANITOR CLOSET	JANITORCLOSET
KITCHEN	KITCHEN
KW	KW
KWH	KHW
LAG	LAG
LAG BOILER	LAGBLR
LAG PUMP	LAGPMP
LAP	LAP
LAP POOL	LAP POOL
LEAD	LEAD
LEAD	LEAD
LEAD BOILER	LEADBLR
LEAD PUMP	LEADPMP
LEAD PUMP OVERIDE	LEADPMPOVRD
LEAK	LEAK
LEAVING AIR HUM	LAH
LEAVING AIR TEMP	LAT
LEAVING WATER TEMP	LWT
LEISURE	LEISURE
LEISURE POOL	LEISURE POOL

LEVEL	LVL
LIBRARY	LIBRARYLIBRARY
LIGHT CYCLE	LTGCYCLE
LIGHT LEVEL	LTGLVL
LIGHTING	LTG
LIGHTING OCCUPIED	LTGOCC
LIGHTING UNOCCUPIED	LTGUNOCC
LIMIT	LIMIT
LOAD	LOAD
LOBBY	LOBBY
LOCAL OVER TIME	LOCALOT
LOCAL SETPOINT	LOCALSPT
LOCK OUT	LOCKOT
LON	LON
LOOP	LOOP
LOOP DIFFERNTIAL PRESSURE	LOOPDP
LOOP SUPPLY TEMPERTAUTRE	LOOP_SPT
LOW	LO
LOW DELAY	LODELAY
LOW LEVEL	LOLVL
LOW LIGHT LEVEL	LOLTGLVL
LOW LIGHT LEVEL DELAY	LOLTGLVLDELAY
LOW OIL PRESSURE	LOOILPRS
LOW PRESSURE	LOPRS
LOW ROOM TEMPERATURE	LORMT
LOW SPEED	LOSPEED
LUNCH ROOM	LUNCHRM
MAIN	MAIN
MAINTENANCE	MAINTENANCE
MAKE UP AIR UNIT	MUA
MAKE UP WATER VALVE	MUWVLV
MASTER LIGHT	MASTERLTG
MAX COOLING AIR FLOW	MAXCLGAF
MAXIMUM CYCLE	MAXCYCLE
MAXIMUM POSITION	MAXPOS
MECHANICAL ROOM	MECHRM
MEDIA	MEDIA
MEETING ROOM	MEETRM
MEN CHANGE ROOM	MENCHNGRM
METER	MTR
METER THERMAL	MTRTHERMAL
MIN COOLING AIR FLOW	MINCLGAF
MINIMUM CYCLE TIME	MINCYCLETIME
MINIMUM DEADBAND	MINDEADBAND
MINIMUM POSITION	MINPOS
MIXED AIR DAMPER	MAD
MIXED AIR DAMPER MAXIMUM	MADPRMAX

MIXED AIR DAMPER MINIMUM	MADPRMIN
MIXED AIR DAMPER OVERIDE	MADOVRD
MIXED AIR HUMIDITY	MAH
MIXED AIR TEMP LOW LIMIT	MATLLIMIT
MIXED AIR TEMPERATURE	MAT
MIXING VALVE	MIXINGVLV
MOD BUS	MODBUS
MODE	MODE
MODULATE	MOD
MODULATION	MOD
MOTION	MOTION
MULTIPURPOSE ROOM	MULTIPURPOSE
NATURAL GAS	NG
NEW	NEW
NIGHT	NTG
NITROGEN DIOXIDE	NO2
NORTH	NORTH
OA DEADBAND	OADB
OCC HEATING	OCCHTG
OCCUAPNCY	OCC
OCCUPANCY	OCCUPANCY
OCCUPANCY OVERIDE TIME LIMIT	OCCOVRDTME
OCCUPANCY SENSOR	OCCSENSOR
OCCUPIED	OCC
OCCUPIED COOLING	OCCCLG
OCCUPIED COOLING PLANT ON	OCCCLGPLNTON
OCCUPIED DEWPOINT	OCCDEW
OCCUPIED HEATING	OCCHTG
OCCUPIED HEATING PLANT ON	OCCHTGPLNTON
OCCUPIED PROCESS FAN SPEED	OCCPROCESSF
OFFICE	OFFICE
OIL	OIL
OIL INTERCEPTOR	OILINTERCEPTOR
OIL TEMP	OILT
OPEN	OPEN
OPERATING	OP
OPERATING HOURS	OPHR
OPERATION	OPERATION
OPERATION MODE	OPMODE
OUT	OUT
OUT DOOR TEMP SET POINT	OATSPT
OUT LET	OUTLET
OUTDOOR AIR DAMPER	OAD
OUTDOOR AIR DAMPER MINIUM POSITION	OADMIN
OUTDOOR AIR DEWPOINT	OADEWP
OUTDOOR AIR FILTER	OAFILT
OUTDOOR AIR FILTER PRESSURE	OAFP

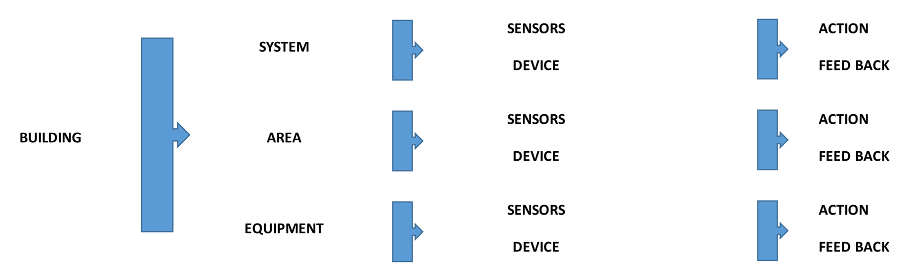
OUTDOOR AIR TEMPERATURE	OAT
OUTDOOR AIR TEMPERATURE DRY BULB	OATDB
OUTDOOR AIR TEMPERATURE WET BULB	OATWB
OUTDOOR TEMP SET POINT	OAT_SPT
OVER TIME REMAIN	OTREMAIN
OVERLOAD	OVERLOAD
OVERRIDE	OVRD
OVERRIDE TIME	OVRDT
OVERRIDE TIME DURATION	OVRDTDUR
OVERRIDE TIME REMAINING	OVRDTREMAIN
PAINTING	PAINTING
PANEL	PNL
PARK	PARK
PARKING	PARKING
PERIMETER	PERIMETER
PERIMETER HEATER	PHTGL
PHOTOCELL	PHOTOCELL
PITT	PITT
PLANT	PLNT
POOL	POOL
POOL DEHUMIDIFICATION UNIT	POOLDH
POOL OFFICE	POOLOFFICE
POSITION	POS
POTS	POT
PRE COOLING COIL TEMP	PRECLGCOILT
PRE HEAT	PREHEAT
PRESSURE	PRS
PRIMARY	PR
PROCESS AIR FILTER PRESSURE DROP	PROCESSFLTPRSDRP
PROCESS FAN	PROCESSF
PROCESS FAN ALARM	PROCESSF_ALM
PROGRAM ROOM	PRORM
PROGRAMM ROOM	PROGRAMRM
PROSHOP	PROSHOP
PROTOCOL	PROTOCOL
PUMP	PMP
PUMP CONTROL	PMPCNTRL
PUMP CONTROLLER	PMPCONTROLLER
PUMP LOCK	PMPLCK
PURGING MODE	PMODE
PUSH BUTTON	PB
PUSH BUTTON OCCUPANCY	PBOCC
PUSH BUTTON OVERRIDE	PBOVRD
QUIET ROOM	QUIETRM
RADIANT HEATER	RADH
RADIATOR	RAD
REACTIVATION	REACT

REACTIVATION FAN	REACTF
REACTIVATION FAN ALARM	REACTF_ALM
REACTIVATION FAN FAULT	RFANFAULT_ALM
REACTIVATION FILTER	REACTFILT
REACTIVATION TEMPERATURE	REACTT
RECEPTION	RECEPTION
RECIRC PUMP	RPMP
RECIRCULATING PUMP	RPMP
RECLAIMED RAIN WATER SYSTEM	RRWS
REFRIGERANT RECOVERY UNIT	RRI
REFRIGERATION PLANT	REFPLANT
REFRIGERATION SOLENOID VALVE	DXVLV
REHEATING VALVE	RHVLV
RELATIVE HUMIDITY	RH
RESET	RESET
RESET SETPOINT	RESETSP
RESET STAGE CONTROL	RESETSTGCNTRL
RETUN DAMPER	RADPR
RETURN AIR CO2	RACO2
RETURN AIR FILTER PRESSURE	RAFP
RETURN AIR HUMIDITY	RAH
RETURN AIR STATIC PRESSURE	RASP
RETURN AIR TEMPERATURE	RAT
RETURN FAN	RF
RETURN FAN ALARM	RF_ALM
RETURN FAN VSD	RFVSD
RETURN WATER PRESSURE	RWPRS
RETURN WATER SET POINT	RWTSPT
RETURN WATER SETPOINT	RWSP
RETURN WATER TEM OVERRIDE	RWTOVRD
RETURN WATER TEMPERATURE	RWT
REVERSING	RE
REVERSING VALVE	REVLV
RINK	RNK
RINK DH	RNKDH
ROOFTOP UNIT	RTU
ROOM	RM
ROOM HUMIDITY	RMH
ROOM TEMPERATURE	RMT
ROTATION SP	ROTATIONSPT
ROTATION TIME	ROTATIONTM
RUN TIME	RUNTIME
RUNTIME	RUNTME
SANITARY	SAN
SCHEDULE	SCH
SCHEDULE MODE	SCHMODE
SCHEDULE SELECTED	SCHSELECTED

SCHEUDLE OVERRRIDE	SCHOVRD
SECOND	SEC
SECURITY	SECURITY
SENIOR	SENIOR
SENSOR FAULT	SENSORFAULT
SENSORS	SENSOR
SET POINT	SPT
SETTING	SETTING
SHOULDER	SHOULDER
SKATING	SKATING
SLAB	SLAB
SLOW	SLOW
SMOKE	SMOKE
SNACK BAR	SNACKBAR
SOCCER	SOCCER
SOLAR	SOLAR
SOUTH	SOUTH
SPEED	SPD
SPRAY PUMP	SPRAYPMP
SQUASH	SQUASH
STAGE	STG
STAGE CONTROL	STGCNTRL
STAGING	STAGING
STAIR	STAIR
STATE	STATE
STATIC PRESSURE	STATICPRS
STATUS	STS
STEAM GENERATOR	EGEN
STOP ALARM	STOP_ALM
STORAGE	STORAGE
STORM	STORM
SUCTION	SUC
SUCTION PRESSURE	SUCPRS
SUCTION TEMP	SUCT
SUMMER	SUMMER
SUMP	SUMP
SUMP PUMP	SUMPPMP
SUPPLU LOW LIMIT	SLLIMIT
SUPPLY AIR FLOW	SAFLOW
SUPPLY AIR HUMIDITY	SAH
SUPPLY AIR STATIC PRESSURE	SASPRS
SUPPLY AIR TEMPERATURE	SAT
SUPPLY AIR TEMPERATURE LOW LIMIT	SATLO
SUPPLY FAN	SF
SUPPLY FAN FAULT	SFFAULT_ALM
SUPPLY FAN MODULATION	SFMOD
SUPPLY FAN OVERIDE	SFOVRD

SUPPLY FAN VSD	SFVSD
SUPPLY HIGH LIMIT	SHLIMIT
SUPPLY WATER	SW
SUPPLY WATER RESET HIGH	SWRESETHI
SUPPLY WATER RESET LO	SWRESETLO
SUPPLY WATER SETPOINT	SWSP
SUPPLY WATER TEMP RESET HIGH	SWTRESTHI
SUPPLY WATER TEMP RESET LOW	SWTRESTLO
SUPPLY WATER TEMP SET POINT	SWTSPT
SUPPLY WATER TEMPERATURE	SWT
SWITCH	SWITCH
SYSTEM	SYS
SYSTEM MODE	SYSMODE
TANK	TNK
TEMPERATURE	T
THEATER	THEATER
THERAPY POOL	THERAPY POOL
THERMAL	THERMAL
TICKET BOOTH	TICKETBOOTH
TIME	TIME
TIMER	TMR
TORQUE	TORQ
TOTAL	TOTAL
TUB HEATER	TUBEH
TUBE HEATER	TUBEHTR
UNDERFLOOR	UNDERFLR
UNIT HEATER	UH
UNIT OFF	UNITOFF_ALM
UNIT VENTILATOR	UV
UNLOAD	UNLOAD
UNOCCUPIED	UNOCC
UNOCCUPIED COOLING	UNOCCCLG
UNOCCUPIED DEWPOINT	UNOCCDEW
UNOCCUPIED HEATING	UNOCCHTG
UNOCCUPIED PROCESS FAN SPEED	UNOCCPROCESSF
UPS	UPS
UV LIGHT	UVLTG
VALVE	VLV
VALVE CLOSED	VLVCL
VALVE OPEN	VLVOP
VALVE OVERRIDE	VLVOVRD
VARIABLE AIR VOLUME	VAV
VENTING MODE	VMODE
VESTIBULE	VESTIBULE
VFD	VFD
VFD OCCUPIED SPEED	VFDOCCSPD
VFD SINK TEMP	VFDSINKT

VFD UNOCCUPIED SPEED	VFDUNOCCSPD
VISUAL ART	VISUALART
VOLT	VOLT
VVT	VVT
WARM /HOT BRINE	WB
WARM BRINE PUMP	WBPMP
WASHROOM	WASHRM
WATER	WTR
WATER METER	WTRMTR
WATER PUMP	WPMP
WATER PUMP	WPMP
WATER TEMPERATURE	WT
WATER TREATMENT SYSTEM	WTS
WEIGHT ROOM	WEIGHTRM
WEST	WEST
WET BULB	WETB
WINTER	WINTER
WOMEN CHANGE ROOM	WOMENCHGRM
WORK ROOM	WORKRM
ZAMBONI	ZAMBONI
ZONE	ZN



SYSTEM	
AIR COMPRESSOR	ACMP
AIR COOLED CONDENSER	CND
BRINE SYSTEM	BS
CHILLER	CHLR
COOLING SYSTEM	CLG
COOLING TOWER	CT
DOMESTIC HOT WATER	DHW
EVAPORATOR CONDENSER	ECND
FLUID COOLER	FCL
FUEL SYSTEM	FUEL
GAS DETECTION SYSTEM	GASD
GENERATOR	GEN
GREY WATER SYSTEM	GWS
HEATING SYSTEM	HTG
ICE PLANT	ICEP
LIGHTING	LTG
METER	MTR
POOL	POOL
RECLAIMED RAIN WATER SYSTEM	RRWS
SOLAR	SOLAR
ICE MELT	ICEMELT
REFRIGERATION PLANT	REFPLANT
SOLAR	SOLAR
ICE PLANT DEHUMIDIFICATION UNIT	ICEDH
HVAC	HVAC

AREA	
ADMIN	ADMIN
AEROBICS	AEROBICS
ART GALLERY	ART GALLERY
ATRIUM	ATRIUM
BACK	BACK
BACK STAGE	BACKSTAGE
BANQUET	BANQUET
BASKETBALL	BSKTBALL
BILLIARDS	BILLIARDS
BOXING	BOXING
BUILDING	BLDG
CHANGE ROOM	CHNGRM
CIRCLE DESK	CIRCLEDESK
COIN ROOM	COINRM
COMMUNITY	COMMUNITY
CORRIDOR	CORRIDOR
COUNCIL	COUNCIL
COURTROOM	COURTRM
CRAFT	CRAFT
DINING ROOM	DININGRM
DRESSING RM	DRESSINGRM
EAST	EAST
ELECTRICAL ROOM	ELECRM
FACILITY	FACILITY
FAMILY CHANGE ROOM	FAMCHNGRM
FILE ROOM	FILERM
FIRST AID ROOM	1STAIDRM
FITNESS	FITNESS
FLOOR	FLR
FPM	FPM
FRONT	FRONT
GALLERIA	GALLERIA
GARDEN	GARDEN
GLASS BLOWING	GLASSBLOW
GROUND	GRND
GYM	GYM
GYMNASTIC	GYMNASTIC
HALL	HALL
INTERVIEW ROOM	INTERVIEWRM
JANITOR CLOSET	JANITORCLOSET
KITCHEN	KITCHEN
LAP	LAP
LEISURE	LEISURE
LIBRARY	LIBRARYLIBRARY
LOBBY	LOBBY
LUNCH ROOM	LUNCHRM
MAINTENANCE	MAINTENANCE
MECHANICAL ROOM	MECHRM
MEETING ROOM	MEETRM
MEN CHANGE ROOM	MENCHNGRM
MULTIPURPOSE ROOM	MULTIPURPOSE
NORTH	NORTH
OFFICE	OFFICE
OIL INTERCEPTOR	OILINTERCEPTOR
OPERATION	OPERATION
PARK	PARK
PARKING	PARKING
PERIMETER	PERIMETER
POOL	POOL
POOL OFFICE	POOLOFFICE
PROGRAM ROOM	PRORM
PROSHOP	PROSHOP
QUIET ROOM	QUIETRM
RECEPTION	RECEPTION
RINK	RNK
ROOM	RM
SECURITY	SECURITY
SENIOR	SENIOR
SNACK BAR	SNACKBAR
SOCCER	SOCCER
SOUTH	SOUTH
SQUASH	SQUASH
STAGING	STAGING
STAIR	STAIR
STORAGE	STORAGE
THEATER	THEATER
TICKET BOOTH	TICKETBOOTH
VESTIBULE	VESTIBULE
VISUAL ART	VISUALART
WASHROOM	WASHRM
WEIGHT ROOM	WEIGHTRM
WEST	WEST
WOMEN CHANGE ROOM	WOMENCHGRM
WORK ROOM	WORKRM
LEAD	LEAD
LAG	LAG
ICE RESURFACING	ICER
ICE MELT	ICEMELT
PITT	PITT
UNDERFLOOR	UNDERFLR
ICE	ICE
SLAB	SLAB
ZAMBONI	ZAMBONI
ARENA	ARENA
ZONE	ZN
LAP POOL	LAP POOL
LEISURE POOL	LEISURE POOL

EQUIPMENT	
AIR COMPRESSOR	ACMP
AIR CURTAIN	ACURT
AIR HANDLING UNIT	AHU
BOILER	BLR
CEILING FAN	CFAN
CHILLER	CHLR
COLD DECK	CLDDECK
DEHUMIDIFIER	DHU
DOMESTIC COLD WATER	DCW
DOMESTIC HOT WATER	DHW
ELECTRIC HEATER	EH
ELECVATOR SUMP PUMP	ESUMP
ELEVATOR	ELV
ENERGY RECOVERY VENTILATOR	ERV
EXHAUST FAN	EF
FAN COIL	FC
FLUID COOLER	FCL
FOUNTAIN	FOUNTAIN
FUEL SYSTEM	FUEL
GAS	GAS
GAS DETECTION SYSTEM	GASD
GAS METER	GASMTR
GREY WATER SYSTEM	GWS
HEAT PUMP	HP
HEAT RECOVERY VENTILATOR	HRV
HEAT RECOVERY WHEEL	HRW
HEATING VENTILATOR	HV
HOT DECK	HTDECK
HOT WATER TANK	HWT
HYDRO METER	ELECMTR
ICE MELT	ICEMELT
ICE RESURFACING	ICER
MAKE UP AIR UNIT	MUA
METER	MTR
POOL DEHUMIDIFICATION UNIT	POOLDH
RADIANT HEATER	RADH
RADIATOR	RAD
RINK DK	#N/A
ROOFTOP UNIT	RTU
SANITARY	SAN
SOLAR	SOLAR
STEAM GENERATOR	EGEN
SUMP	SUMP
UNIT HEATER	UH
UNIT VENTILATOR	UV
UPS	UPS
WATER	WTR
WATER METER	WTRMTR
GLYCOL	GL
ICE PLANT COMPRESSOR	CMPR
COLD BRINE	CB
BRINE	B
ICE PLANT DEHUMIDIFICATION UNIT	ICEDH
COOLING TOWER	CT
CONDENSER	CND
ENTRANCE HEATER	HAC
PERIMETER HEATER	PHTGL
ELECTRIC UNIT HEATER	EUH
FORCE FLOW HEATER	FFH
BASEBOARD HEATER	BBH
HEAT RECOVERY UNIT	HRU
LEAD BOILER	LEADBLR
LAG BOILER	LAGBLR
HEATING LOOP	HTGL
AIR COOLED CONDENSER	CND
EVAPORATOR CONDENSER	ECND
TANK	TNK

DEVICES	
ALARM	ALM
BURNER	BUR
COMPRESSOR	CMP
COMPRESSOR JACKET PUMP	CJPMP
DAMPER	DPR
EXHAUST FAN	EF
FAN	FAN
GENERAL	GENERAL
GLYCOL	GL
HEAT EXCHANGER	HX
HEAT PUMP	HP
HEATING LOOP	HTGL
HEATING PUMP	HTGPMP
HEATING PUMP LOOP	HPL
ICE PLANT COMPRESSOR	CMPR
MAIN	MAIN
OUTDOOR AIR DAMPER	OAD
POOL DEHUMIDIFICATION UNIT	POOLDH
PUMP	PMP
RADIANT HEATER	RADH
RADIATOR	RAD
RETURN FAN	RF
RINK	RNK
RINK DK	#N/A
SENSORS	SENSOR
SET POINT	SPT
SUPPLY FAN	SF
TEMPERATURE	T
TUB HEATER	TUBEH
UNIT HEATER	UH
VALVE	VLV
VARIABLE AIR VOLUME	VAV
VFD	VFD
VVT	VVT
SUPPLY FAN VSD	SFVSD
RETURN FAN VSD	RFVSD
HEATING VALVE	HTGVLV
REHEATING VALVE	RHVLV
COOLING VALVE	CLGVLV
DIFFERENTIAL PRESSURE VALVE	DPVLV
REFRIGERATION SOLENOID VALVE	DXVLV
MAKE UP WATER VALVE	MUWVLV
REVERSING VALVE	REVLV
DRAIN VALVE	DRVLV
FILTER	FLT
MIXED AIR DAMPER	MAD
HIGH DISCHARGE PRESSURE	HIDISPRS
HIGH	HI
LOW	LO
COMMON	COM
OIL TEMP	OILT
DISCHARGE	DIS
SUCTION	SUC
DIFFERENCE	DIFF
EFFECTIVE	EFF
DISCHARGE PRESSURE	DISPRS
SUCTION PRESSURE	SUCPRS
LEAD	LEAD
LAG	LAG
CURRENT	CRNT
SETTING	SETTING
WARM BRINE PUMP	WBPMP
BRINE RETURN TEMP	BRT
COLD BRINE RETURN TEMP	CBRT
UNDERFLOOR	UNDERFLR
INFRARED	IR
OPERATION	OPERATION
ENABLE	ENABLE
ACTIVE	ACTIVE
SLAB	SLAB
VALVE OPEN	VLVOP
VALVE CLOSED	VLVCL
DRAIN	DRAIN
EVAPORATOR CONDENSING VALVE	ECNDVLV
HEAT EXCHANGER VALVE	HXVLV
HOT WATER VLAVE	HWVLV
END SWITCH	ES
FAN FAST	FANFAST
FAN SLOW	FANSLOW
SPEED	SPD
SPRAY /WATER PUMP	#N/A
CEILING FAN	CFAN
OPERATION MODE	OPMODE
CYCLE ON TIME PERIOD	CYCLEON
CYCLE OFF TIME PERIOD	CYCLEOFF
FAN VFD	FANVFD
COOLING PUMP	CLGPMP
CONDENSER WATER PUMP	CNDWTRPMP
CONDENSATE PUMP	CONPMP
COLD BRINE PUMP	CBPMP
GLYCOL PUMP	GLPMP
SPRAY PUMP	SPRAYPMP
LEAD PUMP	LEADPMP
RECIRC PUMP	RPMP
OVERLOAD	OVERLOAD
BRINE SYSTEM	BS
COLD BRINE	CB
INFARED SENSOR	INFAREDSENSOR
VOLT	VOLT
FREQUENCY	FREQ
HAND AUTO MODE	AUTOMODE
TORQUE	TORQ
KWH	KHW
BRINE PUMP	BPMP
WARM /HOT BRINE	WB
BRINE SUPPLY TEMP	BST
COLD BRINE SUPPLY TEMP	CBST
COMPRESSOR FAIL	CMPRFAIL
COMPRESSOR STAGE	CMPRSTAGE
DISCHARGE TEMPERATURE	DIST
COMPRSSOR SLIDE VLV	CMPRSLIDEVLV
COMPRESSOR RUN FAILED	CMPRUNFAIL
COMPRESSOR AMPS	CMPRAMP
COMPRESSOR RUNTIME	CMPRRUN
COMMON COLD BRINE	COMCB
BRINE	B
WATER PUMP	WPMP
CONDENSER FAN	CNDFAN
CONDENSER FAN VFD	CNDFANVFD
CONDENSER FAN RUNTIME	CNDFANRUN
HIGH SPEED	HISPEED
LOW SPEED	LOSPEED
SUMP PUMP	SUMPPMP
CONDENSER STAGE	CNDSTG
CONDENSER VALVE	CNDVLV
CONDENSER TANK	CNDTANK
CONTROL SCHEDULE	CNTRLSCH
RESET STAGE CONTROL	RESETSTGCNTRL
STAGE CONTROL	STGCNTRL
REACTIVATION FAN	REACTF
PROCESS FAN	PROCESSF
EVAPORATOR CONDENSER	ECND
EVAPORATOR CONDENSER PUMP	ECNDPMP
MINIMUM CYCLE TIME	MINCYCLETIME
CONDENSER PUMP	CNDPMP
INFARED CONTROL	INFAREDCNTL
OCCUPIED DEWPOINT	OCCDEW
UNOCCUPIED DEWPOINT	UNOCCDEW
CARBON DIOXIDE	CO2
CARBON MONOXIDE	CO
OCCUPIED PROCESS FAN SPEED	OCCPROCESSF
UNOCCUPIED PROCESS FAN SPEED	UNOCCPROCESSF
SUPPLY AIR TEMPERATURE	SAT
FREE COOLING	FREECLG
RETURN AIR TEMPERATURE	RAT
CO2 LEVEL	CO2LVL
RETURN AIR CO2	RACO2
RETURN AIR HUMIDITY	RAH
SUPPLY AIR HUMIDITY	SAH
COOLING OVERIDE	CLGOVRD
HEAT RECOVERY WHEEL	HRW
HEAT RECOVERY WHEEL OVERIDE	HRWOVRD
HEATING STAGE	HTGSTG
COOLING STAGE	CLGSTG
LOCAL SETPOINT	LOCALSPT
ROOM HUMIDITY	RMH
HUMIDIFIER	HUM
DEHUMIDIFIER	DHU
DEWPOINT	DEWP
DEWPOINT TEMPERATURE	DEWT
MIXED AIR HUMIDITY	MAH
ROOM TEMPERATURE	RMT
SYSTEM MODE	SYSMODE
OCCUAPNCY	OCC
NATURAL GAS	NG
COOLING DAY	CLGDAY
COOLING NIGHT	CLGNIGHT
HEATING DAY	HTGDAY
HEATING NIGHT	HTGNIGHT
DESICANT WHEEL	DWHEEL
MAXIMUM POSITION	MAXPOS
MINIMUM POSITION	MINPOS
OUTDOOR AIR DAMPER MINIUM POSITION	OADMIN
MIXED AIR DAMPER OVERIDE	MADOVRD
FAN OPERATION	FANOP
FAN OFF CYCLE	FANOFFCYCLE
FAN OFF CYCLE DELAY	FANOFFCYCLEDELAY
SUPPLY FAN OVERIDE	SFOVRD
VFD OCCUPIED SPEED	VFDOCCSPD
VFD UNOCCUPIED SPEED	VFDUNOCCSPD
SUPPLY FAN MODULATION	SFMOD
FAN MODE	FANMODE
HEAT PIPE	HEATEPIPE
PRE HEAT	PREHEAT
HEAT RECOVERY VENTILATOR	HRV
EFFECTIVE HEATING	EFFHTG
EFFECTIVE COOLING	EFFCLG
COIL	COIL
OVERRIDE	OVRD
CONTROLLER	CONTROLLER
DEWPOINT HIGH LIMIT	DEWHILIMIT
OCCUPANCY OVERIDE TIME LIMIT	OCCOVRDTME
MIXED AIR DAMPER MINIMUM	MADPRMIN
MIXED AIR DAMPER MAXIMUM	MADPRMAX
SUMMER	SUMMER
SHOULDER	SHOULDER
WINTER	WINTER
PUSH BUTTON OCCUPANCY	PBOCC
SCHEDULE	SCH
ENERGY RECOVERY VENTILATOR	ERV
FAN COIL	FC
FLUID COOLER	FCL
HEAT RECOVER SYSTEM	HRS
HEAT RECOVER WHEEL	HRWHEEL
SUPPLY WATER RESET HIGH	SWRESETHI
SUPPLY WATER RESET LO	SWRESETLO
LOOP DIFFERNTIAL PRESSURE	LOOPDP
FIRE OVERIDE	FIROVRD
FIRING	FIRE
LEAD BOILER	LEADBLR
VALVE OVERRIDE	VLVOVRD
PUMP LOCK	PMPLCK
SUPPLY WATER TEMPERATURE	SWT
RETURN WATER TEMPERATURE	RWT
LOOP SUPPLY TEMPERTAUTRE	LOOP_SPT
HEAT EXCHANGER TEMPERATURE	HXT
HEADER	HEADER
SUCTION TEMP	SUCT
LEAVING WATER TEMP	LWT
CONTROL	CNTRL
PUSH BUTTON OVERRIDE	PBOVRD
OVERRIDE TIME	OVRDT
MIXING VALVE	MIXINGVLV
CYCLE COUNT	CYCLECOUNT
HIGH LIGHT LEVEL DELAY	HILTGLVLDELAY
LOW LIGHT LEVEL DELAY	LOLTGLVLDELAY
LEVEL	LVL

SENSORS	
AIR FLOW	AFLOW
AVERAGE	AVG
COMMON	COM
COMMUNICATION	COMM
DIFFERENCE	DIFF
DIFFERENTIAL PRESSURE	DP
DISCHARGE	DIS
DISCHARGE PRESSURE	DISPRS
EFFECTIVE	EFF
EXHAUST	EXH
EXTERIOR	EXT
FIRE STAT	FIRZ
FLOW	FLOW
FREEZE STAT	FRZ
HIGH DISCHARGE PRESSURE	HIDISPRS
HIGH	HI
INFRARED	IR
INTERIOR	INT
LOW	LO
MIXED AIR TEMPERATURE	MAT
OIL TEMP	OILT
OUTDOOR AIR TEMPERATURE	OAT
RETURN AIR HUMIDITY	RAH
RETURN AIR STATIC PRESSURE	RASP
RETURN AIR TEMPERATURE	RAT
ROOM TEMPERATURE	RMT
STATIC PRESSURE	STATICPRS
SUCTION	SUC
SUCTION PRESSURE	SUCPRS
SUPPLY AIR HUMIDITY	SAH
SUPPLY AIR STATIC PRESSURE	SASPRS
SUPPLY AIR TEMPERATURE	SAT
UNDERFLOOR	UNDERFLR
GLYCOL SUPPLY TEMP	GLST
GLYCOL RETURN TEMP	GLRT
ICE TEMPERATURE	ICET
AVERAGE SURFACE TEMPERATURE	AVGSRFT
AVERAGE TEMPERATURE	AVGT
EXHAUST AIR TEMPERATURE	EAT
ROOM HUMIDITY	RMH
RETURN AIR CO2	RACO2
OUTDOOR AIR DEWPOINT	OADEWP
SUPPLY WATER TEMPERATURE	SWT
RETURN WATER TEMPERATURE	RWT
WATER TEMPERATURE	WT
HEAT EXCHANGE SUPPLY WATER TEMPERATURE	HXSWT
RETURN WATER PRESSURE	RWPRS

ACTION/FEEDBACK	
STATUS	STS
LEVEL	LVL
COMMAND	CMD
RELATIVE HUMIDITY	RH
PRESSURE	PRS
SET POINT	SPT
FEEDBACK	FBK
ALARM	ALM
FLOW	FLOW
TEMPERATURE	T
MODULATE	MOD
COMMUNICATION PROTOCAL	VP

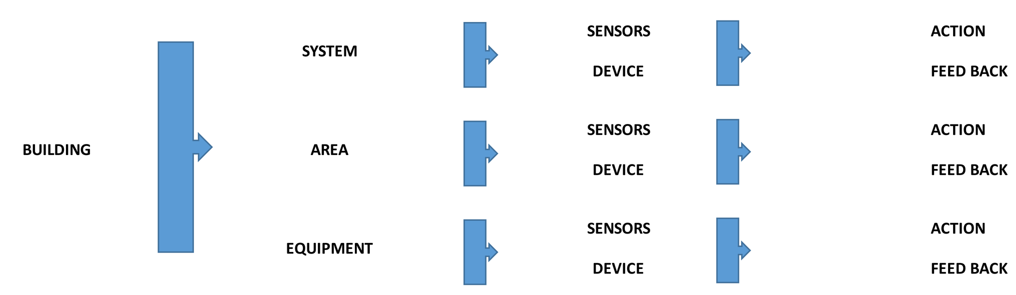
MODE	
VENTING MODE	VMODE
PURGING MODE	PMODE
COOLING MODE	CLGMODE
HEATING MODE	HTGMODE
DEHUMIDIFICATION MODE	DHMODE
FREE COOLING	FREECLG
IDLE	IDLE
COOLING	CLG
ENABLE	ENABLE
ACTIVE	ACTIVE
UNLOAD	UNLOAD
LOAD	LOAD
STATUS	STS
LEVEL	LVL
SET POINT	SPT
COMMAND	CMD
ALARM	ALM
MODULATE	MOD

ALARM	
AMONIA LEAK ALARM	NH3_ALM
COMMON	COM
DIFFERENCE	DIFF
DISCHARGE	DIS
DISCHARGE PRESSURE	DISPRS
EFFECTIVE	EFF
HIGH DISCHARGE PRESSURE	HIDISPRS
HIGH LIMIT SHUT DOWN ALARM	HILIMIT_ALM
HIGH	HI
HIGH OIL TEMP	HIOIL
HIGH PRESSURE	HIPRS
LOW	LO
LOW OIL PRESSURE	LOOILPRS
LOW PRESSURE	LOPRS
OIL TEMP	OILT
STOP ALARM	STOP_ALM
SUCTION	SUC
SUCTION PRESSURE	SUCPRS
BEACON	BEACON
HIGH LOAD SHUTDOWN ALARM	HILOADSHUT_ALM
REACTIVATION FAN ALARM	REACTF_ALM
PROCESS FAN ALARM	PROCESSF_ALM
RETURN FAN ALARM	RF_ALM
BURNER ALARM	BUR_ALM
HIGH SUCTION PRESSURE	HISUCPRS
HIGH OIL TEMPERATURE	HIOILT
HIGH DISCHARGE TEMPERATURE	HIDIST
GENERAL	GENERAL
HIGH TEMPERATURE ALARM	HIT_ALM
AIR FLOW	AFLOW
UNIT OFF	UNITOFF_ALM
SUPPLY FAN FAULT	SFFAULT_ALM
REACTIVATION FAN FAULT	RFANFAULT_ALM
DESICANT WHEEL FAULT	DWHEELFAULT_ALM
SUPPLY AIR TEMPERATURE LOW LIMIT	SATLO
LOW ROOM TEMPERATURE	LORMT

SETPOINT	
COOLING	CLG
INFARED CONTROL	INFAREDCNTL
OCCUPIED DEWPOINT	OCCDEW
UNOCCUPIED DEWPOINT	UNOCCDEW
CARBON DIOXIDE	CO2
CARBON MONOXIDE	CO
OCCUPIED PROCESS FAN SPEED	OCCPROCESSF
UNOCCUPIED PROCESS FAN SPEED	UNOCCPROCESSF
MIXED AIR TEMPERATURE	MAT
HEATING	HTG
RELATIVE HUMIDITY	RH
COOLING EFFECTIVE	CLGEFF
HEATING EFFECTIVE	HTGEFF
OCCUPIED COOLING	OCCCLG
UNOCCUPIED COOLING	UNOCCCLG
OCCUPIED HEATING	OCCHTG
UNOCCUPIED HEATING	UNOCCHTG
DEWPOINT OCCUPIED	DEWOCC
DEWPOINT UNOCCUPIED	DEWUNOCC
EFFECTIVE	EFF
DAMPER MAXIMUM POSITION	DPRMAX
DAMPER MINIMUM POSITION	DPRMIN
ROOM TEMPERATURE	RMT
NITROGEN DIOXIDE	NO2
LOCAL SETPOINT	LOCALSPT
HEATING DAY	HTGDAY
HEATING NIGHT	HTGNIGHT
COOLING DAY	CLGDAY
COOLING NIGHT	CLGNIGHT
OUTDOOR TEMP SET POINT	OAT_SPT
CONTROL TEMP SET POINT	CNTRL_SPT
HEATING SET POINT	HTG_SPT
OCCUPIED	OCC
UNOCCUPIED	UNOCC
LIGHTING OCCUPIED	LTGOCC
LIGHTING UNOCCUPIED	LTGUNOCC

COMMUNICATION	
COMMUNICATION	COMM
BAC NET	BAC
LON	LON
MOD BUS	MODBUS

INTERIOR	INT
UV Light	UVLTG
MOTION	MOTION
PHOTOCELL	PHOTOCELL
TIMER	TMR
LIGHT LEVEL	LTGLVL
HIGH LIGHT LEVEL	HILTGLVL
LOW LIGHT LEVEL	LOLTGLVL
# LIGHT LEVEL	LTG#
LIGHT CYCLE	LTGCYCLE
EXTERIOR	EXT
MAXIMUM CYCLE	MAXCYCLE
DRAIN OVERRIDE	DRAINOVRD
CHLORINE	CHLORINE
CHLORINE LEVEL	CHLORINELVL
HEAT EXCHANGE SUPPLY WATER TEMPERATURE	HXSWT
PUMP CONTROLLER	PMPCONTROLLER
LEAD PUMP OVERIDE	LEADPMPOVRD
CHLORINE PUMP	CHLORINEPMP
BOILER	BLR
HOT WATER RETURN TEMPERATURE	HWRT
FLOW	FLOW
WATER	WTR
RECIRCULATING PUMP	RPMP
LAG PUMP	LAGPMP
RETURN WATER PRESSURE	RWPRS
HEAT RECOVERY	HR
OCCUPANCY SENSOR	OCCSENSOR



SYSTEM	
AIR COMPRESSOR	ACMP
AIR COOLED CONDENSER	CND
COOLING SYSTEM	CLG
COOLING TOWER	CT
EVAPORATOR CONDENSER	ECND
CHILLER	CHLR
ICE PLANT	ICEP
REFRIGERATION PLANT	REFPLANT
ICE PLANT DEHUMIDIFICATION UNIT	ICEDH

AREA	
ICE RESURFACING	ICER
ICE MELT	ICEMELT
PITT	PITT
ZONE	ZN
PERIMETER	PERIMETER
RINK	RNK
UNDERFLOOR	UNDERFLR
ICE	ICE
SLAB	SLAB
ZAMBONI	ZAMBONI
ARENA	ARENA

EQUIPMENT	
GLYCOL	GL
ICE PLANT COMPRESSOR	CMPR
COLD BRINE	CB
BRINE	B
ICE PLANT DEHUMIDIFICATION UNIT	ICEDH
COOLING TOWER	CT
CONDENSER	CND

DEVICES	
ALARM	ALM
BRINE SYSTEM	BS
COLD BRINE	CB
COMMON	COM
COMPRESSOR	CMP
COMPRESSOR JACKET PUMP	CJPMP
DIFFERENCE	DIFF
DISCHARGE	DIS
DISCHARGE PRESSURE	DISPRS
EFFECTIVE	EFF
FAN	FAN
GENERAL	GENERAL
GLYCOL	GL
HEAT EXCHANGER	HX
HEATING PUMP	HTGPMP
HIGH DISCHARGE PRESSURE	HIDISPRS
HIGH	HI
ICE PLANT COMPRESSOR	CMPR
INFARED SENSOR	INFAREDSENSOR
LAG	LAG
LEAD	LEAD
LOW	LO
MAIN	MAIN
OIL TEMP	OILT
PUMP	PMP
RADIATOR	RAD
RINK	RNK
SENSORS	SENSOR
SET POINT	SPT
SUCTION	SUC
SUCTION PRESSURE	SUCPRS
TEMPERATURE	T
UNIT HEATER	UH
VALVE	VLV
VARIABLE AIR VOLUME	VAV
VFD	VFD
VVT	VVT
DRAIN VALVE	DRVLV
VALVE OPEN	VLVOP
VALVE CLOSED	VLVCL
DRAIN	DRAIN
EVAPORATOR CONDENSING VALVE	ECNDVLV
HEAT EXCHANGER VALVE	HXVLV
HOT WATER VLAVE	HWVLV
END SWITCH	ES
EXHAUST FAN	EF
FAN FAST	FANFAST
FAN SLOW	FANSLOW
RETURN FAN	RF
SPEED	SPD
SPRAY /WATER PUMP	#N/A
SUPPLY FAN	SF
CEILING FAN	CFAN
OPERATION MODE	OPMODE
CYCLE ON TIME PERIOD	CYCLEON
CYCLE OFF TIME PERIOD	CYCLEOFF
FAN VFD	FANVFD
COOLING PUMP	CLGPMP
CONDENSER WATER PUMP	CNDWTRPMP
CONDENSATE PUMP	CONPMP
GLYCOL PUMP	GLPMP
SPRAY PUMP	SPRAYPMP
LEAD PUMP	LEADPMP
RECIRC PUMP	RPMP
OVERLOAD	OVERLOAD
VOLT	VOLT
CURRENT	CRNT
FREQUENCY	FREQ
HAND AUTO MODE	AUTOMODE
TORQUE	TORQ
KWH	KHW
BRINE PUMP	BPMP
WARM /HOT BRINE	WB
SETTING	SETTING
BRINE RETURN TEMP	BRT
BRINE SUPPLY TEMP	BST
COLD BRINE RETURN TEMP	CBRT
COLD BRINE SUPPLY TEMP	CBST
COMPRESSOR FAIL	CMPRFAIL
COMPRESSOR STAGE	CMPRSTAGE
DISCHARGE TEMPERATURE	DIST
COMPRSSOR SLIDE VLV	CMPRSLIDEVLV
COMPRESSOR RUN FAILED	CMPRUNFAIL
COMPRESSOR AMPS	CMPRAMP
COMPRESSOR RUNTIME	CMPRRUN
BRINE PUMP	BPMP
WARM /HOT BRINE	WB
COLD BRINE PUMP	CBPMP
WARM BRINE PUMP	WBPMP
COMMON COLD BRINE	COMCB
BRINE	B
INFRARED	IR
WATER PUMP	WPMP
CONDENSER FAN	CNDFAN
CONDENSER FAN VFD	CNDFANVFD
CONDENSER FAN RUNTIME	CNDFANRUN
HIGH SPEED	HISPEED
LOW SPEED	LOSPEED
COLD BRINE PUMP	CBPMP
WARM BRINE PUMP	WBPMP
SUMP PUMP	SUMPPMP
CONDENSER STAGE	CNDSTG
CONDENSER VALVE	CNDVLV
CONDENSER TANK	CNDTANK
CONTROL SCHEDULE	CNTRLSCH
RESET STAGE CONTROL	RESETSTGCNTRL
STAGE CONTROL	STGCNTRL
REACTIVATION FAN	REACTF
PROCESS FAN	PROCESSF
OUTDOOR AIR DAMPER	OAD
EVAPORATOR CONDENSER	ECND
EVAPORATOR CONDENSER PUMP	ECNDPMP
MINIMUM CYCLE TIME	MINCYCLETIME
CONDENSER PUMP	CNDPMP

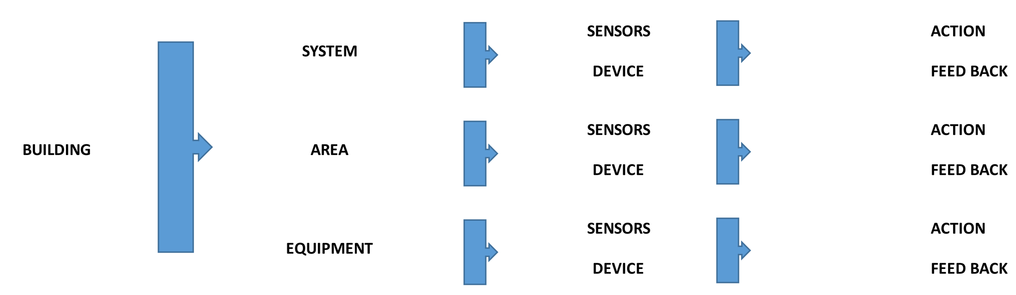
SENSORS	
DIFFERENTIAL PRESSURE	DP
MIXED AIR TEMPERATURE	MAT
SUPPLY AIR TEMPERATURE	SAT
RETURN AIR TEMPERATURE	RAT
OUTDOOR AIR TEMPERATURE	OAT
ROOM TEMPERATURE	RMT
RETURN AIR HUMIDITY	RAH
SUPPLY AIR HUMIDITY	SAH
RETURN AIR STATIC PRESSURE	RASP
SUPPLY AIR STATIC PRESSURE	SASPRS
STATIC PRESSURE	STATICPRS
FREEZE STAT	FRZ
GLYCOL SUPPLY TEMP	GLST
GLYCOL RETURN TEMP	GLRT
ICE TEMPERATURE	ICET
AVERAGE SURFACE TEMPERATURE	AVGSRFT
AVERAGE TEMPERATURE	AVGT

ACTION/FEEDBACK	
STATUS	STS
LEVEL	LVL
COMMAND	CMD
RELATIVE HUMIDITY	RH
PRESSURE	PRS
SET POINT	SPT
FEEDBACK	FBK
ALARM	ALM
FLOW	FLOW
TEMPERATURE	T
MODULATE	MOD
COMMUNICATION PROTOCAL	VP

MODE	
VENTING MODE	VMODE
PURGING MODE	PMODE
COOLING MODE	CLGMODE
HEATING MODE	HTGMODE
DEHUMIDIFICATION MODE	DHMODE
FREE COOLING	FREECLG
UNLOAD	UNLOAD
LOAD	LOAD
ENABLE	ENABLE
ACTIVE	ACTIVE

ALARM	
AMONIA LEAK ALARM	NH3_ALM
HIGH LIMIT SHUT DOWN ALARM	HILIMIT_ALM
STOP ALARM	STOP_ALM
BEACON	BEACON
HIGH LOAD SHUTDOWN ALARM	HILOADSHUT_ALM
REACTIVATION FAN ALARM	REACTF_ALM
PROCESS FAN ALARM	PROCESSF_ALM
RETURN FAN ALARM	RF_ALM
BURNER ALARM	BUR_ALM
HIGH SUCTION PRESSURE	HISUCPRS
LOW OIL PRESSURE	LOOILPRS
HIGH OIL TEMPERATURE	HIOILT
HIGH DISCHARGE TEMPERATURE	HIDIST
COMMON	COM
GENERAL	GENERAL

SETPOINT	
COOLING	CLG
INFARED CONTROL	INFAREDCNTL
OCCUPIED DEWPOINT	OCCDEW
UNOCCUPIED DEWPOINT	UNOCCDEW
CARBON DIOXIDE	CO2
CARBON MONOXIDE	CO
OCCUPIED PROCESS FAN SPEED	OCCPROCESSF
UNOCCUPIED PROCESS FAN SPEED	UNOCCPROCESSF



SYSTEM	
HVAC	HVAC

AREA	
ADMIN	ADMIN
AEROBICS	AEROBICS
ART GALLERY	ART GALLERY
ATRIUM	ATRIUM
BACK	BACK
BACK STAGE	BACKSTAGE
BANQUET	BANQUET
BASKETBALL	BSKTBALL
BILLIARDS	BILLIARDS
BOXING	BOXING
BUILDING	BLDG
CHANGE ROOM	CHNGRM
CIRCLE DESK	CIRCLEDESK
COIN ROOM	COINRM
COMMUNITY	COMMUNITY
CORRIDOR	CORRIDOR
COUNCIL	COUNCIL
COURTROOM	COURTRM
CRAFT	CRAFT
DINING ROOM	DININGRM
DRESSING RM	DRESSINGRM
EAST	EAST
ELECTRICAL ROOM	ELECRM
FACILITY	FACILITY
FAMILY CHANGE ROOM	FAMCHNGRM
FILE ROOM	FILERM
FIRST AID ROOM	1STAIDRM
FITNESS	FITNESS
FLOOR	FLR
FPM	FPM
FRONT	FRONT
GALLERIA	GALLERIA
GARDEN	GARDEN
GLASS BLOWING	GLASSBLOW
GROUND	GRND
GYM	GYM
GYMNASTIC	GYMNASTIC
HALL	HALL
INTERVIEW ROOM	INTERVIEWRM
JANITOR CLOSET	JANITORCLOSET
KITCHEN	KITCHEN
LAP	LAP
LEISURE	LEISURE
LIBRARY	LIBRARYLIBRARY
LOBBY	LOBBY
LUNCH ROOM	LUNCHRM
MAINTENANCE	MAINTENANCE
MECHANICAL ROOM	MECHRM
MEETING ROOM	MEETRM
MEN CHANGE ROOM	MENCHNGRM
MULTIPURPOSE ROOM	MULTIPURPOSE
NORTH	NORTH
OFFICE	OFFICE
OIL INTERCEPTOR	OILINTERCEPTOR
OPERATION	OPERATION
PARK	PARK
PARKING	PARKING
PERIMETER	PERIMETER
POOL	POOL
POOL OFFICE	POOLOFFICE
PROGRAM ROOM	PRORM
PROSHOP	PROSHOP
QUIET ROOM	QUIETRM
RECEPTION	RECEPTION
RINK	RNK
ROOM	RM
SECURITY	SECURITY
SENIOR	SENIOR
SNACK BAR	SNACKBAR
SOCCER	SOCCER
SOUTH	SOUTH
SQUASH	SQUASH
STAGING	STAGING
STAIR	STAIR
STORAGE	STORAGE
THEATER	THEATER
TICKET BOOTH	TICKETBOOTH
VESTIBULE	VESTIBULE
VISUAL ART	VISUALART
WASHROOM	WASHRM
WEIGHT ROOM	WEIGHTRM
WEST	WEST
WOMEN CHANGE ROOM	WOMENCHGRM
WORK ROOM	WORKRM
ZONE	ZN

EQUIPMENT	
AIR HANDLING UNIT	AHU
ROOFTOP UNIT	RTU
POOL DEHUMIDIFICATION UNIT	POOLDH
HEAT PUMP	HP
MAKE UP AIR UNIT	MUA
UNIT HEATER	UH
ENTRANCE HEATER	HAC
PERIMETER HEATER	PHTGL
ELECTRIC UNIT HEATER	EUH
FORCE FLOW HEATER	FFH
AIR CURTAIN	ACURT
BASEBOARD HEATER	BBH
HEAT RECOVERY UNIT	HRU
DEHUMIDIFIER	DHU
HUMIDIFIER	HUM

DEVICES	
ALARM	ALM
COMMON	COM
DIFFERENCE	DIFF
EFFECTIVE	EFF
GENERAL	GENERAL
VARIABLE AIR VOLUME	VAV
SUPPLY AIR TEMPERATURE	SAT
FREE COOLING	FREECLG
RETURN AIR TEMPERATURE	RAT
CARBON DIOXIDE	CO2
CO2 LEVEL	CO2LVL
RETURN AIR CO2	RACO2
RETURN AIR HUMIDITY	RAH
SUPPLY AIR HUMIDITY	SAH
COOLING OVERIDE	CLGOVRD
HEAT RECOVERY WHEEL	HRW
HEAT RECOVERY WHEEL OVERIDE	HRWOVRD
HEATING STAGE	HTGSTG
COOLING STAGE	CLGSTG
LOCAL SETPOINT	LOCALSPT
ROOM HUMIDITY	RMH
HUMIDIFIER	HUM
DEHUMIDIFIER	DHU
DEWPOINT	DEWP
DEWPOINT TEMPERATURE	DEWT
MIXED AIR HUMIDITY	MAH
ROOM TEMPERATURE	RMT
SYSTEM MODE	SYSMODE
ENABLE	ENABLE
OCCUAPNCY	OCC
NATURAL GAS	NG
COMPRESSOR	CMP
COOLING DAY	CLGDAY
COOLING NIGHT	CLGNIGHT
HEATING DAY	HTGDAY
HEATING NIGHT	HTGNIGHT
DESICANT WHEEL	DWHEEL
HEATING VALVE	HTGVLV
COOLING VALVE	CLGVLV
REVERSING VALVE	REVLV
DAMPER	DPR
MAXIMUM POSITION	MAXPOS
MINIMUM POSITION	MINPOS
MIXED AIR DAMPER	MAD
OUTDOOR AIR DAMPER	OAD
OUTDOOR AIR DAMPER MINIUM POSITION	OADMIN
MIXED AIR DAMPER OVERIDE	MADOVRD
SUPPLY FAN	SF
RETURN FAN	RF
FAN	FAN
FAN OPERATION	FANOP
FAN OFF CYCLE	FANOFFCYCLE
FAN OFF CYCLE DELAY	FANOFFCYCLEDELAY
SUPPLY FAN OVERIDE	SFOVRD
VFD	VFD
VFD OCCUPIED SPEED	VFDOCCSPD
VFD UNOCCUPIED SPEED	VFDUNOCCSPD
SUPPLY FAN MODULATION	SFMOD
FAN MODE	FANMODE
EXHAUST FAN	EF
LOW	LO
HIGH	HI
REACTIVATION FAN	REACTF
EXHAUST FAN	EF
HEAT PIPE	HEATEPIPE
PRE HEAT	PREHEAT
HEAT RECOVERY VENTILATOR	HRV
MIXED AIR DAMPER	MAD
EFFECTIVE HEATING	EFFHTG
EFFECTIVE COOLING	EFFCLG
COIL	COIL
OVERRIDE	OVRD
CONTROLLER	CONTROLLER
FAN OPERATION	FANOP
FAN OFF CYCLE	FANOFFCYCLE
FAN OFF CYCLE DELAY	FANOFFCYCLEDELAY
DEWPOINT HIGH LIMIT	DEWHILIMIT
OCCUPANCY OVERIDE TIME LIMIT	OCCOVRDTME
MIXED AIR DAMPER MINIMUM	MADPRMIN
MIXED AIR DAMPER MAXIMUM	MADPRMAX
SUMMER	SUMMER
SHOULDER	SHOULDER
WINTER	WINTER
PUSH BUTTON OCCUPANCY	PBOCC
OUTDOOR AIR DAMPER MINIUM POSITION	OADMIN
SCHEDULE	SCH

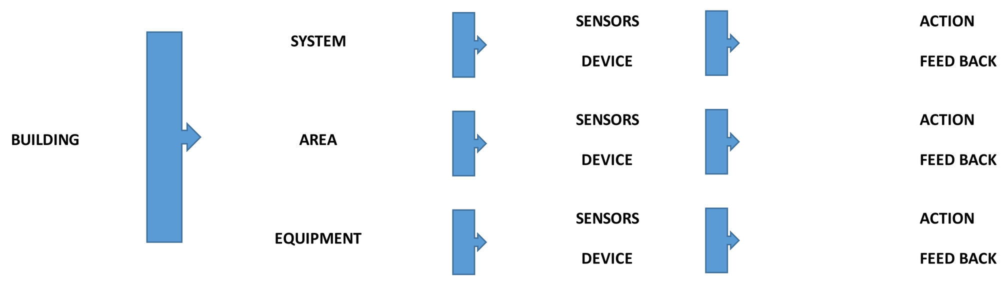
SENSORS	
DIFFERENTIAL PRESSURE	DP
MIXED AIR TEMPERATURE	MAT
SUPPLY AIR TEMPERATURE	SAT
RETURN AIR TEMPERATURE	RAT
OUTDOOR AIR TEMPERATURE	OAT
ROOM TEMPERATURE	RMT
RETURN AIR HUMIDITY	RAH
SUPPLY AIR HUMIDITY	SAH
RETURN AIR STATIC PRESSURE	RASP
SUPPLY AIR STATIC PRESSURE	SASPRS
STATIC PRESSURE	STATICPRS
EXHAUST AIR TEMPERATURE	EAT
ROOM HUMIDITY	RMH
RETURN AIR CO2	RACO2
OUTDOOR AIR DEWPOINT	OADEWP

ACTION/FEEDBACK	
STATUS	STS
LEVEL	LVL
COMMAND	CMD
RELATIVE HUMIDITY	RH
PRESSURE	PRS
SET POINT	SPT
FEEDBACK	FBK
ALARM	ALM
FLOW	FLOW
TEMPERATURE	T
MODULATE	MOD
COMMUNICATION PROTOCAL	VP

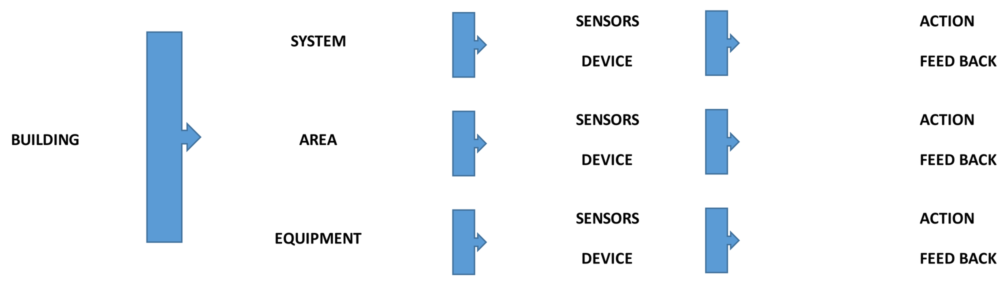
MODE	
VENTING MODE	VMODE
PURGING MODE	PMODE
COOLING MODE	CLGMODE
HEATING MODE	HTGMODE
DEHUMIDIFICATION MODE	DHMODE
FREE COOLING	FREECLG
ENABLE	ENABLE
ACTIVE	ACTIVE

ALARM	
HIGH TEMPERATURE ALARM	HIT_ALM
GENERAL	GENERAL
AIR FLOW	AFLOW
UNIT OFF	UNITOFF_ALM
SUPPLY FAN FAULT	SFFAULT_ALM
REACTIVATION FAN FAULT	RFANFAULT_ALM
DESICANT WHEEL FAULT	DWHEELFAULT_ALM
SUPPLY AIR TEMPERATURE LOW L	SATLO
LOW ROOM TEMPERATURE	LORMT

SETPOINT	
COOLING	CLG
MIXED AIR TEMPERATURE	MAT
HEATING	HTG
RELATIVE HUMIDITY	RH
COOLING EFFECTIVE	CLGEFF
HEATING EFFECTIVE	HTGEFF
OCCUPIED COOLING	OCCCLG
UNOCCUPIED COOLING	UNOCCCLG
OCCUPIED HEATING	OCCHTG
UNOCCUPIED HEATING	UNOCCHTG
DEWPOINT OCCUPIED	DEWOCC
DEWPOINT UNOCCUPIED	DEWUNOCC
EFFECTIVE	EFF
DAMPER MAXIMUM POSITION	DPRMAX
DAMPER MINIMUM POSITION	DPRMIN
ROOM TEMPERATURE	RMT
CARBON MONOXIDE	CO
NITROGEN DIOXIDE	NO2
LOCAL SETPOINT	LOCALSPT
HEATING DAY	HTGDAY
HEATING NIGHT	HTGNIGHT
COOLING DAY	CLGDAY
COOLING NIGHT	CLGNIGHT

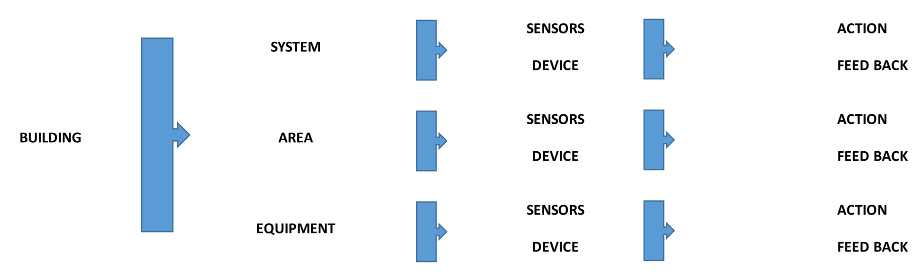


SYSTEM		AREA		EQUIPMENT		DEVICES		SENSORS		ACTION/FEEDBACK		MODE		ALARM		SETPOINT	
COOLING SYSTEM	CLG	BUILDING	BLDG	CHILLER	CHLR	ALARM	ALM	OUTDOOR AIR TEMPERATURE	OAT	STATUS	STS	UNLOAD	UNLOAD	HIGH TEMPERATURE ALARM	HIT_ALM	OUTDOOR TEMP SET POINT	OAT_SPT
		PERIMETER	PERIMETER	COOLING TOWER	CT	COMMON	COM	ROOM TEMPERATURE	RMT	LEVEL	LVL	LOAD	LOAD			CONTROL TEMP SET POINT	CNTRL_SPT
		ZONE	ZN	AIR COOLED CONDENSER	CND	DIFFERENCE	DIFF	SUPPLY WATER TEMPERATURE	SWT	COMMAND	CMD	ENABLE	ENABLE			HEATING SET POINT	HTG_SPT
				EVAPORATOR CONDENSER	ECND	EFFECTIVE	EFF	RETURN WATER TEMPERATURE	RWT	RELATIVE HUMIDITY	RH	ACTIVE	ACTIVE			OCCUPIED	OCC
						GENERAL	GENERAL			PRESSURE	PRS					UNOCCUPIED	UNOCC
										SET POINT	SPT						
										FEEDBACK	FBK						
										ALARM	ALM						
										FLOW	FLOW						
										TEMPERATURE	T						
										MODULATE	MOD						
										COMMUNICATION PROTOCAL	VP						



SYSTEM		AREA		EQUIPMENT	
LIGHTING	LTG	ADMIN	ADMIN	LIGHTING	LTG
		AEROBICS	AEROBICS		
		ART GALLERY	ART GALLERY		
		ATRIUM	ATRIUM		
		BACK	BACK		
		BACK STAGE	BACKSTAGE		
		BANQUET	BANQUET		
		BASKETBALL	BSKTBALL		
		BILLIARDS	BILLIARDS		
		BOXING	BOXING		
		BUILDING	BLDG		
		CHANGE ROOM	CHNGRM		
		CIRCLE DESK	CIRCLEDESK		
		COIN ROOM	COINRM		
		COMMUNITY	COMMUNITY		
		CORRIDOR	CORRIDOR		
		COUNCIL	COUNCIL		
		COURTROOM	COURTRM		
		CRAFT	CRAFT		
		DINING ROOM	DININGRM		
		DRESSING RM	DRESSINGRM		
		EAST	EAST		
		ELECTRICAL ROOM	ELECRM		
		FACILITY	FACILITY		
		FAMILY CHANGE ROOM	FAMCHNGRM		
		FILE ROOM	FILERM		
		FIRST AID ROOM	1STAIDRM		
		FITNESS	FITNESS		
		FLOOR	FLR		
		FPM	FPM		
		FRONT	FRONT		
		GALLERIA	GALLERIA		
		GARDEN	GARDEN		
		GLASS BLOWING	GLASSBLOW		
		GROUND	GRND		
		GYM	GYM		
		GYMNASTIC	GYMNASTIC		
		HALL	HALL		
		INTERVIEW ROOM	INTERVIEWRM		
		JANITOR CLOSET	JANITORCLOSET		
		KITCHEN	KITCHEN		
		LAP	LAP		
		LEISURE	LEISURE		
		LIBRARY	LIBRARYLIBRARY		
		LOBBY	LOBBY		
		LUNCH ROOM	LUNCHRM		
		MAINTENANCE	MAINTENANCE		
		MECHANICAL ROOM	MECHRM		
		MEETING ROOM	MEETRM		
		MEN CHANGE ROOM	MENCHNGRM		
		MULTIPURPOSE ROOM	MULTIPURPOSE		
		NORTH	NORTH		
		OFFICE	OFFICE		
		OIL INTERCEPTOR	OILINTERCEPTOR		
		OPERATION	OPERATION		
		PARK	PARK		
		PARKING	PARKING		
		PERIMETER	PERIMETER		
		POOL	POOL		
		POOL OFFICE	POOLOFFICE		
		PROGRAM ROOM	PRORM		
		PROSHOP	PROSHOP		
		QUIET ROOM	QUIETRM		
		RECEPTION	RECEPTION		
		RINK	RNK		
		ROOM	RM		
		SECURITY	SECURITY		
		SENIOR	SENIOR		
		SNACK BAR	SNACKBAR		
		SOCCER	SOCCER		
		SOUTH	SOUTH		
		SQUASH	SQUASH		
		STAGING	STAGING		
		STAIR	STAIR		
		STORAGE	STORAGE		
		THEATER	THEATER		
		TICKET BOOTH	TICKETBOOTH		
		VESTIBULE	VESTIBULE		
		VISUAL ART	VISUALART		
		WASHROOM	WASHRM		
		WEIGHT ROOM	WEIGHTRM		
		WEST	WEST		
		WOMEN CHANGE ROOM	WOMENCHGRM		
		WORK ROOM	WORKRM		
		ZONE	ZN		

DEVICES		SENSORS		ACTION/FEEDBACK		MODE		ALARM		SETPOINT	
ALARM	ALM	OCCUPANCY SENSOR	OCCSENSOR	STATUS	STS	ENABLE	ENABLE	GENERAL	GENERAL	LIGHTING OCCUPIED	LTGOCC
COMMON	COM	INFARED SENSOR	INFAREDSENSOR	LEVEL	LVL	ACTIVE	ACTIVE	UNIT OFF	UNITOFF_ALM	LIGHTING UNOCCUPIED	LTGUNOCC
GENERAL	GENERAL	DAYLIGHT	DAYLTG	SET POINT	SPT					OCCUPIED	OCC
CYCLE COUNT	CYCLECOUNT	MOTION	MOTION	COMMAND	CMD					UNOCCUPIED	UNOCC
HIGH LIGHT LEVEL DELAY	HILTGLVLDELAY			ALARM	ALM						
LOW LIGHT LEVEL DELAY	LOLTGLVLDELAY			MODULATE	MOD						
LEVEL	LVL			COMMUNICATION PROTOCAL	VP						
INTERIOR	INT										
UV Light	UVLTG										
PHOTOCELL	PHOTOCELL										
TIMER	TMR										
LIGHT LEVEL	LTGLVL										
HIGH LIGHT LEVEL	HILTGLVL										
LOW LIGHT LEVEL	LOLTGLVL										
# LIGHT LEVEL	LTG#										
LIGHT CYCLE	LTGCYCLE										
EXTERIOR	EXT										
MAXIMUM CYCLE	MAXCYCLE										
EXTERIOR	EXT										
INTERIOR	INT										
DAYLIGHT CONTROLS	DAYLTGCNTL										



SYSTEM	
POOL	POOL

AREA	
ZONE	ZN
LAP POOL	LAP POOL
LEISURE POOL	LEISURE POOL
CHANGE ROOM	CHNGRM
MEN CHANGE ROOM	MENCHNGRM
WOMEN CHANGE ROOM	WOMENCHGRM

EQUIPMENT	
POOL DEHUMIDIFICATION UNIT	POOLDH
BOILER	BLR

DEVICES	
ALARM	ALM
COMMON	COM
DIFFERENCE	DIFF
EFFECTIVE	EFF
GENERAL	GENERAL
VARIABLE AIR VOLUME	VAV
SUPPLY AIR TEMPERATURE	SAT
FREE COOLING	FREECLG
RETURN AIR TEMPERATURE	RAT
CARBON DIOXIDE	CO2
CO2 LEVEL	CO2LVL
RETURN AIR CO2	RACO2
RETURN AIR HUMIDITY	RAH
SUPPLY AIR HUMIDITY	SAH
COOLING OVERIDE	CLGOVRD
HEAT RECOVERY WHEEL	HRW
HEAT RECOVERY WHEEL OVERIDE	HRWOVRD
HEATING STAGE	HTGSTG
COOLING STAGE	CLGSTG
LOCAL SETPOINT	LOCALSPT
ROOM HUMIDITY	RMH
HUMIDIFIER	HUM
DEHUMIDIFIER	DHU
DEWPOINT	DEWP
DEWPOINT TEMPERATURE	DEWT
MIXED AIR HUMIDITY	MAH
ROOM TEMPERATURE	RMT
SYSTEM MODE	SYSMODE
ENABLE	ENABLE
OCCUAPNCY	OCC
NATURAL GAS	NG
COMPRESSOR	CMP
COOLING DAY	CLGDAY
COOLING NIGHT	CLGNIGHT
HEATING DAY	HTGDAY
HEATING NIGHT	HTGNIGHT
DESICANT WHEEL	DWHEEL
HEATING VALVE	HTGVLV
COOLING VALVE	CLGVLV
REVERSING VALVE	REVLV
DAMPER	DPR
MAXIMUM POSITION	MAXPOS
MINIMUM POSITION	MINPOS
MIXED AIR DAMPER	MAD
OUTDOOR AIR DAMPER	OAD
OUTDOOR AIR DAMPER MINIUM POSITION	OADMIN
MIXED AIR DAMPER OVERIDE	MADOVRD
SUPPLY FAN	SF
RETURN FAN	RF
FAN	FAN
FAN OPERATION	FANOP
FAN OFF CYCLE	FANOFFCYCLE
FAN OFF CYCLE DELAY	FANOFFCYCLEDELAY
SUPPLY FAN OVERIDE	SFOVRD
VFD	VFD
VFD OCCUPIED SPEED	VFDOCCSPD
VFD UNOCCUPIED SPEED	VFDUNOCCSPD
SUPPLY FAN MODULATION	SFMOD
FAN MODE	FANMODE
EXHAUST FAN	EF
LOW	LO
HIGH	HI
REACTIVATION FAN	REACTF
DRAIN	DRAIN
DRAIN OVERRIDE	DRAINOVRD
RETURN WATER TEMPERATURE	RWT
CHLORINE	CHLORINE
CHLORINE LEVEL	CHLORINELVL
HEAT EXCHANGE SUPPLY WATER TEMPERATURE	HXSWT
SUPPLY WATER TEMPERATURE	SWT
LEAD PUMP	LEADPMP
PUMP CONTROLLER	PMPCONTROLLER
LEAD PUMP OVERIDE	LEADPMPOVRD
CHLORINE PUMP	CHLORINEPMP

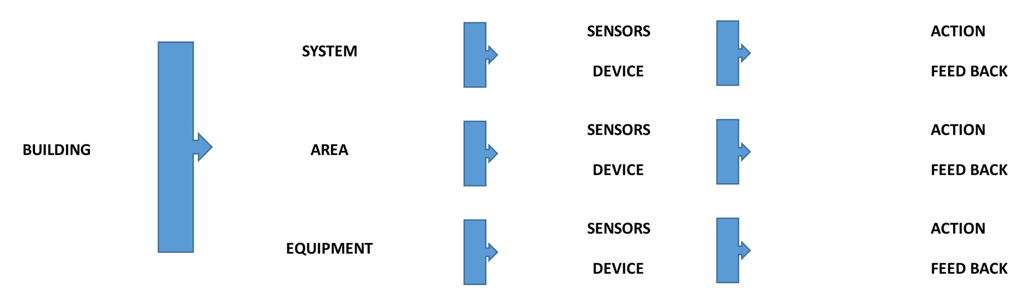
SENSORS	
DIFFERENTIAL PRESSURE	DP
MIXED AIR TEMPERATURE	MAT
SUPPLY AIR TEMPERATURE	SAT
RETURN AIR TEMPERATURE	RAT
OUTDOOR AIR TEMPERATURE	OAT
ROOM TEMPERATURE	RMT
RETURN AIR HUMIDITY	RAH
SUPPLY AIR HUMIDITY	SAH
RETURN AIR STATIC PRESSURE	RASP
SUPPLY AIR STATIC PRESSURE	SASPRS
STATIC PRESSURE	STATICPRS
RETURN WATER TEMPERATURE	RWT
SUPPLY WATER TEMPERATURE	SWT
HEAT EXCHANGE SUPPLY WATER TEMPERATURE	HXSWT

ACTION/FEEDBACK	
STATUS	STS
LEVEL	LVL
COMMAND	CMD
RELATIVE HUMIDITY	RH
PRESSURE	PRS
SET POINT	SPT
FEEDBACK	FBK
ALARM	ALM
FLOW	FLOW
TEMPERATURE	T
MODULATE	MOD
COMMUNICATION PROTOCAL	VP

MODE	
VENTING MODE	VMODE
PURGING MODE	PMODE
COOLING MODE	CLGMODE
HEATING MODE	HTGMODE
DEHUMIDIFICATION MODE	DHMODE
FREE COOLING	FREECLG
ENABLE	ENABLE
ACTIVE	ACTIVE
OCCUPIED	OCC

ALARM	
HIGH TEMPERATURE ALARM	HIT_ALM
GENERAL	GENERAL
AIR FLOW	AFLOW
UNIT OFF	UNITOFF_ALM
SUPPLY FAN FAULT	SFFAULT_ALM
REACTIVATION FAN FAULT	RFANFAULT_ALM
DESICANT WHEEL FAULT	DWHEELFAULT_ALM

SETPOINT	
COOLING	CLG
MIXED AIR TEMPERATURE	MAT
HEATING	HTG
RELATIVE HUMIDITY	RH
COOLING EFFECTIVE	CLGEFF
HEATING EFFECTIVE	HTGEFF
OCCUPIED COOLING	OCCCLG
UNOCCUPIED COOLING	UNOCCCLG
OCCUPIED HEATING	OCCHTG
UNOCCUPIED HEATING	UNOCCHTG
DEWPOINT OCCUPIED	DEWOCC
DEWPOINT UNOCCUPIED	DEWUNOCC
EFFECTIVE	EFF
DAMPER MAXIMUM POSITION	DPRMAX
DAMPER MINIMUM POSITION	DPRMIN
ROOM TEMPERATURE	RMT
CARBON MONOXIDE	CO
NITROGEN DIOXIDE	NO2



SYSTEM		AREA		EQUIPMENT		DEVICES		SENSORS		ACTION/FEEDBACK		MODE		ALARM		SETPOINT	
DOMESTIC HOT WATER	DHW	BUILDING	BLDG	TANK	TNK	ALARM	ALM	SUPPLY WATER TEMPERATURE	SWT	STATUS	STS	ENABLE	ENABLE	GENERAL	GENERAL	OCCUPIED	OCC
HOT WATER PLANT	HWP	PERIMETER	PERIMETER	BOILER	BLR	COMMON	COM	WATER TEMPERATURE	WT	LEVEL	LVL	ACTIVE	ACTIVE	UNIT OFF	UNITOFF_ALM	UNOCCUPIED	UNOCC
		ZONE	ZN			GENERAL	GENERAL	RETURN WATER PRESSURE	RWPRS	COMMAND	CMD						
						SUPPLY WATER TEMPERATURE	SWT	RETURN WATER TEMPERATURE	RWT	RELATIVE HUMIDITY	RH						
						BOILER	BLR	FLOW	FLOW	PRESSURE	PRS						
						HOT WATER RETURN TEMPERATURE	HWRT			SET POINT	SPT						
						FLOW	FLOW			FEEDBACK	FBK						
						LEAD	LEAD			ALARM	ALM						
						WATER	WTR			FLOW	FLOW						
						PUMP	PMP			TEMPERATURE	T						
						RECIRCULATING PUMP	RPMP			MODULATE	MOD						
						OVERRIDE	OVRD			COMMUNICATION PROTOCAL	VP						
						LEAD PUMP	LEADPMP										
						LAG PUMP	LAGPMP										
						HEAT EXCHANGER	HX										
						VALVE OVERRIDE	VLVOVRD										
						RETURN WATER PRESSURE	RWPRS										
						RETURN WATER TEMPERATURE	RWT										
						HEAT RECOVERY	HR										

Point	Name	Identifier
AIR COMPRESSOR	ACMP	S
AIR COOLED CONDENSER	CND	S
BRINE SYSTEM	BS	S
CHILLER	CHLR	S
COOLING SYSTEM	CLG	S
COOLING TOWER	CT	S
DOMESTIC HOT WATER	DHW	S
EVAPORATOR CONDENSER	ECND	S
FLUID COOLER	FCL	S
FUEL SYSTEM	FUEL	S
GAS DETECTION SYSTEM	GASD	S
GENERATOR	GEN	S
GREY WATER SYSTEM	GWS	S
HEATING SYSTEM	HTG	S
ICE PLANT	ICEP	S
LIGHTING	LTG	S
METER	MTR	S
POOL	POOL	S
RECLAIMED RAIN WATER SYSTEM	RRWS	S
SOLAR	SOLAR	S
ICE MELT	ICEMELT	S
REFRIGERATION PLANT	REFPLANT	S
SOLAR	SOLAR	S
ICE PLANT DEHUMIDIFICATION UNIT	ICEDH	S
HVAC	HVAC	S
ADMIN	ADMIN	A
AEROBICS	AEROBICS	A
ART GALLERY	ART GALLERY	A
ATRIUM	ATRIUM	A
BACK	BACK	A
BACK STAGE	BACKSTAGE	A
BANQUET	BANQUET	A
BASKETBALL	BSKTBALL	A
BILLIARDS	BILLIARDS	A
BOXING	BOXING	A
BUILDING	BLDG	A
CHANGE ROOM	CHNGRM	A
CIRCLE DESK	CIRCLEDESK	A
COIN ROOM	COINRM	A
COMMUNITY	COMMUNITY	A
CORRIDOR	CORRIDOR	A
COUNCIL	COUNCIL	A
COURTROOM	COURTRM	A
CRAFT	CRAFT	A
DINING ROOM	DININGRM	A
DRESSING RM	DRESSINGRM	A

EAST	EAST	A
ELECTRICAL ROOM	ELECRM	A
FACILITY	FACILITY	A
FAMILY CHANGE ROOM	FAMCHNGRM	A
FILE ROOM	FILERM	A
FIRST AID ROOM	1STAIDRM	A
FITNESS	FITNESS	A
FLOOR	FLR	A
FPM	FPM	A
FRONT	FRONT	A
GALLERIA	GALLERIA	A
GARDEN	GARDEN	A
GLASS BLOWING	GLASSBLOW	A
GROUND	GRND	A
GYM	GYM	A
GYMNASTIC	GYMNASTIC	A
HALL	HALL	A
INTERVIEW ROOM	INTERVIEWRM	A
JANITOR CLOSET	JANITORCLOSET	A
KITCHEN	KITCHEN	A
LAP	LAP	A
LEISURE	LEISURE	A
LIBRARY	LIBRARYLIBRARY	A
LOBBY	LOBBY	A
LUNCH ROOM	LUNCHRM	A
MAINTENANCE	MAINTENANCE	A
MECHANICAL ROOM	MECHRM	A
MEETING ROOM	MEETRM	A
MEN CHANGE ROOM	MENCHNGRM	A
NORTH	NORTH	A
OFFICE	OFFICE	A
OIL INTERCEPTOR	OILINTERCEPTOR	A
OPERATION	OPERATION	A
PARK	PARK	A
PARKING	PARKING	A
PERIMETER	PERIMETER	A
POOL	POOL	A
POOL OFFICE	POOLOFFICE	A
PROGRAM ROOM	PRORM	A
PROSHOP	PROSHOP	A
QUIET ROOM	QUIETRM	A
RECEPTION	RECEPTION	A
RINK	RNK	A
ROOM	RM	A
SECURITY	SECURITY	A
SENIOR	SENIOR	A
SNACK BAR	SNACKBAR	A

SOCCER	SOCCER	A
SOUTH	SOUTH	A
SQUASH	SQUASH	A
STAGING	STAGING	A
STAIR	STAIR	A
STORAGE	STORAGE	A
THEATER	THEATER	A
TICKET BOOTH	TICKETBOOTH	A
VESTIBULE	VESTIBULE	A
VISUAL ART	VISUALART	A
WASHROOM	WASHRM	A
WEIGHT ROOM	WEIGHTRM	A
WEST	WEST	A
WOMEN CHANGE ROOM	WOMENCHGRM	A
WORK ROOM	WORKRM	A
ZONE	ZN	A
LEAD	LEAD	A
LAG	LAG	A
ICE	ICE	A
MULTIPURPOSE ROOM	MULTIPURPOSE	A
ICE RESURFACING	ICER	A
ICE MELT	ICEMELT	A
PITT	PITT	A
UNDERFLOOR	UNDERFLR	A
SLAB	SLAB	A
ZAMBONI	ZAMBONI	A
ARENA	ARENA	A
LAP POOL	LAP POOL	A
LEISURE POOL	LEISURE POOL	A
AIR COMPRESSOR	ACMP	E
AIR CURTAIN	ACURT	E
AIR HANDLING UNIT	AHU	E
BOILER	BLR	E
CEILING FAN	CFAN	E
CHILLER	CHLR	E
COLD DECK	CLDDECK	E
DEHUMIDIFIER	DHU	E
DOMESTIC COLD WATER	DCW	E
DOMESTIC HOT WATER	DHW	E
ELECTRIC HEATER	EH	E
ELECVATOR SUMP PUMP	ESUMP	E
ELEVATOR	ELV	E
ENERGY RECOVERY VENTILATOR	ERV	E
EXHAUST FAN	EF	E
FAN COIL	FC	E
FLUID COOLER	FCL	E
FOUNTAIN	FOUNTAIN	E

FUEL SYSTEM	FUEL	E
GAS	GAS	E
GAS DETECTION SYSTEM	GASD	E
GAS METER	GASMTR	E
GREY WATER SYSTEM	GWS	E
HEAT PUMP	HP	E
HEAT RECOVERY VENTILATOR	HRV	E
HEAT RECOVERY WHEEL	HRW	E
HEATING VENTILATOR	HV	E
HOT DECK	HTDECK	E
HOT WATER TANK	HWT	E
HYDRO METER	ELECMTR	E
ICE MELT	ICEMELT	E
ICE RESURFACING	ICER	E
MAKE UP AIR UNIT	MUA	E
METER	MTR	E
POOL DEHUMIDIFICATION UNIT	POOLDH	E
RADIANT HEATER	RADH	E
RADIATOR	RAD	E
ICE PLANT DEHUMIDIFICATION UNIT	ICEDH	E
ROOFTOP UNIT	RTU	E
SANITARY	SAN	E
SOLAR	SOLAR	E
STEAM GENERATOR	EGEN	E
SUMP	SUMP	E
UNIT HEATER	UH	E
UNIT VENTILATOR	UV	E
UPS	UPS	E
WATER	WTR	E
WATER METER	WTRMTR	E
PLANT	PLNT	E
RINK DK	#N/A	E
SOLAR	SOLAR	E
GLYCOL	GL	E
ICE PLANT COMPRESSOR	CMPR	E
COLD BRINE	CB	E
BRINE	B	E
COOLING TOWER	CT	E
CONDENSER	CND	E
ENTRANCE HEATER	HAC	E
PERIMETER HEATER	PHTGL	E
ELECTRIC UNIT HEATER	EUH	E
FORCE FLOW HEATER	FFH	E
BASEBOARD HEATER	BBH	E
HEAT RECOVERY UNIT	HRU	E
LEAD BOILER	LEADBLR	E
LAG BOILER	LAGBLR	E

HEATING LOOP	HTGL	E
AIR COOLED CONDENSER	CND	E
EVAPORATOR CONDENSER	ECND	E
TANK	TNK	E

Point	Name	Identifier
ALARM	ALM	D
BURNER	BUR	D
COMPRESSOR	CMP	D
COMPRESSOR JACKET PUMP	CJPMP	D
DAMPER	DPR	D
EXHAUST FAN	EF	D
FAN	FAN	D
GENERAL	GENERAL	D
GLYCOL	GL	D
HEAT EXCHANGER	HX	D
HEAT PUMP	HP	D
HEATING LOOP	HTGL	D
HEATING PUMP	HTGPMP	D
HEATING PUMP LOOP	HPL	D
ICE PLANT COMPRESSOR	CMPR	D
MAIN	MAIN	D
OUTDOOR AIR DAMPER	OAD	D
POOL DEHUMIDIFICATION UNIT	POOLDH	D
PUMP	PMP	D
RADIANT HEATER	RADH	D
RADIATOR	RAD	D
RETURN FAN	RF	D
RINK	RNK	D
RINK DK	#N/A	D
SENSORS	SENSOR	D
SET POINT	SPT	D
SUPPLY FAN	SF	D
TEMPERATURE	T	D
TUB HEATER	TUBEH	D
UNIT HEATER	UH	D
VALVE	VLV	D
VFD	VFD	D
VVT	VVT	D
SUPPLY FAN VSD	SFVSD	D
RETURN FAN VSD	RFVSD	D
HEATING VALVE	HTGVLV	D
REHEATING VALVE	RHVLV	D
COOLING VALVE	CLGVLV	D
DIFFERENTIAL PRESSURE VALVE	DPVLV	D
REFRIGERATION SOLENOID VALVE	DXVLV	D
MAKE UP WATER VALVE	MUWVLV	D
REVERSING VALVE	REVLV	D
DRAIN VALVE	DRVLV	D
FILTER	FLT	D
MIXED AIR DAMPER	MAD	D
BYPASS DAMPER	BPDPR	D

VARIABLE AIR VOLUME	VAV	D
HIGH DISCHARGE PRESSURE	HIDISPRS	D
HIGH	HI	D
LOW	LO	D
COMMON	COM	D
OIL TEMP	OILT	D
DISCHARGE	DIS	D
SUCTION	SUC	D
DIFFERENCE	DIFF	D
EFFECTIVE	EFF	D
DISCHARGE PRESSURE	DISPRS	D
SUCTION PRESSURE	SUCPRS	D
LEAD	LEAD	D
LAG	LAG	D
CURRENT	CRNT	D
SETTING	SETTING	D
WARM BRINE PUMP	WBPMP	D
BRINE RETURN TEMP	BRT	D
COLD BRINE RETURN TEMP	CBRT	D
UNDERFLOOR	UNDERFLR	D
INFRARED	IR	D
OPERATION	OPERATION	D
ENABLE	ENABLE	D
ACTIVE	ACTIVE	D
SLAB	SLAB	D
VALVE OPEN	VLVOP	D
VALVE CLOSED	VLVCL	D
DRAIN	DRAIN	D
EVAPORATOR CONDENSING VALVE	ECNDVLV	D
HEAT EXCHANGER VALVE	HXVLV	D
HOT WATER VLAVE	HWVLV	D
END SWITCH	ES	D
FAN FAST	FANFAST	D
FAN SLOW	FANSLOW	D
SPEED	SPD	D
SPRAY /WATER PUMP	#N/A	D
CEILING FAN	CFAN	D
OPERATION MODE	OPMODE	D
CYCLE ON TIME PERIOD	CYCLEON	D
CYCLE OFF TIME PERIOD	CYCLEOFF	D
FAN VFD	FANVFD	D
COOLING PUMP	CLGPMP	D
CONDENSER WATER PUMP	CNDWTRPMP	D
CONDENSATE PUMP	CONPMP	D
COLD BRINE PUMP	CBPMP	D
GLYCOL PUMP	GLPMP	D
SPRAY PUMP	SPRAYPMP	D

LEAD PUMP	LEADPMP	D
RECIRC PUMP	RPMP	D
OVERLOAD	OVERLOAD	D
BRINE SYSTEM	BS	D
COLD BRINE	CB	D
INFARED SENSOR	INFAREDSENSOR	D
VOLT	VOLT	D
FREQUENCY	FREQ	D
HAND AUTO MODE	AUTOMODE	D
TORQUE	TORQ	D
KWH	KHW	D
BRINE PUMP	BPMP	D
WARM /HOT BRINE	WB	D
BRINE SUPPLY TEMP	BST	D
COLD BRINE SUPPLY TEMP	CBST	D
COMPRESSOR FAIL	CMPRFAIL	D
COMPRESSOR STAGE	CMPRSTAGE	D
DISCHARGE TEMPERATURE	DIST	D
COMPRSSOR SLIDE VLV	CMPRSLIDEVLV	D
COMPRESSOR RUN FAILED	CMPRUNFAIL	D
COMPRESSOR AMPS	CMPRAMP	D
COMPRESSOR RUNTIME	CMPRRUN	D
COMMON COLD BRINE	COMCB	D
BRINE	B	D
WATER PUMP	WPMP	D
CONDENSER FAN	CNDFAN	D
CONDENSER FAN VFD	CNDFANVFD	D
CONDENSER FAN RUNTIME	CNDFANRUN	D
HIGH SPEED	HISPEED	D
LOW SPEED	LOSPEED	D
SUMP PUMP	SUMPPMP	D
CONDENSER STAGE	CNDSTG	D
CONDENSER VALVE	CNDVLV	D
CONDENSER TANK	CNDTANK	D
CONTROL SCHEDULE	CNTRLSCH	D
RESET STAGE CONTROL	RESETSTGCNTRL	D
STAGE CONTROL	STGCNTRL	D
REACTIVATION FAN	REACTF	D
PROCESS FAN	PROCESSF	D
EVAPORATOR CONDENSER	ECND	D
EVAPORATOR CONDENSER PUMP	ECNDPMP	D
MINIMUM CYCLE TIME	MINCYCLETIME	D
CONDENSER PUMP	CNDPMP	D
INFARED CONTROL	INFAREDCNTL	D
OCCUPIED DEWPOINT	OCCDEW	D
UNOCCUPIED DEWPOINT	UNOCCDEW	D
CARBON DIOXIDE	CO2	D

CARBON MONOXIDE	CO	D
OCCUPIED PROCESS FAN SPEED	OCCPROCESSF	D
UNOCCUPIED PROCESS FAN SPEED	UNOCCPROCESSF	D
SUPPLY AIR TEMPERATURE	SAT	D
FREE COOLING	FREECLG	D
RETURN AIR TEMPERATURE	RAT	D
CO2 LEVEL	CO2LVL	D
RETURN AIR CO2	RACO2	D
RETURN AIR HUMIDITY	RAH	D
SUPPLY AIR HUMIDITY	SAH	D
COOLING OVERIDE	CLGOVRD	D
HEAT RECOVERY WHEEL	HRW	D
HEAT RECOVERY WHEEL OVERIDE	HRWOVRD	D
HEATING STAGE	HTGSTG	D
COOLING STAGE	CLGSTG	D
LOCAL SETPOINT	LOCALSPT	D
ROOM HUMIDITY	RMH	D
HUMIDIFIER	HUM	D
DEHUMIDIFIER	DHU	D
DEWPOINT	DEWP	D
DEWPOINT TEMPERATURE	DEWT	D
MIXED AIR HUMIDITY	MAH	D
ROOM TEMPERATURE	RMT	D
SYSTEM MODE	SYSMODE	D
OCCUAPNCY	OCC	D
NATURAL GAS	NG	D
COOLING DAY	CLGDAY	D
COOLING NIGHT	CLGNIGHT	D
HEATING DAY	HTGDAY	D
HEATING NIGHT	HTGNIGHT	D
DESICANT WHEEL	DWHEEL	D
MAXIMUM POSITION	MAXPOS	D
MINIMUM POSITION	MINPOS	D
OUTDOOR AIR DAMPER MINIUM POSITION	OADMIN	D
MIXED AIR DAMPER OVERIDE	MADOVRD	D
FAN OPERATION	FANOP	D
FAN OFF CYCLE	FANOFFCYCLE	D
FAN OFF CYCLE DELAY	FANOFFCYCLEDELAY	D
SUPPLY FAN OVERIDE	SFOVRD	D
VFD OCCUPIED SPEED	VFDOCCSPD	D
VFD UNOCCUPIED SPEED	VFDUNOCCSPD	D
SUPPLY FAN MODULATION	SFMOD	D
FAN MODE	FANMODE	D
HEAT PIPE	HEATEPIPE	D
PRE HEAT	PREHEAT	D
HEAT RECOVERY VENTILATOR	HRV	D
EFFECTIVE HEATING	EFFHTG	D

EFFECTIVE COOLING	EFFCLG	D
COIL	COIL	D
OVERRIDE	OVRD	D
CONTROLLER	CONTROLLER	D
DEWPOINT HIGH LIMIT	DEWHILIMIT	D
OCCUPANCY OVERIDE TIME LIMIT	OCCOVRDTME	D
MIXED AIR DAMPER MINIMUM	MADPRMIN	D
MIXED AIR DAMPER MAXIMUM	MADPRMAX	D
SUMMER	SUMMER	D
SHOULDER	SHOULDER	D
WINTER	WINTER	D
PUSH BUTTON OCCUPANCY	PBOCC	D
SCHEDULE	SCH	D
ENERGY RECOVERY VENTILATOR	ERV	D
FAN COIL	FC	D
FLUID COOLER	FCL	D
HEAT RECOVER SYSTEM	HRS	D
HEAT RECOVER WHEEL	HRWHEEL	D
SUPPLY WATER RESET HIGH	SWRESETHI	D
SUPPLY WATER RESET LO	SWRESETLO	D
LOOP DIFFERNTIAL PRESSURE	LOOPDP	D
FIRE OVERIDE	FIROVRD	D
FIRING	FIRE	D
LEAD BOILER	LEADBLR	D
VALVE OVERRIDE	VLVOVRD	D
PUMP LOCK	PMPLCK	D
SUPPLY WATER TEMPERATURE	SWT	D
RETURN WATER TEMPERATURE	RWT	D
LOOP SUPPLY TEMPERTAUTRE	LOOP_SPT	D
HEAT EXCHANGER TEMPERATURE	HXT	D
HEADER	HEADER	D
SUCTION TEMP	SUCT	D
LEAVING WATER TEMP	LWT	D
CONTROL	CNTRL	D
PUSH BUTTON OVERRIDE	PBOVRD	D
OVERRIDE TIME	OVRDT	D
MIXING VALVE	MIXINGVLV	D
CYCLE COUNT	CYCLECOUNT	D
HIGH LIGHT LEVEL DELAY	HILTGLVLDELAY	D
LOW LIGHT LEVEL DELAY	LOLTGLVLDELAY	D
LEVEL	LVL	D
INTERIOR	INT	D
UV Light	UVLTG	D
MOTION	MOTION	D
PHOTOCELL	PHOTOCELL	D
TIMER	TMR	D
LIGHT LEVEL	LTGLVL	D

HIGH LIGHT LEVEL	HILTGLVL	D
LOW LIGHT LEVEL	LOLTGLVL	D
# LIGHT LEVEL	LTG#	D
LIGHT CYCLE	LTGCYCLE	D
EXTERIOR	EXT	D
MAXIMUM CYCLE	MAXCYCLE	D
DRAIN OVERRIDE	DRAINOVRD	D
CHLORINE	CHLORINE	D
CHLORINE LEVEL	CHLORINELVL	D
HEAT EXCHANGE SUPPLY WATER TEMPERA	HXSWT	D
PUMP CONTROLLER	PMPCONTROLLER	D
LEAD PUMP OVERIDE	LEADPMPOVRD	D
CHLORINE PUMP	CHLORINEPMP	D
BOILER	BLR	D
HOT WATER RETURN TEMPERATURE	HWRT	D
FLOW	FLOW	D
WATER	WTR	D
RECIRCULATING PUMP	RPMP	D
LAG PUMP	LAGPMP	D
RETURN WATER PRESSURE	RWPRS	D
HEAT RECOVERY	HR	D
AIR FLOW	AFLOW	S
AVERAGE	AVG	S
COMMON	COM	S
COMMUNICATION	COMM	S
DIFFERENCE	DIFF	S
DIFFERENTIAL PRESSURE	DP	S
DISCHARGE	DIS	S
DISCHARGE PRESSURE	DISPRS	S
EFFECTIVE	EFF	S
EXHAUST	EXH	S
EXTERIOR	EXT	S
FIRE STAT	FIRZ	S
FLOW	FLOW	S
FREEZE STAT	FRZ	S
HIGH DISCHARGE PRESSURE	HIDISPRS	S
HIGH	HI	S
INFRARED	IR	S
INTERIOR	INT	S
LOW	LO	S
MIXED AIR TEMPERATURE	MAT	S
OIL TEMP	OILT	S
OUTDOOR AIR TEMPERATURE	OAT	S
RETURN AIR HUMIDITY	RAH	S
RETURN AIR STATIC PRESSURE	RASP	S
RETURN AIR TEMPERATURE	RAT	S
ROOM TEMPERATURE	RMT	S

STATIC PRESSURE	STATICPRS	S
SUCTION	SUC	S
SUCTION PRESSURE	SUCPRS	S
SUPPLY AIR HUMIDITY	SAH	S
SUPPLY AIR STATIC PRESSURE	SASPRS	S
SUPPLY AIR TEMPERATURE	SAT	S
UNDERFLOOR	UNDERFLR	S
LEAVING AIR TEMP	LAT	S
GLYCOL SUPPLY TEMP	GLST	S
GLYCOL RETURN TEMP	GLRT	S
ICE TEMPERATURE	ICET	S
AVERAGE SURFACE TEMPERATURE	AVGSRFT	S
AVERAGE TEMPERATURE	AVGT	S
EXHAUST AIR TEMPERATURE	EAT	S
ROOM HUMIDITY	RMH	S
RETURN AIR CO2	RACO2	S
OUTDOOR AIR DEWPOINT	OADEWP	S
SUPPLY WATER TEMPERATURE	SWT	S
RETURN WATER TEMPERATURE	RWT	S
WATER TEMPERATURE	WT	S
HEAT EXCHANGE SUPPLY WATER TEMPERA	HXSWT	S
RETURN WATER PRESSURE	RWPRS	S
GAS ZONE	GZN	S

Point	Name	Identifier
STATUS	STS	AF
LEVEL	LVL	AF
COMMAND	CMD	AF
RELATIVE HUMIDITY	RH	AF
PRESSURE	PRS	AF
SET POINT	SPT	AF
FEEDBACK	FBK	AF
ALARM	ALM	AF
FLOW	FLOW	AF
TEMPERATURE	T	AF
MODULATE	MOD	AF
COMMUNICATION PROTOCAL	VP	AF

SYSTEM

AIR COOLED CONDENSER	CND
AIR COMPRESSOR	ACMP
BRINE SYSTEM	BS
CHILLER	CHLR
COOLING SYSTEM	CLG
COOLING TOWER	CT
DOMESTIC HOT WATER	DHW
EVAPORATOR CONDENSER	ECND
FLUID COOLER	FCL
FUEL SYSTEM	FUEL
GAS DETECTION SYSTEM	GASD
GENERATOR	GEN
GREY WATER SYSTEM	GWS
HEATING SYSTEM	HTG
ICE MELT	ICEMELT
ICE PLANT	ICEP
LIGHTING	LTG
METER	MTR
POOL	POOL
RECLAIMED RAIN WATER SYSTEM	RRWS
SOLAR	SOLAR
BOILER	BLR
PLANT	PLNT
REFRIGERATION PLANT	REFPLANT
ICE PLANT DEHUMIDIFICATION UNIT	ICEDH
SOLAR	SOLAR
HVAC	HVAC

AREA	
ADMIN	ADMIN
AEROBICS	AEROBICS
ART GALLERY	ART GALLERY
ATRIUM	ATRIUM
BACK	BACK
BACK STAGE	BACKSTAGE
BANQUET	BANQUET
BASKETBALL	BSKTBALL
BILLIARDS	BILLIARDS
BOXING	BOXING
BUILDING	BLDG
CHANGE ROOM	CHNGRM
CIRCLE DESK	CIRCLEDESK
COIN ROOM	COINRM
COMMUNITY	COMMUNITY
CORRIDOR	CORRIDOR
COUNCIL	COUNCIL
COURTROOM	COURTRM
CRAFT	CRAFT
DINING ROOM	DININGRM
DRESSING RM	DRESSINGRM
EAST	EAST
ELECTRICAL ROOM	ELECRM
FACILITY	FACILITY
FAMILY CHANGE ROOM	FAMCHNGRM
FILE ROOM	FILERM
FIRST AID ROOM	1STAIDRM
FITNESS	FITNESS
FLOOR	FLR
FPM	FPM
FRONT	FRONT
GALLERIA	GALLERIA
GARDEN	GARDEN
GLASS BLOWING	GLASSBLOW
GROUND	GRND
GYM	GYM
GYMNASTIC	GYMNASTIC
HALL	HALL
INTERVIEW ROOM	INTERVIEWRM
JANITOR CLOSET	JANITORCLOSET
KITCHEN	KITCHEN
LAP	LAP
LEISURE	LEISURE
LIBRARY	LIBRARYLIBRARY

LOBBY	LOBBY
LUNCH ROOM	LUNCHRM
MAINTENANCE	MAINTENANCE
MECHANICAL ROOM	MECHRM
MEETING ROOM	MEETRM
MEN CHANGE ROOM	MENCHNGRM
NORTH	NORTH
OFFICE	OFFICE
OIL INTERCEPTOR	OILINTERCEPTOR
OPERATION	OPERATION
PARK	PARK
PARKING	PARKING
PERIMETER	PERIMETER
POOL	POOL
POOL OFFICE	POOLOFFICE
PROGRAM ROOM	PRORM
PROSHOP	PROSHOP
QUIET ROOM	QUIETRM
RECEPTION	RECEPTION
RINK	RNK
ROOM	RM
SECURITY	SECURITY
SENIOR	SENIOR
SNACK BAR	SNACKBAR
SOCCER	SOCCER
SOUTH	SOUTH
SQUASH	SQUASH
STAGING	STAGING
STAIR	STAIR
STORAGE	STORAGE
THEATER	THEATER
TICKET BOOTH	TICKETBOOTH
VESTIBULE	VESTIBULE
VISUAL ART	VISUALART
WASHROOM	WASHRM
WEIGHT ROOM	WEIGHTRM
WEST	WEST
WOMEN CHANGE ROOM	WOMENCHGRM
WORK ROOM	WORKRM
ZONE	ZN
LEAD	LEAD
LAG	LAG
ICE	ICE
MULTIPURPOSE ROOM	MULTIPURPOSE
ICE RESURFACING	ICER
ICE MELT	ICEMELT
PITT	PITT

UNDERFLOOR	UNDERFLR
SLAB	SLAB
ZAMBONI	ZAMBONI
ARENA	ARENA
LAP POOL	LAP POOL
LEISURE POOL	LEISURE POOL

EQUIPMENT

AIR COMPRESSOR	ACMP
AIR CURTAIN	ACURT
AIR HANDLING UNIT	AHU
BOILER	BLR
CEILING FAN	CFAN
CHILLER	CHLR
COLD DECK	CLDDECK
DEHUMIDIFIER	DHU
DOMESTIC COLD WATER	DCW
DOMESTIC HOT WATER	DHW
ELECTRIC HEATER	EH
ELECVATOR SUMP PUMP	ESUMP
ELEVATOR	ELV
ENERGY RECOVERY VENTILATOR	ERV
EXHAUST FAN	EF
FAN COIL	FC
FLUID COOLER	FCL
FOUNTAIN	FOUNTAIN
FUEL SYSTEM	FUEL
GAS	GAS
GAS DETECTION SYSTEM	GASD
GAS METER	GASMTR
GREY WATER SYSTEM	GWS
HEAT PUMP	HP
HEAT RECOVERY VENTILATOR	HRV
HEAT RECOVERY WHEEL	HRW
HEATING VENTILATOR	HV
HOT DECK	HTDECK
HOT WATER TANK	HWT
HYDRO METER	ELECMTR
ICE MELT	ICEMELT
ICE RESURFACING	ICER
MAKE UP AIR UNIT	MUA
METER	MTR
POOL DEHUMIDIFICATION UNIT	POOLDH
RADIANT HEATER	RADH
RADIATOR	RAD
ICE PLANT DEHUMIDIFICATION UNIT	ICEDH
ROOFTOP UNIT	RTU
SANITARY	SAN
SOLAR	SOLAR
STEAM GENERATOR	EGEN
SUMP	SUMP
UNIT HEATER	UH
UNIT VENTILATOR	UV
UPS	UPS
WATER	WTR
WATER METER	WTRMTR
PLANT	PLNT
RINK DK	#N/A
SOLAR	SOLAR
GLYCOL	GL
ICE PLANT COMPRESSOR	CMPR
COLD BRINE	CB
BRINE	B
COOLING TOWER	CT

CONDENSER	CND	
ENTRANCE HEATER	HAC	
PERIMETER HEATER	PHTGL	DONE
ELECTRIC UNIT HEATER	EUH	
FORCE FLOW HEATER	FFH	
BASEBOARD HEATER	BBH	
HEAT RECOVERY UNIT	HRU	
LEAD BOILER	LEADBLR	
LAG BOILER	LAGBLR	
HEATING LOOP	HTGL	
AIR COOLED CONDENSER	CND	
EVAPORATOR CONDENSER	ECND	
TANK	TNK	

DEVICES		
ALARM	ALM	
BURNER	BUR	
COMPRESSOR	CMP	
COMPRESSOR JACKET PUMP	CJPMP	
DAMPER	DPR	
EXHAUST FAN	EF	
FAN	FAN	
GENERAL	GENERAL	
GLYCOL	GL	
HEAT EXCHANGER	HX	
HEAT PUMP	HP	
HEATING LOOP	HTGL	
HEATING PUMP	HTGPMP	
HEATING PUMP LOOP	HPL	
ICE PLANT COMPRESSOR	CMPR	
MAIN	MAIN	
OUTDOOR AIR DAMPER	OAD	
POOL DEHUMIDIFICATION UNIT	POOLDH	
PUMP	PMP	
RADIANT HEATER	RADH	
RADIATOR	RAD	
RETURN FAN	RF	
RINK	RNK	
RINK DK	#N/A	
SENSORS	SENSOR	
SET POINT	SPT	
SUPPLY FAN	SF	
TEMPERATURE	T	
TUB HEATER	TUBEH	
UNIT HEATER	UH	
VALVE	VLV	
VFD	VFD	
VVT	VVT	
SUPPLY FAN VSD	SFVSD	
RETURN FAN VSD	RFVSD	
HEATING VALVE	HTGVLV	
REHEATING VALVE	RHVLV	
COOLING VALVE	CLGVLV	
DIFFERENTIAL PRESSURE VALVE	DPVLV	
REFRIGERATION SOLENOID VALVE	DXVLV	
MAKE UP WATER VALVE	MUWVLV	
REVERSING VALVE	REVLV	
DRAIN VALVE	DRVLV	
FILTER	FLT	
MIXED AIR DAMPER	MAD	
BYPASS DAMPER	BPDPR	
VARIABLE AIR VOLUME	VAV	
HI DISCHARGE PRESSURE	#N/A	
HIGH	HI	
LOW	LO	
COMMON	COM	
OIL TEMP	OILT	
DISCHARGE	DIS	
SUCTION	SUC	
DIFFERENCE	DIFF	
EFFECTIVE	EFF	
DISCHARGE PRESSURE	DISPRS	
SUCTION PRESSURE	SUCPRS	
LEAD	LEAD	
LAG	LAG	
CURRENT	CRNT	
SETTING	SETTING	
WARM BRINE PUMP	WBPMP	
BRINE RETURN TEMP	BRT	
COLD BRINE RETURN TEMP	CBRT	
UNDERFLOOR	UNDERFLR	
INFRARED	IR	
OPERATION	OPERATION	
ENABLE	ENABLE	
ACTIVE	ACTIVE	
SLAB	SLAB	
VALVE OPEN	VLVOP	
VALVE CLOSED	VLVCL	
DRAIN	DRAIN	
EVAPORATOR CONDENSING VALVE	ECNDVLV	
HEAT EXCHANGER VALVE	HXVLV	
HOT WATER VLAVE	HWVLV	
END SWITCH	ES	
FAN FAST	FANFAST	
FAN SLOW	FANSLOW	
SPEED	SPD	
WATER PUMP	WPMP	DONE
CEILING FAN	CFAN	
OPERATION MODE	OPMODE	
CYCLE ON TIME PERIOD	CYCLEON	
CYCLE OFF TIME PERIOD	CYCLEOFF	
FAN VFD	FANVFD	
COOLING PUMP	CLGPMP	
CONDENSER WATER PUMP	CNDWTRPMP	
CONDENSATE PUMP	CONPMP	
COLD BRINE PUMP	CBPMP	
GLYCOL PUMP	GLPMP	
SPRAY PUMP	SPRAYPMP	
LEAD PUMP	LEADPMP	
RECIRC PUMP	RPMP	

OVERLOAD	OVERLOAD
BRINE SYSTEM	BS
COLD BRINE	CB
INFARED SENSOR	INFAREDSENSOR
VOLT	VOLT
FREQUENCY	FREQ
HAND AUTO MODE	AUTOMODE
TORQUE	TORQ
KWH	KHW
BRINE PUMP	BPMP
WARM /HOT BRINE	WB
BRINE SUPPLY TEMP	BST
COLD BRINE SUPPLY TEMP	CBST
COMPRESSOR FAIL	CMPRFAIL
COMPRESSOR STAGE	CMPRSTAGE
DISCHARGE TEMPERATURE	DIST
COMPRSSOR SLIDE VLV	CMPRSLIDEVLV
COMPRESSOR RUN FAILED	CMPRUNFAIL
COMPRESSOR AMPS	CMPRAMP
COMPRESSOR RUNTIME	CMPRRUN
COMMON COLD BRINE	COMCB
BRINE	B
WATER PUMP	WPMP
CONDENSER FAN	CNDFAN
CONDENSER FAN VFD	CNDFANVFD
CONDENSER FAN RUNTIME	CNDFANRUN
HIGH SPEED	HISPEED
LOW SPEED	LOSPEED
SUMP PUMP	SUMPPMP
CONDENSER STAGE	CNDSTG
CONDENSER VALVE	CNDVLV
CONDENSER TANK	CNDTANK
CONTROL SCHEDULE	CNTRLSCH
RESET STAGE CONTROL	RESETSTGCNTRL
STAGE CONTROL	STGCNTRL
REACTIVATION FAN	REACTF
PROCESS FAN	PROCESSF
EVAPORATOR CONDENSER	ECND
EVAPORATOR CONDENSER PUMP	ECNDPMP
MINIMUM CYCLE TIME	MINCYCLETIME
CONDENSER PUMP	CNDPMP
INFARED CONTROL	INFAREDCNTL
OCCUPIED DEWPOINT	OCCDEW
UNOCCUPIED DEWPOINT	UNOCCDEW
CARBON DIOXIDE	CO2
CARBON MONOXIDE	CO
OCCUPIED PROCESS FAN SPEED	OCCPROCESSF
UNOCCUPIED PROCESS FAN SPEED	UNOCCPROCESSF
SUPPLY AIR TEMPERATURE	SAT
FREE COOLING	FREECLG
RETURN AIR TEMPERATURE	RAT
CO2 LEVEL	CO2LVL
RETURN AIR CO2	RACO2
RETURN AIR HUMIDITY	RAH
SUPPLY AIR HUMIDITY	SAH
COOLING OVERIDE	CLGOVRD
HEAT RECOVERY WHEEL	HRW
HEAT RECOVERY WHEEL OVERIDE	HRWOVRD
HEATING STAGE	HTGSTG
COOLING STAGE	CLGSTG
LOCAL SETPOINT	LOCALSPT
ROOM HUMIDITY	RMH
HUMIDIFIER	HUM
DEHUMIDIFIER	DHU
DEWPOINT	DEWP
DEWPOINT TEMPERATURE	DEWT
MIXED AIR HUMIDITY	MAH
ROOM TEMPERATURE	RMT
SYSTEM MODE	SYSMODE
OCCUAPNCY	OCC
NATURAL GAS	NG
COOLING DAY	CLGDAY
COOLING NIGHT	CLGNIGHT
HEATING DAY	HTGDAY
HEATING NIGHT	HTGNIGHT
DESICANT WHEEL	DWHEEL
MAXIMUM POSITION	MAXPOS
MINIMUM POSITION	MINPOS
OUTDOOR AIR DAMPER MINIUM POSITION	OADMIN
MIXED AIR DAMPER OVERIDE	MADOVRD
FAN OPERATION	FANOP
FAN OFF CYCLE	FANOFFCYCLE
FAN OFF CYCLE DELAY	FANOFFCYCLEDELAY
SUPPLY FAN OVERIDE	SFOVRD
VFD OCCUPIED SPEED	VFDOCCSPD
VFD UNOCCUPIED SPEED	VFDUNOCCSPD
SUPPLY FAN MODULATION	SFMOD
FAN MODE	FANMODE
HEAT PIPE	HEATEPIPE
PRE HEAT	PREHEAT
HEAT RECOVERY VENTILATOR	HRV
EFFECTIVE HEATING	EFFHTG
EFFECTIVE COOLING	EFFCLG
COIL	COIL
OVERRIDE	OVRD
CONTROLLER	CONTROLLER
DEWPOINT HIGH LIMIT	DEWHILIMIT
OCCUPANCY OVERIDE TIME LIMIT	OCCOVRDTME

MIXED AIR DAMPER MINIMUM	MADPRMIN
MIXED AIR DAMPER MAXIMUM	MADPRMAX
SUMMER	SUMMER
SHOULDER	SHOULDER
WINTER	WINTER
PUSH BUTTON OCCUPANCY	PBOCC
SCHEDULE	SCH
ENERGY RECOVERY VENTILATOR	ERV
FAN COIL	FC
FLUID COOLER	FCL
HEAT RECOVER SYSTEM	HRS
HEAT RECOVER WHEEL	HRWHEEL
SUPPLY WATER RESET HIGH	SWRESETHI
SUPPLY WATER RESET LO	SWRESETLO
LOOP DIFFERNTIAL PRESSURE	LOOPDP
FIRE OVERIDE	FIROVRD
FIRING	FIRE
LEAD BOILER	LEADBLR
VALVE OVERRIDE	VLVOVRD
PUMP LOCK	PMPLCK
SUPPLY WATER TEMPERATURE	SWT
RETURN WATER TEMPERATURE	RWT
LOOP SUPPLY TEMPERTAUTRE	LOOP_SPT
HEAT EXCHANGER TEMPERATURE	HXT
HEADER	HEADER
SUCTION TEMP	SUCT
LEAVING WATER TEMP	LWT
CONTROL	CNTRL
PUSH BUTTON OVERRIDE	PBOVRD
OVERRIDE TIME	OVRDT
MIXING VALVE	MIXINGVLV
CYCLE COUNT	CYCLECOUNT
HIGH LIGHT LEVEL DELAY	HILTGLVLDELAY
LOW LIGHT LEVEL DELAY	LOLTGLVLDELAY
LEVEL	LVL
INTERIOR	INT
UV Light	UVLTG
MOTION	MOTION
PHOTOCELL	PHOTOCELL
TIMER	TMR
LIGHT LEVEL	LTGLVL
HIGH LIGHT LEVEL	HILTGLVL
LOW LIGHT LEVEL	LOLTGLVL
# LIGHT LEVEL	LTG#
LIGHT CYCLE	LTGCYCLE
EXTERIOR	EXT
MAXIMUM CYCLE	MAXCYCLE
DRAIN OVERRIDE	DRAINOVRD
CHLORINE	CHLORINE
CHLORINE LEVEL	CHLORINELVL
HEAT EXCHANGE SUPPLY WATER TEMPERATURE	HXSWT
PUMP CONTROLLER	PMPCONTROLLER
LEAD PUMP OVERIDE	LEADPMPOVRD
CHLORINE PUMP	CHLORINEPMP
BOILER	BLR
HOT WATER RETURN TEMPERATURE	HWRT
FLOW	FLOW
WATER	WTR
RECIRCULATING PUMP	RPMP
LAG PUMP	LAGPMP
RETURN WATER PRESSURE	RWPRS
HEAT RECOVERY	HR

SENSORS

AIR FLOW	AFLOW
AVERAGE	AVG
COMMON	COM
COMMUNICATION	COMM
DIFFERENCE	DIFF
DIFFERENTIAL PRESSURE	DP
DISCHARGE	DIS
DISCHARGE PRESSURE	DISPRS
EFFECTIVE	EFF
EXHAUST	EXH
EXTERIOR	EXT
FIRE STAT	FIRZ
FLOW	FLOW
FREEZE STAT	FRZ
HIGH DISCHARGE PRESSURE	HIDISPRS
HIGH	HI
INFRARED	IR
INTERIOR	INT
LOW	LO
MIXED AIR TEMPERATURE	MAT
OIL TEMP	OILT
OUTDOOR AIR TEMPERATURE	OAT
RETURN AIR HUMIDITY	RAH
RETURN AIR STATIC PRESSURE	RASP
RETURN AIR TEMPERATURE	RAT
ROOM TEMPERATURE	RMT
STATIC PRESSURE	STATICPRS
SUCTION	SUC
SUCTION PRESSURE	SUCPRS
SUPPLY AIR HUMIDITY	SAH
SUPPLY AIR STATIC PRESSURE	SASPRS
SUPPLY AIR TEMPERATURE	SAT
UNDERFLOOR	UNDERFLR
LEAVING AIR TEMP	LAT
GLYCOL SUPPLY TEMP	GLST
GLYCOL RETURN TEMP	GLRT
ICE TEMPERATURE	ICET
AVERAGE SURFACE TEMPERATURE	AVGSRFT
AVERAGE TEMPERATURE	AVGT
EXHAUST AIR TEMPERATURE	EAT
ROOM HUMIDITY	RMH
RETURN AIR CO2	RACO2
OUTDOOR AIR DEWPOINT	OADEWP
SUPPLY WATER TEMPERATURE	SWT

RETURN WATER TEMPERATURE	RWT
WATER TEMPERATURE	WT
HEAT EXCHANGE SUPPLY WATER TEMPERATURE	HXSWT
RETURN WATER PRESSURE	RWPRS
GAS ZONE	GZN

GENERAL

ACTIVE	ACTIVE
BACK UP	BA
BOOTH	BOOTH
ACTIVITY	ACTIVITY
CLOSED	CL
HAND AUTO MODE	AUTOMODE
DAY	DAY
DIESEL	DISEL
DRAIN	DRAIN
ELEVATOR	ELV
CAPACITY	CAP
ENGINE	ENGINE
FAST	FAST
FILTER	FLT
FLOOR	FLR
FREEZE STAT	FRZ
CONTROL	CNTRL
HEADER	HEADER
CONTROLLER	CONTROLLER
HOUR	HR
DELAY	DELAY
EMERGENCY	EMERGENCY
LEVEL	LVL
ENABLE	ENABLE
MAIN	MAIN
GENERAL	GENERAL
NIGHT	NTG
OIL	OIL
OPEN	OPEN
PAINTING	PAINTING
PRIMARY	PR
PUSH BUTTON	PB
REFRIGERATION SOLENOID VALVE	DXVLV
HEATER	HTER
REVERSING	RE
SANITARY	SAN
SLOW	SLOW
SMOKE	SMOKE
INVERTER	INVERTER
STORM	STORM
LEAD	LEAD
TIME	TIME
TIMER	TMR
LEAK	LEAK

WATER TREATMENT SYSTEM	WTS
PUSH BUTTON OVERRIDE	PBOVRD
OVERRIDE TIME	OVRDT
AIR CURTAIN	ACURT
DOOR	DOOR
SWITCH	SWITCH
OVERRIDE TIME REMAINING	OVRDTREMAIN
OVERRIDE TIME DURATION	OVRDTDUR
SCHEDULE	#N/A
LOCK OUT	LOCKOT
STATIC PRESSURE	STATICPRS
END SWITCH	ES
LIMIT	LIMIT
LOAD	LOAD
LOOP	LOOP
MODE	MODE
OUT DOOR TEMP SET POINT	OATSPT
RESET	RESET
RUN TIME	RUNTIME
HEATSINK	SINK
SPEED	SPD
STAGE	STG
SYSTEM	SYS
THERMAL	THERMAL
UNLOAD	UNLOAD
OCCUPIED	OCC
SCHEDULE	#N/A
ROOM TEMPERATURE	RMT
OVERRIDE	OVRD
UNOCCUPIED	UNOCC
FILTER	FLT
FLOW	FLOW
OUTDOOR AIR TEMPERATURE	OAT
OCCUPANCY	OCCUPANCY
OPERATION	OPERATION
DUCT STATIC PRESSURE	DUCTSTATICPRS
ACTIVE	ACTIVE
CONTROLLER	CONTROLLER
OCCUPANCY OVERIDE TIME LIMIT	OCCOVRDTME
TIME	TIME
PUSH BUTTON	PB
ROOM	RM
SUPPLY AIR TEMPERATURE LOW LIMIT	SATLO
BASKETBALL	BSKTBALL
LIBRARY	LIBRARYLIBRARY
SOCCER	SOCCER
OUTDOOR AIR FILTER	OAFILT

REACTIVATION FILTER	REACTFILT
REACTIVATION	REACT
OUTDOOR AIR FILTER PRESSURE	OAFP
MINIMUM DEADBAND	MINDEADBAND
DEADBAND	DEADBAND
MULTIPURPOSE ROOM	MULTIPURPOSE
2ND FLOOR OFFICE	2FLROFFICE
1ST FLOOR OFFICE	1FLROFFICE
DRESSING ROOM	DRESSRM

ALARM

AMONIA LEAK ALARM	NH3_ALM
HIGH LIMIT SHUT DOWN ALARM	HILIMIT_ALM
STOP ALARM	STOP_ALM
HIGH DISCHARGE PRESSURE	HIDISPRS
HIGH	HI
LOW	LO
COMMON	COM
OIL TEMP	OILT
DISCHARGE	DIS
SUCTION	SUC
DIFFERENCE	DIFF
EFFECTIVE	EFF
DISCHARGE PRESSURE	DISPRS
SUCTION PRESSURE	SUCPRS
HIGH PRESSURE	HIPRS
LOW PRESSURE	LOPRS
HIGH OIL TEMP	HIOIL
LOW OIL PRESSURE	LOOILPRS
BEACON	BEACON
HIGH LOAD SHUTDOWN ALARM	HILOADSHUT_ALM
REACTIVATION FAN ALARM	REACTF_ALM
PROCESS FAN ALARM	PROCESSF_ALM
RETURN FAN ALARM	RF_ALM
BURNER ALARM	BUR_ALM
HIGH SUCTION PRESSURE	HISUCPRS
HIGH OIL TEMPERATURE	HIOILT
HIGH DISCHARGE TEMPERATURE	HIDIST
GENERAL	GENERAL
HIGH TEMPERATURE ALARM	HIT_ALM
AIR FLOW	AFLOW
UNIT OFF	UNITOFF_ALM
SUPPLY FAN FAULT	SFFAULT_ALM
REACTIVATION FAN FAULT	RFANFAULT_ALM
DESICANT WHEEL FAULT	DWHEELFAULT_ALM
SUPPLY AIR TEMPERATURE LOW LIMIT	SATLO
LOW ROOM TEMPERATURE	LORMT

MODE

VENTING MODE	VMODE
PURGING MODE	PMODE
COOLING MODE	CLGMODE
HEATING MODE	HTGMODE
DEHUMIDIFICATION MODE	DHMODE
FREE COOLING	FREECLG
OPERATION MODE	OPMODE
IDLE	IDLE
STATE	STATE
COOLING	CLG
ENABLE	ENABLE
ACTIVE	ACTIVE
UNLOAD	UNLOAD
LOAD	LOAD
STATUS	STS
LEVEL	LVL
SET POINT	SPT
COMMAND	CMD
ALARM	ALM
MODULATE	MOD

COMPRESSOR

CHILLER	CHLR
CHILLED WATER	CHW
COMPRESSOR	CMP
COMPRESSOR JACKET PUMP	CJPMP
AIR COMPRESSOR	ACMP
ICE PLANT COMPRESSOR	CMPR
AIR COOLED CONDENSER	CND
BRINE SYSTEM	BS
CHILLER	CHLR
COOLING TOWER	CT
CONDENSING WATER	CDW
CHILLED WATER	CHW
CHILLED WATER SUPPLY	CHWS
CHILLED WATER RETURN	CHWR
CONDENSING WATER SUPPLY	CDWS
CONDENSING WATER RETURN	CDWR
AMP	AMP
VFD	VFD
LOW LEVEL	LOLVL
HIGH LEVEL	HILVL
GLYCOL	GL
HEAT EXCHANGER	HX
VOLT	VOLT
CURRENT	CRNT
FREQUENCY	FREQ
SPEED	SPD

HEAT EXCHANGER

GLYCOL	GL
HEAT EXCHANGER	HX
HEAT PUMP	HP
HEATING LOOP	HTGL
HEATING PUMP	HTGPMP
HEATING PUMP LOOP	HPL
HEATING VALVE	HTGVLV
PUMP	PMP

RINK

RINK	RNK
UNDERFLOOR	UNDERFLR
INFRARED	IR
OPERATION	OPERATION
ENABLE	ENABLE
ACTIVE	ACTIVE
ICE RESURFACING	ICER
ICE MELT	ICEMELT
PITT	PITT

VALVE

COOLING VALVE	CLGVLV
DIFFERENTIAL PRESSURE VALVE	DPVLV
DRAIN	DRAIN
DRAIN VALVE	DRVLV
EVAPORATOR CONDENSING VALVE	ECNDVLV
HEAT EXCHANGER VALVE	HXVLV
HEATING VALVE	HTGVLV
HOT WATER VALVE	HOTWTRVLV
MAKE UP WATER VALVE	MUWVLV
REFRIGERATION SOLENOID VALVE	DXVLV
REHEATING VALVE	RHVLV
REVERSING VALVE	REVLV
VALVE	VLV
VALVE CLOSED	VLVCL
VALVE OPEN	VLVOP
END SWITCH	ES

FAN

EXHAUST FAN	EF
FAN	FAN
FAN FAST	FANFAST
FAN SLOW	FANSLOW
RETURN FAN	RF
SPEED	SPD
SPRAY /WATER PUMP	#N/A
SUPPLY FAN	SF
CEILING FAN	CFAN
CYCLE ON TIME PERIOD	CYCLEON
CYCLE OFF TIME PERIOD	CYCLEOFF
FAN VFD	FANVFD

PUMP

WARM BRINE PUMP	WBPMP
Spray Pump	SPRAYPMP
RECIRC PUMP	RPMP
PUMP	PMP
OVERLOAD	OVERLOAD
LEAD PUMP	LEADPMP
GLYCOL PUMP	GLPMP
COOLING PUMP	CLGPMP
CONDENSER WATER PUMP	CNDWTRPMP
CONDENSATE PUMP	CONPMP
COMPRESSOR JACKET PUMP	CJPMP
COLD BRINE PUMP	CBPMP
BRINE PUMP	BPMP
Heating Pump	HTGPMP
Cooling Pump	CLGPMP
Domestic Water Recirc Pump	DWRPMP
Domestic Water Bosster Pump	DWBPMP
COLD BRINE PUMP	CBPMP
Heat Pump	HP
Lead Pump	LEADPMP
LEAD PUMP	LEADPMP
PUMP CONTROLLER	PMPCONTROLLER
LEAD PUMP OVERIDE	LEADPMPOVRD
CHLORINE PUMP	CHLORINEPMP

VFD

VOLT	VOLT
CURRENT	CRNT
FREQUENCY	FREQ
SPEED	SPD
FLOW	FLOW

GLYCOL

GLYCOL	GL
GLYCOL PUMP	GLPMP

SETPOINT		
ACTIVE	ACTIVE	Sample
ACTIVE(CALCULATED)	ACTIVESP	EMA1_MUA01_OCCCLGPLNTON_SPT
CHAMGE OVER	CHNGOVR	EMA1_MUA01_OCCHTGPLNTON_SPT
CARBON DIOXIDE	CO2	EMA1_MUA01_UNOCCCLGPLNTON_SPT
COOLING	CLG	EMA1_MUA01_UNOCCHTGPLNTON_SPT
COOLING ENABLE	CLGENABLE	EMA1_MUA02_OCCCLGPLNTON_SPT
DEADBAND	DEADBAND	EMA1_MUA02_OCCHTGPLNTON_SPT
DEW	DEW	EMA1_MUA02_UNOCCCLGPLNTON_SPT
DEW SET POINT	DEWSPT	EMA1_MUA02_UNOCCHTGPLNTON_SPT
DEWPOINT TEMPERATURE	DEWT	
DIFFERENCE	DIFF	
EFFECTIVE SETPOPINT	EFFSPT	
FIXED SET POINT	FIXEDSP	
FREE COOLING	FREECLG	
HEATING	HTG	
HEATING ENABLE	HTGENABLE	
HIGH DELAY	HIDELAY	
HIGH DISCHARGE	HIDIS	
HIGH DISCHARGE PRESSURE	HIDISPRS	
LOW DELAY	LODELAY	
MAXIMUM POSITION	MAXPOS	
MINIMUM POSITION	MINPOS	
MIXED AIR DAMPER	MAD	
MIXED AIR TEMPERATURE	MAT	
MIXED AIR TEMP LOW LIMIT	MATLLIMIT	
OA DEADBAND	OADB	
OUTDOOR AIR DEWPOINT	OADEWP	
OCCUPIED COOLING	OCCCLG	
OCC HEATING	OCCHTG	
OCCUPIED	OCC	
OCCUPIED COOLING PLANT ON	OCCCLGPLNTON	
OCCUPIED HEATING PLANT ON	OCCHTGPLNTON	
POSITION	POS	
RESET SETPOINT	RESETSP	
RETURN WATER SET POINT	RWTSPT	
RETURN WATER TEM OVERRIDE	RWTOVRD	
SET POINT	SPT	
SUCTION PRESSURE	SUCPRS	
SUPPLU LOW LIMIT	SLLIMIT	
SUPPLY HIGH LIMIT	SHLIMIT	
SUPPLY WATER TEMP RESET HIGH	SWTRESTHI	
SUPPLY WATER TEMP RESET LOW	SWTRESTLO	
SUPPLY WATER TEMP SET POINT	SWTSPT	
UNOCCUPIED COOLING	UNOCCCLG	
UNOCCUPIED HEATING	UNOCCHTG	
UNOCCUPIED	UNOCC	
VFD SINK TEMP	VFDSINKT	
DRAIN OVERRIDE	DRAINOVRD	
RETURN WATER TEMPERATURE	RWT	
CHLORINE	CHLORINE	
CHLORINE LEVEL	CHLORINELVL	
HEAT EXCHANGE SUPPLY WATER TEMPERATURE	HXSWT	
DEW	DEW	
DEWPOINT	DEWP	

TEMPERATURE

SUPPLY AIR TEMPERATURE	SAT
RETURN AIR TEMPERATURE	RAT
MIXED AIR TEMPERATURE	MAT
LEAVING AIR TEMP	LAT
COOLING COIL LEAVING TEMP	CLGCOILT
PRE COOLING COIL TEMP	PRECLGCOILT
OUTDOOR AIR TEMPERATURE	OAT
DEWPOINT	DEWP
SUPPLY AIR HUMIDITY	SAH
RETURN AIR HUMIDITY	RAH
MIXED AIR HUMIDITY	MAH
LEAVING AIR HUM	LAH
SUPPLY WATER	SW
SUPPLY WATER TEMPERATURE	SWT
RETURN WATER TEMPERATURE	RWT
SUPPLY WATER TEMP RESET HIGH	SWTRESTHI
SUPPLY WATER TEMP RESET LOW	SWTRESTLO
RETURN WATER SET POINT	RWTSPT
SUPPLY WATER TEMP SET POINT	SWTSPT
RETURN WATER TEM OVERRIDE	RWTOVRD
LOW DELAY	LODELAY
HIGH DELAY	HIDELAY
ICE TEMPERATURE	ICET
ROOM TEMPERATURE	RMT
COLD BRINE RETURN TEMP	CBRT
COLD BRINE SUPPLY TEMP	CBST
HOT BRINE RETURN TEMP	WBRT
HOT BRINE SUPPLY TEMP	WBST
DEWPOINT TEMPERATURE	DEWT
DEW SET POINT	DEWSPT
OCCUPIED	OCC
UNOCCUPIED	UNOCC
OCCUPIED COOLING PLANT ON	OCCCLGPLNTON
OCCUPIED HEATING PLANT ON	OCCHTGPLNTON
HEAT RECOVERY WHEEL TEMP	HRWT
HEAT RECOVERY WHEEL IN TEMP	HRWINT
HEAT RECOVERY WHEEL OUT TEMP	HRWOUTT
HEAT RECOVERY WHEEL SUPPLY AIR TEMP	HRWSAT
COLD WATER TEMP	CWT
COLD WATER	CW
DIFFERENCE	DIFF
HIGH DISCHARGE	HIDIS
HIGH DISCHARGE PRESSURE	HIDISPRS
DEADBAND	DEADBAND

VFD SINK TEMP	VFDSINKT
DUCT INLET	DUCTINLET
TEMPERATURE	T
HIGH	HI
LOW	LO
RESET	RESET
SET POINT	SPT
DELAY	DELAY
OVERRIDE	OVRD
ROOM	RM
DEW	DEW
IN	IN
OUT	OUT

DAMPER

ECONOMIZER	ECO
MIXED AIR DAMPER	MAD
OUTDOOR AIR DAMPER	OAD
EXHAUST AIR DAMPER	EADPR
BYPASS DAMPER	BPDPR
ACTUATOR	ACTUATOR
CHAMGE OVER	CHNGOVR
DAMPER	DPR
MAXIMUM POSITION	MAXPOS
MINIMUM POSITION	MINPOS
MIXED AIR DAMPER	MAD
OUTDOOR AIR DAMPER	OAD
OUTDOOR AIR DAMPER MINIUM POSITION	OADMIN
MIXED AIR DAMPER OVERIDE	MADOVRD

BRINE

BRINE PUMP	BPMP
BRINE RETURN TEMP	BRT
BRINE SUPPLY TEMP	BST
COLD BRINE PUMP	CBPMP
COLD BRINE	CB
COLD BRINE RETURN TEMP	CBRT
COLD BRINE SUPPLY TEMP	CBST
CURRENT	CRNT
FREQUENCY	FREQ
HOT BRINE RETURN TEMP	WBRT
HOT BRINE SUPPLY TEMP	WBST
SETTING	SETTING
VFD	VFD
VOLT	VOLT
WARM /HOT BRINE	WB
WARM BRINE PUMP	WBPMP

METERS

METER	MTR
GAS METER	GASMTR
HYDRO METER	ELECMTR
WATER METER	WTRMTR

GAS DETECTION SYSTEM

GAS DETECTION SYSTEM	GASD
AMMONIA	NH3
CARBON MONOXIDE	CO
CARBON DIOXIDE	CO2
NATURAL GAS	NG
SMOKE	SMOKE
DETECTION/DETECTOR	DETECT
ZONE	ZN
GAS ZONE	GZN

HVAC

SUPPLY FAN	SF
RETURN FAN	RF
EXHAUST FAN	EF
DAMPER	DPR
OUTDOOR AIR DAMPER	OAD
RETUN DAMPER	RADPR
MIXED AIR DAMPER	MAD
EXHAUST AIR DAMPER	EADPR
BYPASS DAMPER	BPDPR
COOLING COIL	CLGCOIL
HEATING COIL	HTGCOIL
HEATING STAGES	HTGSTG
COOLING STAGE	CLGSTG
HEATING VALVE	HTGVLV
COOLING VALVE	CLGVLV
FREEZE STAT	FRZ
STATIC PRESSURE	STATICPRS
RELATIVE HUMIDITY	RH
VFD	VFD
SPEED	SPD
VOLT	VOLT
AMP	AMP
KW	KW
KWH	KHW
FIRE STAT	FIRZ

POOL

THERAPY POOL	THERAPY POOL
LEISURE POOL	LEISURE POOL
LAP POOL	LAP POOL
PUMP	PMP
LEAD	LEAD
ROTATION TIME	ROTATIONTM
ROTATION SP	ROTATIONSPT
FLOW	FLOW
SUPPLY WATER TEMPERATURE	SWT
RETURN WATER TEMPERATURE	RWT
SUPPLY WATER SETPOINT	SWSP
RETURN WATER SETPOINT	RWSP
VALVE	VLV
HEAT RECOVERY	HR
HEAT EXCHANGER	HX
FILTER	FLT
CITY WATER	CITYW
DRAIN	DRAIN
DRAIN OVERRIDE	DRAINOVRD
RETURN WATER TEMPERATURE	RWT
CARBON DIOXIDE	CO2
CHLORINE	CHLORINE
CHLORINE LEVEL	CHLORINELVL
HEAT EXCHANGE SUPPLY WATER TEMPERATURE	HXSWT
SUPPLY WATER TEMPERATURE	SWT

DHW

TANK	TNK
DOMESTIC HOT WATER	DHW
PUMP	PMP
RECIRCULATING PUMP	RPMP
SUPPLY WATER TEMPERATURE	SWT
DOMESTIC COLD WATER	DCW

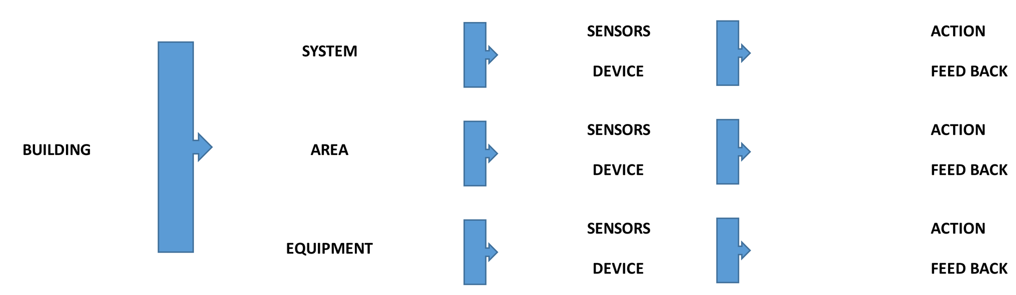
LIGHTING

LIGHTING	LTG
LIGHT LEVEL	LTGLVL
CYCLE COUNT	CYCLECOUNT
EXTERIOR	EXT
FIGURE	FIGURE
GAME	GAME
HIGH LIGHT LEVEL	HILTGLVL
HIGH LIGHT LEVEL DELAY	HILTGLVLDELAY
INTERIOR	INT
LEVEL	LVL
LIGHT CYCLE	LTGCYCLE
LIGHT LEVEL	LTGLVL
LOW LIGHT LEVEL	LOLTGLVL
LOW LIGHT LEVEL DELAY	LOLTGLVLDELAY
MAINTENANCE	MAINTENANCE
MASTER LIGHT	MASTERLTG
MAXIMUM CYCLE	MAXCYCLE
MOTION	MOTION
PHOTOCELL	PHOTOCELL
POTS	POT
SECURITY	SECURITY
SKATING	SKATING
TIMER	TMR
UV Light	UVLTG
LIGHTING OCCUPIED	LTGOCC
LIGHTING UNOCCUPIED	LTGUNOCC
MASTER LIGHT	MASTERLTG
POTS	POT
SECURITY	SECURITY
MAINTENANCE	MAINT
SKATING	SKATE
FIGURE	FIGURE
GAME	GAME
CONTROLLER	CONTROLLER
GYM	GYM
LOBBY	LOBBY
BUILDING EXTERIOR	BLDGEXT
NEW	NEW
DELAY	DELAY

HEAT PUMP, VAV, VVT

DUCT	DUCT
IN LET	INLET
OUT LET	OUTLET
DUCT INLET	DUCTINLET
TUBE HEATER	TUBEHTR
RADIANT HEATER	RADH
UNIT HEATER	UH
INFRARED HEATER	IRHTER
HEATER	HTER
OVERRIDE	OVRD
REVERSING VALVE	REVLV
COMPRESSOR	CMP
OVER TIME REMAIN	OTREMAIN
ROOM TEMPERATURE	RMT
SCHEDULE MODE	SCHMODE
SCHEDULE SELECTED	SCHSELECTED
LOCAL OVER TIME	LOCALOT
HEATING SETPOINT	HTGSPT
COOLING SET POINT	CLGSPT
SUPPLY AIR FLOW	SAFLOW
AIR FLOW SET POINT	ALSPT
BASEBOARD VALVE	BASEBOARDVLV
MIN COOLING AIR FLOW	MINCLGAF
MAX COOLING AIR FLOW	MAXCLGAF

POINT TYPE	DESCRIPTION	TAG	TYPICAL UNITS
DI	STATUS	STS	OPEN / CLOSE
			ON / OFF
			ALARM / NORMAL
			OCC/ UNOCC
AI	STATUS	STS	AMPS
	LEVEL	LVL	PPM
			LUX
	RELATIVE HUMIDITY	RH	%RH
	TEMP	T	C
	FEEDBACK	FBK	HZ
			%
	PRESSURE	PRS	PSI
	SETPOINT	SPT	VARIANT
	FLOW	FLOW	L/S
DO	COMMAND	CMD	OPEN / CLOSE
			ON / OFF
	ALARM	ALM	ALM
AO	MODULATE	MOD	% OPEN
			%
			% FRESH AIR
COM	COMMUINCATION PROTOCAL BacNet/Lon/Modbus	VP	



SYSTEM		AREA		EQUIPMENT		DEVICES		SENSORS		ACTION/FEEDBACK		MODE		ALARM		SETPOINT	
HEATING SYSTEM	HTG	BUILDING	BLDG	BOILER	BLR	ALARM	ALM	OUTDOOR AIR TEMPERATURE	OAT	STATUS	STS	UNLOAD	UNLOAD	HIGH TEMPERATURE ALARM	HIT_ALM	OUTDOOR TEMP SET POINT	OAT_SPT
BOILER	BLR	PERIMETER	PERIMETER	LEAD BOILER	LEADBLR	COMMON	COM	ROOM TEMPERATURE	RMT	LEVEL	LVL	LOAD	LOAD			CONTROL TEMP SET POINT	CNTRL_SPT
		ZONE	ZONE	LAG BOILER	LAGBLR	DIFFERENCE	DIFF	SUPPLY WATER TEMPERATURE	SWT	COMMAND	CMD	ENABLE	ENABLE			HEATING SET POINT	HTG_SPT
				HEATING LOOP	HTGL	EFFECTIVE	EFF	RETURN WATER TEMPERATURE	RWT	RELATIVE HUMIDITY	RH	ACTIVE	ACTIVE				
						GENERAL	GENERAL	WATER TEMPERATURE	WT	PRESSURE	PRS						
						BURNER	BUR			SET POINT	SPT						
						ENERGY RECOVERY VENTILATOR	ERV			FEEDBACK	FBK						
						FAN COIL	FC			ALARM	ALM						
						FLUID COOLER	FCL			FLOW	FLOW						
						HEAT PUMP	HP			TEMPERATURE	T						
						HEAT RECOVER SYSTEM	HRS			MODULATE	MOD						
						HEAT RECOVER WHEEL	HRWHEEL			COMMUNICATION PROTOCAL	VP						
						RADIATOR	RAD										
						SUPPLY WATER RESET HIGH	SWRESETHI										
						SUPPLY WATER RESET LO	SWRESETLO										
						HEATING LOOP	HTGL										
						HEATING PUMP LOOP	HPL										
						LOOP DIFFERNTIAL PRESSURE	LOOPDP										
						FIRE OVERIDE	FIROVRD										
						FIRING	FIRE										
						LEAD BOILER	LEADBLR										
						LOW	LO										
						HEAT EXCHANGER	HX										
						ENABLE	ENABLE										
						ACTIVE	ACTIVE										
						VALVE	VLV										
						DRAIN VALVE	DRVLV										
						VALVE CLOSED	VLVCL										
						VALVE OPEN	VLVOP										
						HEATING VALVE	HTGVLV										
						VALVE OVERRIDE	VLVOVRD										
						FAN	FAN										
						SPEED	SPD										
						WATER PUMP	WPMP										
						PUMP	PMP										
						COOLING PUMP	CLGPMP										
						CONDENSER WATER PUMP	CNDWTRPMP										
						CONDENSATE PUMP	CONPMP										
						GLYCOL PUMP	GLPMP										
						COMPRESSOR JACKET PUMP	CJPMP										
						SPRAY PUMP	SPRAYPMP										
						LEAD PUMP	LEADPMP										
						PUMP LOCK	PMPLCK										
						SUPPLY WATER TEMPERATURE	SWT										
						RETURN WATER TEMPERATURE	RWT										
						LOOP SUPPLY TEMPERTAUTRE	LOOP_SPT										
						HEAT EXCHANGER TEMPERATURE	HXT										
						HEADER	HEADER										
						VOLT	VOLT										
						CURRENT	CRNT										
						FREQUENCY	FREQ										
						HEATING PUMP	HTGPMP										
						SUCTION TEMP	SUCT										
						LEAVING WATER TEMP	LWT										
						COMPRESSOR	CMP										
						CONTROL	CNTRL										
						PUSH BUTTON OVERRIDE	PBOVRD										
						OVERRIDE TIME	OVRDT										
						OVERLOAD	OVERLOAD										
						SUMMER	SUMMER										
						SHOULDER	SHOULDER										
						WINTER	WINTER										
						MIXING VALVE	MIXINGVLV										
						SCHEDULE	SCH										

Appendix A2 - Site ID and Naming

SITE ID #	SITE ID NAME	SIT NAME	SITE ID #	SITE ID NAME	SIT NAME	SITE ID #	SITE ID NAME	SIT NAME
400	BGC1	Braeben Golf Course Club House-Heritage Listed	350	MV1	Mississauga Valley Community Centre Library Pool & Arena	300		
399	BCC1	Burnhamthorpe Community Centre & Arena	349	MV2	Mississauga Valley Gymnasium	299		
398	BL1	Burnhamthorpe Library & Maja Prentice Theatre-DBNC-Heritage Listed	348	OCJ1	Ontario Court of Justice (950 Burnhamthorpe)	298		
397	BRT1	Mississauga Transitway: Central Parkway Station-North (westbound)	347	PCA1	Port Credit Arena-Heritage Designation	297		
396	BRT10	Mississauga Transitway: Tahoe Blvd Station-East (eastbound)	346	PCP1	Paul Coffey Arena-Heritage Listed	296		
395	BRT11	Mississauga Transitway: Etobicoke Creek Station	345	RCC1	River Grove Community Centre & Pool	295		
394	BRT12	Mississauga Transitway: Spectrum Way Station-South (eastbound)	344	SAL1	Small Arms Ltd Inspection Building - Heritage Designation	294		
393	BRT13	Mississauga Transitway: Spectrum Way Station-North (westbound)	343	SBT1	City Centre Transit Terminal/ Square One Bus Terminal	293		
392	BRT14	Mississauga Transitway: Orbitor Drive Station-South (eastbound)	342	SC1	Semenyk Court T&W Admin	292		
391	BRT15	Mississauga Transitway: Orbitor Drive Station-North (westbound)	341	SCC1	South Common Community Centre Pool & Library	291		
390	BRT16	Mississauga Transitway: Renforth Drive Station	340	TTA1	Tomken Twin Arena	290		
389	BRT17	Mississauga Transitway: Erin Mills Station-North (westbound)	339	WL1	Woodlands Library	289		
388	BRT18	Mississauga Transitway: Erin Mills Station-South (eastbound)	338			288		
387	BRT19	Mississauga Transitway: Erin Mills Station-Service Building	337			287		
386	BRT2	Mississauga Transitway: Central Parkway Station-South (eastbound)	336			286		
385	BRT20	Mississauga Transitway: Winston Churchill Station-North (westbound)	335			285		
384	BRT21	Mississauga Transitway: Winston Churchill Station-South (eastbound)	334			284		
383	BRT22	Mississauga Transitway: Winston Churchill Station-Service Building	333			283		
382	BRT3	Mississauga Transitway: Cawthra Rd Station-North (westbound)	332			282		
381	BRT4	Mississauga Transitway: Cawthra Rd Station-South (eastbound)	331			281		
380	BRT5	Mississauga Transitway: Tomken Rd Station-North (westbound)	330			280		
379	BRT6	Mississauga Transitway: Tomken Rd Station-South (eastbound)	329			279		
378	BRT7	Mississauga Transitway: Dixie Rd Station-North (Westbound)	328			278		
377	BRT8	Mississauga Transitway: Dixie Rd St-South (eastbound)	327			277		
376	BRT9	Mississauga Transitway: Tahoe Blvd Station-West (westbound)	326			276		
375	CAW2	Mississauga Senior Citizens Centre	325			275		
374	CCC1	Community Common Comfort Station	324			274		
373	CD1	Clarkson Depot Main Building	323			273		
372	CLK1	Clarkson Community Centre Pool Arena & Library	322			272		
371	EMA1	Erin Mills Twin Arena	321			271		
370	EMC1	Erin Meadows Community Centre Pool & Library	320			270		
369	FMC1	Frank McKechnie Community Centre Library & Pool	319			269		
368	GMC1	Garry W. Morden Fire Training Centre	318			268		
367	HP1	Huron Park Community Centre Pool & Arena	317			267		
366	HWE1	Harding Waterfront Estate: Bell-Gairdner House- Heritage Designation	316			266		
365	IA1	Iceland Arena	315			265		
364	LAC1	Living Arts Centre-Heritage Listed	314	PFF3	Paramount Sport Zone	264		
363	LCP1	Lions Club Of Credit Valley Outdoor Pool	313	PFF2	Paramount FFC Coumunty Building	263		
362	MAD1	Malton Depot Main Building	312	PFF1	Paramount FFC Main Building	262		
361	MCH1	Mississauga City Hall (Civic Centre)-Heritage Listed	311			261		
360	MDV1	Meadowvale Community Centre Pool & Library	310			260		
359	MED1	Meadowvale Depot Main Building	309			259		
358	MFR1	Meadowvale Four Rinks (Arena)	308			258		
357	MN1	Mavis North Main Building	307			257		
356	TCT3	Transit Building E	306			256		
355	TCT2	Transit Building F	305			255		
354	TCT1	Transit Building ABCD	304			254		
353	MS1	Mavis South Main Building	303			253		
352	MST1	Malton Satellite Terminal	302			252		
351	MV1	Mississauga Valley Community Centre Library Pool & Arena	301			251		

SITE ID #	SITE ID NAME	SIT NAME	SITE ID #	SITE ID NAME	SIT NAME	SITE ID #	SITE ID NAME	SIT NAME
250			200			150		
249			199			149		
248			198			148		
247			197			147		
246	MCT1	Meadowvale Theater	196			146		
245			195			145		
244	MCL1	Mississuga Central Library	194			144		
243			193			143		
242			192			142		
241			191			141		
240			190			140		
239			189			139		
238			188			138		
237			187			137		
236			186			136		
235			185			135		
234			184	LAC1	Living Art Center	134		
233			183			133		
232			182			132		
231			181			131		
230	MAL1	Malton CC	180			130		
229			179			129		
228			178			128		
227			177			127		
226			176			126		
225			175			125		
224			174			124		
223			173			123		
222			172			122		
221			171			121		
220			170			120		
219			169			119		
218			168			118		
217			167			117		
216			166			116		
215			165			115		
214			164			114		
213			163			113		
212			162			112		
211			161			111		
210			160			110		
209			159			109		
208			158			108		
207			157			107		
206			156			106		
205			155			105		
204			154			104		
203			153			103		
202			152			102		
201			151	CAW1	Carmen CC	101	CHC1	Churchill Meadows Community Centre & Pool
						100	CHC1	Churchill Meadows Community Centre & Pool

	Site Name	Site Number
CLARKSON CC	CLK1	372

DEVICES TYPE	DEVICE NAME IN SYSTEM
JACE	SRPDC
NETWORK SWITCH	NSU
FIELD CONTROLLER	RPDC
TEC	TEC
3RD PART CONTROLLER	OEMASC
BACNet I/O MODULE	IO
Non BACNet I/O MODULE	M

JACE NAMING & NO.

	SITE ID	JACE NAME	JACE NO.	
	XXXX_	XXXXX	X	
JACE # 1	CLK1	SRPDC	1	CLK1_SRPDC1
JAC2#2	CLK1	SRPDC	2	CLK1_SRPDC2

JACE Name	Location
CLK1_SRPDC1	
CLK1_SRPDC2	

Net work switch#1 connected on JACE#1	NSU1_1
Net work switch#1 connected on JACE # 2	NSU2_1

FIELD CONTROLLER DEVICE NAMING & NO.

	DEVICE NAMING				DEVICE NETWORK NO.			
	DEVICE TYPE	SRPDC#	RPDC DEVICE #		SITE ID #	SRPDC#	DEVICE #	DEVICE NETWORK NO.
	XXXX	X_	XXX	DEVICE NAME	XXX	X	XXX	XXXXXXX
CONTROLLER #1 CONI SRPDC#1	RPDC	1_	001	RPDC1_001	372	1	001	3721001
CONTROLLER #2 CONNECTED TO SRPDC# 1	RPDC	1_	002	RPDC1_002	372	1	002	3721002
TEC# 3 CONNECTED TO SRPDC # 1	TEC	1_	003	TEC1_003	372	1	003	3721003
3RD PART CONTROLLER # 4 CONNECTED TO SRPDC#1	OEMASC	1_	004	OEMASC1_004	372	1	004	3721004

BACNet I/O MODULES

	DEVICE NAMING					DEVICE NETWORK NO.			
	DEVICE TYPE	SRPDC#	RPDC DEVICE #	I/O NO.		SITE ID #	SRPDC#	I/O NO.	DEVICE NETWORK NO.
	XXXX	X_	XXX_	XXX	I/O NAME	XXX	X	XXX	XXXXXXX
I/O MODULE # 5 CONNECTED TO RPDC1_003	IO	1-	003	005	IO1_001_005	372	1	005	3721005

NON BACNet I/O MODULES

NO NEED FOR DEVICE NETWORK NO.

	DEVICE NAMING				
	FIELD CONTROLLER NAME	SRPDC#	RPDC DEVICE #	I/O NAME&NO.	I/O NAME
	XXXX	X_	XXX	XXX	XXXXX_XXXXXX
I/O # 2 CONNECTED TO RPDC2_008	RPDC	2_	008	M02	RPDC2_008M02

Examples

SRPDC #1

Device Naming	Device Numbering
RPDC1_001	3721001
RPDC1_002	3721002
RPDC1_003	3721003
RPDC1_004	3721004
RPDC1_005	3721005
RPDC1_006	3721006
RPDC1_007	3721007
RPDC1_008	3721008
RPDC1_009	3721009
RPDC1_010	3721010
RPDC1_011	3721011
RPDC1_012	3721012
RPDC1_013	3721013
TEC1_014	3721014
TEC1_015	3721015
TEC1_016	3721016
TEC1_017	3721017
TEC1_018	3721018
TEC1_019	3721019
TEC1_020	3721020
TEC1_021	3721021
TEC1_022	3721022
TEC1_023	3721023
TEC1_024	3721024
TEC1_025	3721025
OEMASC1_026	3721026
IO1_001_027	3721027
IO1_001_028	3721028

SRPDC#2

Device Naming	Device Numbering
RPDC2_001	3722001
RPDC2_002	3722002
RPDC2_003	3722003
RPDC2_004	3722004
RPDC2_005	3722005
RPDC2_006	3722006
RPDC2_007	3722007
RPDC2_008	3722008
RPDC2_009	3722009
RPDC2_010	3722010
RPDC2_011	3722011
RPDC2_012	3722012
RPDC2_013	3722013
TEC2_014	3722014
TEC2_015	3722015
TEC2_016	3722016
TEC2_017	3722017
TEC2_018	3722018
TEC2_019	3722019
TEC2_020	3722020
TEC2_021	3722021
TEC2_022	3722022
TEC2_023	3722023
TEC2_024	3722024
TEC2_025	3722025
OEMASC2_026	3722026
IO1_001_027	3722027
IO1_001_028	3722028

City of Mississauga EMCS Labeling Requirements

The following describes the labeling requirements for all CoM Projects that include EMCS work. Labeling should be completed as the EMCS is being replaced and shouldn't all be done at the end of the project. If you have any questions regarding the template, discuss with the Project Manager. Attached to this descriptor are two panel layouts and pictures from another project. The pictures are for reference only, and are not examples of the complete standard we are below.

Enclosures

Controller Panels

Each enclosure that houses at least one RPDC shall have the following information:

- Panel # - lamicoid outside panel
- RPDC # (identify all RPDCs in the Panel) - lamicoid outside panel
- Equipment Served by Panel – lamicoid outside panel
- Controller Layout Diagram(s) – Laminated sheet inside door of panel
- EMCS Sticker

Example:

Panel #1

RPDC2_001 – Boilers

RPDC2_002 – AHU 101

Misc Panels

Any enclosure that houses anything BUT a controller shall have the following information:

- Panel # - lamicoid outside panel
- Device(s) located inside panel – lamicoid outside panel
- Power supply (if electrical panel) – lamicoid outside panel
- EMCS sticker

Example:

Panel #10 **Backup UPS Inside** **120-24V Transformers** **120V Power Fed from Panel LP-12, CCT 18**

Wires

Controller to Terminal Block

All wires connecting a Controller to a terminal block shall be Orange in colour and labeled with following info on a sticker wrapped around the wire:

- IO port connected to on the controller (ie. DO1, AI2, AO3 etc.)
- Terminal number on terminal strip (ie T1, T2, T3 etc.)

Example:

T1:DO1 or T3:A1

Terminal Block to Device

All wires connecting a terminal block to a BAS control device shall be Grey in colour and labeled at both ends of the wire with the following info on a sticker wrapped around the wire.

- Controller # (ie. RPDC2_001)
- IO port connected to on controller
- Point name

Example:

RPDC2_001, AO1

BLR1_BUR_MOD

Controller to BAS Switch

All communication wire connected controllers and BAS Switch shall be blue in colour and be labelled as follows on a sticker wrapped around the wire:

- Near the controller – “to Switch #”
- Near the Switch – “to RPDC#”

Conduit – Junction Boxes

All conduit that houses EMCS wiring shall be labeled as follows:

- Conduit shall be identified every 5 feet in mechanical rooms with Orange tape wrapped around the conduit
- Mark all junction boxes and conduit fittings with Orange Stickers that read “EMCS”

End Device Identification

MCC/Starter

If there are BAS devices located inside an MCC, there shall be a P-Touch label on the MCC starter identifying the following info:

- Equipment served (if not already labeled)
- Controller #
- Point(s) located in starter (CMD/STS)
- IO Port

Example:

AHU 1 Supply Fan

RPDC2_003, DO1, DI1

AHU1_SF_CMD

AHU1_SF_STS

Conduit

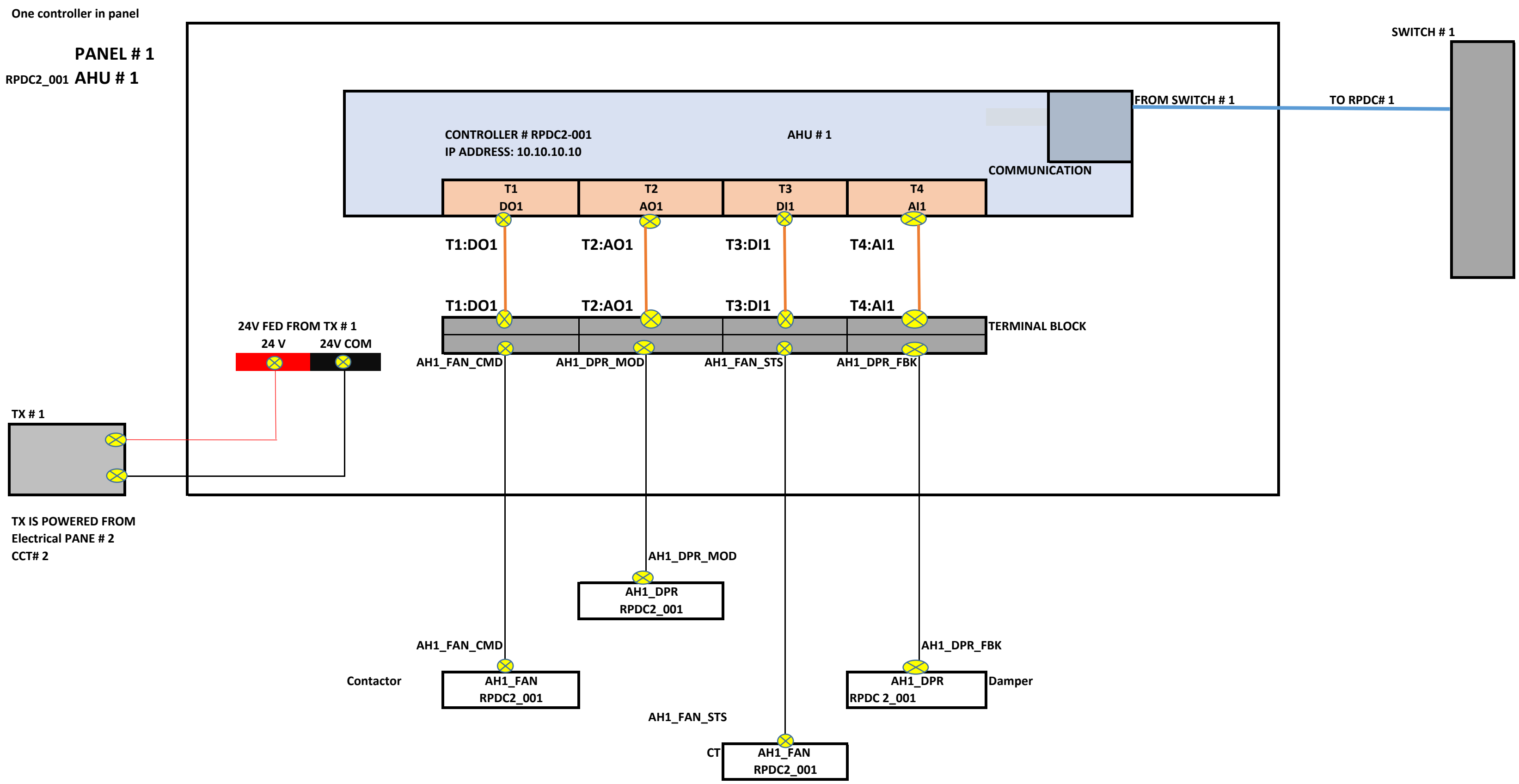
Every conduit with BAS wiring entering a piece of equipment or control device shall have a laminated card with the following info for each point. If a boiler has six (6) points being controlled through one conduit, there shall be six (6) labels:

- Point name
- Controller #
- IO Port

Example:

RPDC1_001, DO1

MUA1_SFVFD_CMD

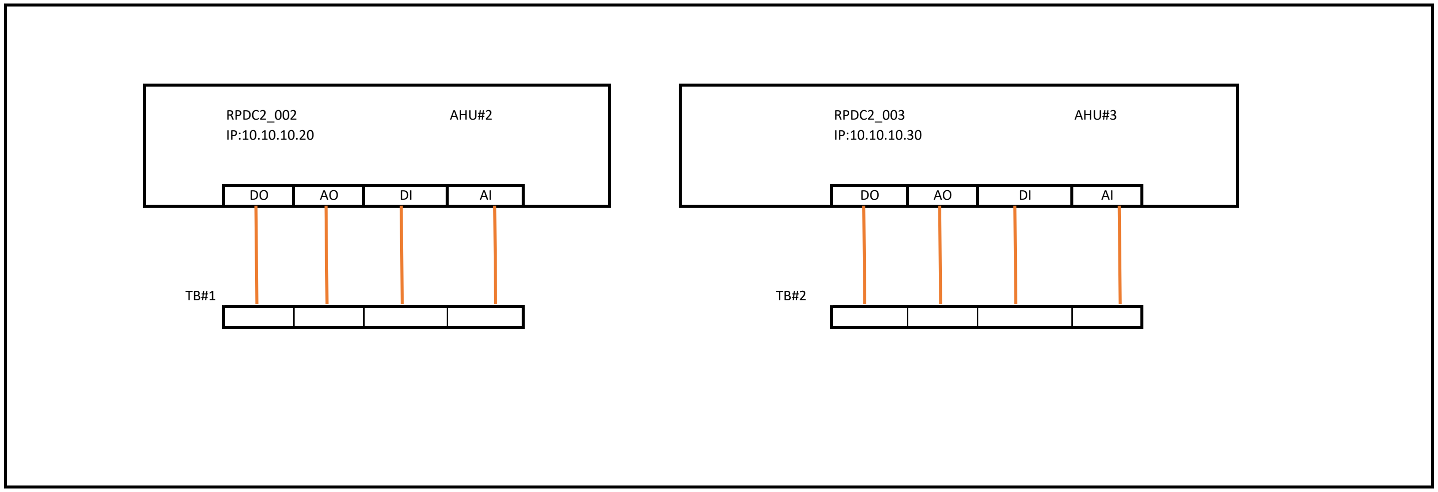

One controller in panel
PANEL # 1
RPDC2_001 AHU # 1
SWITCH # 1
FROM SWITCH # 1
TO RPDC# 1
CONTROLLER # RPDC2-001
IP ADDRESS: 10.10.10.10
AHU # 1
COMMUNICATION
T1 DO1
T2 AO1
T3 DI1
T4 AI1
T1:DO1
T2:AO1
T3:DI1
T4:AI1
T1:DO1
T2:AO1
T3:DI1
T4:AI1
TERMINAL BLOCK
24V FED FROM TX # 1
24 V
24V COM
AH1_FAN_CMD
AH1_DPR_MOD
AH1_FAN_STS
AH1_DPR_FBK
TX # 1
TX IS POWERED FROM
Electrical PANE # 2
CCT# 2
AH1_DPR_MOD
AH1_DPR
RPDC2_001
AH1_FAN_CMD
Contactor
AH1_FAN
RPDC2_001
AH1_DPR_FBK
AH1_DPR
RPDC 2_001
Damper
AH1_FAN_STS
CT
AH1_FAN
RPDC2_001

Panel# 2

RPDC2_002 **AHU#2**

RPDC2_003 **AHU#3**

If we have more than one controller in the panel, each controller should have its Terminal Blocks, and have seperator between each set.




BOILER #2
RPDC102100 AI1406
1700_BLR2MOD_FBK


RPDC102100 AI1406
BLR2MOD_FBK
DC102100 AO1104
1700_BLR2BUR_MOD
BI1201
BLR2BUR_STS
BI1202
BLR2ALM_ALM
ZENA_CMD
LISTED
138778 REV. D
CONDUCTORS ONLY.

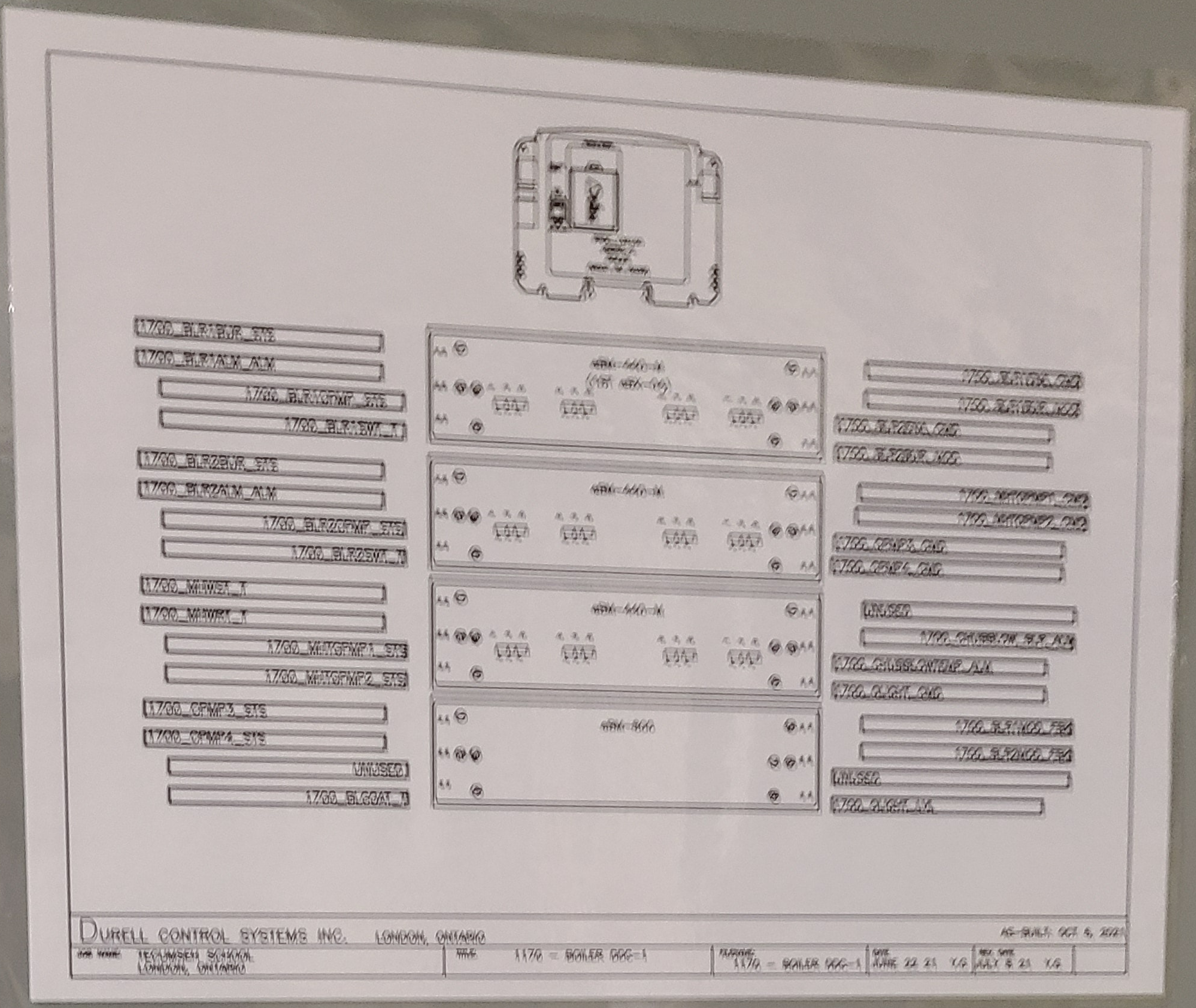

GREYSTONE
RPDC102100 AI1302
1700_MHWRT_T


EMCS
DURELL
EMCS
DURELL
DURELL

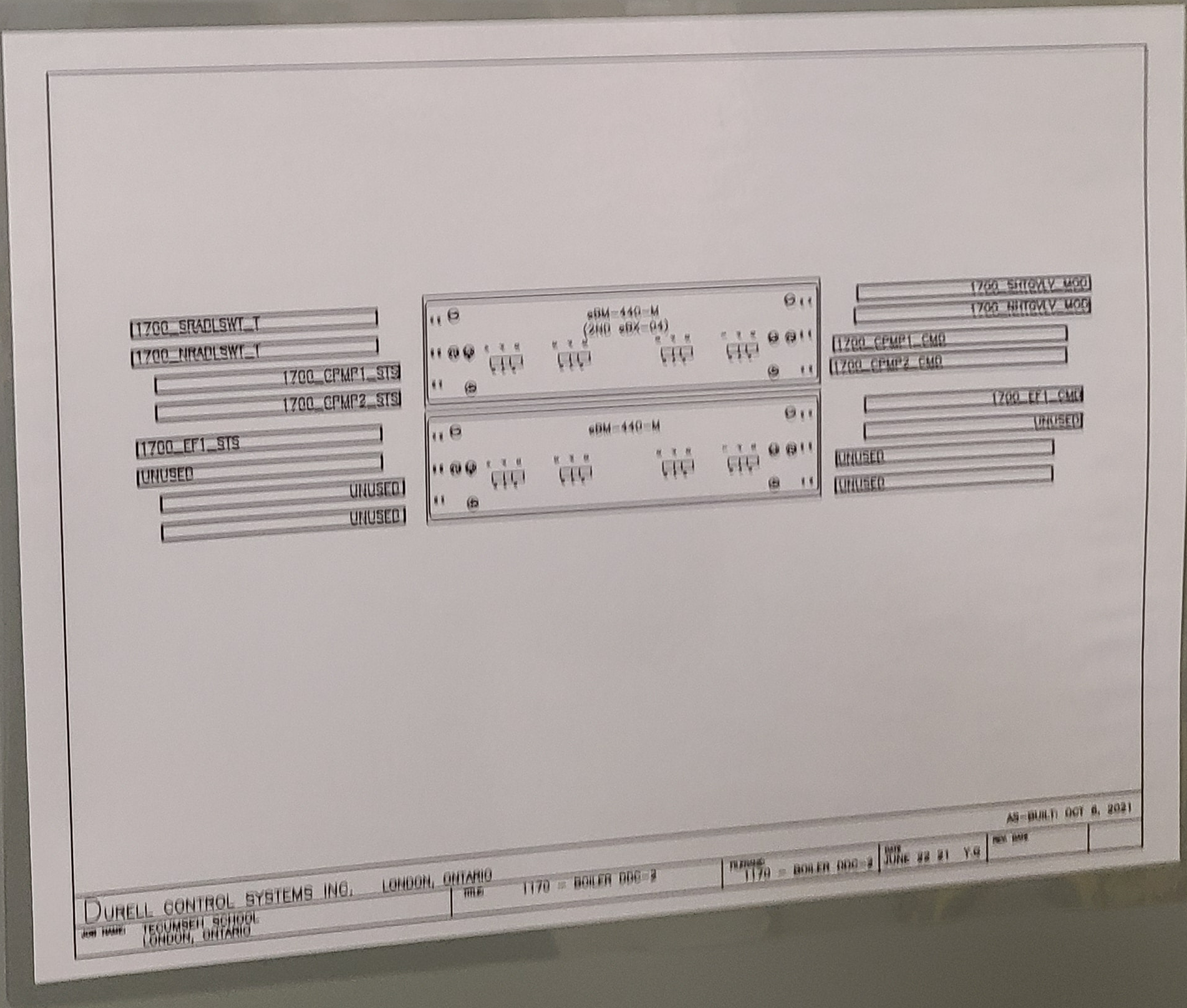

RPDC102100
BOILER
CONTROLS
EMCS


RPDC102103
TEC102109
TEC102111
TEC102113
TEC102116
TEC102117
TEC102122
TEC102124
EMCS


PANEL A
CCT 18
120 V - 24 V
TRANSFORMERS
BACKUP UPS
INSIDE



1700_BLR1BUR_STS
1700_BLR1ALM_ALM
1700_BLR1CPMP_STS
1700_BLR1SWT_T
1700_BLR2BUR_STS
1700_BLR2ALM_ALM
1700_BLR2CPMP_STS
1700_BLR2SWT_T
1700_MHWST_T
1700_MHWRT_T
1700_MHTGPMP1_STS
1700_MHTGPMP2_STS
1700_CPMP3_STS
1700_CPMP4_STS
UNUSED
UNUSED
DURELL CONTROL SYSTEMS INC. LONDON, ONTARIO
AS-BUILT: OCT 6, 2021
TECUMSEH SCHOOL
LONDON, ONTARIO
1170 = BOILER DDC-1
1170 = BOILER DDC-1



sBM-440-M
(2ND sBX-04)
sBM-440-M
1700_SRADLSWT_T
1700_NRADLSWT_T
1700_CPMP1_STS
1700_CPMP2_STS
1700_EF1_STS
UNUSED
UNUSED
UNUSED
1700_SHTGVLV_MOD
1700_NHTGVLV_MOD
1700_CPMP1_CMD
1700_CPMP2_CMD
1700_EF1_CMD
UNUSED
UNUSED
UNUSED
AS-BUILT: OCT 6, 2021
DURELL CONTROL SYSTEMS INC. LONDON, ONTARIO
JOB NAME: TECUMSEH SCHOOL
LONDON, ONTARIO
TITLE 1170 = BOILER DDC-2
FILENAME 1170 = BOILER DDC-2
DATE JUNE 22 21 Y.G
REV DATE


BLR1 BUR
RPDC102100
RPDC102100
BI1102 ALM
AI1103 STS
BLR1 CPMP
AI1104 SWT
BLR1
RPDC102100


ETPS1
0.5A @ 24V
OUTPUT
Power ON
Vout ADJ. to 24VDC
FUSE 2A
RPDC102100
A02102
SHTGVLV


RPDC102100
TR100VA002
VA RATING:96VA
PRIMARY WIRES:
120V NEUT
Blk Wht
SECONDARY WIRES:
COM 24Vac
Yel Yel-Wht
UL FILE NO. E197146
A
TEC102109
TEC102111
TEC102116
TEC102117
TR100VA002
VA RATING:96VA
PRIMARY WIRES:
120V NEUT
Blk Wht
SECONDARY WIRES:
COM 24Vac
Yel Yel-Wht
UL FILE NO. E197146
B
TEC102113
TEC102122
TEC102124
TR100VA002
VA RATING:96VA
PRIMARY WIRES:
120V NEUT
Blk Wht
SECONDARY WIRES:
COM 24Vac
Yel Yel-Wht
UL FILE NO. E197146


CHKO18186
APC
PANEL A
TRANSFORMERS


A-B
QUALITY
HAND OFF AUTO
ALLEN-BRADLEY
RPDC102103 BO01
1700_MAU1SF_CMD
EMCS


RPDC102103 BO01
1700_MAU1SF_CMD


B001
MUA1SF CMD


RPDC102100 AI1103
1700_BLR1CPMP_STS
RPDC102100 AI1203
1700_BLR2CPMP_STS
ALLEN-BRADLEY
BOILER CIRC PUMPS
CONTROLLED BY BOILER
ALLEN-BRADLEY
BOILER CIRC PUMPS
CONTROLLED BY BOILER
SIEMENS
FED FROM PANEL B
3PH 208 VOLT
CIRC # 25,27,29
PUMP #1
BOILER CIRC PUMPS
CONTROLLED BY BOILER
SIEMENS
SIEMENS
FED FROM PANEL B
3PH 208 VOLT
CIRC # 26,28,30
PUMP #2
BOILER CIRC PUMPS
CONTROLLED BY BOILER
SIEMENS


CS
VERIS
SUMP
PUMP 4
ALLEN-BRADLEY


PUMP #1
2001
RPDC 102100
AI2104
BO2104
VERIS
INDUSTRIES TM
+1 503.598.4564
www.veris.com
Hawkeye™ 548
Read instructions before installing
Type 1 50° C. Max.
STATUS OUTPUT:
1A@30VAC/DC; N.O. (Class 2)
RELAY COIL: 24VAC/DC; 36mA nom.
LOAD RATING:
15A@250VAC
1HP@120VAC
LISTED
IND. CONT. EQ.
3T60
Made in the USA
of US & other parts
Z202729-0D
HAND
OFF
AUTO
RELAY STATUS
STATUS OPEN
SET POINT
STATUS CLOSED

Appendix A4
CITY OF MISSISSAUGA
BAS SYSTEM ARCHITECTURES & COMMUNICATION PROTOCOLS

<u>**System Architectures**</u>

The new CoM BAS system architecture will be based on BacNet over IP controller technology using the project specified Network Cable (ie CAT 5/CAT6/CAT6E – Minimum CAT 5). The installing BAS contractor shall supply and install all necessary components of the BAS system including the Supervisory Controller(s) (SRPDC – JACE800) and any necessary switches/routers. The new facility BAS shall communicate to the Niagara N4 Supervisor using Fox Communication Protocol and shall communicate to all downstream field controllers using BacNet over IP. The CoM will provide a singular CoM IT network drop, all controller addressing shall be by the installing BAS contractor.

In some instances (where directed by CoM) connection to existing (non-obsolete) Legacy BAS systems already operating on either BacNet or LON network may be required. In those instances it may be applicable to retain existing 3-wire BacNet MS/TP or LON Networks. Approval from CoM is require in advance.

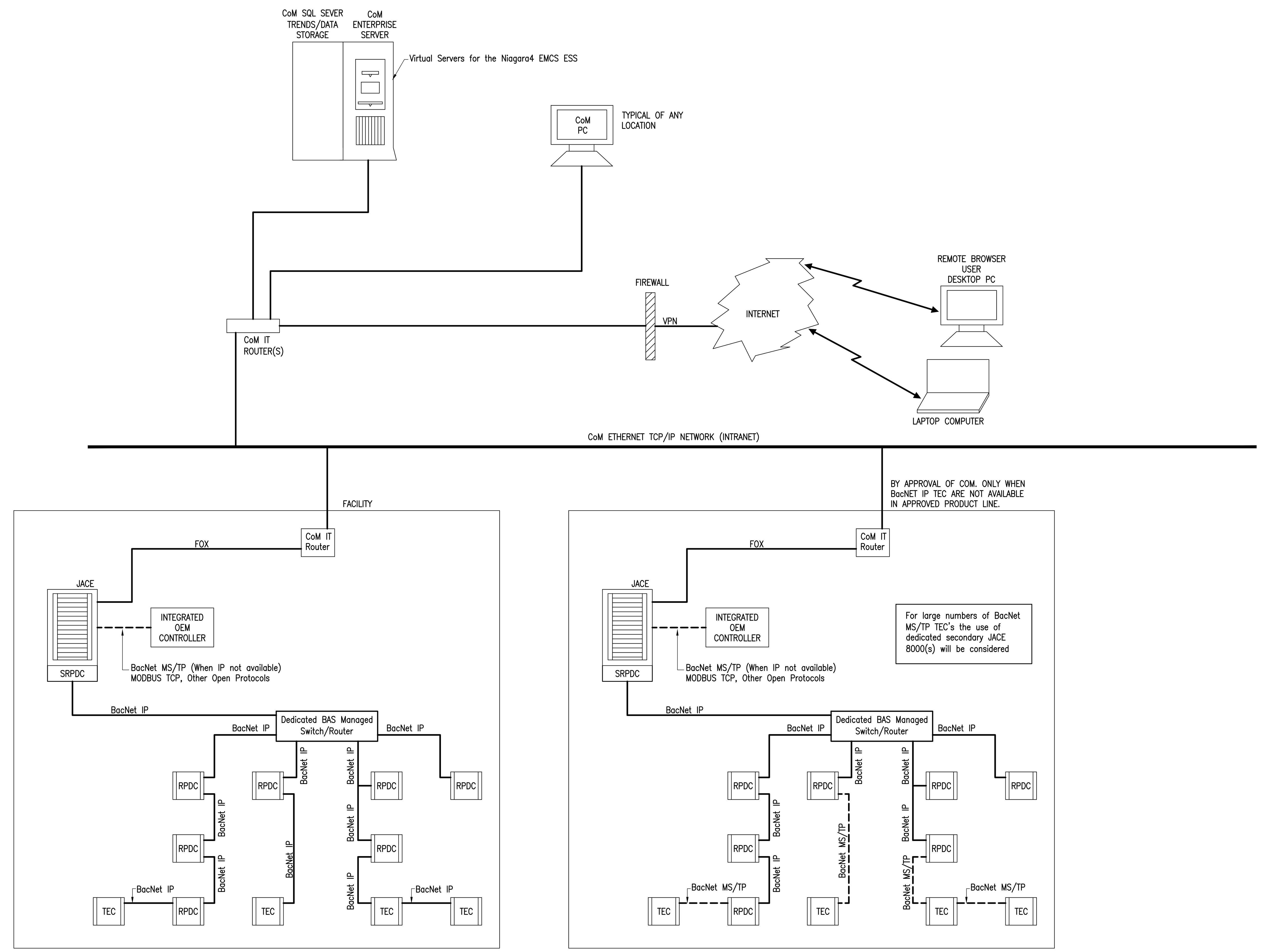
Connection to other OEMASC shall be via dedicated sub-networks using available open communication protocol of that systems (BacNet/IP, BacNET MSTP, LON, etc)

Description of system architecture is as follows:

- CoM IT Network to SRDPC (JACE 8000 Series Controller): 1-IP Drop using Specified Network Cable (ie CAT 5/CAT6/CAT6E)
- IT Network to dedicated managed switch/router: 1 IP Drop per managed switch using Specified Network Cable
- Dedicated BAS Managed Switch/Router to connect up-to four (4) BacNet-IP Subnetworks (per managed switch). Sub-networks can each handle up-to 20 IP Based field controllers (RPDC), daisy chained together in series using Specified Network Cable (ie CAT 5/CAT6/CAT6E)
- From RPDC to any Non-IP based Terminal Equipment controllers (TEC), install a new 3-wire MS/TP network from an RPDC connect multiple TEC in that same area of facility. (This only applies where BacNet IP terminal controllers are not available in the pre-approved Family of controllers – ie VAV Box controllers). **Contractors must identify this in their Bid Submission.**

- SRPDC (JACE) to be configured to manage the Sub-Network controller(s) using FOX Communication protocol. This limits the Niagara device count (for licensing) to one (1) per building.
- From the Sub-Network Controller(s) to RPDC the communication protocol shall be BacNet/IP.
- From RPDC to terminal equipment controllers (TEC) communication shall be BacNet IP or in certain instances BacNet MS/TP (see above).
- Connection to other OEMASC shall be a dedicated sub-network or via IP connection from OEMASC to CoM IT using available open communication protocol of that systems (BacNet/IP, BacNET MS/TP, LON, etc)

Refer to Drawing SK-2 Attached



GENERAL NOTES

- INTEGRATED OEM CONTROLLERS REPRESENT A MULTITUDE OF DIFFERENT CONTROLLER APPLICATION INCLUDING DEDICATED APPLICATION SPECIFIC CONTROL SYSTEMS SUCH AS LIGHTING, REFRIGERATION PLANT CONTROL, METERING, AND/OR DIRECT CONNECTION OF OEMASC SUCH AS ROOFTOP UNITS, CHILLERS, BOILERS, ETC
- SRPDC – SUPERVISORY REMOTE PROGRAMMABLE DIGITAL CONTROLLER
- RPDC – REMOTE PROGRAMMABLE DIGITAL CONTROLLER
- TEC – TERMINAL EQUIPMEMT CONTROLLERS
- DAISY CHAIN SUBNETWORK CAN REACH A MAXIMUM OF 2000FT.
- CAT 5 MAX CABLE LENGTH OF 100m. DEVICE COUNT PURCHASED BY VENDOR ON EACH PROJECT.
- COMMUNICATION FROM N4 WORKSTATION TO SRPDC SHALL BE FOX COMMUNICATION PROTOCOL DOWNSTREAM SUB–NETWORK SHALL BE SET–UP BY CONTRACTOR AND SHALL BE BACNET IP

LEGEND

SPECIFIED IT NETWORK CABLING CAT 5, 6, 6E ————

MS/TP NETWORK CABLING 3–WIRE BELDON CABLE – – – – –

Contractor must verify all dimensions on the job and report any discrepancy to consultant before proceeding with the work.

All drawings and specifications are instruments of service and the property of the consultant and must be returned at the completion of the work.

Key to detail location

Detail number

Where drawn

This drawing is not to be used for construction until countersigned.

Signed Date

Prints issued to

Particulars	No.	Date	By
ISSUED FOR REVIEW	4	APR 15/21	G.M.
ISSUED FOR REVIEW	3	APR 06/21	G.M.
ISSUED FOR REVIEW	2	AUG 18/20	G.M.
ISSUED FOR REVIEW	1	JUN 02/20	G.M.
Particulars	No.	Date	By

Revisions to drawing

All previous issues of this drawing are superseded.

Client

AMERESCO
Green • Clean • Sustainable

30 Leek Crescent, Suite 301
Richmond Hill, ON, L4B 4N4, tel: 647-788-6030

North Sign

Stamp

Project title

CITY OF MISSISSAUGA

BAS STANDARDIZATION STUDY

Project number	Checked by	Scale
#840754	G.M.	AS NOTED
	Drawn by B.G.	Date JUNE 2020

Sheet title: FACILITY BAS PROPOSED SYSTEM ARCHITECTURE

Drawing no. SK2

2 of 2

FILE NAME: MISSISSAUGA–BAS_SK2_APRIL15 2021.DWG
DATE SAVED: 15–Apr–2021 10:05 AM
DATE PLOTTED: 15–Apr–2021 10:30 AM

City of Mississauga Graphic Template

The following are notes relating to the screen shots of the current available CoM Sample Graphic Workstation (attached). At the start of each new project the EMCS Vendor shall coordinate with the CoM to do a live review the most recent version of the Sample Graphics Work Station to see the present standard and any requested changes to that standard in the create of the project specific Custom EMCS graphics.

Page 1 – CoM Landing Page

1. Each page on each site shall have the same Blue coloured banner with consistent information.
   1.1. City of Mississauga Logo to be provide by the City of Mississauga and will not include the text shown. To be located on the top left of each page in each site.
   1.2. Outside Air Temperature and Relative Humidity to be displayed in top right corner. Information to be grabbed from Internet Source.
   1.3. Time and Date to be displayed below Temperature and Humidity. Information to be grabbed from Internet Source.
   1.4. User who is logged into the system shall be displayed on the right of the banner.
2. Each Page shall have a Pale Blue background.
   2.1. In The centre of the landing page, a map of the city of Mississauga shall be shown with the locations of the sites on the Niagara Server shown on the map.
   2.2. As each site is connected to the Niagara Server, the site links shall be populated and rearranged in Alphabetical order.
      2.2.1. Site links shall send the user to the appropriate Site Landing Page
      2.2.2. Site links shall have a dark blue background with white text when operating normally. If the connection to the JACE is interrupted at a site, the link shall turn red to indicate an alarm.
   2.3. A "WELCOME TO THE CITY OF MISSISSAUGA BAS" message shall appear above the CoM Map in the top center of the page, below the banner.
3. In the bottom left-hand corner on the landing page, there should be a link to the BAS contractor Landing Page and named "CONTRACTORS PAGE".
4. In the bottom right-hand corner on the landing page, there should be a link to the City of Mississauga Alarm Console named "ALARMS PAGE"

Page 2 – Site Landing Page

1. Each page on each site shall have the same Blue coloured banner with consistent information.
   1.1. City of Mississauga Logo to be provide by the City of Mississauga and will not include the text shown. To be located on the top left of each page in each site.
   1.2. Outside Air Temperature and Relative Humidity to be displayed in top right corner. Information to be grabbed from Internet Source.
   1.3. Time and Date to be displayed below Temperature and Humidity. Information to be grabbed from Internet Source.
2. Each Page shall have a pale blue background.

2.1. In the Center of the site landing page, a picture of the facility shall be shown. This will be provided by the city of Mississauga.
2.2. The name of the facility shall be in the top center of the Site Page below the banner. Font to be consistent with the Title on the Main Landing Page (Page 1, 2.3) and in all capital letters.

3. In the top left corner of the site page, a Status Icon shall indicate the status of the JACE at the site, green for Normal, Red for Alarm. There shall be one status icon for every JACE at the facility. If there are 3 Jaces, there shall be 3 status icons.
4. On the top right corner of the site page shall be a hyperlink to send the user to the Main City of Mississauga Landing Page
5. On the left hand side near the top of the page, below the banner, shall be a button or some sort of icon to allow the navigation bar to pop out or be hidden from view. The icon shall be labelled appropriately, and the navigation bar shall have the ability to be 'Pinned' in place. The banner shall be a dark blue colour with white font.

5.1. The first Icon in the Navigation bar shall be the Floorplan of the site. If there are multiple floors or buildings, there shall be multiple floorplans that shall pop out to be selected
5.2. The second icon in the navigation bar shall be a link to the Operating Schedule for the entire building.
5.3. The next links in the navigation bar shall be the Groups of the Major Mechanical Systems. Only systems that are present in the building shall be displayed.
5.4. If you click or hover over a specific navigation bar icon, there shall be a pop out to show the individual sub links associated with that group. Colour and font to match the main navigation bar.
5.5. If there is further breakdown needed to reduce the number of links in the navigation bar, a tertiary pop out bar shall be available for those links. IE. LIGHTING->INDOOR->NorthWest
5.6. Below the System links, if available, there shall be a link to the lighting controls
5.7. Below the the system links, there shall be a link to the alarm console of the building to view the alarm data for the entire facility
5.8. Below the trend data link, there shall be a link to the trend data of the building. This is not a link to the individual equipment trends, rather trends to view the status of the whole building. Work with CoM to develop what points go in this trend data
5.9. Below the building trends shall be a link to the BAS asbuilts for the site.
5.10. Below the BAS asbuilt link, shall be a link to view the status of the controllers at the facility
5.11. Below the Controllers, shall be a link to the point acronym chart of the building. See pageXX
5.12. Below the controller status link shall be a link to view the as built documentation for the BAS.
5.13. If there is no further space available on the left hand navigation bar, but there are more items to display, a "more links" button shall be available to pop out a second navigation bar on the right hand side to view that data
5.14. The bottom of the navigation bar should be the date and time shown through the JACE

Page 3. – System/Unit Graphic

1. Each page on each site shall have the same Blue coloured banner with consistent information.

1.1. City of Mississauga Logo to be provide by the City of Mississauga and will not include the text shown. To be located on the top left of each page in each site.
1.2. Outside Air Temperature and Relative Humidity to be displayed in top right corner. Information to be grabbed from Internet Source.
1.3. Time and Date to be displayed below Temperature and Humidity. Information to be grabbed from Internet Source.

2. Each Page shall have a pale blue background.
   2.1. In the Center of the page, an accurate graphical representation of the system or equipment shall be shown.
   2.2. The name of the unit or system shall be in the top center of the Site Page below the banner. Font to be consistent with the Title on the Main Landing Page (Page 1, 2.3) and in all capital letters.
   2.3. Below the banner, there shall be a link to a new page that shows the Sequence of Operation of the unit.
   2.4. Below the banner, to the right of the Sequences of Operation Link, There shall be a link to send the user to the "CONTROL SETTINGS" of the unit.
   2.5. Below the banner, to the right of the Control Setting link, a hyperlink to view and change the Time-of-Day Schedule of the unit
   2.6. Below the banner, to the right of the TOD Schedule, there shall be a hyperlink to send the user to a page to view the Trend data for the system/unit.
   2.7. Below the banner, to the right of the trends on the right hand side of the page shall be a hyperlink to return the user to the City of Mississauga main landing page.
3. The Unit/System graphic shall be developed using animated icons in the Niagara 4 Library
   3.1. The status of the command point shall be shown only. There shall be no ability to override the points from this page.
   3.2. Mode of Operation, and any other control mode information is to be displayed to the bottom left of the system
   3.3. Room Setpoints shall be displayed in a chart on the bottom left of the system setpoints
   3.4. Point names to be in a dark blue box, with white lettering.
      3.4.1. Point values to be beside the name, in a white box with blue letters.
      3.4.2. If point is controlled by OEM Controller, point value to be GOLD with black lettering
   3.5. If there is an Outside air temperature sensor associated with the controller of the system/unit, it shall be displayed in an appropriate place on the graphic. This point will be compared to the Outside air temperature picked up from the internet, displayed in the banner for alarming purposes.
   3.6. Any reset schedule or effective setpoint of the unit shall be displayed

Page 4 – Setpoints Page

1. Each Page shall have a pale blue background.
   1.1. In the Top left of the page, below the banner, shall be a link to the home page of the facility.
   1.2. Below the Home page link, shall be a link to the Unit or system graphic associated with the settings page
   1.3. If all the charts are filled with more points to be displayed, Below the System/Unit link shall be a link to the "More Setpoints" top show the additional information

1.4. Below the system link and the More settings link(when applicable), an advance settings link shall send the user to the PID control, adjustments, and alarm settings.
1.5. In the Top Right corner, below the banner, there shall be a link to the City of Mississauga main landing page.
1.6. The name of the unit or system shall be in the top center of the Site Page below the banner. Font to be consistent with the Title on the Main Landing Page (Page 1, 2.3) and in all capital letters.

2. On the right hand side, there shall be a chart to display and change the system setpoints
   2.1. On the left hand side, there shall be a chart to display the equipment command and status values, with ability to override. These will be timed overrides, not to exceed 24 hrs.

Page 5 – Advanced Settings Page

1. Each Page shall have a pale blue background.
   1.1. In the Top left of the page, below the banner, shall be a link to the home page of the facility.
   1.2. Below the Home page link, shall be a link to the Unit or system graphic associated with the settings page
   1.3. If all the charts are filled with more points to be displayed, Below the System/Unit link shall be a link to the “More Settings” top show the additional information
   1.4. In the Top Right corner, below the banner, there shall be a link to the City of Mississauga main landing page.
   1.5. The name of the unit or system shall be in the top center of the Site Page below the banner. Font to be consistent with the Title on the Main Landing Page (Page 1, 2.3) and in all capital letters.
2. In the center of the page, a chart shall be present to display the alarm settings, and detailed control settings available to the Super user group.
   2.1. Alarm Parameters to be grouped by alarm type. To include alarm delays and setpoints. Any extra details to be in a note below the alarm to make them clearer to the user.
   2.2. In the CoM graphics, there shall be no “set” or “on/off/auto” buttons. Adjustment of any of the settings to be accomplished by ‘right-click’ and shall be permanent overrides

Page 6 – Point Acronyms

1. Each page on each site shall have the same Blue coloured banner with consistent information.
   1.1. City of Mississauga Logo to be provide by the City of Mississauga and will not include the text shown. To be located on the top left of each page in each site.
   1.2. Outside Air Temperature and Relative Humidity to be displayed in top right corner. Information to be grabbed from Internet Source.
   1.3. Time and Date to be displayed below Temperature and Humidity. Information to be grabbed from Internet Source.
2. Each Page shall have a pale blue background.
   2.1. In the Top left of the page, below the banner, shall be a link to the home page of the facility.
   2.2. In the Top Right corner, below the banner, there shall be a link to the City of Mississauga main landing page.

2.3. The name of the unit or system shall be in the top center of the Site Page below the banner. Font to be consistent with the Title on the Main Landing Page (Page 1, 2.3) and in all capital letters.

3. A chart shall be shown with all the point accronyms present at the system so operators are able to know what certain points mean

Page 7 – Controller Statuses

1. Each Page shall have a pale blue background.
   1.1. In the Top left of the page, below the banner, shall be a link to the home page of the facility.
   1.2. Below the Home page link, shall be a link to the Network Layout graphic of the facility.
   1.3. In the Top Right corner, below the banner, there shall be a link to the City of Mississauga main landing page.
   1.4. "CONTROLLER STATUS" shall be in the top center of the Site Page below the banner. Font to be consistent with the Title on the Main Landing Page (Page 1, 2.3) and in all capital letters.
2. In the center of the page, there shall be a chart that shows all the RPDC Controllers in the facility, their location, and their communication status
   2.1. If the status of the controller is OFF, there shall be an alarm generated and the box shall turn Red
   2.2. Controllers names to follow point naming convention as specified in the master specification.

Page 8 – Contractor Landing Page – first page viewed when certain user group accesses the server

1. Each page on each site shall have the same Blue coloured banner with consistent information.
   1.1. City of Mississauga Logo to be provide by the City of Mississauga. To be located on the top left of each page in each site.
   1.2. Outside Air Temperature and Relative Humidity to be displayed in top right corner. Information to be grabbed from Internet Source.
   1.3. Time and Date to be displayed below Temperature and Humidity. Information to be grabbed from Internet Source.
2. Each Page shall have a pale blue background.
   2.1. In the Top Right corner, below the banner, there shall be a link to the City of Mississauga main landing page.
   2.2. In the top center below the banner, the title "Contractor Page" shall be in the same colour and font as the other title blocks

Pages 9 – Network Layout

1. Each page on each site shall have the same Blue coloured banner with consistent information.
   1.1. City of Mississauga Logo to be provide by the City of Mississauga. To be located on the top left of each page in each site.
   1.2. Outside Air Temperature and Relative Humidity to be displayed in top right corner. Information to be grabbed from Internet Source.
   1.3. Time and Date to be displayed below Temperature and Humidity. Information to be grabbed from Internet Source.
2. Each Page shall have a pale blue background.

2.1. In the Top left of the page, below the banner, shall be a link to the home page of the facility.
2.2. In the Top Right corner, below the banner, there shall be a link to the City of Mississauga main landing page.
2.3. "SITE NAME BAS NETWORK" shall be displayed in the centre of page below the banner. Font to be consistent with the Title on the Main Landing Page (Page 1, 2.3) and in all capital letters.

3. The first page of the network layout shall display an accurate representation of the following info
   3.1. Number of JACE 8000 controllers present on site
   3.2. Connection to COM Network
   3.3. Hyperlinks to BACnet IP Network connected to specific JACE 8000
   3.4. Location of JACE 8000 controller
   3.5. Hyperlinks to MS/TP Network connected to specified JACE 8000

Page 10 – BACnet IP Network

1. Each Page shall have a pale blue background.
   1.1. In the Top left of the page, below the banner, shall be a link to the home page of the facility.
   1.2. In the Top Right corner, below the banner, there shall be a link to the City of Mississauga main landing page.
   1.3. "SITE NAME BACnet IP NETWORK" shall be displayed in the centre of page below the banner. Font to be consistent with the Title on the Main Landing Page (Page 1, 2.3) and in all capital letters.
2. The IP network graphic of the network layout shall display an accurate representation of the following info:
   2.1. Number of Network Switches Present on site and connected to specific JACE 8000.
   2.2. Network runs between subnetwork switches
   2.3. Link to COM Network (Page 9)
   2.4. Hyperlinks to MS/TP Network connected to specified JACE 8000
   2.5. Hyperlinks to Network Switch Controller Graphic
   2.6. Location of Network Switches

Page 11 – MSTP Network

1. Each Page shall have a pale blue background.
   1.1. In the Top left of the page, below the banner, shall be a link to the home page of the facility.
   1.2. In the Top Right corner, below the banner, there shall be a link to the City of Mississauga main landing page.
   1.3. "SITE NAME MSTP NETWORK" shall be displayed in the centre of page below the banner. Font to be consistent with the Title on the Main Landing Page (Page 1, 2.3) and in all capital letters.
2. The MSTP network graphic of the network layout shall display an accurate representation of the following info:
   2.1. Link to COM Network (Page 9)
   2.2. Hyperlinks to BACnet IP Network connected to specified JACE 8000
   2.3. Location of MS/TP Controllers
   2.4. Network runs between controllers

Page 12 – Network Floorplan

1. Each page on each site shall have the same Blue coloured banner with consistent information.
   1.1. City of Mississauga Logo to be provide by the City of Mississauga and will not include the text shown. To be located on the top left of each page in each site.
   1.2. Outside Air Temperature and Relative Humidity to be displayed in top right corner. Information to be grabbed from Internet Source.
   1.3. Time and Date to be displayed below Temperature and Humidity. Information to be grabbed from Internet Source.
2. Each Page shall have a pale blue background.
   2.1. In the Top left of the page, below the banner, shall be a link to the home page of the facility.
   2.2. Below the Home page link, shall be a link to the Network layout
   2.3. If all the charts are filled with more points to be displayed, Below the System/Unit link shall be a link to the “More Settings” top show the additional information
   2.4. In the Top Right corner, below the banner, there shall be a link to the City of Mississauga main landing page.
   2.5. The name of the unit or system shall be in the top center of the Site Page below the banner. Font to be consistent with the Title on the Main Landing Page (Page 1, 2.3) and in all capital letters.
3. Floorplan shall show layout of the network trunk from each controller. Loop, controller #, and communication protocol to be defined.

Page 13 – Floorplan

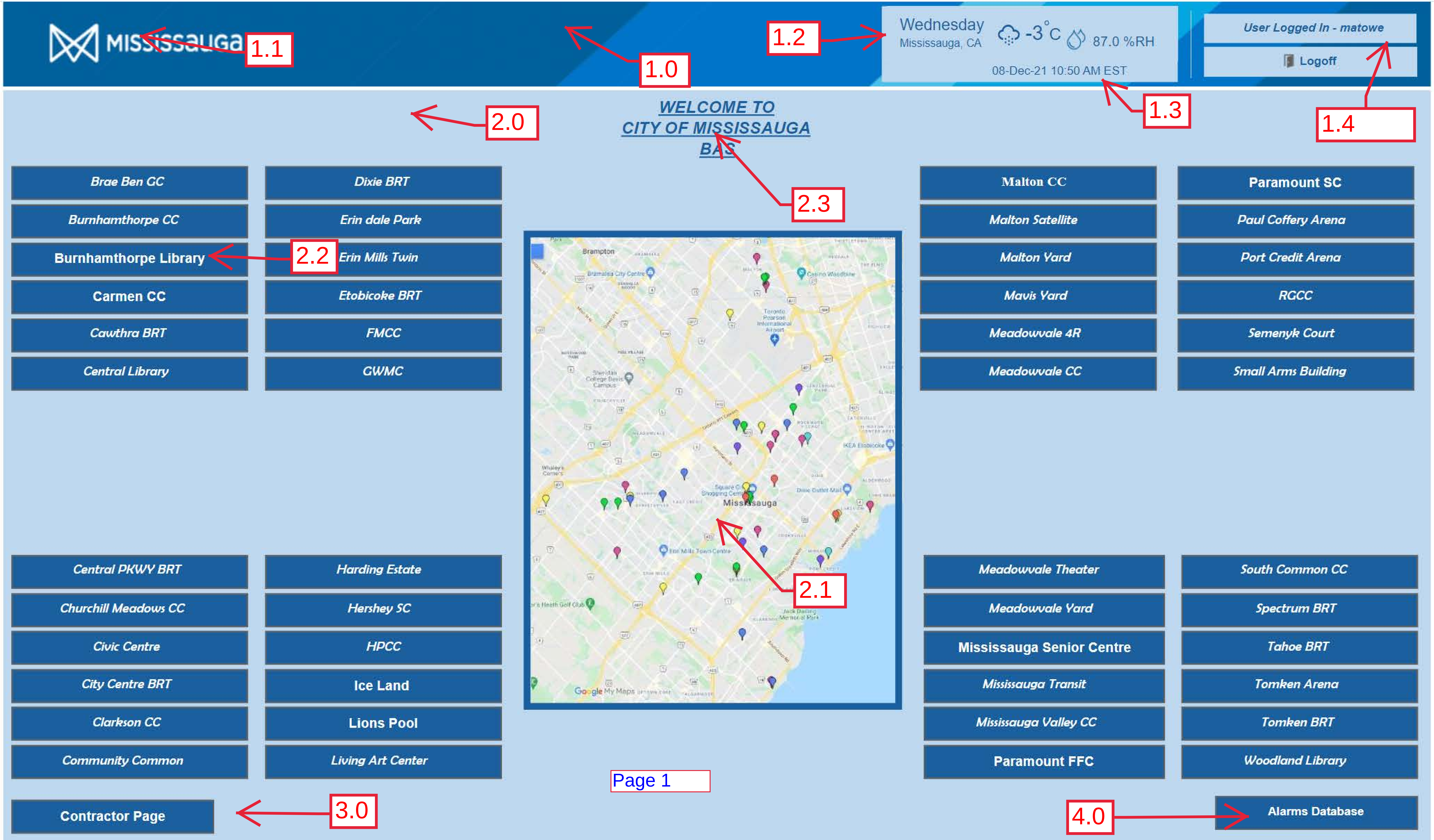
1. Each page on each site shall have the same Blue coloured banner with consistent information. See different page for example
   1.1. Navigation bar to be the same as the main facility page
2. Each page to have a light blue background
   2.1. Areas served by Ventilation Equipment to have a specific colour associated with the unit.
   2.2. Temperature, Humidity and CO2 level to be displayed on floorplan. If the facility is too large to view information, facility shall be broken into multiple smaller floorplans.
   2.3. Building security alarm status to be displayed in the top right corner of the floorplan
   2.4. Arrow to point in direction of “north” in relation to the orientation of the floorplans
   2.5. A link to AHUs serving floorplan are shall be located below the COM Homepage link

Page 14 & 15 – Logic Flow

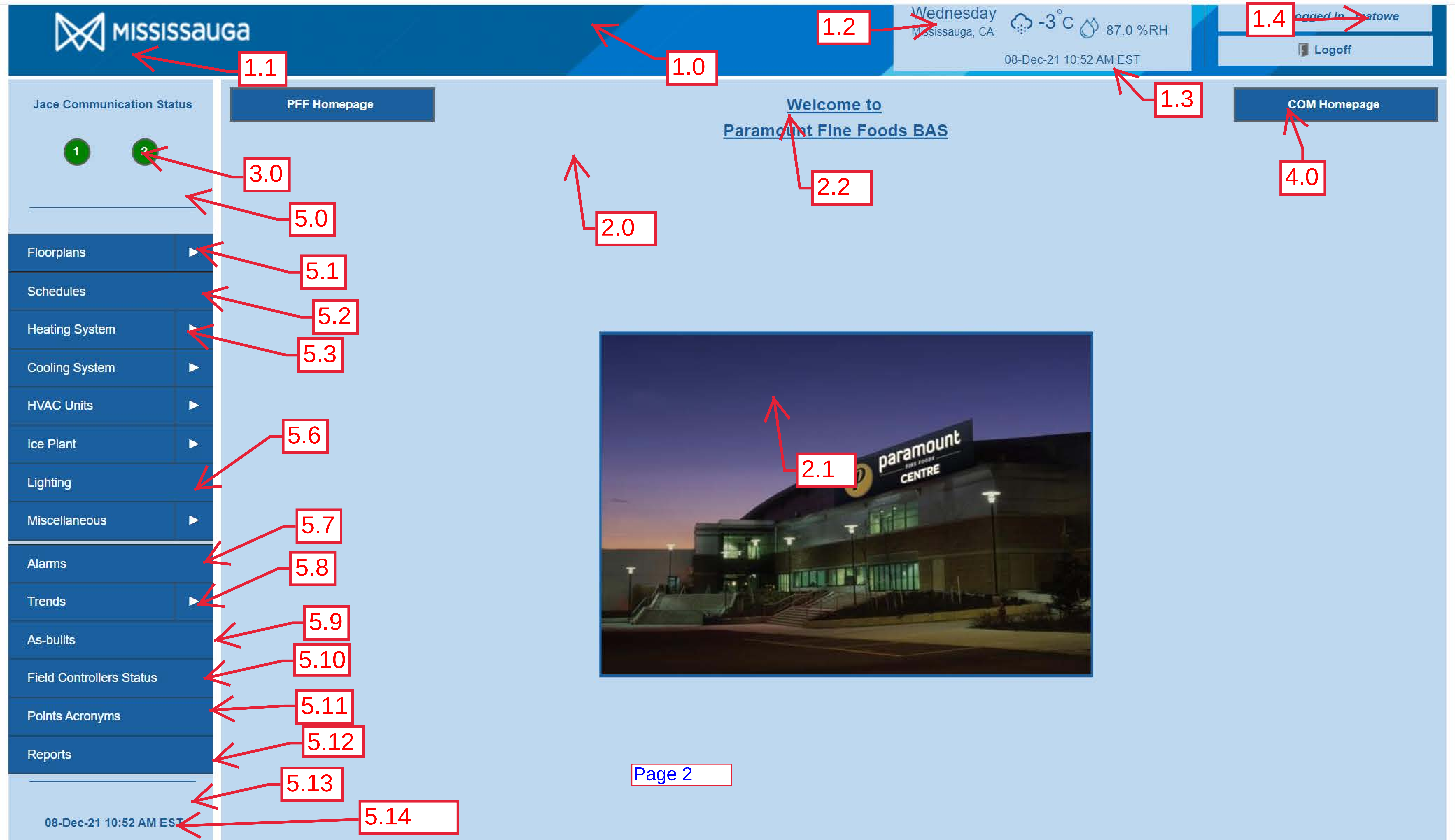
1. Each page on each site shall have the same Blue coloured banner with consistent information.
   1.1. City of Mississauga Logo to be provide by the City of Mississauga and will not include the text shown. To be located on the top left of each page in each site.
   1.2. Outside Air Temperature and Relative Humidity to be displayed in top right corner. Information to be grabbed from Internet Source.
   1.3. Time and Date to be displayed below Temperature and Humidity. Information to be grabbed from Internet Source.
2. Each Page shall have a pale blue background.
   2.1. In the Top left of the page, below the banner, shall be a link to the home page of the facility.

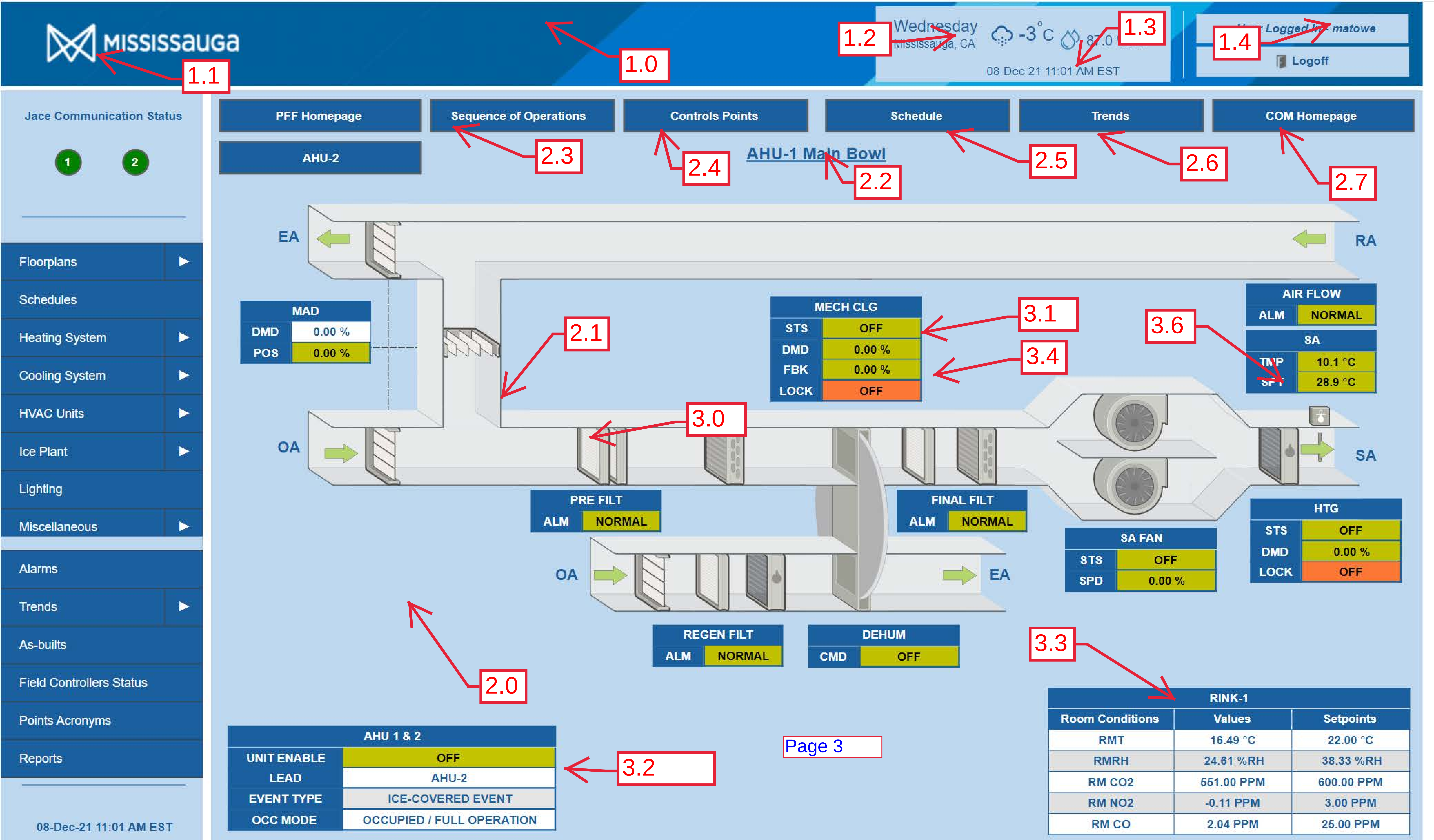
2.2. Below the Home page link, shall be a link to the Unit or system graphic associated with the logic flow diagram
2.3. In the Top Right corner, below the banner, there shall be a link to the City of Mississauga main landing page.
2.4. The name of the unit or system shall be in the top center of the Site Page below the banner. Font to be consistent with the Title on the Main Landing Page (Page 1, 2.3) and in all capital letters.

3. The rest of the graphic shall display a detailed visual of the sequence of operation of the complicated systems
   3.1. If more than one graphic page is required, there shall be a “prev” and “next” navigation links in the bottom right corner



MISSISSAUGA
1.1
1.0
1.2
Wednesday
Mississauga, CA
-3°C
87.0 %RH
08-Dec-21 10:50 AM EST
1.3
User Logged In - matowe
Logoff
1.4
2.0
WELCOME TO
CITY OF MISSISSAUGA
BAS
2.3
Brae Ben GC
Burnhamthorpe CC
Burnhamthorpe Library
2.2
Carmen CC
Cawthra BRT
Central Library
Dixie BRT
Erin dale Park
Erin Mills Twin
Etobicoke BRT
FMCC
GWMC
Malton CC
Malton Satellite
Malton Yard
Mavis Yard
Meadowvale 4R
Meadowvale CC
Paramount SC
Paul Coffery Arena
Port Credit Arena
RGCC
Semenyk Court
Small Arms Building
Brampton
Mississauga
2.1
Central PKWY BRT
Churchill Meadows CC
Civic Centre
City Centre BRT
Clarkson CC
Community Common
Harding Estate
Hershey SC
HPCC
Ice Land
Lions Pool
Living Art Center
Meadowvale Theater
Meadowvale Yard
Mississauga Senior Centre
Mississauga Transit
Mississauga Valley CC
Paramount FFC
South Common CC
Spectrum BRT
Tahoe BRT
Tomken Arena
Tomken BRT
Woodland Library
Page 1
Contractor Page
3.0
4.0
Alarms Database


MISSISSAUGA
1.1
1.0
1.2
Wednesday
Mississauga, CA
-3 °C
87.0 %RH
08-Dec-21 10:52 AM EST
1.3
1.4
Logoff
Jace Communication Status
1
2
3.0
5.0
PFF Homepage
Welcome to
Paramount Fine Foods BAS
2.2
2.0
COM Homepage
4.0
Floorplans
5.1
Schedules
5.2
Heating System
5.3
Cooling System
HVAC Units
Ice Plant
5.6
Lighting
Miscellaneous
5.7
Alarms
5.8
Trends
5.9
As-builts
5.10
Field Controllers Status
5.11
Points Acronyms
5.12
Reports
5.13
08-Dec-21 10:52 AM EST
5.14
2.1
paramount
CENTRE
Page 2


MISSISSAUGA
Wednesday
Mississauga, CA
-3°C
08-Dec-21 11:01 AM EST
User Logged in: matowe
Logoff
1.0
1.1
1.2
1.3
1.4
Jace Communication Status
1
2
Floorplans
Schedules
Heating System
Cooling System
HVAC Units
Ice Plant
Lighting
Miscellaneous
Alarms
Trends
As-builts
Field Controllers Status
Points Acronyms
Reports
08-Dec-21 11:01 AM EST
PFF Homepage
Sequence of Operations
Controls Points
Schedule
Trends
COM Homepage
AHU-2
AHU-1 Main Bowl
2.0
2.1
2.2
2.3
2.4
2.5
2.6
2.7
EA
RA
OA
SA
MAD
DMD 0.00 %
POS 0.00 %
MECH CLG
STS OFF
DMD 0.00 %
FBK 0.00 %
LOCK OFF
AIR FLOW
ALM NORMAL
SA
TMP 10.1 °C
SPT 28.9 °C
PRE FILT
ALM NORMAL
FINAL FILT
ALM NORMAL
SA FAN
STS OFF
SPD 0.00 %
HTG
STS OFF
DMD 0.00 %
LOCK OFF
REGEN FILT
ALM NORMAL
DEHUM
CMD OFF
3.0
3.1
3.2
3.3
3.4
3.6
AHU 1 & 2
UNIT ENABLE OFF
LEAD AHU-2
EVENT TYPE ICE-COVERED EVENT
OCC MODE OCCUPIED / FULL OPERATION
Page 3
RINK-1
Room Conditions | Values | Setpoints
RMT | 16.49 °C | 22.00 °C
RMRH | 24.61 %RH | 38.33 %RH
RM CO2 | 551.00 PPM | 600.00 PPM
RM NO2 | -0.11 PPM | 3.00 PPM
RM CO | 2.04 PPM | 25.00 PPM

MISSISSAUGA

Wednesday Mississauga, CA -2°C 87.0 %RH
08-Dec-21 11:24 AM EST

User Logged In - matowe
Logoff

Jace Communication Status
1 2

- Floorplans
- Schedules
- Heating System
- Cooling System
- HVAC Units
- Ice Plant
- Lighting
- Miscellaneous
- Alarms
- Trends
- As-builts
- Field Controllers Status
- Points Acronyms
- Reports

08-Dec-21 11:24 AM EST

PFF Homepage 1.1
System Graphic 1.2
Settings Graphic 1.4

AHU 1 & 2 MAIN BOWL SETPOINTS

1.6 1.0 1.5

COM Homepage

AHU-1 & 2	
Parameters	Values
AHU EVENT TYPE	ICE-COVERED EVENT
OCCUPANCY MODE	OCCUPIED / FULL OPERATION

AHU-1 & 2 LEAD LAG	
Parameters	Values
LEAD SELECT	AHU-2
LEAD ROTATION HOURS	200.00 HR
LEAD RUNTIME HOURS	102.16 HR

AHU-1	
Command	Values
UNIT ENABLE	OFF
PRE COOL ENABLE	OFF
DE-HUMIDIFICATION ENABLE	OFF
HEATING DEMAND	0.00 %
COOLING DEMAND	0.00 %

AHU-2	
Command	Values
UNIT ENABLE	OFF
PRE COOL ENABLE	OFF
DE-HUMIDIFICATION ENABLE	OFF
HEATING DEMAND	0.00 %
COOLING DEMAND	0.00 %

AHU-1 & 2	
Parameters	Values
DEHUMIDIFICATION INTERLOCK	ON
UNOCCUPIED CALL STS	OFF

RINK-1	
Room Temperature Setpoints	Values
Ice In or Ice Make	9.00 °C
Ice Covered or Ice Out Occ Spt	22.00 °C
Ice Covered or Ice Out UnOcc Htg Spt	18.00 °C
Ice Covered or Ice Out UnOcc Clg Spt	28.00 °C
Calculated Setpoint	Values
ROOM TEMPERATURE SETPOINT	22.00 °C

RINK-1 (RMT-RMRH SPT RESET CURVE)	
Room Temperature	RMRH
4.44 °C	65.00 %RH
12.78 °C	45.00 %RH
18.33 °C	35.00 %RH
23.89 °C	25.00 %RH
29.44 °C	15.00 %RH
Calculated Room Humidity Setpoint	Values
RESET SPT	38.30 %RH

RINK-1 (RMT-SAT SPT RESET CURVE)	
Room Terminal Load	Supply Air Temperature
-100% = FULL HEATING	29.40 °C
+100% = FULL COOLING	7.20 °C
Calculated Parameters	Values
TERMINAL LOAD	-100.00 %
SUPPLY AIR TEMPERATURE SETPOINT	29.40 °C

RINK-1 GAS VENTILAITON	
Setpoints	Values
CARBON DIOXIDE	600.00 PPM
CARBON MONOXIDE	25.00 PPM
NITROGEN DIOXIDE	3.00 PPM

MINIMUM DAMPER POSITION	
AHU	Values
AHU-1	18.00 %
AHU-2	20.00 %

RINK-1 NORMAL FRESH AIR REQUIREMENT	
Occupancy Type	Values
UNOCCUPIED	5.00 %
MODERATE OCCUPANCY - WITH 1 AHU DMD	50.00 %
MODERATE OCCUPANCY - WITH 2 AHU DMD	25.00 %
FULL OPERATION OCCUPANCY	75.00 %

Rink-1 GAS VENTILATION	
Occupancy Type	Values
NO2 UNOCCUPIED DAMPER POSITION SPT	60.00 %
CO UNOCCUPIED DAMPER POSITION SPT	60.00 %

AHU-1 & 2	
Command	Values
AHU-1 DAMPER POSITION DEMAND	0.00 %
AHU-2 DAMPER POSITION DEMAND	0.00 %

2.1 2.0

MISSISSAUGA

Wednesday
Mississauga, CA
-2°C
87.0 %RH
08-Dec-21 11:25 AM EST

User Logged In - matowe

Logoff

Jace Communication Status

1 2

- Floorplans
- Schedules
- Heating System
- Cooling System
- HVAC Units
- Ice Plant
- Lighting
- Miscellaneous
- Alarms
- Trends
- As-builts
- Field Controllers Status
- Points Acronyms
- Reports

08-Dec-21 11:25 AM EST

PFF Homepage 1.1

System Graphic 1.2

Controls Points

AHU 1 & 2 MAIN BOWL SETTINGS

1.5

1.4 COM Homepage

2.1

ENGINEERED AIR BACnet ALARMS		
MAINTENANCE ALARMS		
	AHU-1	AHU-2
AIRFLOW ALARM	NORMAL	NORMAL
AMBIENT SENSOR ALARM	NORMAL	NORMAL
SAT SENSOR ALARM	NORMAL	NORMAL
GENERAL SENSOR FAILURE ALARM	NORMAL	NORMAL
PRE FILTER ALARM	NORMAL	NORMAL
FINAL FILTER ALARM	NORMAL	NORMAL
REGEN FILTER ALARM	NORMAL	NORMAL

2.1

ENVIRONMENTAL ALARMS	
ROOM CARBON DIOXIDE	
ROOM CARBON DIOXIDE HIGH LIMIT ALARM	NORMAL
ROOM CARBON DIOXIDE HIGH LIMIT SETPOINT	800.00 PPM
ROOM CARBON DIOXIDE ALARM ON DELAY	30.00 MIN
ROOM CARBON DIOXIDE ALARM OFF DELAY	5.00 MIN
ROOM CARBON DIOXIDE ALARM RESET DEADBAND	20.00 PPM
AHU-2 FAN	
AHU-2 FAN FAIL ALARM	NORMAL
AHU-2 FAN FAIL ALARM ON DELAY	30.00 MIN
AHU-1 FAN	
AHU-1 FAN FAIL ALARM	NORMAL
AHU-1 FAN FAIL ALARM ON DELAY	30.00 MIN

2.0

ENVIRONMENTAL ALARMS	
ROOM TEMPERATURE	
ROOM TEMPERATURE LOW LIMIT ALARM	NORMAL
ROOM TEMPERATURE LOW LIMIT SETPOINT	6.00 °C
ROOM TEMPERATURE HIGH LIMIT ALARM	NORMAL
ROOM TEMPERATURE HIGH LIMIT SETPOINT	24.00 °C
ROOM TEMPERATURE ALARM ON DELAY	30.00 MIN
ROOM TEMPERATURE ALARM OFF DELAY	5.00 MIN
ROOM TEMPERATURE ALARM RESET DEADBAND	1.00 °C
ROOM HUMIDITY	
ROOM HUMIDITY LOW LIMIT ALARM	NORMAL
ROOM HUMIDITY LOW LIMIT SETPOINT	14.00 %RH
ROOM HUMIDITY HIGH LIMIT ALARM	ALARM
ROOM HUMIDITY HIGH LIMIT SETPOINT	24.00 %RH
ROOM HUMIDITY ALARM ON DELAY	30.00 MIN
ROOM HUMIDITY ALARM OFF DELAY	5.00 MIN
ROOM HUMIDITY ALARM RESET DEADBAND	1.00 %RH
ROOM CARBON MONOXIDE	
ROOM CARBON MONOXIDE HIGH LIMIT ALARM	NORMAL
ROOM CARBON MONOXIDE HIGH LIMIT SETPOINT	26.00 PPM
ROOM CARBON MONOXIDE ALARM ON DELAY	30.00 MIN
ROOM CARBON MONOXIDE ALARM OFF DELAY	5.00 MIN
ROOM CARBON MONOXIDE ALARM RESET DEADBAND	2.00 PPM
ROOM NITROGEN DIOXIDE	
ROOM NITROGEN DIOXIDE HIGH LIMIT ALARM	NORMAL
ROOM NITROGEN DIOXIDE HIGH LIMIT SETPOINT	3.00 PPM
ROOM NITROGEN DIOXIDE ALARM ON DELAY	30.00 MIN
ROOM NITROGEN DIOXIDE ALARM OFF DELAY	5.00 MIN
ROOM NITROGEN DIOXIDE ALARM RESET DEADBAND	0.50 PPM

1.0

~~Our Corporate Intranet~~
~~Inside Mississauga~~

1.1 1.0 1.2 1.3

OAT RH

Time & Date

Site Home Page 2.1

Points Acronym 2.2

City Home Page

2.3

3.0

2.0

Description	Tag
Supply Fan	SF
Return Fan	RF
Exhaust Fan	EF
Supply Fan VSD	SFVSD
Return Fan VSD	RFVSD
Heating Control Valve	HTGVLV
Cooling Valve	CLGVLV
Differential Pressure Valve	DPVLV
Refrigeration Solenoid Valve	DXVLV
Damper	DPR
Freeze stat	FRZ
Supply Air Temp Sensor	SAT

CONTROLLER STATUS - 1

Jace Communication Status

1 2

PEE Homepage

Network Layout

Controller Status - 2

COM Homepage

1.1

1.2

1.3

1.4

1.0

oorplans

hedules

eating System

ooling System

/AC Units

e Plant

ghting

scellaneous

arms

ends

-builts

eld Controllers Status

oints Acronyms

eports

Controllers	Status	Location	System
RPDC1_001	ONLINE	EMCSCP01 - Rink 1 Boiler Room	Heating Plant - Rink 1 & 2
RPDC1_002	ONLINE	EMCSCP01 - Rink 1 Boiler Room	Heating Plant - Rink 1 & 2
RPDC1_003	ONLINE	EMCSCP01 - Rink 1 Boiler Room	Heating Plant - Rink 1 & 2
RPDC1_004	ONLINE	EMCSCP01 - Rink 1 Boiler Room	Heating Plant - Rink 1 & 2

2.2

2.0

Controllers	Status	Location	System
RPDC2_001	ONLINE	EMCSCP14 - Refrigeration Room 1308	Heating Plant - Rink 3 & 4
RPDC2_002	ONLINE	-	-
RPDC2_003	ONLINE	EMCSCP14 - Refrigeration Room 1308	Heating Plant - Rink 3 & 4
RPDC2_004	OFFLINE	EMCSCP14 - Refrigeration Room 1308	Heating Plant - Rink 3 & 4
RPDC2_005	OFFLINE	EMCSCP14 - Refrigeration Room 1308	Heating Plant - Rink 3 & 4

2.1

08-Dec-21 11:28 AM EST

MISSISSAUGA

1.2

Wednesday
Mississauga, CA
-3°C 87.0 %RH
08-Dec-21 10:49 AM EST

User Logged In - matowe

Logoff

1.1

CONTRACTOR PAGE

COM Homepage

2.2

1.3

2.1

Notes:

1 - Please contact one of the emails below before conducting any system changes

	Contact Name	Email	ext	
IT	Alex Kuzmin	alex.kuzmin@mississauga.ca	5981	or IT helpdesk @3222
BAS Coordinator	Daniel Khoshaba	daniel.khoshaba@mississauga.ca	5838	
Facility Maintenance	Douglas Hughes	douglas.hughes@mississauga.ca	5205	
Energy Management	Rajesh Mehta	rajesh.mehta@mississauga.ca	5786	

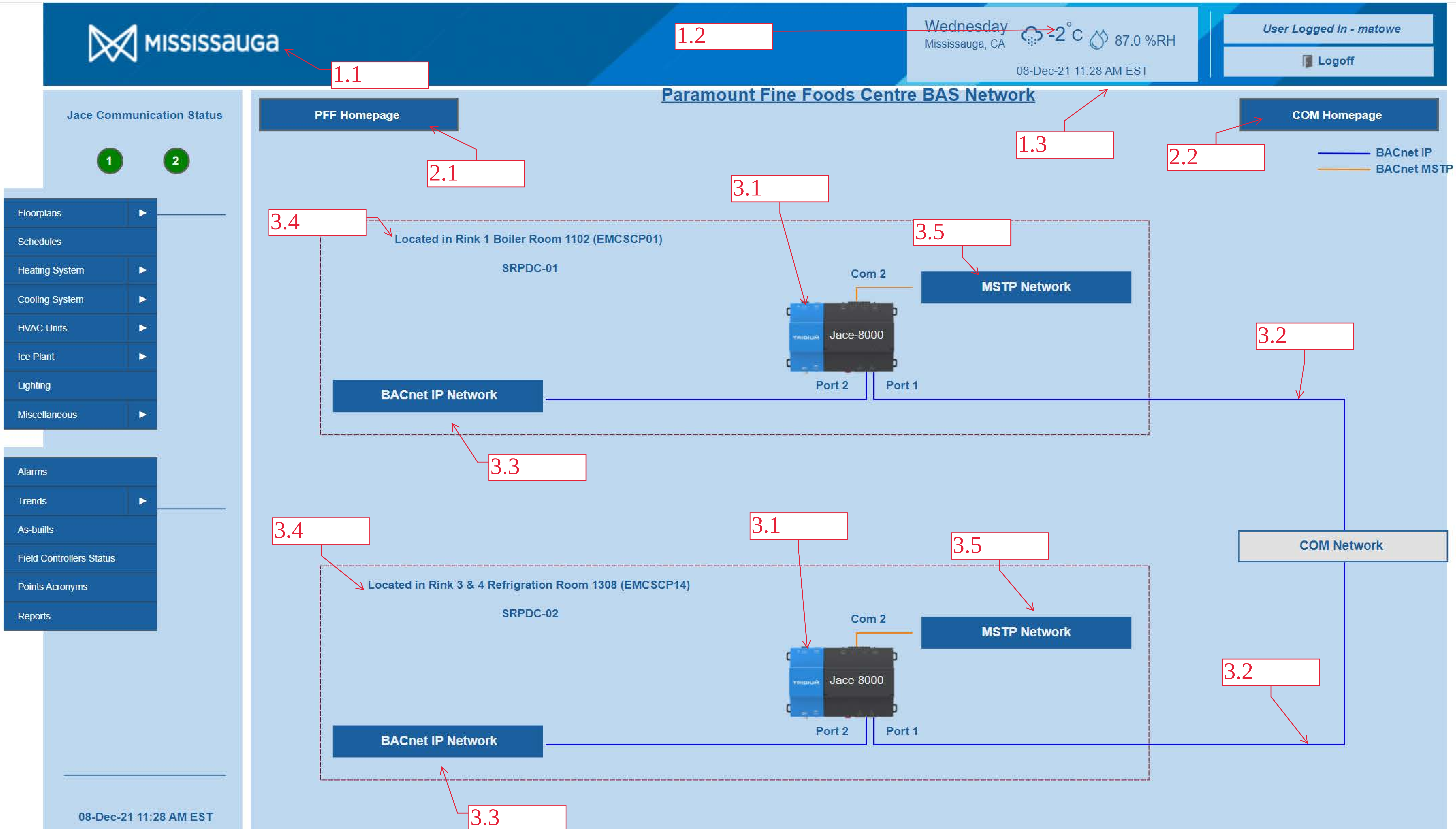
2 - Save any changes made to database and/or graphics on the server backup file

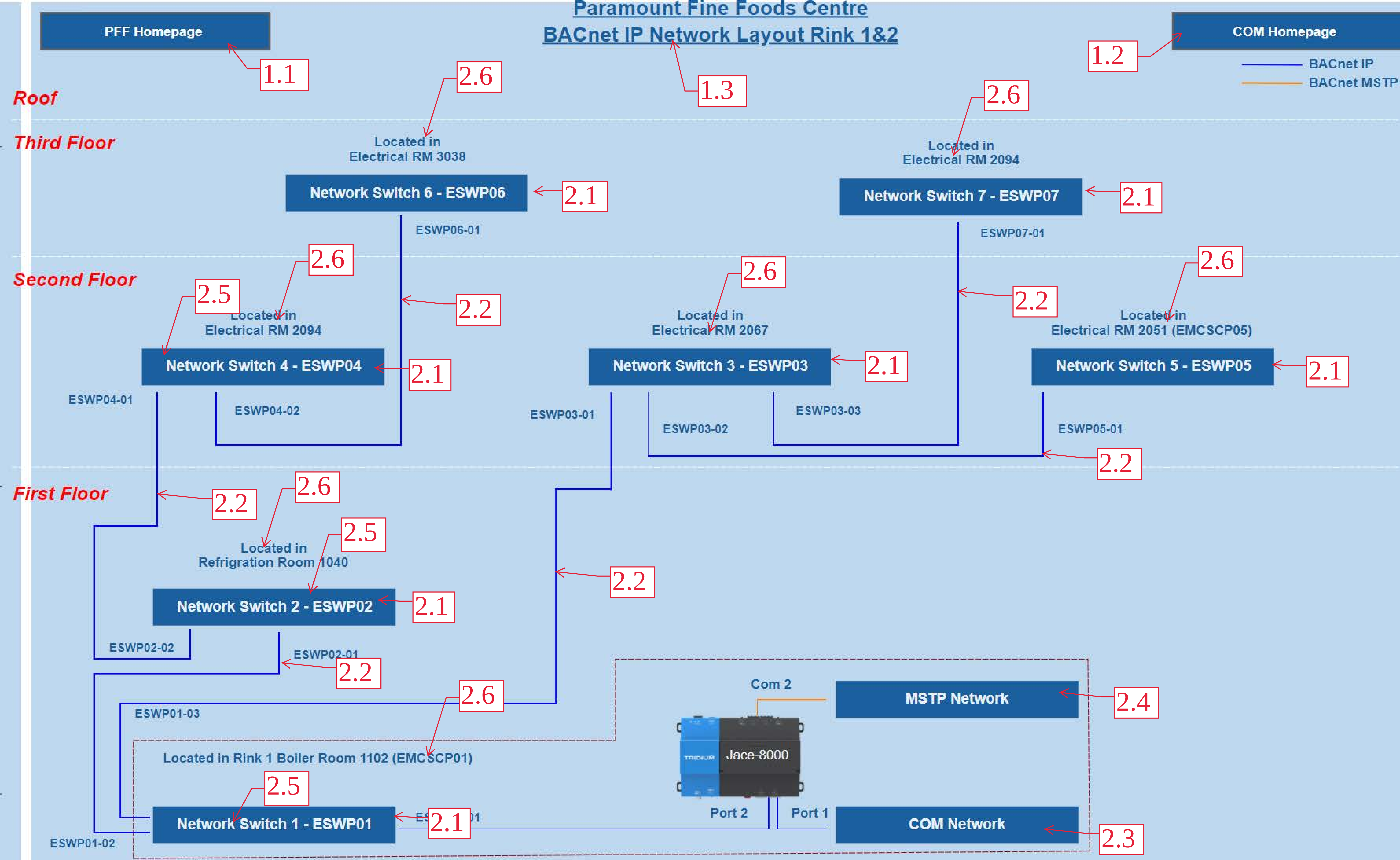
3 - Don't install any software without the proper approval from COM

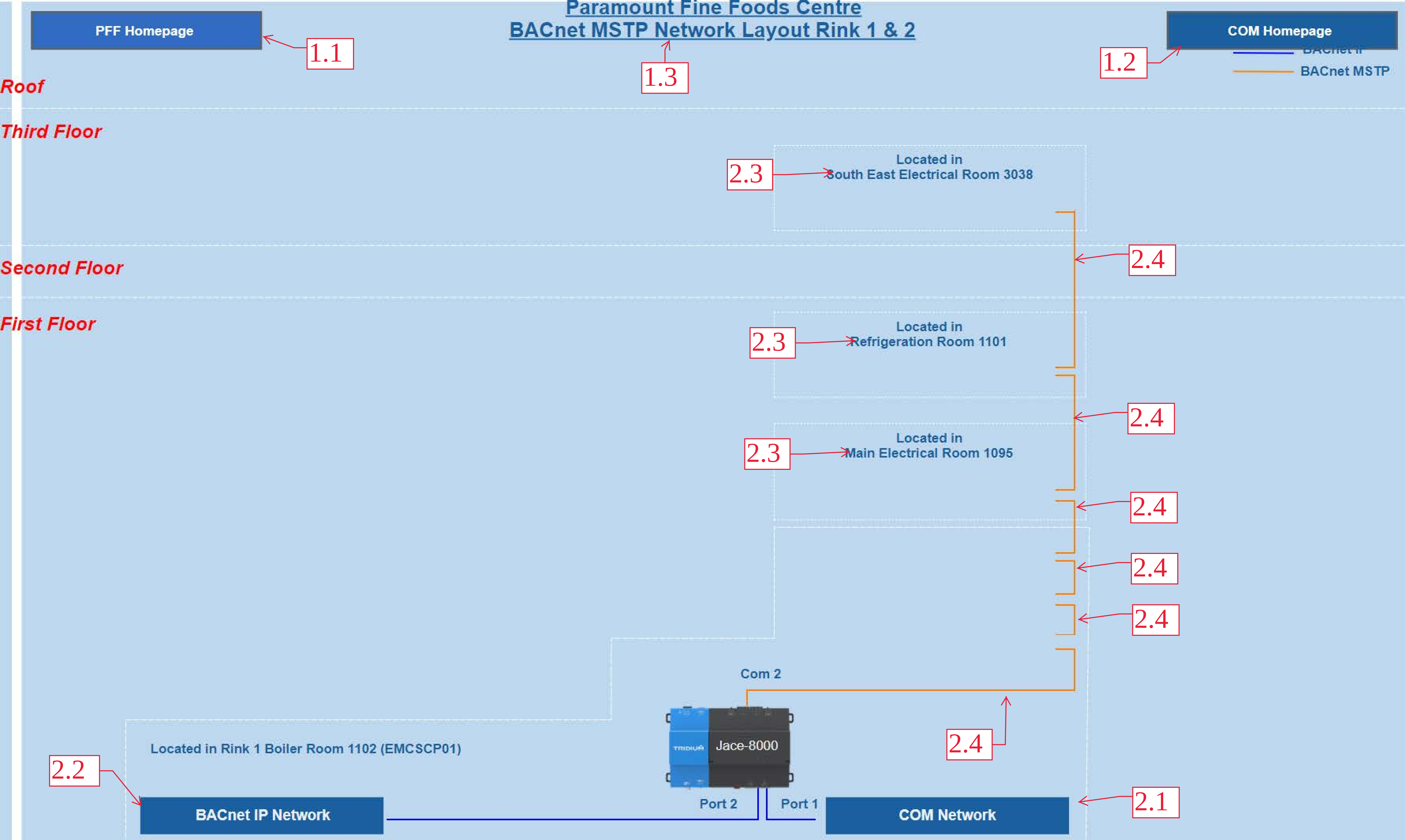
4 - Don't create or modify any user account without approval from COM

5 - Don't reset or restart the server, JACE or any field devices witout approval from COM

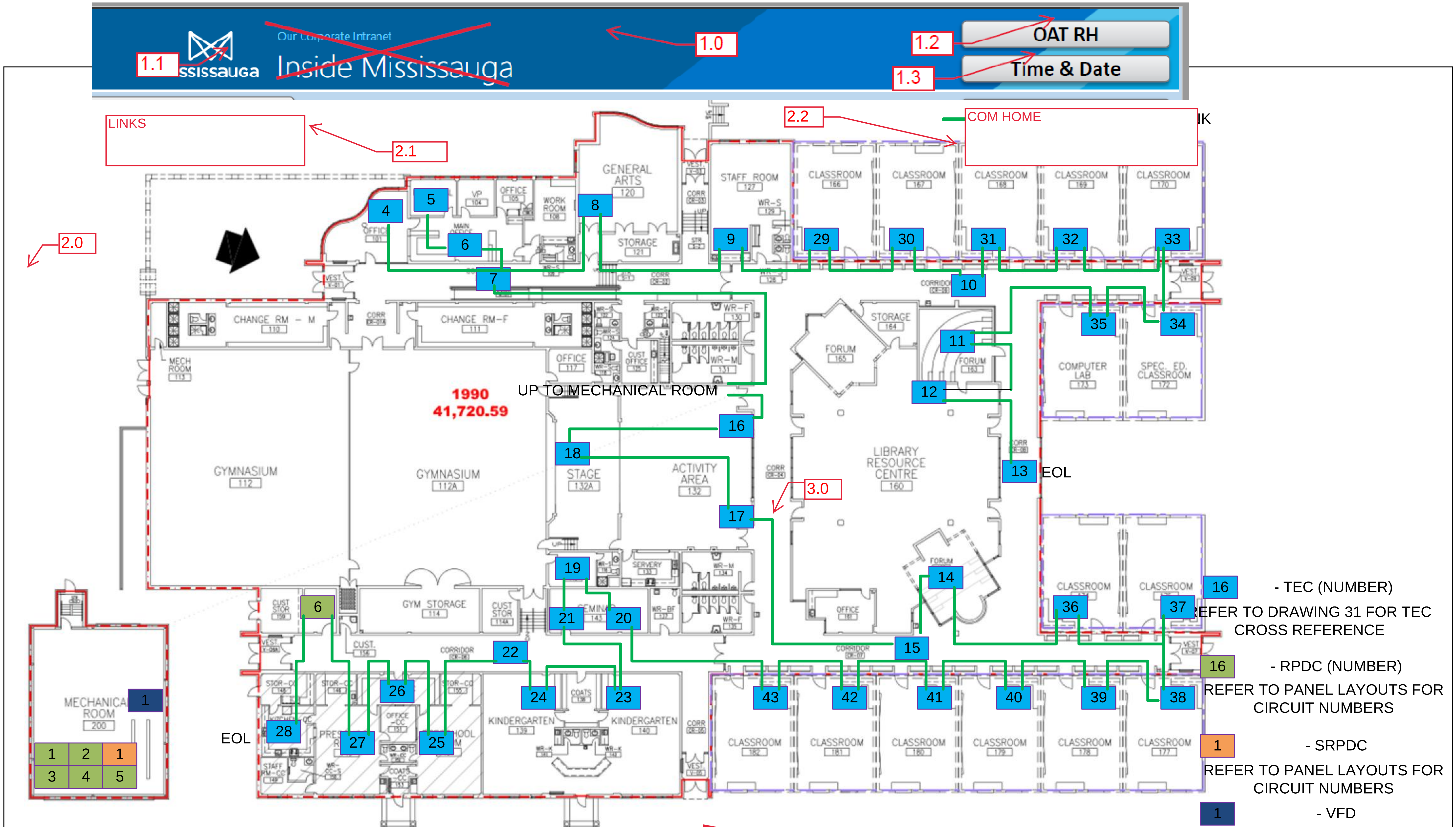
6 - In case of urgent issue with server, BAS, or any Jace please inform COM immediately using the info above


MISSISSAUGA
1.1
1.2
Wednesday
Mississauga, CA
-2 °C
87.0 %RH
08-Dec-21 11:28 AM EST
User Logged In - matowe
Logoff
Paramount Fine Foods Centre BAS Network
1.3
Jace Communication Status
1
2
PFF Homepage
2.1
COM Homepage
2.2
BACnet IP
BACnet MSTP
Floorplans
Schedules
Heating System
Cooling System
HVAC Units
Ice Plant
Lighting
Miscellaneous
Alarms
Trends
As-builts
Field Controllers Status
Points Acronyms
Reports
08-Dec-21 11:28 AM EST
3.1
3.4
Located in Rink 1 Boiler Room 1102 (EMCSCP01)
SRPDC-01
3.5
Com 2
MSTP Network
Jace-8000
3.2
BACnet IP Network
Port 2
Port 1
3.3
3.4
3.1
3.5
Located in Rink 3 & 4 Refrigration Room 1308 (EMCSCP14)
SRPDC-02
COM Network
Com 2
MSTP Network
Jace-8000
3.2
BACnet IP Network
Port 2
Port 1
3.3


Paramount Fine Foods Centre
BACnet IP Network Layout Rink 1&2
PFF Homepage
COM Homepage
BACnet IP
BACnet MSTP
Roof
Third Floor
Second Floor
First Floor
1.1
1.2
1.3
Located in Electrical RM 3038
Network Switch 6 - ESWP06
ESWP06-01
Located in Electrical RM 2094
Network Switch 7 - ESWP07
ESWP07-01
Located in Electrical RM 2094
Network Switch 4 - ESWP04
ESWP04-01
ESWP04-02
Located in Electrical RM 2067
Network Switch 3 - ESWP03
ESWP03-01
ESWP03-02
ESWP03-03
Located in Electrical RM 2051 (EMCSCP05)
Network Switch 5 - ESWP05
ESWP05-01
Located in Refrigration Room 1040
Network Switch 2 - ESWP02
ESWP02-02
ESWP02-01
ESWP01-03
Located in Rink 1 Boiler Room 1102 (EMCSCP01)
Network Switch 1 - ESWP01
ESWP01-02
Com 2
Jace-8000
Port 2
Port 1
MSTP Network
COM Network
2.1
2.2
2.3
2.4
2.5
2.6



Paramount Fine Foods Centre
BACnet MSTP Network Layout Rink 1 & 2
PFF Homepage
COM Homepage
BACnet MSTP
1.1
1.2
1.3
Roof
Third Floor
Second Floor
First Floor
Located in
South East Electrical Room 3038
Located in
Refrigeration Room 1101
Located in
Main Electrical Room 1095
2.3
2.3
2.3
2.4
2.4
2.4
2.4
2.4
2.4
Com 2
Jace-8000
Located in Rink 1 Boiler Room 1102 (EMCSCP01)
2.2
BACnet IP Network
Port 2
Port 1
COM Network
2.1



Byron Somerset PS 175 Whisperwood Ave, London, ON N6K 4C6	Drawing Title Network Layout Ground Floor	01 RELEASED FOR BUILD 2020-10-17 PR
	Project Title EMCS Upgrade 2020 Tender Package 11	THIS DOCUMENT CONTAINS CONFIDENTIAL AND PROPRIETARY INFORMATION THAT CANNOT BE REPRODUCED OR DIVULGED, IN WHOLE OR IN PART, WITHOUT WRITTEN AUTHORIZATION FROM INGENUITY BET.
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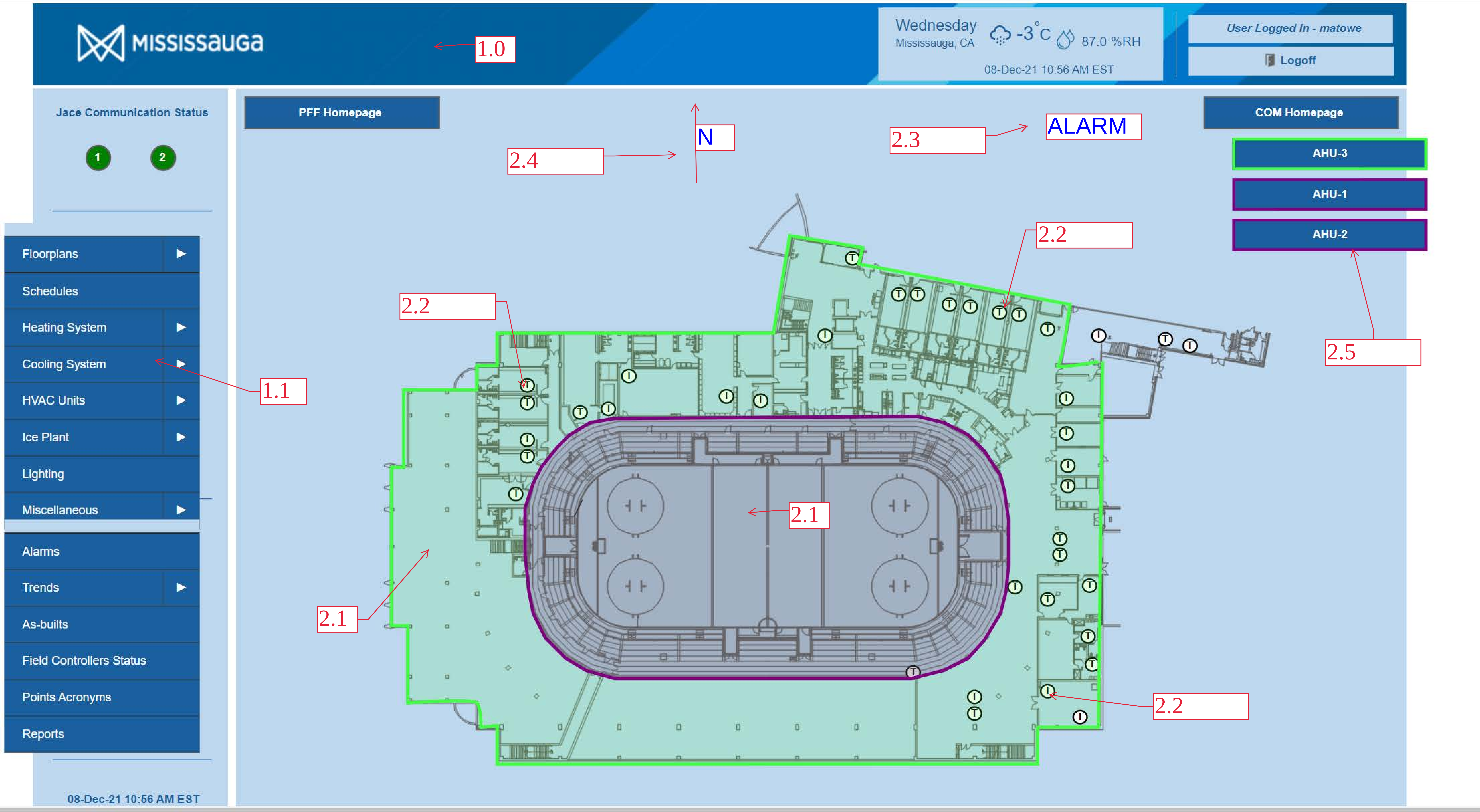

MISSISSAUGA
1.0
Wednesday
Mississauga, CA
-3 °C
87.0 %RH
08-Dec-21 10:56 AM EST
User Logged In - matowe
Logoff
Jace Communication Status
1
2
PFF Homepage
COM Homepage
N
2.4
2.3
ALARM
AHU-3
AHU-1
AHU-2
2.5
2.2
2.2
2.2
2.1
2.1
1.1
Floorplans
Schedules
Heating System
Cooling System
HVAC Units
Ice Plant
Lighting
Miscellaneous
Alarms
Trends
As-builts
Field Controllers Status
Points Acronyms
Reports
08-Dec-21 10:56 AM EST

MISSISSAUGA 1.1

1.2

Wednesday
Mississauga, CA
-3 °C 87.0 %RH
08-Dec-21 11:04 AM EST

1.3

User Logged In - matowe

Logoff

Jace Communication Status

1 2

- Floorplans
- Schedules
- Heating System
- Cooling System
- HVAC Units
- Ice Plant
- Lighting
- Miscellaneous
- Alarms
- Trends
- As-builts
- Field Controllers Status
- Points Acronyms
- Reports

08-Dec-21 11:04 AM EST

PFF Homepage 2.1

AHU-1 2.2

AHU-2 2.2

AHU 1 & 2 BMS SOP - 1

2.4

COM Homepage

2.3

Sequence of Operations

Main Bowl Event Type is set by BMS manually:

1. Ice-In Event
2. Ice-Covered Event
3. Ice-Out Event
4. Ice-Making Event

Main Bowl Activity Level is set by BMS via Schedule:

1. Unoccupied/No Activity
2. Occupied/Moderate Activity
3. Occupied/Full Operation

Lead-Lag Operation

1. AHU 1 & 2 work in a Lead/Lag operation during normal operation and rotate after every 400 hr (adj.)

Temperature Control

ICE-In or ICE-Make Events:

1.) During the Ice-In and Ice-Make events Lead AHU operates 24/7, and maintain the rink temperature by resetting the supply air temperature via BACnet.

ICE-Out or ICE-Cover Events:

1.) During the Ice-Out and Ice-Cover events, AHU 1&2 follows the Occupancy Schedule and perform the (Unoccupied, Moderate/Full Operation) activities.

2.) During the occupied hours, Lead AHU maintains the rink temperature by resetting the supply air temperature via BACnet.

3.) During the unoccupied hours, AHU follows the unoccupied heating/cooling setpoint, if rink temperature goes out of unoccupied temperature limits then, Lead AHU turns ON to maintain the room temperature. If Lead AHU cannot satisfy the rink temperature in next 15 minutes then, the LAG AHU turns ON.

Dehumidification Control

ICE-IN or ICE-MAKE Events:

1.) During the Ice-In and Ice-Make events, Lead AHU maintains the rink relative humidity level 24/7, and rink relative humidity setpoint resets based on room temperature conditions.

RINK-1 (RMT-RMRH SPT RESET CURVE)	
Room Temperature	Room Relative Humidity
4.44 °C	65.00 %RH
12.78 °C	45.00 %RH
18.33 °C	35.00 %RH
23.89 °C	25.00 %RH
29.44 °C	15.00 %RH

ICE-Out or ICE-Cover Events:

1.) During the Ice-Out and Ice-Cover events, AHUs does not perform the dehumidification process and it always stay locked.

Next

AHU 1 & 2 BMS SOP - 2

Gas Ventilation (CO/NO2)

Unoccupied/No Activity

1. If the rink gas concentration's goes out of its setpoint limits then the lead AHU cycles ON at 60% (adj.) OA damper to bring in fresh air. If the gas concencentration does not decrease to its acceptable level within 15 minutes then, the lag AHU turn ON to bring in more fresh air.

Occupied/Moderate Activity

1. If the rink gas concentration's goes out of its setpoint limits then the lead AHU modulates the OA damper to bring in fresh air. If the gas concencentration does not decrea its acceptable level within 15 minutes then, the lag AHU turn ON to bring in more fresh air.

Occupied/Full Activity

1. If the rink gas concentration's goes out of its setpoint limits then the both the AHU's modulates the OA damper to bring in fresh air.

Gas Ventilation (CO2)

1. If the rink CO2 concentration goes out of its setpoint limits then the AHU modulates the OA damper to bring in fresh air.

Minimum Ventilation

Unoccupied/No Activity

1. Set the lead handler OA damper minimum position at 5% (adj).

Occupied/Moderate Activity

1. Set the lead handler OA damper minimum position at 50% (adj). If both air handlers are running, set the AHU OA minimum position at 25% (adj).

Occupied/Full Activity

1. Set the lead handler OA damper minimum position at 75% (adj).

Note: Engineered air integral controller has highest priority on the mixed air dampers, and it can override the BMS damper command at anytime.

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City of Mississauga - Typical Points List
& Standard Sequences of Operation

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Appendix A6
City of Mississauga - Typical Points List & Standard Sequences of Operation

Overview

This document forms a part of the City of Mississauga BAS Installation Standard. The document is intended to be a Design Guideline for the specifying Engineer/Consultant working on City of Mississauga (control system upgrade) projects and shall be used as the basis of all BAS design work for the City of Mississauga (CoM).

Engineers/Consultants working for the CoM shall use these points list and sequences as the starting point to design, modifying them to the extent necessary to meet the needs of a particular project. The final specifications issued by any Engineer/Consultant and used in the design and specification of building automation controls shall not deviate from the basic concepts and requirements set forth in this document.

Engineers/Consultants working for the CoM are expected to produce their own project specifications incorporating the elements and design principals of this Design Guideline and the CoM Master Specifications and shall make clear reference to these **City of Mississauga Master Specifications for EMCS Installation (Latest Revision)** within their own design document.

To create a facilities network of buildings that can be maintained and operated efficiently, each new BAS system designed and installed for the City of Mississauga (CoM) must conform to CoM BAS standard. The following outlines a **Typical Points list** and **standard sequence of operation** for a variety of systems found within the City of Mississauga Facilities. For new systems not currently included in the list, the specifying Engineer/Consultant shall use the same format, point naming conventions, and design principals to create additional templates for the guideline. The points list and sequences are to be submitted to the CoM project manager for review and approval by the City before incorporation into the BAS Design Guideline and the project specific specifications (the Engineer/Consultant should anticipate a reiterative process of submission/review/approval).

Application of Specified Sequences

- The following sequences are generic in nature and are meant to form the basis of design for all CoM EMCS Projects
- The sequences shall be used as the initial starting point for each project, customized by the specifying Consultant and tailored for the specifics of individual project and system requirements.
- All project specific sequences to be submitted to the COM for review and approval prior to Tender.

Appendix A6
City of Mississauga - Typical Points List & Standard Sequences of Operation

HVAC Operating Schedules & Modes (Common)

General:

- Equipment/Systems will be controlled to operate continuously in a variety of different modes of operation. Control shall be done locally at RPDC, TEC and OEMASC, interfaced with the EMCS ESS through the SRPDC.
- All scheduling shall be time of day (TOD) calendar based and shall factor in; Holidays, Weekends, and other modes of operation where indicated. In some cases, indoor or outdoor temperatures shall dictate a part of the permissible operation of equipment.
- Whenever fan systems are scheduled "off", outdoor and exhaust air dampers will be closed, hot water heating coil valves will be open, chilled water coil valves will be closed (except as noted), electrical heating coils, humidifiers, and refrigeration coils (DX cooling) shall be locked out. (as applicable)
- Mixing damper and valve actuators shall be powered such that when the fan system if OFF (in either "auto" or "manual") the actuators shall be de-energized and will return to the fail-safe position.

Master Building Occupancy Schedule (MBOS):

- The EMCS shall run each defined system (or groups of equipment/Systems) according to a Master System Occupancy Schedule (MSOSx), and then again individually for programmed events and temporary overrides outside of the MSOSx.

Occupied Mode

- The EMCS shall run the associated equipment/systems continuously according to the (MSOSx) occupied operating schedule. During occupied operation of the equipment, systems shall run according to a specified Time of Day (TOD) and calendar operating schedule. The specific **Mode of Operation** (Occupied/Unoccupied/Holiday/etc.) shall be identified as "MODE" and displayed on the systems page. The calendar and start/stop times shall be accessed through the associated system "Settings" page and adjustable through the graphics by assigned user levels.
- Each occupancy schedule shall have three distinct modes of operation – OCCUPIED, UNOCCUPIED, and HOLIDAY. **The Calendar dates for the Holidays shall be pulled from the EMCS ESS by the local EMCS SRPDC**.
- Activity Settings (AS)
- Various **Activity Settings** will be required for systems serving different rooms/spaces associated with the City of Mississauga Room Booking Database System (**NAME of System TBD**). The AS will permit different control settings based on the scheduled activity of the

room/space that occur during the MSOSx (ie – minimum ventilation, pre-cool/heat time, room temperature, room humidity, ice surface temperature, lighting levels, etc) .

- The scheduled time of different AS shall occur through a specified methodology still to be defined by the City of Mississauga (example – programmed link to external database, or ACTIVITY SCHEDULE button on graphics, etc.). EMCS vendors shall be provided pre-programmed sub-routines for use and customization to accomplish the site/system specific sequence of operation associated with the Activity (example – Concert Settings, Orchestra Settings, Public Swim Settings, Competitive Swim Settings, Yoga Settings, Aerobics Settings, etc) causing the system to take priority over all other specified modes of operation.
- The EMCS shall operate all necessary HVAC system(s) associated with maintain the environmental settings of the Activity including all related axillary services as necessary (such as chillers, pumps, make-up air, exhaust, etc.) to allow for the specified conditioning of the specified activity with the Room/Zone. **Refer to ACTIVITY SETTINGS Table and individual Specified Sequence of Operation of associated systems.** The EMCS will utilize the Activity Settings for that room/zone when the booking starts and will return to default settings (NONE) when the booking is over.
- When an Activity begins, the EMCS will provide graphical indication (on the system page) identifying the current "Activity"
- Schedule of Modes and Settings
    - **Designer/Consultant** (in collaboration with CoM project team) to complete a Facility Schedule (per site) of the systems, areas served operating schedules and activity settings to be included in specifications of new/replacement EMCS.
    - Please see Sample Facility Schedule below:

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City of Mississauga - Typical Points List & Standard Sequences of Operation

Facility/Site Name

Master System Occupancy (MSOS) Schedules and Activity Settings

Sched #	System	Room(s)	MSOSx	Activity	Activity Settings	Notes
1	AHU 1	Gym A	6am to 11pm Mon to Fri 7am to 3 pm Sat/Sun Holidays - UNOCC	UNOCC (Default)	RMT_SP = UNOCC MIN OA = 0% LTG_CMD =OFF	AHU 1 will operate to the default "UNOCC" settings 10 Min (Adjustable) after the last booked activity setting.
				SPORT1 (Light Play)	RMT_SP = 22.5C MIN OA = 20% LTG_CMD = ON	Pre-Cool =0min
				SPORT2 (Team Sports)	RMT_SP = 21.0C MIN OA = 25% LTG_CMD = ON	Pre-Cool = 5min
				VOTE (Election)	RMT_SP = 22.5C MIN OA = 35% LTG_CMD = ON	Pre-Cool = 15min
3	RTU 1	RM 201 (Multi-Purpose Rm)	6am to 7pm Mon to Fri 7am to 3 pm Sat/Sun Holidays - UNOCC	NONE (Default)	RMT_SP = UNOCC MIN OA = 0%	
				MTG1 (<10 people)	RMT_SP = 22.5C MINOA = CO2_SP	Pre-cool = 0min CO2_SP = 900ppm
				MTG2 (>10 people)	RMT_SP = 21.0C MIN OA = CO2_SP	Pre-cool = 5 min CO2_SP = 1000ppm

				CLASS1 (Art, Seniors)	RMT_SP = 23.0C MIN OA = CO2_SP	Pre-cool = 0 min CO2_SP= 900 ppm
				CLASS2 (Spin, Areobics)	RMT_SP = 20.5C MIN OA = CO2_SP	Pre-cool time = 7 min CO2_SP = 800ppm
3,4,…	System ID	Rooms served from booking systems	Primary operating schedule	Activities options in Room Booking Settings	Settings for the activity (adjustable on system settings page)	Additional control notes.

Holiday Mode

- During scheduled holidays, systems shall remain in their Unoccupied operational state.

Unoccupied Mode

- In un-occupied mode fans, heating, and cooling will all be de-energized, and the outside air dampers will be closed unless required by the specified sequence for maintaining un-occupied heating and cooling set points or as required for night purge/morning warm-up, etc.
- For units with VSD's when cycled on the fans shall operate at a reduced speed of 60% output (user adjustable) to start, after 15 Min (adjustable) if the un-occupied heating/cooling setpoint has not be attained, the fan system will start to ramp up slowly until the unoccupied setpoints have been satisfied.

Night Purge Mode

- Between the hours of 3am and 5am, if the outdoor air temperature is between 10ºC and 19ºC (user adjustable via associated Settings page) and the average room temperature associated with a fan or make-up air system is above 26ºC (user adjustable via associated settings page), the fan (or make-up air) system will be energized with economizer cooling until the space temperatures is 21ºC (user adjustable via associated systems Settings page) and then shall be switched off.

Morning Start-up Mode

- The EMCS shall use an optimized morning start-up routine, incorporating outside air temperature, zone temperatures, heating valves and cooling valves positions, and past history of the building response to determine the optimum time to start the HVAC systems. The maximum start-up period shall not exceed 3 hours (adjustable).

Activity Modes

- The following Activity Modes shall be applied to each of the different Facility Types:

Typical Facility Activity Modes

Appendix A6
City of Mississauga - Typical Points List & Standard Sequences of Operation

Building Type	Activity Modes	Activity Settings	Notes
Indoor/Outdoor Ice Rinks	Unoccupied		
	Occupied		
	General Skating		
	Figure Skating		
	Ice Hockey		
	Tournament		
	Ice Skating		
Sports Complex	Unoccupied		
	Occupied		
	Sport 1		
	Sport 2		
	Sport 3		
	Sport 4		
Community Centres/Indoor Pools/Senior Citizen Centres	Unoccupied		
	Occupied		
	Swimming 1		
	Swimming 2		
	Sport 1		
	Sport 2		
	Sport 3		
	Sport 4		

	Party 1		
	Party 2		
	Party 3		
	Meeting 1		
	Meeting 2		
Admin Buildings, Transit, Depots/Yards, Libraries	Unoccupied		
	Occupied		
	Meeting 1		
	Meeting 2		
Cultural and Performing Arts, Golf Courses, Outdoor Pools	Unoccupied		
	Occupied		
	Event 1		
	Event 2		
	Event 3		

Temporary Override Schedules (TOS)

- Temporary overrides will be provided to the operator through the thermostat override button or where the space sensor is flat plate (no occupancy button) through a graphical Override Button on the associated floor plan and HVAC system graphic. The override will enable the associated HVAC unit with fan operation and heating control only to maintain the Daytime Occupied Heating set point for a period of up to 2 hours (adjustable via associated Settings Page). Minimum ventilation setting shall remain 0% and no mechanical cooling shall be permitted.

Alarm Management

- Alarms shall be set-up to be functional during the appropriate seasons and inactive when outside of the related season (i.e. – low heating water temperature alarms shall not be active during summer; chilled water alarms shall not be active after the central chilled water has been shut off to the building).
- Alarms that are stored at the EMCS Server shall be stored under various file headings (i.e.

Critical, Maintenance, Energy) date and time stamped to include when the occurred and the date of acknowledgement of the alarm parameter.

- All alarms in database shall remain until cleared by the system administrator access level.
- There shall be **Four (4)** types of primary alarms, Critical, Environmental, Maintenance, and Energy. The vendor shall set up EMCS system to provide appropriate level of response as follows:

Critical Alarms:

- Critical Alarms are those designated to send a signal to the Security System and the following email address (BASAlerts@mississauga.ca) on site. There are no situations where a Critical Alarm only shows up on the graphics/alarming console, without sending a signal to the Security System and specified email. Refer to part 1.4.1.3 (to follow) for a detailed list of the CoM typical critical alarms.
- Critical alarms shall also provide indication on the graphics (Flashing Red) both the Enterprise Server Software (ESS) operator workstation(s) and workstations connected through the SRPDC.
- Records of a Critical Alarms shall be stored on the EMCS ESS and an Email generated and sent to the Owner's designate email address (BASAlerts@mississauga.ca) indicating the Building ID, Alarm Indication/Descriptor, Alarm Parameter, Time of Alarm, etc.

Environmental Alarms:

- Environmental alarms shall provide indication on the graphics (Flashing Yellow) both the ESS operator workstation(s) and workstations connected through the SRPDC and shall remain in alarm until the condition has been corrected.
- The history or environmental alarms will not be recorded at the EMCS server.

Maintenance Alarms:

- Maintenance alarms shall provide indication on the graphics (Solid Yellow) both the ESS operator workstation(s) and workstations connected through the SRPDC and shall remain in alarm until the specified alarm condition has been removed. For "Time Based" Maintenance Alarms, the graphical indication of alarm shall remain active for 2 hours then shall return to normal until the alarm conditions have been flagged again.
- A secondary separate graphic on the EMCS ESS shall be created by the EMCS Vendor and populated with live data to track the cumulative number of Maintenance Alarms at each site until reset by the Administrative User.

- Record of a Maintenance Alarm shall be stored on the EMCS Server, separated by site. NOTE: You could route maintenance alarms to an email as well or just have a dedicated graphical page on the EMCS server where Operator Level 1 & 2 go to daily/weekly and will see the alarms by site listed and then can be addressed at a later date.

Energy Alarms:

- Energy alarms shall not generate any indication on the SRPDC graphics
- An EMCS ESS Graphical Page shall be created and populated with live data by the EMCS Vendor for Energy Alarms. The Graphic will have a listing of all sites with a cumulative running total of Energy alarms generated for each site. The number will continue to increase until reset by the Administrative Level User.
- A Record of an Energy Alarm shall be stored in the database at the EMCS ESS server. They shall also send out an Email to owner designated email indicating record of a new alarm.
- All alarm limits shall be as specified in the sequence of operation and with final set-up established during the commissioning process.

Appendix A6
City of Mississauga - Typical Points List & Standard Sequences of Operation

System Sequences

Critical Alarms

- Critical alarms are designate specifically as alarms that send a direct signal to the Security Panel on site and to the following email address: BASAlerts@mississauga.ca. Each alarm type will have a separate digital output to the security panel. *Needs to be coordinated with Security company and process put in place for when they receive alarms – ie CALL OUT LIST.*
- In addition to the output command to the security panel, critical alarms shall follow the requirements of part **1.4. Alarm Management**
- Critical Alarm points will be listed in the points matrix for each site and may include the following:
    - Low Boiler Temp (HWST<35°C when OAT<5°C)
    - Low Room Temp (RMT<14°C when OAT<5°C)
    - Cooling Tower Temp (Tower Leaving Temp>40°C or <15°C)
    - Temperature based alarms above shall all have an adjustable time delay before triggering alarm (10 min – adjustable)
    - Heat Pump Flow (No Flow indication or pump status for >30s)
    - Power Phase Loss (Monitored Dry Contact)
    - Sewage pump level (Monitored High Limit Sensor)
    - Sump pump level (Monitored High Limit Sensor)
    - Greenhouse temp (Dry Contact or Specified EMCS Temp Sensor Limit)
    - Inverter Trouble (Monitored Dry Contact)
    - Generator Trouble (Monitored Dry Contact)
    - Server high temp (Server RMT>26°C or monitored dry contact)
    - *LIST ANY CoM SPECIFIC CRITICAL ALARMS HERE, DELTE THOSE NOT DESIGNATED AS CRITICAL*
- All alarm settings shall be user adjustable via the Associated Settings page by the assigned level of access.

Appendix A6
City of Mississauga - Typical Points List & Standard Sequences of Operation

***NOTE:** These are the typical systems we have sequences for please review with your Operations Group to see Typical Points/Sequence/alarms – the list can be added to later as projects are put out for tender and then added to future revisions of the Master Spec*

Recirculatory AHU Systems

Start/Stop:

- The EMCS shall enable the fan system to start when commanded on through either MSOSx or other specified modes of operation. When commanded on, supply fan shall start first. Once the supply fan status is proven on, the EMCS shall start the return fan. Once return fan status is proven the EMCS shall allow application of the specified mixed air, heating and cooling sequences. (***Note: Where fans are hard wire interlocked – both shall be started simultaneously***).
- When the EMCS sends the signal to stop; both fans shall stop, mixed air dampers shall close to full re-circulation, heating and cooling valves shall return to their fail-safe position.

(Optional) Mixed Air/Supply Air Control

- During occupied operation of the unit the EMCS shall modulate the mixed air dampers (MADMPR) between minimum ventilation and 100% outside air, in sequence with heating coil to maintain the supply air set-point (SAT_SPT).
- The EMCS shall reset the supply air temperature to maintain the space temperature set point as follows:

Space Temp SPT Deviation	Supply Air Temp Set-point
RMT_SPT -2 °C	26 °C
RMT_SPT +2°C	14°C

- A mixed air low limit set-point (MAT-LL) shall be used to override the mixed air damper to maintain a minimum temperature of 6.6°C (adjustable)
  - If the mixed air temperature falls below the mixed air low limit, the EMCS shall generate an environmental alarm.
  - If the mixed air low limit requires the dampers to be below the minimum ventilation position for more than 2 minutes (adjustable), the EMCS shall generate a maintenance alarm
- If the outdoor air temperature rises above the economizer setpoint of 18°C (adjustable), the following cooling strategy shall be as follows:
  - Mixed air dampers shall revert to minimum ventilation position
  - When the space temperature rises 1°C above the occupied cooling setpoint of 23°C (adjustable), the DX cooling shall be energized to satisfy the cooling requirements.

- When the space temperature drops 1°C below the occupied cooling setpoint, the DX cooling shall be switched off.

(Optional) Mixed Air/Return Air Control

- During occupied operation of the unit the EMCS shall modulate the mixed air dampers (MADMPR) between minimum ventilation and 100% outside air, in sequence with heating coil to maintain the supply air set-point (SAT_SPT).
- The EMCS shall reset the supply air temperature to maintain the Return Air temperature set point as follows:

Return Air Temp Dev	Supply Air Temp Set-point
RAT_T -2 °C	26 °C
RMT_T +2°C	14°C

- A mixed air low limit set-point (MAT_LL) shall be used to override the mixed air damper to maintain a minimum temperature of 6.6°C (adjustable)
  - If the mixed air temperature falls below the mixed air low limit, the EMCS shall generate an environmental alarm.
  - If the mixed air low limit requires the dampers to be below the minimum ventilation position for more than 2 minutes (adjustable), the EMCS shall generate a maintenance alarm
- If the outdoor air temperature rises above the economizer setpoint of 18°C (adjustable), the following cooling strategy shall be as follows:
  - Mixed air dampers shall revert to minimum ventilation position
  - When the space temperature rises 1°C above the occupied cooling setpoint of 23°C (adjustable), the DX cooling shall be energized to satisfy the cooling requirements.
  - When the space temperature drops 1°C below the occupied cooling setpoint, the DX cooling shall be switched off.

(Optional) VFD Control

- The EMCS shall modulate the supply fan Variable Frequency Drive to maintain the Supply air static pressure set-point (SASP_SPT) of 1.2'' WG (adjustable) from a sensor located approximately 2/3 of the way downstream of the fan. The EMCS will modulate the return fan VFD to maintain a fixed differential between the supply fan speed and the return fan speed. This differential will be coordinated with the air balance contractor for proper building pressurization or as set-up by the CA during

(Optional) Bypass Damper Pressure Control

- The EMCS shall modulate the Bypass Damper to maintain the Supply air static pressure setpoint (SASP_SPT) of 1.2'' WG (adjustable) from a sensor located approximately 2/3 of the way downstream of the fan.

Night Setback Control

- During un-occupied operating, the fan system shall remain off unless the space temperature falls below the Night Set-Back Temperature of 18°C (adjustable).
- When the space temperature falls to NSB_SPT -0.5°C, the fan system shall be enabled in full recirculation mode, heating valve full open, until the space temperature reaches NSB_SPT +1.0°C. The fan system will then shut off until the next cycle.

(Optional) Minimum Ventilation and CO2 Control

- The maximum Minimum Ventilation Setting shall be 25% (adjustable via associated settings pages). The EMCS shall monitor return air CO2 levels and lower the active minimum ventilation from the (Maximum) minimum ventilation of 25% down to 0% based on maintain a maximum CO2 level of 900ppm.
- When the RA CO2< 900 ppm, the EMCS shall reduce the active Minimum Ventilation setting by 2% every minute until reaching 0% or until the RACO2>900ppm.
- When the RACO2>900ppm the EMCS shall increase the active minimum damper position until reaching the (Maximum) minimum ventilation setting.

(Optional) Heating Coil Circulation Pump Control

- (OPTIONAL) The primary heating pumps shall operate as Lead/Lag operation with one operational and one standby pump. The Lead pump shall be rotated on a weekly basis (Tuesday @ 8am) with graphical indication as to which pump is Lead and which is Lag.
    - If the lead pump status is OFF, the lag pump shall start within 3 seconds and a maintenance alarm shall be generated.
    - If the lead pump status returns to ON, both pumps shall operate for 2 minutes before the lag pump is shut OFF.
    - When switching to a new Lead pump, status shall be proven ON before the Lag pump is switched OFF.
- If the outdoor temperature rises above the Warm Weather Lock Out Set Point (WWLO_SPT) (Refer to Heating Plant Sequences and Graphics) the heating coil pump shall turn off.
- If the outdoor air temperature is below 5°C (41°F) and the pump status is "off", the EMCS shall generate a maintenance alarm.

Safeties

- Low Temperature Protection Control: When air temperature downstream of the heating coil drops below 5 °C (40 °F - adjustable, as sensed by low limit (DPDT) freeze stat), the supply and return fans will shut down, outdoor air dampers will close and return air damper will open, the heating/cooling coil valves will open to full flow to the coil. A maintenance alarm will be generated. The freeze stat will need to be manually reset for normal operation to resume.

- High Temperature Protection Control: If high temperature limit located in the return air duct rises above the setting of 60°C the supply and return fans shall shut down and a maintenance alarm will be generated. Once the high temperature protection control has been manually reset, the unit will return to normal control.
- Fire Alarm Fan Shutdown: Where Fire Alarm interlocks exist, the EMCS shall not restrict the fire alarm system from shutting down all fans on a fire alarm condition (with starter in either hand or auto position). Where FA panel is monitored by EMCS< upon clearing all fire alarms the EMCS shall start all the fans in a staggered manner to prevent excessive power demand.

Alarms

- Critical
  - None
- Environmental
  - Fan Status ON – Command OFF
  - Supply Air High/Low Limit
  - Mixed Air High/Low Limit
  - Return Air High/Low Limit
  - CO_2 Level Alarms (900ppm adjustable, if CO_2 sensor present)
- Maintenance
  - Fan Command ON – Status OFF
  - Freeze Stat Alarm
  - Heating Coil Pump Status Off Below 5°C (adjustable)
  - Mixed air dampers operating below the Minimum Ventilation setting for more than 2 minutes (adjustable)
  - When OAT< 0°C (adjustable) and mixed air dampers operating above the minimum setting for more than 2 minutes (adjustable)
- Energy Alarms
  - Fan Status On for more than 2 hours cumulatively (adjustable) during un-occupied (NSB) operation.
  - Fan system operating in Occupied Mode outside of Originally Scheduled MSOSx
  - VFD Modulation greater than 80% (adjustable) for more than 2 hours cumulatively

(adjustable) during occupied operation.

- The initial set up values for all alarms shall be established during the commissioning process.

Adjustable Points (to be displayed on system Setting Page)

- Summer/Academic Schedules
- Minimum Ventilation Setpoint
- CO2_SPT (when applicable)
- RMT_ SPT
- NSB_SPT
- Reset Schedule Parameters
- Mixed Air Low Limit (MA_LL)
- MA_LL Time Delay
- Economizer Setpoint (ECON_SPT)
- Occupied Cooling Setpoint
- Warm Weather Lockout Setpoint (Displayed, adjustable from Heating Plant Graphics
- Alarm Settings – (setpoints and time delay parameters as noted in part 8 Alarms)

Appendix A6
City of Mississauga - Typical Points List & Standard Sequences of Operation

Non-Recirculatory AHU (100% MUA)

Start/Stop

- The EMCS shall enable the fan system(s) to start when commanded on through either MSOSx or other specified modes of operation.
- When commanded on, the outdoor air damper shall open first. Once damper position is proven open, the supply fan shall be allowed to start. If after 30 seconds (after the start command) the fan status is "off" the outdoor air damper shall be closed.
- When the EMCS sends the signal to stop; the fans shall stop, outdoor air damper shall close, and the heating valve shall return to the fail-safe (open) position.
- The associated classroom exhaust fan (where applicable) shall operate with the supply fan.

Supply Air Control

- During occupied operation of the unit the EMCS shall modulate the heating coil valve and Heat Recovery Wheel to maintain the supply air set-point (SAT_SPT) or 21^{o}C (adjustable)

(Optional) Heat Wheel Control

- During occupied operation, when the outdoor air temperature is below 10^{o}C (adjustable) the ERW shall be allowed to operate at 100% and mechanical cooling shall remain off.
- If the OAT is greater than 10^{o}C (adjustable) and below 18oC (adjustable), the ERW shall modulate between 50% and 100% to maintain the SAT_SPT.
- If the OAT is greater than 18^{o}C (adjustable), the ERW shall be commanded to 100%
- If the Heating Valve is Closed, and the HRAT rises 2^{o}C above the SAT_SPT, a Maintenance Alarm shall be generated.

(Optional) Humidity Control

- If the OAT is above 24^{o}C (adjustable), the BAS shall enable stages of mechanical cooling to maintain a Return Air Humidity Setpoint of 55%RH (adjustable).
- If both stages of mechanical cooling are active, and the Return Air Humidity level rises above setpoint for 15 min (adjustable), a maintenance alarm should be generated.

(Optional) VFD Control

- The EMCS will modulate the supply fan Variable Frequency Drive to maintain the Supply air static pressure set-point (SASP_SPT) of 1.2'' WG (adjustable) from a sensor located approximately 2/3 of the way downstream of the fan. The EMCS will modulate the return fan VFD to maintain a fixed differential between the supply fan speed and the return fan speed. This differential will be coordinated with the air balance contractor for proper building pressurization or as set-up by the CA during

(Optional) Face and Bypass Dampers

- When the OAT < 5ºC (adjustable), the heating valve shall be 100% open (and no longer used in the heating demand offset), the F&B dampers shall replace the heating valve in the heating demand offset calculation and shall be modulated to maintain SAT_SPT.
- When the OAT > 5ºC, the heating valve and F&B dampers shall be modulated in sequence. When SAT> SAT_SPT the heating valve shall be modulated closed first followed by the F&B to full bypass to maintain the SAT_SPT. When SAT<SAT_SPT the F&B will modulate to full FACE followed by heating valve modulation to maintain SAT_SPT.

(Optional) Return Air Humidity Control

- Enable stages of mechanical cooling to maintain the maximum return air humidity setpoint of 55% (adjustable)

Heating Coil Circulation Pump Control

- (OPTIONAL) The primary heating pumps shall operate as Lead/Lag operation with one operational and one standby pump. The Lead pump shall be rotated on a weekly basis (Tuesday @ 8am) with graphical indication as to which pump is Lead and which is Lag.
  - If the lead pump status is OFF, the lag pump shall start within 3 seconds and a maintenance alarm shall be generated.
  - If the lead pump status returns to ON, both pumps shall operate for 2 minutes before the lag pump is shut OFF.
  - When switching to a new Lead pump, status shall be proven ON before the Lag pump is switched OFF.
- If the outdoor temperature rises above the Heating Lock Out Set Point (HLO_SPT) of 15ºC (adjustable and displayed on heating plant graphics) the heating coil pump shall turn off.
- If the outdoor air temperature is below 5ºC (41ºF) and the pump status is "off", the EMCS shall not allow the fan to operate and shall generate a maintenance alarm.

Safeties

- The outdoor air damper shall be wired in such a way that when the fan starter is in the "Hand" position the outdoor air damper shall drive open and the fan will start after the damper switch has proven the damper to be open. When Starter is in the "Off" position, the outdoor air damper shall be de-energized closed and the fan shall remain off.
- Low Temperature Protection Control: When air temperature downstream of the heating coil drops below 5ºC (adjustable, as sensed by low limit (DPDT) freeze stat), the supply fan will shut down, the outdoor air damper will be de-energized closed, and the heating valve will be de-energized open to allow full flow to the coil. A maintenance alarm will be generated. The freeze stat will need to be manually reset for normal operation to resume.

- Fire Alarm Fan Shutdown: Where Fire Alarm interlocks exist, the EMCS shall not restrict the fire alarm system from shutting down all fans on a fire alarm condition (with starter in either hand or auto position). Where FA panel is monitored by EMCS< upon clearing all fire alarms the EMCS shall start all the fans in a staggered manner to prevent excessive power demand.

Alarms

- Critical
  - None
- Environmental
  - Fan Command OFF – Status ON
  - Supply Air High and Low Limits
- Maintenance
  - Freeze Stat Alarm
  - Fan Command ON – Status OFF
  - Heating Coil Pump Status Off Below 5^{o}C (adjustable)
  - Fan Command “On” but damper status not open after 40s (adjustable)
- Energy Alarms
  - Fan system operating in Occupied Mode outside of Originally Scheduled MSOSx
  - Fan status “On” for more than 5 minutes outside of MSOSx
- The initial set up values for all alarms shall be established during the commissioning process.

Adjustable Points (to be displayed on system Setting Page)

- Summer/Academic Schedules
- Minimum Ventilation Setpoint
- Reset Schedule Parameters
- Occupied Cooling Setpoints
- Warm Weather Lockout Setpoint (Displayed, adjustable from Heating Plant Graphics
- Alarm Settings – (setpoints and time delay parameters as noted in part 6 Alarms)

Appendix A6
City of Mississauga - Typical Points List & Standard Sequences of Operation

Boilers

Start/Stop

- The Heating System shall be enabled by the EMCS when the outside air temperature is 1^{o}C below WWLO_SPT (15^{o}C adjustable) and disabled when the outdoor air temperature rises 1^{o}C above the WWLO_SPT as follows:
    - When the Heating System has been enabled, the primary heating pumps and coil circulators shall be switched on first, after a 3-minute delay and at minimum one (1) pump status verification the boilers shall be allowed to operate in accordance with the specified Boiler control sequence.
    - When the heating system has been disabled, the boilers shall be shut off first, and after a 3-minute time delay all primary pumps and coil circulators shall be switched off.
- Heating pumps with one operational and one standby shall operate as Lead/Lag operation. The "Lead" shall be rotated on a weekly basis (every Tuesday at 8am) with graphical indication as to which pump is Lead and which is Lag. If the lead pump status is off, the lag pump shall be started within 3 seconds. If the primary pump status returns to "on", both pumps shall operate for 2 minutes before the standby pump is shut off. When switching New primary pump shall be started and status proven before standby (old primary) pump is switched off.
- When an individual boiler is commanded off, the associated boilers circulated shall continue to run for 3 minutes to dissipate heat and then will shut off (internal to boilers).
- The boilers shall operate as Lead/Lag operation. The "Lead" shall be rotated on a weekly basis (every Tuesday at 8am) with graphical indication as to which boiler/pump is Lead and which is Lag. If the lead boiler is in Alarm or status has not been verified within 3 minutes (adjustable) after enable, the lag boiler shall become the lead boiler and a maintenance alarm shall be generated.
    - (OPTIONAL – replace if there are 3 boilers)
    - Two (2) Boilers are to be operational, and one (1) Boiler shall always be standby. Lead, Lag and Standby Boilers shall be rotated on a weekly basis (every Tuesday at 8am) and graphically indicated as to which boiler is Lead, Lag and Standby. If either the Lead or Lag Boiler status has not been verified within 3 minutes (adjustable) after enable command, the standby boiler shall replace that boiler as either Lead or Lag and a maintenance alarm shall be generated to indicate Boiler Failure. This standby boiler shall remain in rotation in the operating sequence until the alarm has been reset.
- When the heating system has first be enabled through the WWLO_SPT and the primary heating water pump has operated for 3 minutes, the lead boiler and associated circulation pump should be turned ON at high fire, once status is proven the burner shall be allowed to modulate. After Lead Boiler burner status has been proven and boiler command is at 100% for 10 minutes (adjustable), the lag boiler shall be enabled at high fire. Once the lag boiler burner status has

proven, both boilers shall be allowed to modulate together on the same command signal.

- Both boilers shall be operated together until the Main Heating Water Supply Temperature setpoint (MHSWT-SPT) has been satisfied and then normal boiler sequence of operation shall begin.

Boiler Control (condensing)

- When the main heating water supply temperature (**MHTG_SWT_T**) is more than 2.5 °C (Adjustable) below set point **(MHTG_SWT_SPT**) the lead boiler shall be commanded ON by the EMCS, followed by burner modulation. The burner shall first be enabled at low fire, 3 Minutes (adjustable) after Burner Status is proven the burner shall be allowed to gradually increase output using PID control to maintain the heating system set point (MHTG_SWT_ SPT).
- If the **MHTG_SWT_T** falls to more than 8.5 °C (User Adjustable) below the **MHTG_SWT_ SPT**, and the lead boiler is burner modulation is at 90% or greater output, the lag boiler (and associated circulation pump) shall be commanded "ON" and held at low fire while the lead boiler continues to modulate according to its PID loop to maintain **MHTG_SWT_SPT.**
- When the lag boiler Burner Status has proven there shall be a 3-minute (adjustable) time delay followed stepped control of burner (increases in increments of 5% output every 2 minutes) until reaching 50% output or until the lead boiler output command falls to 60% modulation output or lower. When either of these conditions are met, both boilers (lead and lag) shall go to low fire and then be allowed to modulate together to satisfy the **MHTG_SWT_SPT**.
- When the **MHTG_SWT_T** reaches set point, the lag boiler shall be disabled and the lead boiler shall continue to modulate. When the **MHTG_SWT_T** rises to set point + 3°C, the lead boiler shall hold at minimum fire. When at low fire, if the **MHTG_SWT_T** reaches set point + 5°C the lead boiler shall be switched off. If the **MHTG_SWT_T** drops to set point - 1°C the boiler may begin to modulate again according to the PID loop command.

Boiler Control (non-Condensing modulating)

- When the main heating water supply temperature (**MHTG_SWT_T**) is more than 2.5 °C (Adjustable) below set point **(MHTG_SWT_SPT**) the lead boiler shall be commanded ON by the EMCS, followed by burner modulation. The burner shall first be enabled at high fire, after burner status has been proven there shall be a 3 Minutes (adjustable) time delay before the burner is allowed to modulate (using PID control) to maintain the heating system set point (MHTG_SWT_ SP).
- If the **MHTG_SWT_T** falls to more than 5 °C (User Adjustable) below the **MHTG_SWT_ SPT**, and the lead boiler is burner modulation is at 90% or greater output, the lag boiler (and associated circulation pump) shall be commanded "ON" and held at low fire while the lead boiler continues to modulate according to its PID loop to maintain **MHTG_SWT_SPT.**
- After burner status of the lag boiler has been proven there shall be a 5 minutes (adjustable) low fire hold followed by step control of the lag boiler burner to increases output in increments of 5%

every 1 minutes until reaching 50% output or until the lead boiler output command falls to 60% modulation output or lower. If either of these two conditions are met, both boilers (lead and lag) shall be commanded to low fire first and then be allowed to modulate together to satisfy the **MHTG_SWT_SPT**.

- When the **MHTG_SWT_T** reaches set point, the lag boiler shall be disabled, and the lead boiler shall continue to modulate. When the **MHTG_SWT_T** rises to set point + 3°C, the lead boiler shall hold at minimum fire. When at low fire, if the **MHTG_SWT_T** reaches set point + 5°C the lead boiler shall be switched off. If the **MHTG_SWT_T** drops to set point - 1°C the boiler may begin to modulate again according to the PID loop command.

Boiler Control (non-Condensing Staged)

- When the main heating water supply temperature (**MHTG_SWT**) is more than 2.5 °C (Adjustable) below set point **(MHTG_SWT_SPT**) the lead boiler shall be commanded ON at low fire by the EMCS. Once burner status is proven there shall be a 5 minute (adjustable) time delay before allowing the boiler to switch between low and high fire to satisfy the **MHTG_SWT_SPT**.
- When the **MHTG_SWT** falls 4 °C below set point (adjustable) high fire shall be enabled.
- After a further 3 minute time delay (adjustable), if the **MHTG_SWT** falls 6°C below set point (adjustable), the lag boiler shall be enabled at low fire. Once burner status has proven there shall be a 3 minute (adjustable) time delay before allowing the lag boiler to switch between low and high fire to satisfy the **MHTG_SWT_SPT**.
- When the **MHTG_SWT** falls 8 °C (adjustable) below **MHTG_SWT_SPT** lag boiler high fire shall be enabled.
- The lag boiler High Fire should be stopped when the **MHTG_SWT** is more than 1 °C (adjustable) below the **MHTG_SWT_SPT**. The lag boiler low fire should be stopped if the **MHTG_SWT** is more than 1.5 °C (adjustable) above the **MHTG_SWT_SPT**.
- The lead boiler high fire should be stopped when the **MHTG_SWT** is more than 2.5 °C (adjustable) above the set point. The lead boiler low fire should be stopped (boiler off) when the **MHTG_SWT** is 5 °C (adjustable) above the **MHTG_SWT_SPT**.

Boiler Control (Fire-Tube)

- The boilers shall be enabled seasonally by the building operator. Once enabled the boilers shall run on their own operating limit.
- The EMCS shall monitor the boiler status and provide indication of burner operation when the boiler cycles on.

Hot Water Supply Reset (Condensing)

- The outside air temperature reset schedule shall reset the heating water supply temperature set-point (**MHTG_SWT_ SPT**) according to the following schedule: *Resets to be adjusted based on existing site reset schedules*

OAT-T	**MHTG SWT SPT**
-15 ºC	**80 ºC**
10 ºC	**35 ºC**

- All parameters of the reset schedule shall be (super used) adjustable through the graphics. The indoor/outdoor reset schedule shall also be offset by actual heating demand and the calculated setpoint shall be displayed on the system graphics.

Hot Water Supply Reset (Non-Condensing)

- The outside air temperature reset schedule shall reset the heating water supply temperature set-point (**MHTG_SWT_ SPT**) according to the following schedule: *Resets to be adjusted based on existing site reset schedules*

OAT-T	**MHTG SWT SPT**
-10 ºC	**82 ºC**
10 ºC	**65 ºC**

- All parameters of the reset schedule shall be (super-user) adjustable through the graphics. The indoor/outdoor reset schedule shall also be offset by actual heating demand and the calculated setpoint shall be displayed on the system graphics.
- The main heating water return temperature (MHTG_RWT) shall not be less than 60°C, EMCS shall override MHTG_SWT reset schedule to ensure minimum water temperature is maintained.

Heating Demand Offset

- Actual heating demand shall be measured by available (site specific) conditions including but not limited to the following:
  - ***Perimeter Heating Demand***
  - ***AHU Heating Valve Demand (AHU with greatest heating demand)***
  - ***Condenser Water Loop Heating Valve Demand (where applicable)***
- If all of the heating valves are less than 60% heating demand, decrease the MHTG_SWT_SPT by 1 ºC every 2 minutes to a maximum of **MHTG_SWT_SPT** -7.5 ºC. This shall be considered the **ACTIVE MHTG_SWT_SPT** (displayed on the Graphics).
- If any of the heating valves have greater than 95% heating demand, increase the **ACTIVE MHTG_SWT_SPT by 1** ºC every 2 minutes until reaching the original MHTG_SWT_SPT or when the maximum heating demand is less than 70%.

Radiation Loop Control (Optional)

- The perimeter radiation loop pump(s) will be switched on/off according to the same parameters as specified in the Boiler Control Sequence.
- Perimeter Radiation Control:
- The radiation 3-way mixing valve shall be modulated based on the radiation zone heating water supply temperature set point (RADL_SWT_SPT).
- The outside air temperature shall reset the heating zone water supply temperature set-point (**RADL_SWT_ SPT**) according to the following schedule: *Resets to be adjusted based on existing site reset schedules*

BLDOAT-T	RADL SWT SPT
-10 ºC	**75 ºC**
10 ºC	**40 ºC**

- All parameters of the reset schedule shall be (super used) adjustable through the graphics. The indoor/outdoor reset schedule shall also be offset by actual heating demand within the associated zone and the calculated setpoint shall be displayed on the system graphics.

Safeties

- When the boiler lead pump is commanded on by the EMCS, and no proof is received after 30 seconds, then the lead pump shall be commanded off and a maintenance alarm shall be generated. The lag pump shall start on failure of the lead pump. If the lag pump also fails, then a critical alarm shall be generated.
- A manual reset in programming shall be provided to release all pumps from emergency status and return to normal status and restart lead/lag sequence.
- ***The hot water return temperature for noncondensing boilers shall not be less than 60ºC. (non-condensing boilers)***

Alarms

- Critical
  - Low Boiler Temp (MHTG_SWT<35ºC when OAT<5ºC)
- Environmental
  - MHTG_SWT
    - High Limit
  - MHTG_RWT
    - Low Limit
  - Pump Command OFF – Status ON

    - Boiler Command OFF – Status ON
- Maintenance
    - Boiler Alarm
    - Boiler Command ON – Status OFF
    - Pump Command ON – Status OFF
- Energy Alarms
    - Boiler cycles more than 4 times/hour (adjustable)
    - Minimum Boiler operating time < 5 minutes (adjustable)
- The initial set up values for all alarms shall be established during the commissioning process.

Adjustable Points (to be displayed and accessed on system Setting Page)

- Calendar Operating Schedule
- Outdoor/Supply Water Reset Schedule Parameters
- Lead Boiler Minimum Run Time
- Boiler Staging Differential Set Points and Lead/Lag Boiler Time Delays
- Warm Weather Lockout Setpoint and differential
- Alarm Settings – (setpoints and time delay parameters as noted in part 7 Alarms)

Appendix A6
City of Mississauga - Typical Points List & Standard Sequences of Operation

Heat Pump Loop and Evaporative Cooling Tower Control

Start/Stop:

- The Cooling Tower controls, and the variable frequency drive (VFD) shall be enabled any time when heat pump recirculation pump is running and the OAT>0°C (adjustable).
- When the condenser water lead pump is commanded on by the EMCS, and no proof is received after 15 seconds, then the lag pump shall be commanded on and a maintenance alarm shall be generated.
- If the lag pump fails (or the HPL Flow Switch status is “OFF”) for more than 30 seconds, then a critical alarm shall be generated.
- If the lead pump status returns to “on”, both pumps shall operate for 2 minutes before the lag pump is shut off.

Heat Rejecter

- Heat Rejection shall be disabled when Heat Injection Sequence is Enabled.
- The EMCS shall control in sequence the cooling tower damper, spray pump, and fans, to maintain loop temperature setpoint.
- When the HPL_SWT reaches SPT +0°C (adjustable), the dampers shall open.
- When the HPL_SWT reaches SPT +2°C (adjustable), the spray pump shall be commanded ON.
- When the HPL_SWT reaches SPT +3°C (adjustable), the tower fans shall be commanded ON at 20% speed.
- If the HPL_SWT reaches SPT +5°C (adjustable), the tower fans shall begin to modulate between 20% and 100% to achieve SPT +2°C.
- When the HPL_SWT falls to SPT +3°C (adjustable), the tower fans shall be commanded to 20% speed
- When the HPL_SWT falls to SPT +1°C (adjustable), the tower fans shall be commanded OFF.
- When the HPL_SWT falls to SPT +0°C (adjustable), the spray pump shall be commanded OFF.
- When the HPL_SWT falls to SPT -2°C (adjustable), the tower damper shall be commanded closed.

Heat Injector (Normal Operation)

- The EMCS shall modulate the heat exchanger 3-way control valve (or boilers when directly on HPloop) to maintain a minimum loop supply water temperature of 20°C (adjustable).

Heat Injector (Morning Pre-Heat)

- To avoid the rapid drop in the Heat Pump Loop caused by Morning Warm Up Cycle and the start-up of Heat Pumps, the EMCS shall incorporate a Heat Pump Loop Pre-Heat Strategy.

- When the OAT<-4ºC (adjustable) morning pre-heat sequence shall begin 60 minutes (adjustable) prior to the start of MSOSa for the heat pumps.
- EMCS shall gradually increase the Heat Pump loop heating set point in 2ºC increments every 5 minutes to a reach a maximum of 28 ºC. (Set points, time intervals and differentials all to be Super User Adjustable). This temperature set point shall be maintained until MSOSa + 10 Min and then shall revert back to normal operational setting.

Alarms

- Critical
    - Cooling Tower Temp (Tower Leaving Temp>40ºC or <15ºC)
    - Heat Pump Flow (No Flow indication or pump status for >30s)
- Environmental
    - HPL_SWT/RWT high and low limits
- Maintenance
    - HP_SWT> 38ºC for more than 5 minutes
    - HP_SWT<14ºC for more than 5 minutes
- Energy
    - When OAT< 30ºC and FANVFD at 100% for greater than 3 minutes.
    - Where loop pumps have VFD control, when PMPVFD_MOD>80% for more than 10 minutes.
- The initial set up values for all alarms shall be established during the commissioning process

Adjustable Points (to be displayed and accessed on system Setting Page)

- Spray Water Lockout Set Point
- Loop Temperature Minimum Heat/Heat Rejection Setpoints
- Tower Staging Differential Set Points and Time Delays
- Morning Warm-up Pre-Start Time (based on AHU-1 TOD schedule)
- Alarm Settings – (setpoints and time delay parameters as noted in part 6 Alarms)

Appendix A6
City of Mississauga - Typical Points List & Standard Sequences of Operation

Chiller & Cooling Tower Operation

- The cooling system shall be switched ON/OFF automatically by EMCS or manually by the building operator through the Local/Remote switch at the chiller.
- The cooling system shall operate 24 hrs a day, 365 days a year in either free-cooling mode, or mechanical cooling mode. The chillers (mechanical cooling) shall be locked out when the OAT is below 7C(adjustable) for more than 10 minutes (adjustable). All Calendar parameters shall be adjustable via the settings page by Super User access level.

Free Cooling Mode Operation

- When the Outdoor Air Temperature is 2C below (adjustable) the Free-Cooling Setpoint [FCLG-SP] 9C (adjustable) for more than 10 min (adjustable), mechanical cooling shall be disabled and the Cooling system shall enter Free cooling mode. Valves [insert valve number] are commanded closed and Valves [insert valve number] are commanded open. The Cooling Tower Setpoint is set to 6C (adjustable).
- Cooling Tower Modulating Bypass Valve [insert valve number] is Commanded Closed. Valve [insert valve number] on the condenser is set to bypass water around the condenser.
- On system activation, the valves located in the condenser water supply and return lines for Cooling Tower 2 are commanded open.
- An end switch ensures that both control valves are fully open prior to starting the condenser water pumps serving Cooling Tower 2 and Chiller 2. After proof of flow one of the two secondary chilled water pumps [insert pump number] is started on low speed. The system gradually increases the speed of the VFD to maintain Differential Pressure Setpoint.
- When the chilled water return temperature is above 15.5C(adjustable) for 10 min (adjustable), the switchover sequence to mechanical cooling shall be initiated

Free Cooling to Mechanical Cooling Mode Switchover

- Valves [insert valve number] are commanded open, Valves [insert valve number] shall be commanded closed. The Tower bypass valve [insert valve number] shall modulate to maintain a condenser water temperature of 18C (adjustable).
- The remaining start up procedure shall proceed as stated above.

Mechanical Cooling Mode Operation

- The chiller plant shall be enabled to operate when the outside air temperature is greater than the Cooling Weather Lockout Setpoint of 7C (adjustable). Cooling Tower 2 & Chiller 2 shall operate as the “lead” equipment and operate as follows after the Free-cooling to Mechanical Cooling Switchover has been completed:
- Cooling Tower 2 & Chiller 2
    - Control Valves 3 & 4 located in the Condenser Water Supply and Return Lines for

Cooling Tower 2 Shall Open.

- Valves [insert valve number] shall be closed. Diverting Valves [insert valve number] shall be open.
- An end switch is used to ensure that both control valves in the condenser water supply and return are fully open prior to starting the condenser pumps serving Cooling Tower 2.
- Once the secondary chilled water pump is operating the chiller is enabled.
- After proof of flow one of the two secondary chilled water pumps [insert pump number] is started on low speed. The system gradually increases the speed of the VFD to maintain Differential Pressure Setpoint.

- Cooling Tower 1 & Chiller 1
  - If the chilled water supply is 2C (adjustable) above the Chilled water setpoint and the supply/return differential temperature is greater than 5C (adjustable) for a period of 10 min (adjustable), Chiller plant 1 are Enabled.
    - If Cooling Tower 1 or Chiller 1 Fail to show status after 30 seconds, an alarm shall be generated.
    - If Cooling Tower 1 and Chiller 1 Maintain status for 2 min, the chilled water system for Cooling Tower 2 and Chiller 2 shall be disabled.
  - The system shall them follow the steps outlined above with Pumps [insert pump number], & [insert pump number] and Valves 1 & Valve 2 .
  - If the chilled water supply is 2C (adjustable) above the Chilled water setpoint and the supply/return differential temperature is greater than 10C (adjustable) for a period of 10 min (adjustable), the system for Chiller 2 shall be enabled to work in conjunction with Chiller 1.
    - If the chilled water supply/return differential temperature is less than 5C (adjustable) for a period of 10 min (adjustable), the system for Chiller 2 shall be disabled to allow Chiller 1 to operate on its own.
  - If the chilled water supply/return differential temperature is less than 2C (adjustable) for a period of 10 min (adjustable), the system for Chiller 2 shall be enabled.
  - If Cooling Tower 2 or Chiller 2 Fail to show status after 30 seconds, an alarm shall be generated.
  - If Cooling Tower 2 and Chiller 2 Maintain status for 2 min, the chilled water system for Cooling Tower 1 and Chiller 1 shall be disabled.
- The Central Economizer set point shall be displayed on the Chiller System graphic and all AHU system graphics. The ECON_SP and associated differentials and valve % for switching on/off shall be adjustable and located on the chiller settings graphic page

- When cooling is not required, EMCS should switch OFF the chiller. Hardwired relays in the chiller control panel will shut off the associated condenser pump and chilled water pump with a built in Time delay. The EMCS should switch the cooling tower OFF.
- When cooling is required, EMCS should Enable the chiller ON. The Chiller will first enable the chilled water and condenser water pumps, and after a 1 minute delay (internal to the chiller controls), the chiller will be started. If after 5 minutes the chiller does not start, EMCS shall generate an alarm.

Chilled Water Supply Reset

- The EMCS shall send a signal to the chiller OEMASC to reset the chilled water supply temperature set point according to the following schedule:

OAT-T	CHW SWT SPT
5 ºC	**10 ºC**
32 ºC	**5 ºC**

Cooling Demand Offset:

- When ANY of the air handling unit cooling valves is greater than 90% open, the EMCS shall decrease the Active CHWST_SP by 0.2 deg C every 10 minutes down to 1.5 deg C below scheduled set point (CHWST_SP).
- When ALL of the main air-handling unit cooling valves are less than 70% open, the EMCS shall increased the Active CHWST_SP by 0.2 deg C every 10 minutes up to 1.5 deg C above scheduled set point (CHWST_SP).
- Provide alarm monitoring of chiller alarm status. Provide temperature alarms based on limits discussed with commissioning agent or as detailed in alarm section of Chiller control.

Condenser Water Reheat Mode

- When the Chillers are Disabled or in Unoccupied mode, the diverting valves shall be positioned as follows:

Valve #	System	Position
VLV-9	Chiller 2	0% Open
VLV-10	Chiller 2	100% Open

- When the Chilled water system is in the free cooling mode and diverting valve DV-1 and DV-2 are positioned to provide free cooling, the diverting valves shall be positioned as follows:

Valve #	System	Position

VLV-9	Chiller 2	100% Open
VLV-10	Chiller 2	0% Open

- When switching the diverting valves from one position to the next system, open the valve to the associated cooling tower, and close the valve to the associated heat exchanger.

Chilled Water Differential Pressure Valve Control

- The chilled water differential pressure valve shall be operated whenever the chilled water pump is in operation and shall be modulated to maintain the chilled water differential set point CHW_DP_SP. (Adjustable).
- When the chilled water pump is "OFF" the differential pressure valve shall be in full bypass. Upon start-up of the pump, the valve shall remain open to bypass for 45 seconds (adjustable) and then shall slowly start to modulate to maintain the CHWDP_SP.

Cooling Tower Control

- Condenser Water Pump Enable (in Parallel with Chiller – is either/or may start pump)
- The cooling tower fan shall only be operated when the chiller is in operation shall be controlled via the EMCS. On start-up, control valve CV- I shall be in the full re-Circulation mode. The EMCS shall start to modulate the valve open once the condenser water entering the chiller has reached 18 °C, and shall ramp the valve to 100% open once the condenser temperature reaches 24°C. The EMCS shall then enable and modulate the cooling tower fans to maintain the condenser water loop set point.

Safeties

- Chiller is equipped with on-board safety controls to shut down the chiller including but not limited to Chilled/Condenser water flow switches, high/low oil pressure, high/low refrigerant pressure, high low temperatures, anti-short cycle, etc. An indication of the alarm parameter causing the chiller to stop operation will be displayed on the local chiller control panel.
    - Monitor Tower VFD Alarm Status
    - No (Condenser Water) Flow

Alarms

- Critical
    - Low Temp Alarm
- Environmental
    - CHWST/CHWRT High and Low Limits (setpoint deviation of +/- 2°C)
    - CWST/CWRT High and Low Limits (setpoint deviation of +/- 2°C)

- Differential Pressure Deviation Alarm

- Maintenance
  - Chiller Status versus Command
  - Chiller off for more than 5 mins after enabled
  - Valve Status Vs Command
  - Tower Fan Status versus Command
  - Tower VSD Alarm Status
  - Condenser Pump Status Vs Chiller/Pump Command (If pump is not ON after 3 minute time delay)
- Energy Alarms
  - Chiller operating when not commanded on via EMCS
  - Chiller operating for more than 16 hrs/day
  - When OAT< 27^{o}C and CTFANVSD at 100% for greater than 10 minutes.
  - The initial set up values for all alarms shall be established during the commissioning process.

Adjustable Points (to be displayed and accessed on the system Settings Page)

- Calendar Operating Schedule
- Cooling Demand (Chiller Enable/Disable) Settings - Single cooling valve demand Enable (% open), Minimum average cooling valve demand disable (% open)
- Cold Weather (Economizer) Lockout Set Point and Differential
- Chilled Water Supply Setpoint Reset Schedule parameters
- Chilled Water Differential Set Point (CHWDP_SP) and Start-up time delay
- Tower enable setpoint and dead band
- CV-1 CWRT_SP
- CWRT Reset Schedule Parameters
- Alarm Settings – (Setpoints and time delay parameters as noted in part 7 Alarms)

Heat Pumps

Start/Stop:

- The EMCS shall enable heat pumps in pre-defined group associated with a Make-Up air fan according to the MSOSx, and again individually (by room ###) for events through the Community Use Access software and other specified modes of operation.
- Each group of heat pumps associated with a Make-Up air fan shall be further broken down into sub-groups as defined by the owner and based on school size and the total number of heat pumps (example 15 heat pumps/sub-group or 30 heat pumps/sub-group). When commanded on through the MSOSa, the 1st sub-group shall be enabled at the start of the schedule, the second group shall start 7 minutes after first group, etc.
- When operating in occupied academic mode the EMCS shall operate the fan continuously with heating and cooling sequenced to maintain the room heating and cooling set points.
- When operating is summer occupied mode, the EMCS shall operate the fan continuously but the mechanical cooling shall remain locked out unless required by a Community Access event program.

Heat Pump Controls

- The EMCS shall limit the local room thermostat set points between 20°C and 24°C with a +/- 1°C dead band between heating and cooling (adjustable)
- During the unoccupied mode, the fan shall remain off unless there is a call for heating to maintain the unoccupied heating set-point of 18°C (adjustable). The EMCS shall command the fan on with heating enabled to satisfy the unoccupied setpoint + 1°C and then shall cycle off.
- In rooms with perimeter heating, the EMCS shall operate the perimeter heating as the first stage of heating.
- During the unoccupied schedule of each heat pump, the fan shall be overridden on for two (2) hours when its associated occupancy override pushbutton is activated.

Mixed Air/CO2 Control (Optional)

- The maximum Minimum Ventilation Setting shall be 25% (adjustable via associated settings pages). The EMCS shall monitor return air CO2 levels and lower the active minimum ventilation from the (Maximum) minimum ventilation of 25% down to 0% based on maintain a maximum CO2 level of 900ppm.
- When the RA CO2< 900 ppm, the EMCS shall reduce the active Minimum Ventilation setting by 2% every minute until reaching 0% or until the RACO2>900ppm.
- When the RACO2>900ppm the EMCS shall increase the active minimum damper position until reaching the (Maximum) minimum ventilation setting.

Safeties:

- N/A

Alarms:

- Critical
  - Low Room Temp (RMT<14^{o}C when OAT<5^{o}C)
- Environmental
  - Room temperature high/low limits
  - Supply air high/low limits
  - HP in alarm mode
- Maintenance
  - If SAT< 10^{o}C for more than 5 minutes (adjustable)
  - If cooling is enabled and SAT>18^{o}C for more than 5 minutes (adjustable)
  - If heating is enabled and SAT<28^{o}C for more than 5 minutes (adjustable)
- Energy
  - Fan system operating in Occupied Mode outside of Originally Scheduled MSOSx
  - Heat pump operating for greater than 2 hours (adjustable) cumulatively during to maintain un-occupied heating set points
  - The initial set up values for all alarms shall be established during the commissioning process.

Adjustable Points (to be displayed and accessed on system Setting Page)

- Summer/Academic Operating Schedules (by zone)
- Unoccupied Heating/Cooling Setpoints
- Alarm Settings – (setpoints and time delay parameters as noted in part 5 Alarms)

Appendix A6
City of Mississauga - Typical Points List & Standard Sequences of Operation

Package Rooftop Unit (RTU)

Start/Stop:

- The EMCS shall enable the fan system to start when commanded on through either MSOSx or other specified modes of operation (Night Setback, Night Purge, Morning Warm-Up, Programmed Events). When commanded on, supply fan shall start first. Once the supply fan status is proven on, the EMCS shall allow application of the specified mixed air, heating and cooling sequences.
- When the EMCS sends the signal to stop; the supply fan shall stop, and the heating and cooling coils shall be commanded OFF.

Temperature Control

- The OEMASC shall sequence the Heating Coil, Cooling Coil and Mixed Air Damper to maintain zone temperature cooling and heating set-points.
- If the space temperature associated with the zone control is also controlling a radiation valve for the same area, the EMCS shall modulate first the heating coil to 100% heat position. If the heating set-point is not satisfied, the EMCS shall start to modulate the radiation valve to meet the heating requirements.
    - Occupied mode set-points
        - Space heating set-point: 21.5 oC (adjustable)
        - Space cooling set-point 24.5 oC (adjustable)
        - Minimum dead band 2.5 oC (adjustable)
    - Unoccupied mode set-points
        - Space heating set-point: 18 oC (adjustable)
        - Space cooling set-point 26 oC (adjustable)
        - Minimum dead band 2.5 oC (adjustable)

Cold Weather Cooling Lockout

- When OAT < 15°C (adjustable), mechanical cooling shall be locked out.
- Mechanical cooling shall also be locked out during summer operation unless required by Event programming.

Mixed Air Control

- During Occupied operation, the on-board OEMASC shall open the mixing dampers to achieve a minimum ventilation setting and then shall modulate the dampers as required to achieve the economizer control strategy.
- The OEMASC shall use it's own algorithm to determine when to activate the economizer control

strategy. When the outdoor air temperature is below the economizer set-point (ECON-SPT), mechanical cooling shall be locked out and the mixing dampers shall modulate to maintain the supply air temperature set-point (with a mixed/supply air low limit of 6°C). When the outdoor air temperature rises above the economizer set-point, the mixing dampers shall revert back to maintaining minimum ventilation settings and the cooling shall be sequenced to maintain the supply air temperature set-point.

ERV Control (Optional)

- The ERV shall be energized whenever the unit is operating in Occupied Mode, and the unit is not in free-cool operation.

Unoccupied Mode

- When the RTU is in unoccupied mode and the outside air temperature is below 10oC, the EMCS shall send the Night Heat Command to the OEMASC if the zone temperatures falls below the unoccupied heating setpoint.
- When the night heat command is enabled, the RTU shall turn on the fans with the mixing dampers in full re-circulation mode and full heating enabled to satisfy the unoccupied heating setpoint
- When the space temperature rises to unoccupied heating set-point + 1.5oC (adjustable) the Night Heat command shall be disabled.

Economizer Control (Optional)

- During Occupied operation, the on-board OEMASC shall open the mixing dampers to achieve a minimum ventilation setting and then shall modulate the dampers as required to achieve the economizer control strategy.
- The OEMASC shall use it's own algorithm to determine when to activate the economizer control strategy. When the outdoor air temperature is below the economizer set-point (ECON-SPT), mechanical cooling shall be locked out and the mixing dampers shall modulate to maintain the supply air temperature set-point (with a mixed/supply air low limit of 6°C). When the outdoor air temperature rises above the economizer set-point, the mixing dampers shall revert back to maintaining minimum ventilation settings and the cooling shall be sequenced to maintain the supply air temperature set-point.

CO2 Control (Optional)

- The OEMASC shall monitor return air CO2 levels and lower the active minimum ventilation from the (Maximum) minimum ventilation of 25% down to 0% based on maintain a maximum CO2 level of 900ppm.
- When the RA CO2< 900 ppm, the EMCS shall reduce the active Minimum Ventilation setting by 2% every minute until reaching 0% or until the RACO2>900ppm.
- When the RACO2>900ppm the EMCS shall increase the active minimum damper position until

reaching the (Maximum) minimum ventilation setting.

Alarms

- Critical
  - Low Room Temp
- Environmental
  - Fan Status ON – Command OFF
  - Supply Air High/Low Limits
- Maintenance
  - Fan Command ON – Status OFF
  - Heating ON & SAT<20oC for more than 5 min (adjustable)
  - Cooling ON & SAT>20oC for more than 5 min (adjustable)
- Energy Alarms
  - Fan Status On for more than 2 hours cumulatively (adjustable) during un-occupied (NSB) operation.
  - Fan system operating in Occupied Mode outside of Originally Scheduled MSOSx
- The initial set up values for all alarms shall be established during the commissioning process.

Adjustable Points (to be displayed on the system Settings Page)

- Calendar Operating Schedule
- Space Temperature Setpoint
- Night Setback Temperature
- Alarm Settings – (Setpoints and time delay parameters as noted in part 5 Alarms)

Appendix A6
City of Mississauga - Typical Points List & Standard Sequences of Operation

Exhaust Fans

Start/Stop (No Thermostat)

- The EMCS shall enable the exhaust fan(s) to start when commanded on through an associated MSOSx or for a programmed event.
- At all other times, the exhaust fan(s) shall be scheduled OFF.
- If equipped with an isolating damper, on a command from the EMCS, the exhaust damper shall open and when the end switch makes, the fan shall start and the damper status shall be available at EMCS.

Start/Stop (Thermostat)

- The EMCS shall enable the exhaust fan(s) to start when the RMT_T rises 1^{o}C above RMT_SPT.
- The exhaust fan(s) shall be commanded OFF when RMT_T reaches RMT_SPT.
- If equipped with an isolating damper, on a command from the EMCS, the exhaust damper shall open and when the end switch makes, the fan shall start and the damper status shall be available at EMCS

Safeties:

- N/A

Alarms:

- Critical
    - N/A
- Environmental
    - Command OFF – Status ON
- Maintenance
    - Command ON – Status OFF
- Energy
    - N/A
- The initial set up values for all alarms shall be established during the commissioning process.

Adjustable Points (to be displayed and accessed on system Setting Page)

Alarm Settings – (setpoints and time delay parameters as noted in part 7 Alarms)

Unit Heaters

Start/Stop

- The EMCS shall enable the unit heater (s) to start when the RMT_T falls 1^{o}C below RMT_SPT.
- The unit heater(s) shall be commanded OFF when RMT_T reaches RMT_SPT.

Safeties:

- N/A

Alarms:

- Critical
  - N/A
- Environmental
  - Command OFF – Status ON
- Maintenance
  - Command ON – Status OFF
- Energy
  - N/A
- The initial set up values for all alarms shall be established during the commissioning process.

Adjustable Points (to be displayed and accessed on system Setting Page)

- Alarm Settings – (setpoints and time delay parameters as noted in part 7 Alarms)

Appendix A6
City of Mississauga - Typical Points List & Standard Sequences of Operation

VAV Terminal Control

General:

- The VAV terminal controller and room sensor shall be equipped with warmer/cooler set-point adjustment and override button (or Occupancy Sensor).
- Each room (or zone) shall allow a fixed range of set-point adjustment 20°C to 24°C (Max Range +/-2 °C from Set Point). The EMCS shall adjust the range, or the user may adjust, within this range, via the “Warmer/Cooler” selector on the thermostat.
- Each room or space shall have the capability of an individual occupied/unoccupied schedule, which may be different from the AHU schedule, except that when AHU is in unoccupied operation mode; all rooms must also be in unoccupied mode.
- All thermostats shall have an occupancy override button (and/or room occupancy Sensor). The EMCS shall enable the override button feature on an Owner defined basis, so that only Owner approved rooms and offices can utilize the override button feature.
- A number of rooms and offices should be in occupied mode to assure that when AHU unit is energized it is meeting the manufacturer’s minimum airflow requirements.

Occupied Operation Mode:

- The VAV Terminal equipment controller (TEC) shall measure the room temperature and inlet duct velocity and modulate the VAV control damper through control logic to close the volume damper on decreasing room temperature and open the damper on increasing room temperature, to maintain room temperature set-point while providing pressure independent operation.
- For VAV with heating coils, when the minimum primary air volume is reached and the room temperature continues to fall below the heating set-point, the heating valve shall start modulation to 100 % and then VAV will increase the air volume in order to meet the heating set-point.
- VAV Box Max and Min Airflow settings shall be per schedules on the drawings and verified by the TAB agent in coordination with EMCS contractor

Unoccupied Operation Mode:

- The AHU shall be de-energized. The VAV DDC controller shall switch to the unoccupied heating or cooling set-point of 18 °C or 26.5 °C, respectively (adjustable), and the VAV volume dampers shall be closed to a minimum position.
- If the space temperature falls outside the unoccupied range, the AHU may be activated. When the unoccupied heating mode is initiated at the AHU unit, the VAV DDC controller will measure room temperature and inlet duct velocity and shall modulate the VAV volume damper through control logic to open the damper on decreasing room temperature and close the damper on increasing room temperature. Otherwise the VAV shall operate similar to occupied mode.

Morning Start-up:

- Upon initiation of morning Start-up, room set-points are returned to Occupied Mode. If the EMCS determines the need for morning warm-up, all VAV controllers shall be set to 50% open and the room temperature sensors shall be switched to the occupancy mode. If the EMCS determines the need for morning cool-down or recirculation, the VAV boxes shall operate similar to occupied mode.

Safeties

- N/A

Alarms

- Critical
  - Low Space Temperature Alarm
- Environmental
  - Discharge Air, and Space Temperature; High and Low Limits
- Maintenance
  - Discharge Air greater than 3°C (adjustable) above setpoint for more than 2 minutes (adjustable) – applies to units with reheat coils
  - Space Temperature greater than 2°C above/below set point for greater than 5 minutes (Adjustable)
  - Airflow higher/lower by 5% (adjustable) of airflow set point for greater than 5 minutes (adjustable)
- Energy Alarms
  - During Occupied mode, control Damper command at 100% for greater than 5 minutes (adjustable).

Adjustable Points (to be displayed and accessed on system Setting Page)

- Unoccupied heating/cooling setpoints
- Occupied/Unoccupied Max/Min Airflow Settings
- Alarm Settings – (setpoints and time delay parameters as noted in part 7 Alarms)

Appendix A6
City of Mississauga - Typical Points List & Standard Sequences of Operation

Split AC Unit (Mitsubishi)

Start/Stop:

- The EMCS shall enable the AC unit to start when commanded on through an associated MSOSx or for a programmed event.
- At all other times the AC shall be scheduled OFF.

Temperature Control

- When enabled "ON" the AC unit shall operate on its own thermostatic controls.
- Where indicated, EMCS shall monitor the associated room temperature.

Safeties:

- N/A

Alarms:

- Critical
    - N/A
- Environmental
    - Room Temperature High/Low Limits
    - Fan Command OFF – Status ON
- Maintenance
    - Command ON – Status OFF
    - Room Temperature out of limits (see Environmental above) for greater than 15 minutes (adjustable)
- Energy
    - Fan Status On for more than 2 hours cumulatively (adjustable) during un-occupied (NSB) operation.
    - Fan system operating in Occupied Mode outside of Originally Scheduled MSOSx
    - The initial set up values for all alarms shall be established during the commissioning process.

Adjustable Points (to be displayed and accessed on system Setting Page)

- Summer/Academic Schedule
- Room Temperature Setpoint
- Alarm Settings – (setpoints and time delay parameters as noted in part 4 Alarms)

Appendix A6
City of Mississauga - Typical Points List & Standard Sequences of Operation

Exterior Lighting

Start/Stop:

- The EMCS shall enable the exterior lighting (OLIGHT_CMD, PLIGHT_CMD) according to the associated Outdoor lighting schedule. Pole lights and outdoor lights shall have separate schedules.
- An exterior light level sensor shall be installed in series with the outdoor lighting command such that when OLIGHT_CMD is on, power shall be supplied to the lighting circuit and when the OLIGHT_LVL drops below the OLIGHT_SPT, the exterior lights shall be allowed to switch on.
- Install the exterior light level sensor in a location free of shade or other obstruction between sensor and sky.

Safeties:

- N/A

Alarms:

- Critical
  - N/A
- Environmental
  - N/A
- Maintenance
  - N/A
- Energy
  - Lights on outside of Commanded MSOSx
- The initial set up values for all alarms shall be established during the commissioning process.

Adjustable Points (to be displayed and accessed on system Setting Page)

- Schedules
- Light Level Setpoint
- Alarm Settings – (setpoints and time delay parameters as noted in part 3 Alarms)

Appendix A6
City of Mississauga - Typical Points List & Standard Sequences of Operation

Refrigeration Plant

Start/Stop:

- The EMCS shall enable/disable the refrigeration plant according to the existing sequences of operation as described below:

Controls

- The operator shall have the option to set a weekly schedule to control the equipment for each ice pad for the following activities/modes and schedule (adjustable) for each day of the week:

Activity	Priority Level	Schedule (adjustable)	
		Mon – Fri	Sat – Sun
Unoccupied	6	12AM – 8AM	Unoccupied
General Skating	5	8AM – 11AM	General Skating
Figure Skating	4	11AM – 1PM	Figure Skating
Hockey	3	4PM – 12AM	Hockey
Tournament	2	Virtual button for 24 hours (adjustable)	
Ice Making	1	1PM – 3PM	

- Each activity/mode shall have a virtual button on the B.A.S. graphics to over-ride the scheduled activity/mode for an adjustable amount of time.
- The following setpoints for the identified parameters shall be set based on the scheduled mode. The control sequences noted in ".3 Ice Plant" shall utilize the appropriate parameter(s) in order to control the equipment.

Activity	Infrared Temperature (adjustable)	Brine Return Temperature (adjustable)	Discharge Pressure (adjustable)

Unoccupied	-2.8°C/27°F	-4.4°C/24°F	115psig
General Skating	-3.4°C/26°F	-5°C/23°F	120psig
Figure Skating	-4°C/25°F	-5.5°C/22°F	120psig
Hockey	-4.4°C/24°F	-6.7°C/20°F	120psig
Tournament	-5.5°C/22°F	-7.2°C/19°F	120psig
Ice Making	N/A	-6.7°C/20°F	120psig

- Upon detecting the programmed setpoint, scheduled setpoint shall be reset based on the following reset schedule:

Outside Air Dry Bulb Temperature	Infrared Temperature (adjustable)	Brine Return Temperature (adjustable)	Discharge Pressure (adjustable)
-5C/23F & below	+0°C/+0°F	+ 1°C/2°F	+ -5 psig
Between -5C/23F & 5C/41F	+0°C/+0°F	+ 0°C/0°F	+ 0 psig
Between 5C/41F & 10C/50F	+0°C/+0°F	+ -0.5°C/-1°F	+ 10 psig
Between 10C/50F & 20C/68F	+0°C/+0°F	+ -0.75°C/-1.5°F	+ 20 psig
20C/68F & above	+0°C/+0°F	+ -1.0°C/-2.0°F	+ 30 psig

Ice Plant

- The operator shall have the option to select between Infrared or Brine Return to control brine pump or compressor staging.
- Ice plant operation during “Unoccupied” mode shall vary based on outside dry bulb temperature:
- If the outdoor dry bulb temperature is above 20°C/68°F, the brine pump shall operate continuously at full speed to maintain the brine return temperature for the “unoccupied” schedule.
- Upon selection of the “Ice Making” schedule, both the brine pump staging selection and compressor staging selection shall default to Brine Return, and brine pumps shall operate continuously at full speed.

- If Infrared is out of the range (below -15°C/5°F and above 40°C/4.5°F), the cooling enable and compressor staging shall switch to Brine Return operation, and brine pump shall operate continuously at full speed.

Compressors

- The refrigeration compressors shall not be operable unless a brine pump and the compressor jacket pump are operating.
- In the event that each compressor is controlled via the manufacturer's control panel (example: MYPRO-CP1A Control Panel), the building operator shall be able to set each compressor's suction pressure target through the web-interface. The suction pressure target shall initially be set to 20 psig (adjustable). The manufacturer's control panel shall load and/or unload cylinders for each compressor accordingly to maintain its suction pressure target.
- The refrigeration compressors shall be sequentially staged in order to maintain the selected controlled point by the building operator per the conditions set out below. In no event shall the stage enable/disable sequencing be skipped, overridden or overruled, unless infrared setpoint has been met and the brine pump disable delay has been achieved. In that scenario, all compressors shall be disabled first and then brine pumps shall be disabled after another 15 minutes:

Cooling Stage	Compressor Engaged	Controlled Point	Condition	Enable Delay (adj.)	Unoccupied Enable Delay(adj.)	Disable Delay (adj.)
0	None	Infrared	Current Temp. - Scheduled Setpoint b/w 0.0°C/0.0°F & 0.12°C/0.25°F (adjustable)	2 min.	5 min.	20 min.
		Brine Return	Current Temp. - Scheduled Setpoint b/w 0.0°C/0.0°F & 0.25°C/0.5°F (adjustable)			
1	Lead	Infrared	Current Temp. - Scheduled Setpoint b/w 0.12°C/0.25°F & 0.25°C/0.5°F (adjustable)	5 min.	15 min.	10 min.
		Brine Return	Current Temp. - Scheduled Setpoint b/w 0.25°C/0.5°F & 0.5°C/1.0°F (adjustable)			
2	Lead, Lag#1	Infrared	Current Temp. - Scheduled Setpoint b/w 0.25°C/0.5°F & 0. 37°C/0.75°F (adjustable)	15 min.	45 min.	5 min.
		Brine Return	Current Temp. - Scheduled Setpoint b/w 0.5°C/1.0°F & 0.75°C/1.5°F (adjustable)			
3	Lead, Lag#1,	Infrared	Current Temp. - Scheduled Setpoint b/w 0.37°C/0.75°F			

	Lag#2		& 0.5°C/1.0°F (adjustable)	45 min.	90 min.	2 min.
		Brine Return	Current Temp. - Scheduled Setpoint b/w 0.75°C/1.5°F & 1.0°C/2.0°F (adjustable)			
4	Lead, Lag#1, Lag#2, Lag#3	Infrared	Current Temp. - Scheduled Setpoint b/w 0.5°C/1.0°F & 0.62°C/1.25°F (adjustable)	60 min.	120 min.	5 min.
		Brine Return	Current Temp. - Scheduled Setpoint between 1.0°C/2.0°F & 1.25°C/2.5°F (adjustable)			
5	Lead, Lag#1, Lag#2, Lag#3, Lag#4	Infrared	Current Temp. – Scheduled Setpoint more than 0.62°C/1.25°F (adjustable)	60 min.	120 min.	5 min.
		Brine Return	Current Temp. – Scheduled Setpoint more than 1.25°C/2.5°F (adjustable)			

- In the case of a multi-pad facility, cooling stage shall be determined for each pad that demonstrates brine pump operation and the highest (worst-case) cooling stage shall be utilized for the plant.
- In the case of a single-pad facility, replace the table in section 0.3 above by the following:

Cooling Stage	Compressor Engaged	Controlled Point	Condition	Enable Delay (adj.)	Unoccupied Enable Delay(adj.)	Disable Delay (adj.)

0	None	Infrared	Current Temp. - Scheduled Setpoint between 0.0°C/0.0°F & 0.25°C/0.5°F (adjustable)	2 min.	5 min.	20 min.
		Brine Return	Current Temp. - Scheduled Setpoint between 0.0°C/0.0°F & 0.25°C/0.5°F (adjustable)			
1	Lead	Infrared	Current Temp. - Scheduled Setpoint b/w 0.25°C/0.5°F & 0.5°C/1.0°F (adjustable)	5 min.	15 min.	10 min.
		Brine Return	Current Temp. - Scheduled Setpoint b/w 0.25°C/0.5°F & 0.75°C/1.5°F (adjustable)			
2	Lead, Lag	Infrared	Current Temp. - Scheduled Setpoint b/w 0.5°C/1.0°F & 0.75°C/1.5°F (adjustable)	10 min.	60 min.	7.5 min.
		Brine Return	Current Temp. - Scheduled Setpoint b/w 0.75°C/1.5°F & 1.25°C/2.5°F (adjustable)			

- The building operator shall be able to set the number of stages available (demand- limiting) for each schedule in Section 2.1.1 through the web interface.
- The lead compressor selection shall be rotated between all available compressors after every 200 hours of its operation.
- In no event shall the compressors operate in the following conditions:
- Discharge Pressure below 100 psig and above 190 psig, with a 20 psig deadband.
- Suction Pressure below 12 psig and above 35 psig , with a 3 psig deadband.
- In these conditions, a physical beacon shall flash on-site and an automatic email of the fault shall be sent to the Supervisor of Operations.
- Once the respective pressures are outside the conditions noted in Section 2.2.12, the physical beacon shall stop flashing and the compressors shall be engaged back to normal operation.

Suction Pressure Low-Limit Control

- Whenever suction pressure is below 15 psig (adjustable) for more than 60 minutes, compressor staging shall be decreased (compressors are sequentially shut off) until suction pressure reaches above 20 psig. Ensure that a delay of 10 minutes is maintained between staging decrease to ensure stable operation.

Brine Pumps

- In the case of single speed pumps, the brine pumps shall be enabled whenever the average of the infrared temperature over a 5 min (adjustable) period is above the infrared setpoint for the scheduled activity.
- In the case of variable frequency drives (VFD) on the brine pumps, the pumps shall be sequentially staged to the following speeds:

Controlled Point	Condition	Brine Pump VFD Modulation (adj.)
Infrared	Current Temp. - Scheduled Setpoint less than 0.0°C/0.0°F	0%
Infrared	Current Temp. - Scheduled Setpoint between 0.0°C/0.0°F & 0.25°C/0.5°F (adjustable)	50%

Infrared	Current Temp. - Scheduled Setpoint between 0.25°C/0.5°F & 0.5°C/1.0°F (adjustable)	65%
Infrared	Current Temp. - Scheduled Setpoint between 0.5°C/1.0°F & 0.75°C/1.5°F (adjustable)	75%
Infrared	Current Temp. - Scheduled Setpoint between 0.75°C/1.5°F & 1.0°C/2.0°F (adjustable)	90%
Infrared	Current Temp. - Scheduled Setpoint more than 1.0°C/2.0°F (adjustable)	100%

- In no event shall the stage enable/disable sequencing be skipped, overridden or overruled.
- In no event shall the stage enable/disable sequencing be skipped, overridden or overruled, unless infrared setpoint has been met and the brine pump disable delay has been achieved. In that scenario, all compressors shall de disabled first and then brine pumps shall be disabled after another 15 minutes.

Evaporative Condenser Fan

- The evaporative condenser fan shall be controlled by staging the spray pump, and modulating the cooling tower fan to maintain the discharge pressure setpoints.
- The evaporative condenser fan shall be engaged first when the outside dry bulb temperature is below 8°C/46°F, followed by the spray pump in order to maintain the discharge pressure setpoints.
- The spray pump shall be engaged first when the outside dry bulb temperature is above 10°C/50°F, followed by the evaporative condenser fan in order to maintain the discharge pressure setpoints.
- The condenser fan VFD shall be sequentially staged to the following speeds:

Controlled Point	Condition	Condenser Fan VFD Modulation (adj.)
Discharge Pressure	Current Pressure - Scheduled Setpoint less than -5 psig. (adjustable)	0%
	Current Pressure - Scheduled Setpoint between -5 psig. & 0 psig. (adjustable)	50%
	Current Pressure - Scheduled Setpoint between 0 psig. & 5 psig. (adjustable)	65%
	Current Pressure - Scheduled Setpoint between 5 psig. & 10 psig. (adjustable)	75%
	Current Pressure - Scheduled Setpoint between 10 psig. & 15 psig.	90%

	(adjustable)	
	Current Pressure - Scheduled Setpoint more than 15 psig. (adjustable)	100%

- In no event shall the evaporative condenser fan or spray pump operate below 100 psig.

Dynamic Dehumidification Control

- The dehumidification equipment shall be enabled to meet the following space relative humidity conditions:

Space Dry Bulb Temperature (adjustable)	Space Relative Humidity (adjustable)
4.4°C/40°F or lower	70%
5.5°C/42°F	65%
6.7°C/44°F	60%

7.8°C/46°F	55%
8.9°C/48°F	50%
10°C/50°F	48%
11.1°C/52°F	45%
12.2°C/54°F	40%
13.3°C/56°F	38%
14.4°C/58°F	35%
15.6°C/60°F	32%
16.7°C/62°F	30%
17.8°C/64°F	28%
18.9°C/66°F	27%
20.0°C/68°F	25%
21.1°C/70°F or higher	20%

Trend Logging

- Trend logs for the following points shall be set up, with a sampling rate of 5 minutes per point for at least six (6) months and data shall be able to export and electronically sent (via email) automatically to user(s) on a weekly basis in ".csv" format:
    - All compressor start/stop, status
    - All pump start/stop, status
    - Evaporative condenser fan start/stop, status
    - Evaporative condenser fan speed control signal
    - Evaporative condenser fan speed feedback

- Outside Air Dry Bulb
- Plant Discharge Pressure Setpoint
- Compressor Discharge Pressure (if available)
- Compressor Suction Pressure (if available)
- Compressor Suction Pressure Target (if available)
- Plant Suction Pressure
- Plant Discharge Pressure
- Ice Rink Surface Temperature Setpoint
- Ice Rink Surface Temperature
- Brine Supply Temperature
- Brine Return Temperature
- Brine Return Temperature Setpoint
- Evaporative Cooler SprayWater Tank Temperature (if available)
- Compressor JacketWater Cooling Return Temperature (if available)
- Evaporative Condenser Make-UpWater Solenoid Valve Open/Closed (if available)
- Compressor Run-hour Totalizers (if available)
- Pump Run-hour Totalizers (if available)
- Evaporative Condenser Fan Run-hour Totalizers (if available)
- Evaporative Condenser Make-UpWater Consumption Totalizers (if available)

Alarms

- Alarms for the following points shall be set up to flash in a different colour on the BAS screen and be emailed to the Supervisor of Operations and Facility Manager automatically:

Description	Low	High	Time Delay
Infrared Temperature	18°F	32°F	15 min.
Brine Return Temperature (inhibit with pump status)	12°F	32°F	60 min.

Suction Pressure (inhibit with compressors status)	15 psi	30 psi	60 min.
Discharge Pressure (inhibit with compressors status)	105 psi	180 psi	30 min.
Mismatch of brine pump command and status	5%	5%	5 min.
Mismatch of compressor command and status	-	-	2 min.
Mismatch of condenser fan command and status	5%	5%	5 min.
Mismatch of spray pump command and status	-	-	2 min.

Appendix A6
City of Mississauga - Typical Points List
& Standard Sequences of Operation

Typical Points List

Recirculatory AHU Systems

Anticipated Points:

AHU#_SF_STS	- Air Handling Unit ### Supply Fan Status (1 DI)
AHU#_SF_CMD	- Air Handling Unit ### Supply Fan Command (1 DO)
AHU#_RF_STS	- Air Handling Unit ### Return Fan Status (1 DI)
AHU#_RF_CMD	- Air Handling Unit ### Return Fan Command (1 DO)
AHU#_MAT_T	- Air Handling Unit ### Mixed Air Temperature (1 AI)
AHU#_MAD_MOD	- Air Handling Unit ### Mixed Air Damper Modulate (1 AO)
AHU#_SAT_T	- Air Handling Unit ### Supply Air Temperature (1 AI)
AHU#_RAT_T	- Air Handling Unit ### Return Air Temperature (1 AI)
AHU#_HTGVLV_MOD	- Air Handling Unit ### Heating Coil Valve Modulate (1 AO)
AHU#_HTGPMP_CMD	- Air Handling Unit ### Heating Coil Pump Command (1 DO)
AHU#_HTGPMP_STS	- Air Handling Unit ### Heating Coil Pump Status (1 DI)
AHU#_CLGVLV_MOD	- Air Handling Unit ### Cooling Valve Modulate (1 AO)
or	
AHU#_HTG1_CMD	- Air Handling Unit ### Heating Stage 1 Command (1 DO)
AHU#_HTG1_STS	- Air Handling Unit ### Heating Stage 1 Status (1 DI
AHU#_CLG1_CMD	- Air Handling Unit ### Cooling Stage 1 Command (1 DO)
AHU#_CLG1_STS	- Air Handling Unit ### Cooling Stage 1 Status (1 DI)
AHU#_FRZ_ALM	- Air Handling Unit ### Freeze Stat Status (1 DI)

CO2 Control

AHU#_RACO2_LVL	- Air Handling Unit ### Return Air CO2 Level (1 AI)

Humidity Control

AHU#_RAH_RH	- Air Handling Unit ### Return Air Relative Humidity (1 AI)
AHU#_HUM_CMD	- Air Handling Unit ### Humidifier Command (1 DO)

Appendix A6
City of Mississauga - Typical Points List & Standard Sequences of Operation

VFD Control

AHU#_SFVFD_CMD	- Air Handling Unit ### Supply Fan VFD Command (1 DO)
AHU#_SFVFD_MOD	- Air Handling Unit ### Supply Fan VFD Modulation (1AO)
AHU#_SFVFD_FBK	- Air Handling Unit ### Supply Fan VFD Feedback (1 AI)
AHU#_SFVFD_ALM	- Air Handling Unit ### Supply Fan VFD Alarm Status (1 DI)
AHU#_RFVFD_CMD	- Air Handling Unit ### Return Fan VFD Command (1 DO)
AHU#_RFVFD_MOD	- Air Handling Unit ### Return Fan VFD Modulation (1 AO)
AHU#_RFVFD_FBK	- Air Handling Unit ### Return Fan VFD Feedback (1 AI)
AHU#_RFVFD_ALM	- Air Handling Unit ### Return Fan VFD Alarm (1 DI)
AHU#_SASP_PRS	- Air Handling Unit ### Supply Air Static Pressure (1 AI)

Appendix A6
City of Mississauga - Typical Points List & Standard Sequences of Operation

100% Fresh Air AHU Systems

Anticipated Points

AHU#_FAN_CMD - Air Handling Unit ### Fan Command (1 DO) [SF/RF Interlock]

AHU#_SF_STS - Air Handling Unit ### Supply Fan Status (1 DI)

AHU#_SF_CMD - Air Handling Unit ### Supply Fan Command (1 DO)

AHU#_RF_STS - Air Handling Unit ### Return Fan Status (1 DI)

AHU#_RF_CMD - Air Handling Unit ### Return Fan Command (1 DO)

AHU#_SAT_T - Air Handling Unit ### Supply Air Temperature (1 AI)

AHU#_RAT_T - Air Handling Unit ### Return Air Temperature (1 AI)

AHU#_HTGVLV_MOD - Air Handling Unit ### Heating Coil Valve Modulate (1 AO)

AHU#_HTGPMP_CMD - Air Handling Unit ### Heating Coil Pump Command (1 DO)

AHU#_HTGPMP_STS - Air Handling Unit ### Heating Coil Pump Status (1 DI)

AHU#_FRZ_ALM - Air Handling Unit ### Freeze Stat Alarm Status (1 DI)

AHU#_DMPR_CMD - Air Handling Unit ### Damper Command (1 DO) [OA/EA Interlock]

AHU#_OAD_CMD - Air Handling Unit ### Outside Air Damper Command (1 DO)

AHU#_OADES_STS - Air Handling Unit ### Outside Air Damper End Switch Status (1 DI)

AHU#_EAD_CMD - Air Handling Unit ### Exhaust Air Damper Command (1 DO)

AHU#_EADES_STS - Air Handling Unit ### Exhaust Air Damper End Switch Status (1 DI)

Energy Recovery Wheel Control

AHU#_ERW_CMD - Air Handling Unit ### Energy Recovery Wheel Command (1 DO)

AHU#_ERW_MOD - Air Handling Unit ### Energy Recovery Wheel Modulate (1 AO)

AHU#_ERW_STS - Air Handling Unit ### Energy Recovery Wheel Status (1 DI)

AHU#_FAT_T - Air Handling Unit ### Fresh Air Temperature (1 AI)

AHU#_EAT_T - Air Handling Unit ### Exhaust Air Temperature (1 AI)

AHU#_HRAT_T - Air Handling Unit ### Heat Recovered Air Temperature (1 AI)

VFD Control

AHU#_SFVFD_CMD - Air Handling Unit ### Supply Fan VFD Command (1 DO)

AHU#_SFVFD_MOD	- Air Handling Unit ### Supply Fan VFD Modulate (1 AO)
AHU#_SFVFD_FBK	- Air Handling Unit ### Supply Fan VFD Feedback (1 AI)
AHU#_SFVFD_ALM	- Air Handling Unit ### Supply Fan VFD Alarm (1 DI)
AHU#_EFVFD_CMD	- Air Handling Unit ### Exhaust Fan VFD Command (1 DO)
AHU#_EFVFD_MOD	- Air Handling Unit ### Exhaust Fan VFD Modulate (1 AO)
AHU#_EFVFD_FBK	- Air Handling Unit ### Exhaust Fan VFD Feedback (1 AI)
AHU#_EFVFD_ALM	- Air Handling Unit ### Exhaust Fan VFD Alarm (1 DI)
AHU#_SASP_PRS	- Air Handling Unit ### Supply Air Static Pressure (1 AI)

Humidity Control

AHU#_RAH_RH	- Air Handling Unit ### Return Air Humidity (1 AI)
AHU#_HUM_MOD	-Air Handling Unit ### Humidifier Modulate (1 AO)

Appendix A6
City of Mississauga - Typical Points List & Standard Sequences of Operation

Boiler Plant

Anticipated Points

BLDG_OAT_T	- Building Outdoor Air Temperature (1 AI)
MAINHTG_SWT_T	- Main Heating Supply Water Temperature (1 AI)
MAINHTG_RWT_T	- Main Heating Return Water Temperature (1 AI)
MAINHTG_CPMP30XA_CMD	- Main Heating Circ Pump 30#A Command (1 DO)
MAINHTG_CPMP30XA_STS	- Main Heating Circ Pump 30#A Status (1 DI)
MAINHTG_CPMP30XB_CMD	- Main Heating Circ Pump 30#A Command (1 DO)
MAINHTG_CPMP30XB_STS	- Main Heating Circ Pump 30#A Status (1 DI)
BLR#_BUR_CMD	- Boiler # Burner Command (1 DO)
BLR#_BUR_MOD	- Boiler # Burner Modulate (1 AO)
BLR#_BUR_STS	- Boiler # Burner Status (1 DI)
BLR#_ALM_ALM	- Boiler # Alarm Status (1 DI)
BLR#_SWT_T	- Boiler # Supply Water Temperature (1 AI)
BLR#_CPMP30XX_STS	- Boiler # Circ Pump 30## Status (1 DI)

Perimeter Radiation

RADL_SWT_T	- Rad Loop Supply Water Temperature (1 AI)
RADL_RWT_T	- Rad Loop Return Water Temperature (1 AI)
RADL_HTGVLV_MOD	- Rad Loop Heating Valve Modulate (1 AO)
RADL_CPMP30X_CMD	- Rad Loop Circ Pump 30# Command (1 DO)
RADL_CPMP30X_STS	- Rad Loop Circ Pump 30# Status (1 DI)

Appendix A6
City of Mississauga - Typical Points List & Standard Sequences of Operation

HP Loop & Cooling Tower

Anticipated Points

CT_SPRYPMP_CMD	- Cooling Tower Spray Pump Command (1 DO)
CT_SPRYPMP_STS	- Cooling Tower Spray Pump Status (1 DI)
CT_FANVFD_CMD	- Cooling Tower Fan VFD Command (1 DO)
CT_FANVFD_MOD	- Cooling Tower Fan VFD Modulate (1 AO)
CT_FANVFD_FBK	- Cooling Tower Fan VFD Feedback (1 AI)
CT_FANVFD_ALM	- Cooling Tower Fan VFD Alarm (1 DI)
CT_DMPR_CMD	- Cooling Tower Damper Command (1 DO)
CT_DMPRES_STS	- Cooling Tower Damper End Switch Status (1 DI)
HPL_CPMP30XA_CMD	- Heat Pump Loop Circ Pump 30#A Command (1 DO)
HPL_CPMP30XA_MOD	- Heat Pump Loop Circ Pump 30#A Modulate (1 AO)
HPL_CPMP30XA_FBK	- Heat Pump Loop Circ Pump 30#A Feedback (1 AI)
HPL_CPMP30XA_ALM	- Heat Pump Loop Circ Pump 30#A Alarm (1 DI)
HPL_CPMP30XB_CMD	- Heat Pump Loop Circ Pump 30#A Command (1 DO)
HPL_CPMP30XB_MOD	- Heat Pump Loop Circ Pump 30#B Modulate (1 AO)
HPL_CPMP30XB_FBK	- Heat Pump Loop Circ Pump 30#B Feedback (1 AI)
HPL_CPMP30XB_ALM	- Heat Pump Loop Circ Pump 30#B Alarm (1 DI)
HPL_DP_PRS	- Heat Pump Loop Differential Pressure (1 AI)
HPL_SWT_T	- Heat Pump Loop Supply Water Temperature (1 AI)
HPL_RWT_T	- Heat Pump Loop Return Water Temperature (1 AI)

Heat Injection

HX_CPMP30##_CMD	- Heat Exchanger Circ Pump 30## Command (1 DO)
HX_CPMP30##_STS	- Heat Exchanger Circ Pump 30## Status (1 DI)
HX_BLRSWT_T	- Heat Exchanger Boiler Side Supply Water Temperature (1 AI)
HX_BLRRWT_T	- Heat Exchanger Boiler Side Return Water Temperature (1 AI)
HX_HPSWT_T	- Heat Exchanger HP Side Supply Water Temperature (1 AI)

HX_HPRWT_T - Heat Exchanger HP Side Return Water Temperature (1 AI)

HX_HTGVLV_MOD - Heat Exchanger Heating Valve Modulate (1 AO)

Appendix A6
City of Mississauga - Typical Points List & Standard Sequences of Operation

Chiller and Cooling Tower

Anticipated Points – Chiller

CHLR#_CMD	- Chiller # Command (1 DO)
CHLR#_STS	- Chiller # Status (1 DI)
CHLR#_ALM	- Chiller # Alarm (1 DI)
CHLR#_SWT_SPT	- Chiller # Supply Water Temperature Setpoint (1 AO)
CHLR#_SWT_T	- Chiller # Supply Water Temperature (1 AI)
CHLR#_CNDEWT_T	- Chiller # Condenser Entering Water Temperature (1 AI)
CHLR#_CNDLWT_T	- Chiller # Condenser Leaving Water Temperature (1 AI)
CHLR#_CLGPMP###_CMD	- Chiller # Cooling Pump ### Command (1 DO)
CHLR#_CLGPMP###_STS	- Chiller # Cooling Pump ### Command (1 DO)
CHW_PMP###_CMD	- Chilled Water Pump ### Command (1 DO)
CHW_PMP###_MOD	- Chilled Water Pump ### Modulate (1 AO)
CHW_PMP###_FBK	- Chilled Water Pump ### Feedback (1 AI)
CHW_PMP###_ALM	- Chilled Water Pump ### Alarm (1 DI)
CHW_SWT_T	- Chilled Supply Water Temperature (1 AI)
CHW_RWT_T	- Chilled Return Water Temperature (1 AI)
CHW_DP_PRS	- Chilled Water Differential Pressure (1 AI)

Anticipated Points – Cooling Tower

CT#_FANVFD_CMD	- Cooling Tower Fan VFD Command (1 DO)
CT#_FANVFD_FBK	- Cooling Tower Fan VFD Feedback (1 AI)
CT#_FANVFD_MOD	- Cooling Tower Fan VFD Modulate (1 AO)
CT#_FANVFD_ALM	- Cooling Tower Fan VFD Alarm (1 DI)
CT#_LWT_T	- Cooling Tower Leaving Water Temperature (1 AI)
CT#_EWT_T	- Cooling Tower Entering Water Temperature (1 AI)
CT#_HXVLV_MOD	- Cooling Tower # Heat Exchanger Valve Modulate (1 AO)
CT#_BPVLV_MOD	- Cooling Tower # Bypass Valve Modulate (1 AO)

CT#_CLGPMP###_CMD	- Cooling Tower Cooling Pump ### Command (1 DO)
CT#_CLGPMP###_STS	- Cooling Tower Cooling Pump ### Status (1 DI)
CT#_VLV#OPEN_CMD	- Cooling Tower # Valve # Open Command (1 DO)
CT#_VLV#CLOSE_CMD	- Cooling Tower # Valve # Close Command (1 DO)
CT#_VLV#_CMD	- Cooling Tower # Valve # Command (1 DO)
CT#_VLV#ES_STS	- Cooling Tower # Valve End Switch Status (1 DI)

Appendix A6
City of Mississauga - Typical Points List & Standard Sequences of Operation

Heat Pumps

Anticipated Points

RM###_RMT_T	- Room ### Space Temperature (1 AI)
RM###_OCC_STS	- Room ### Occupancy Status (1 DI)
RM###_RADVLV_MOD	- Room ### Rad Valve Modulate (1 AO)
RM###_HP_FAN_CMD	- Room ### Heat Pump Fan Command (1 DO)
RM###_HP_FAN_STS	- Room ### Heat Pump Fan Status (1 DI)
RM###_HP_REVVLV_CMD	- Room ### Heat Pump Reversing Valve Command (1 DO)
RM###_HP_CMPR_CMD	- Room ### Heat Pump Compressor Command (1 DO)
RM###_HP_CMPR_STS	- Room ### Heat Pump Compressor Status (1 DI)
RM###_HP_ALM_ALM	- Room ### Heat Pump Alarm Status (1 DI)
RM###_HP_REMRST_CMD	- Room ### Heat Pump Remote Reset Command (1 DO)
RM###_HP_SAT_T	- Room ### Heat Pump Supply Air Temperature (1 AI)

Gym HPs

GYM_HP_RMT_T	- Gym Space Temperature (1 AI)
GYM_HP_CO2_LVL	- Gym Space CO2 Level (1 AI)
GYM_HP_MAD_MOD	- Gym Heat Pump Mixed Air Damper Modulate (1 AO)

Appendix A6
City of Mississauga - Typical Points List & Standard Sequences of Operation

Package Rooftop-Unit

Anticipated Points

RTU#_FAN_CMD	- RTU ### Fan Command (1 DO)
RTU#_FAN_STS	- RTU ### Fan Status (1 DI)
RTU#_SAT_T	- RTU ### Supply Air Temperature (1 AI)
RTU#_MAT_T	- RTU ### Mixed Air Temperature (1 AI)
RTU#_CLG1_CMD	- RTU ### Cooling Stage 1 Command (1 DO)
RTU#_CLG2_CMD	- RTU ### Cooling Stage 2 Command (1 DO)
RTU#_CLG_STS	- RTU ### Cooling Status (1 DI)
RTU#_HTG1_CMD	- RTU ### Heating Stage 1 Command (1 DO)
RTU#_HTG2_CMD	- RTU ### Heating Stage 2 Command (1 DO)
RM###_RMT_T	- Room ### Space Temperature (1 AI)

BACnet Card

RM###_RMT_T	- Room ### Space Temperature (1 VP)
RM###_RMT_SPT	- Room ### Space Temperature Setpoint (1 VP)
RTU#_ENA_CMD	- RTU ### Enable Command (1 VP)
RTU#_RAT_T	- RTU ### Return Air Temperature (1 VP)
RTU#_MAT_T	- RTU ### Mixed Air Temperature (1 VP)
RTU#_FAN_CMD	- RTU ### Fan Command (1 VP)
RTU#_ECONENA_CMD	- RTU ### Economizer Enable Command (1 VP)
RTU#_DMPRMIN_SPT	- RTU ### Damper Minimum Position Setpoint (1 VP)
RTU#_DMPR_FBK	- RTU ### Damper Feedback (1 VP)
RTU#_CLG_CMD	- RTU ### Cooling Command (1 VP)
RTU#_HTG_CMD	- RTU ### Heating Command (1 VP)
RTU#_CWLO_CMD	- RTU ### Cold Weather Lock Out Command (1 VP)
RTU#_FAN_STS	- RTU ### Fan Status (1 DI)
RTU#_SAT_T	- RTU ### Supply Air Temperature (1 AI)

ERV

RTU#_ERV_CMD	- RTU ### ERV Command (1 DO)
RTU#_ERV_STS	- RTU ### ERV Status (1 DI)

Appendix A6
City of Mississauga - Typical Points List & Standard Sequences of Operation

Exhaust Fans

Anticipated Points

RM###_RMT_T	- Room ### Space Temperature (1 AI)
EF###_FAN_CMD	- Exhaust Fan ### Fan Command (1 DO)
EF###_FAN_STS	- Exhaust Fan ### Fan Status (1 DI)

Dampers

EF###_DMPR_CMD	- Exhaust Fan ### Damper Command (1 DO)
EF###_DMPRES_STS	- Exhaust Fan ### Damper End Switch Status (1DI)

Unit Heaters

Anticipated Points

RM###RMT_T	- Room ### Space Temperature (1 AI)
RM###_UH_HTG_CMD	- Room ### Unit Heater Command (1 DO)

VAV/VVT Boxes

Anticipated Points

RM###_RMT_T	- Room ### Space Temperature (1 AI)
RM###_OCC_STS	- Room ### Occupancy Status (1 DI)
RM###_VAV_SASP_PRS	- Room ### VAV Supply Air Static Pressure (1 AI)
RM###_VAV_SAFLW_CFM	- Room ### VAV Supply Air Flow (1 AI)
RM###_VAV_DMPR_MOD	- Room ### VAV Damper Modulate (1 AO)

Reheat

RM###_RADVLV_MOD	- Room ### Rad Valve Modulate (1 AO)
RM###_VAV_HTGVLV_MOD	- Room ### VAV Heating Valve Modulate (1 AO)
RM###_VAV_SAT_T	- Room ### VAV Supply Air Temperature (1 AI)

Appendix A6
City of Mississauga - Typical Points List & Standard Sequences of Operation

AC Split-System

Anticipated Points

RM###_RMT_T	- Room ### Space Temperature (1 AI)
RM###_AC_CLG_CMD	- AC ### Cooling Command (1 DO)
RM###_AC_CLG_STS	- AC ### Cooling Status (1 DI)
RM###_AC_ALM_ALM	- AC ### Alarm Status (1 DI)
RM###_AC_FAN_CMD	- AC ### Fan Command (1 DO)
RM###_AC_FAN_STS	- AC ### Fan Status (1 DI)

Outside Lighting

Anticipated Points

BLDG_LGT_LVL	- Building Outside Light Level (1 AI)
BLDG_LGT_CMD	- Building Outside Light Command (1 DO)

Refrigeration Plant

Anticipated Points

RNK###_CHLR#_CMD	- Rink ### Chiller # Command (1 DO)
RNK###_CHLR#_STS	- Rink ### Chiller # Status (1 DI)
RNK###_HBPMP_CMD	- Rink ### Hot Brine Pump Command (1 DO)
RNK###_HBPMP_STS	- Rink ### Hot Brine Pump Status (1 DI)
RNK###_HWPMP_CMD	- Rink ### Hot Water Pump Command (1 DO)
RNK###_HWPMP_STS	- Rink ### Hot Water Pump Status (1 DI)
RNK###_CBPMP_CMD	- Rink ### Cold Brine Pump VFD Command (1 DO)
RNK###_CBPMP_MOD	- Rink ### Cold Brine Pump VFD Modulate (1 AO)
RNK###_CBPMP_FBK	- Rink ### Cold Brine Pump VFD Feedback (1 AI)
RNK###_CBPMP_ALM	- Rink ### Cold Brine Pump VFD Alarm (1 DI)
RNK###_CNDFAN_CMD	- Rink ### Condenser Fan VFD Command (1 DO)

Appendix A6
City of Mississauga - Typical Points List & Standard Sequences of Operation

RNK###_CNDFAN_MOD - Rink ### Condenser Fan VFD Modulate (1 AO)

RNK###_CNDFAN_FBK - Rink ### Condenser Fan VFD Feedback (1 AI)

RNK###_CNDFAN_ALM - Rink ### Condenser Fan VFD Alarm (1 DI)

RNK###_RMT_T - Rink ### Space Temperature (1 AI)

RNK###_CBST_T - Rink ### Cold Brine Supply Temperature (1 AI)

RNK###_CBRT_T - Rink ### Cold Brine Return Temperature (1 AI)

RNK###_CHWRPRS_PRS - Rink ### Chilled Water Return Pressure (1 AI)

RNK###_CNDSWPRS_PRS - Rink ### Condenser Water Supply Pressure (1 AI)

RNK###_CNDRWT_T - Rink ### Condenser Return Water Temperature (1 AI)

RNK###_CNDSUMP_T - Rink ### Condenser Sump Temperature (1 AI)

Appendix B
City of Mississauga Forms and Templates

B1 – CoM Points List Template
B2 – CoM Sample Points List
B3 – CoM Pre-Commissioning Checklist Form
B4 – CoM Project Acceptance Form
B5 – CoM Training Sign-Off Form
B6 – CoM Sample Project Specifications

Template
Address
Points Matrix

All existing power supplies, cabinets, relays, sensors, wiring to be replaced unless otherwise noted. Conduits may be reused in whole or in part. Unused conduit to be removed. Applies to all exisitng points unless otherwise noted.

System Identifier

HVAC 1 Site ID

Existing Point Name	New Point Name	Point Description	Type	Units in Display

Template
Address
Points Matrix

System Identifier				
HVAC 1	Site ID			
Existing Point Name	New Point Name	Point Description	Type	Units in Display
Mixed Air Damper	###1_ HVAC1_MAD_MOD	HVAC1 Mixed Air Damper Modulate	AO	% Fresh Air
Heat Wheel Control	###1_ HVAC1_HRW_CMD	HVAC1 Heat Recovery Wheel Command	DO	ON/OFF
Heat Wheel Status	###1_ HVAC1_HRW_STS	HVAC1 Heat Recovery Wheel Status	DI	ON/OFF
Htg Stg.1	###1_ HVAC1_HTG1_CMD	HVAC1 Heating Stage 1 Command	DO	ON/OFF
Htg Stg.2	###1_ HVAC1_HTG2_CMD	HVAC1 Heating Stage 2 Command	DO	ON/OFF
Clg Stg.1	###1_ HVAC1_CLG1_CMD	HVAC1 Cooling Stage 1 Command	DO	ON/OFF
Clg Stg.2	###1_ HVAC1_CLG2_CMD	HVAC1 Cooling Stage 2 Command	DO	ON/OFF
Supply Fan Control	###1_ HVAC1_SF_CMD	HVAC1 Supply Fan Command	DO	ON/OFF
Supply Fan Status	###1_ HVAC1_SF_STS	HVAC1 Supply Fan Status	DI	ON/OFF
Supply Air Temperature	###1_ HVAC1_SAT_T	HVAC1 Supply Air Temperature	AI	℃
Supply Air Humidity	###1_ HVAC1_SAH_RH	HVAC1 Supply Air Relative Humidity	AI	% RH
Return Air Temperature	###1_ HVAC1_RAT_T	HVAC1 Return Air Temperature	AI	℃
Return Air Humidity	###1_ HVAC1_RAH_RH	HVAC1 Return Air Relative Humidity	AI	% RH
Return Air CO2	###1_ HVAC1_RACO2_LVL	HVAC1 Return Air CO2 Level	AI	PPM
Exhaust Fan Control	###1_ HVAC1_EF_CMD	HVAC1 Exhaust Fan Command	DO	ON/OFF
Court Room 1 Temp.	###1_ HVAC1_RMT_T	HVAC1 Space Temperature	AI	℃
Humidity Control	###1_ HVAC1_HUM_MOD	HVAC1 Humidifier Modulate	AO	%
New Point	###1_ HVAC1_EF_STS	HVAC1 Exhaust Fan Status	DI	ON/OFF
New Point	###1_ HVAC1_CLG1_STS	HVAC1 Cooling Stage 1 Status	DI	ON/OFF
New Point	###1_ HVAC1_CLG2_STS	HVAC1 Cooling Stage 2 Status	DI	ON/OFF
New Point	###1_ HVAC1_OCC_STS	HVAC1 Occupancy Sensor Status	DI	OCCUPIED/UNOCCUPIED

Pre-Commissioning Check List

The following Check List will be prepared by the controls Vendor and Submitted to Ameresco Prior to scheduling of Commissioning

Facility Name ______________________

Municipal Address ______________________

IP Address ______________________

Company ______________________

Panel No:	Location:	Power Supplied From:

Auto Restoration on Loss of Power ____

Wires Labelled ____

Panel Schedule Enclosed ____

Existing Redundant Controls Removed ____

Point No	Name Descriptor	Description	Type	Device	Fail Mode	Verified By	Comments

Additional Comments/Site Notes:

____
Control Technition

____
Print Name

____
Date

EMCS PROJECT ACCEPTANCE SIGN-OFF FORM
DEFICIENCIES AND ACTION ITEMS

Project/Site:

Submitting for:

☐ Provisional Acceptance

☐ Final Acceptance

☐ Warranty Monitoring

The project has been reviewed against the prescribed acceptance criteria:

PROVISIONAL ACCEPTANCE

☐ • System is completely installed, calibrated, tested and operational
☐ • Preliminary deficiency items have been corrected
☐ • Preliminary as-builts have been received
☐ • Functional Testing Check List complete as specified (**Pre-Commissioning Checklist attached**)
☐ • Commissioning has been scheduled with the owner and/or owner's agent
☐ • Graphics Submitted are in accordance with the Graphical Template
☐ • User Sign-In Levels have been Tested and are Operational with Proper Authorities and Restrictions
☐ • Trend have been set up to specified intervals and Auto-upload to server is verified
☐ • All Alarms have been tested and routing verified

FINAL ACCEPTANCE

☐ • Final commissioning is complete
☐ • Attached deficiency list has been completed by the vendor
☐ • Final documentation has been received
☐ • Final as-builts updated and uploaded to graphics, hard copies received
☐ • Software/Programming turned over to Owner
☐ • Training is complete and Sign off Form Attached

WARRANTY MONITORING

☐ • No identified deficiencies remain

This project stage is complete as indicated above.

Approver for the Vendor: Date:

_______________________________ _______________

Approver for the Consultant: Date:

_______________________________ _______________

Approver for the City of Mississauga: Date:

_______________________________ _______________

EMCS PROJECT ACCEPTANCE SIGN-OFF FORM
DEFICIENCIES AND ACTION ITEMS

Project/Site:

ITEM	DESCRIPTION	ACTION BY	Date Completed	Contractor	Owner
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

EMCS PROJECT ACCEPTANCE SIGN-OFF FORM
DEFICIENCIES AND ACTION ITEMS

Project/Site:

Additional Project Comments/Notes:

EMCS PROJECT ACCEPTANCE SIGN-OFF FORM
STAFF TRAINING

Project/Site:

STAFF TRAINING

- ☐ Final commissioning of the new EMCS is complete
- ☐ Facilities Staff can log on to the new EMCS
- ☐ Facilities Staff have the proper levels of EMCS access
- ☐ Facilities Staff have been trained to operate the new EMCS
- ☐ Facilities Staff questions have been addressed by the vendor

This project stage is complete as indicated above.

BAS Vendor: Date:

Name Signature

City of Mississauga Employee: Date:

Name Signature

City of Mississauga Employee: Date:

Name Signature

EMCS: GENERAL SCOPE OF WORK

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EMCS: GENERAL SCOPE OF WORK

Part 1 General

1.1 REQUIREMENTS

1.1.1 Conform to the General requirements of Divisions 00, 01, 22, 23 and 24

1.1.2 Conform to the requirements of the "Master Specifications for Energy Management Control Systems" [Rev #] including requirements of the following Sections:

Specification Note: Design consultant shall obtain the latest revision of the Master Specification from the CoM project manager and make reference to this document here. A copy of the Master Specification should be issued by CoM to the bidding contractors in conjunction with these project specification.

1.1.2.1 Section 25 01 11 – EMCS: Start-up, Verification and Commissioning

1.1.2.2 Section 25 01 12 – EMCS: Training

1.1.2.3 Section 25 05 01 – EMCS: General Requirements

1.1.2.4 Section 25 05 02 – EMCS: Submittals and Review Process

1.1.2.5 Section 25 05 03 – EMCS: Project Record Documents

1.1.2.6 Section 25 05 54 – EMCS: Identification

1.1.2.7 Section 25 08 20 – EMCS: Warranty and Maintenance

1.1.2.8 Section 25 10 01 – EMCS: Local Area Network (LAN)

1.1.2.9 Section 25 30 01 – EMCS: Building Controllers, Family of Controllers

1.1.2.10 Section 25 03 02 – EMCS Field Control Devices

1.1.2.11 Section 25 90 01 – EMCS Site Requirements, Applications and System Sequences of Operation

1.1.2.12 Appendix A – City of Mississauga Standards and Guidelines

1.1.2.13 Appendix B – City of Mississauga Forms and Templates

1.2 GENERAL OBJECTIVES

1.2.1 This project is [PROJECT NAME/DESCRIPTION] for the City of Mississauga Energy Management Control Systems (EMCS) involving the [replacement of existing controls],[installation of a new control system] including work at site and the modification of Owner's EMCS Enterprise Server Software (ESS) for the City of Mississauga.

1.2.2 The scope of work for this contract shall include [the complete removal of existing electrical/pneumatic/digital controls (including abandoned and redundant controls) and] the installation of new direct digital controls including Niagara JACE 8000 Series Supervisory Controller(s), all remote programable digital controllers (RPDC), Terminal Equipment Controllers (TEC) and connection to OEMASC for a complete and functional control system. The number of field controllers shall be of sufficient number to accommodate the points identified in the points list and specified here within. The new control system shall be in accordance with the City of Mississauga "Master Specifications for Energy Management Control Systems (EMCS)" operating on the City of Mississauga Niagara 4 platform.

1.2.3 This contract requires the full development of NEW site-specific customized graphics in accordance with the City of Mississauga Graphical Standards. The contractor shall utilize existing graphical workstation(s) as a guideline for the starting point of development of the new graphics and shall work closely with the Owner and Consultant to create the site specific graphics (including possible enhancements to the existing Graphical Standard).

1.2.4 The EMCS contractor shall meet with the Owner and Consultant within 2 weeks of the Project Start-Up meeting to specifically discuss the requirements for new system graphics and associated plan of execution.

1.2.5 The EMCS contractor shall anticipate a reiterative process whereby the graphics will be submitted multiple times for review and comment, followed by revision(s) until both the Owner and Consultant are satisfied with the end result (and graphics approval is granted). **NO CONTROL INSTALLATION WORK CAN BEGIN ON SITE UNITL THE GRAPHICS ARE SUBMITTED AND APPROVED.**

1.2.6 [Remove existing, supply and install all new cabinet enclosures, new controllers, power supplies, control wiring, hardware and end devices for a complete and total system as indicated. The contractor shall NOT re-use existing cabinets, controllers, wiring, relays, sensors, or other end devices unless otherwise noted. Conduits may be re-used to run new wiring].

1.2.7 Provide all new programming to achieve energy efficiency in accordance with the specified sequence of operation and at the direction of the consultant.

1.2.8 Perform all Pre-Commissioning activities including Functional and Performance Testing, Completion of Pre-Commissioning Checklists, Submission of Provisional Acceptance Forms.

1.2.9 Upon submission and acceptance of the Provisional Acceptance Forms by the Owner and Consultant, arrange for a Commissioning date through the Prime Contractor. EMCS contractor shall guide and assist Commission Agent to inspect and verify a second round of functional and performance testing to achieve optimized performance of the building and building systems.

1.2.10 Complete training, submit documentation and correct all deficiencies in a timely manner prior to submission of Final Acceptance Forms

1.3 SPECIFIC SCOPE OF WORK – [SITE NAME]

Specification Note: This section is where the details of the site-specific project should be described by the Consultant/Design Engineer. The following is a typical example:

1.3.1 The scope of work for [SITE NAME] shall include the complete disconnect and removal of existing abandoned and redundant electrical/pneumatic/digital controls, including all control cabinets, power supplies, wiring, relays, sensors and other end devices. Contractor shall walk through the job site with Owner/Consultant at the start of the job to confirm and review total extent of removals.

1.3.2 Supply and install all new control cabinets, power supplies, relays, actuators, sensors, thermostats, wiring, etc. as specified and as necessary to achieve the specified sequence of operation associated with the replacement of existing and addition of new control points. Refer to points list and sequences of operation in Appendix [A].
Specification Note: Consultant/Design Engineer to make use of the CoM materials as outlined in the Design Guideline and Master Specifications to generate a points lists

and associated sequence of operation to be included in the project specifications. All points to be named using the CoM point naming convention. Sequences and points list shall be submitted to,, and approved by, the CoM before tender.

1.3.2.1 The contractor may re-use existing conduits where possible. All wiring, sensors, relays, end devices, etc. as indicated in points list to be replaced shall be removed and replaced with new.

1.3.2.2 Provide all programming as outlined in the Sequences of Operation detailed in Appendix [A] including all new customized site-specific graphics in accordance with the City of Mississauga Master Specifications for Energy Management Control systems EMCS.

1.3.2.3 All graphics, EMCS control programming, trend data, security settings, access level priorities, etc. shall be uploaded by the EMCS contractor and stored on the EMCS Server prior to the start of commissioning and again upon completion of deficiency clean-up and submission of as-built. The EMCS contractor shall set-up automatic back-up of the site databased and programming to the server at the direction of CoM Energy Management Specialist.

1.3.2.4 The dedicated EMCS server shall be the primary global interface.

1.3.2.5 The SRPDC shall have an Open Nics statement and be licensed to the owner and shall have a minimum of 20% spare capacity for additional points/controllers associated with this installation.

1.3.3 Provide new “as-built” drawings including all new/modified points, communication BUS and location of field panels, terminal equipment controllers, and associated power supplies, updated panel termination diagrams and revised sequence of operation.

1.4 SHOP DRAWINGS AND PRODUCT DATA

1.4.1 Submit shop drawings and product data in accordance with Section 01 33 00 of these specifications and the requirements of City of London Master Specifications for EMCS Upgrades.

1.5 ELECTRICAL WIRING

1.5.1 Submit shop drawings and product data in accordance with Section 01 33 00 of these specifications.

1.5.2 All wiring shall comply with local and national electrical codes and the requirements of Divisions 22, 23 and 24.

1.5.3 All control and sensor wiring shall be colour coded in compliance with designated colour scheme by vendor.

1.5.4 All wiring shall be plenum rated Beldon or equivalent, #18, #20 or #22-gauge, non-shielded wiring when in conduit, shielded where exposed. Lengths for specific gauge and applications shall comply with the control’s manufacturer’s guidelines. Exposed wiring in service areas (Mechanical/Electrical) shall be in EMT conduit, plenum rated cable above ceilings. Any exposed wiring in corridors, classrooms, etc. (finished areas) shall be in wire mold.

1.5.5 Size 24 VAC wiring according to length. Refer to manufacturer’s voltage drop table and size wire to achieve a minimum of 22 VAC at the control being powered.

1.5.6 The use of wire-nuts for connections on communication bus is prohibited. Use “Scotchlok” 3M terminals or other similar terminal block type product.

1.5.7 All new controls shall have an independent power supply with dedicated breaker. This contractor shall be responsible for finding available power and labelling panel(s) for new control circuits.

1.5.8 **120VAC to 24 V power control transformers shall be supplied and installed in a rated electrical enclosure and wired to control panel(s). Control cabinets shall have 24Vdc only and a dedicated terminal strip as per the Master Specifications Rev 1**.

Part 2 Products

2.1 GENERAL

2.1.1 The control system shall be comprised of complete stand-alone controllers, sensor, relays, power and control wiring where required, and other required accessories for the complete control of the specified renovations under this Contract. Control system shall be capable of accomplishing the sequence of operation as specified herein.

2.1.2 New controls shall be in accordance with the City of Mississauga "Master Specifications for Energy Management Control Systems" latest revision. Pre-Qualified bidders shall only submit for the Family of Controllers as listed in Section 25 30 01 and as follows:

Company Name	Branch Location	Contact Person	EMCS Family of Products
Facio Corporation	145 West Beaver Creek Rd, Richmond Hill, ON L4B 1C6	Gary MacMillan gmacmillan@facio.ca	Honeywell Spyder BacNet IP series (programmable via Niagara Workbench) and Ciper series controller. Distech Eclypse BacNet IP series controllers
Automated Controls and Energy Solutions Group Inc.	5285 Solar Dr Unit 103, Mississauga, ON L4W 5B8	Murat Kinaci estimates@acesolutionsgroup.ca	Honeywell Spyder BacNet IP series (programmable via Niagara Workbench) and Ciper series controller
Airon HVAC and Control Ltd.	5150 Fairview St, Burlington, ON L7L 6B7	Tanya Meade ***tanyam@airongroup.ca***	Honeywell Spyder BacNet IP series (programmable via Niagara Workbench) and Ciper series controller

Ainsworth Inc.	131 Bermondsey Rd, North York, ON M4A 1X4	Julian Rogochevsky ***Julian.Rogochevsky @ainsworth.com***	Schneider Smart X BacNet IP series, with Niagara module (programmable via Niagara Workbench)
Accu-Temp Systems Inc.	226 St Leger St, Kitchener, ON N2H 4M5	Scott Ward ***Scottw@accutempsystems.com***	Honeywell Spyder BacNet IP series (programmable via Niagara Workbench) and Ciper series controller
Modern Niagara Toronto Inc	8125 Hwy 50 Vaughan, Ontario L4L 1A5	Sam Boyajian ***Sboyajian@modernniagara.com***	Distech – Eclypse – Bacnet IP series controllers

2.1.3 All products must be CSA approved and BACnet certified.

2.1.4 Where the number of connected field controllers requires multiple SRPDC (Jace) panels for proper operation, contractor shall supply and connect to the EMCS Network including any necessary switches/routers.

2.1.5 All JACE panels shall come with Open NiCS statements.

Part 3 EXECUTION

3.1 GENERAL

3.1.1 The complete control system installation shall be the responsibility of pre-approved Energy Management Control System (EMCS) Contractors only (see 2.1.2). Unsolicited bids/proposals from other vendors will not be considered.

3.1.2 The wiring of the controls system shall be done in accordance with all code authorities having jurisdiction.

3.1.3 Exposed wiring shall be in EMT conduit, plenum rated (FT6) shall be acceptable above ceiling system, and wire mold shall be used in finished areas. Ethernet Communication cabling for EMCS Sub-Networks shall be in conduits throughout.

3.1.4 All conduits shall be extended to with 24-36 in of equipment/end devices before converting to flexible (liquid tight) conduit. Liquid tight/flexible conduit shall not be run for extended lengths, or from sensor to sensor.

3.1.5 Control relays shall be in accordance with Master Specifications and mounted in a dedicated electrical box (unless otherwise noted). RIB shall NOT be accepted.

3.1.6 Safety controls shall have priority with respect to control of equipment. Coordinate installation of the system to ensure that interfacing and connection of controls to equipment will not bypass or interfere with freeze stats, heat detector or other safety controls.

3.2 LOCATION OF CONTROL SYSTEM EQUIPMENT

3.2.1 New controllers, actuators, etc., to be mounted in the associated mechanical/electrical room within a NEMA rated enclosure, in accordance to Section 25 05 01 of the Master Specifications for EMCS Installations.

3.2.2 All wiring shall be brought to a dedicated Terminal Strip within the control cabinet and terminated. Wiring shall then be run from each associated termination point on the Terminal strip to the corresponding termination point on the controller Termination Board. Direct wiring or sensors/devices to the controller shall not be permitted.

3.2.3 The location of Terminal Equipment Controllers (TEC) shall be dictated by the placement/location of terminal equipment to be controlled (i.e. Heat-Pump, Unit Ventilator, perimeter radiation etc.). Only VAV Boxes shall have direct mounted control equipment, all other equipment shall have controller mounted within a rate enclosure (see 3.2.4 below).

3.2.4 Except where otherwise noted, TEC shall be mounted in a NEMA 1 enclosure located on the building structure within five (5) feet of terminal equipment being controlled (duct work & piping are not building structure). Wiring shall be run in liquid Tight flexible conduit between the Controller enclosure and Terminal equipment to be controlled, neatly installed and secured to structure (running as close as possible to point of final termination). EMCS Contractor shall place a lamacoid plate or P-Touch label on the ceiling tile support system directly below each terminal device indicating the controller name (i.e. VAV1).

3.2.5 Controllers may be mounted inside of the equipment where dedicated control space is possible. If controller cannot be mounted inside equipment, it should be mounted in an enclosure located in the ceiling space above. In some instances, it may be necessary (with approval of Owner) to install within the occupied space in a lockable, NEMA enclosure, mounted at serviceable height (4 ft) on wall.

3.3 SEQUENCE OF OPERATIONS

3.3.1 Refer to specified Sequences of Operation in Appendix A.

3.3.2 Sequences are somewhat generic in nature. Contractor shall work with Owner and/or consultant to modify sequences as necessary to achieve optimal system performance. This shall be done at no additional cost to the project.

3.4 WARRANTIES

3.4.1 Control system component manufacturers shall guarantee a minimum one (1) year for all control devices and five (5) years of software updates for the SRPDC. All warranties shall be given to the Owner.

3.4.2 Note that all warranties to commence from time of final acceptance. Contractor to utilize the EMCS Project Acceptance Forms (See Appendix B).

END OF SECTION 25 01 00

Spec Note: Consultant to include points list, Sequence of operations, and applicable CoM Forms (EMCS Acceptance, Training sign-off, Pre-commissioning Checklist) with the project specifications. Refer to CoM EMCS Design Guidelines.