Table of Contents

Dalhousie University Design Guidelines provide assistance to consultants during the planning, and design phases of the University's expansion and renovations. The Guidelines do not relieve a consultant from any professional responsibility, duty or due diligence to design elegant, functional, efficient and low maintenance facilities.

Facility owners have preferred materials and requirements that make the task of maintaining facilities less costly. Dalhousie understands this is a balance between capital and operating cost. The Guidelines are not intended to be the only acceptable solution. Dalhousie expects consultants to bring modern and innovative ideas, materials and methods to the University. If these Guidelines do not allow these new ideas then the consultant is to make a request in writing to the Dalhousie Project Manager for an exception to the guidelines. Necessary reasoning and or calculations shall accompany the request. The exception request will be reviewed internally and either rejected or accepted. The consultant will document this rational and/or justification for each exception in the Basis of Design. The University Guidelines may be updated subsequently.

These documents provide design guidelines only, and are not intended for use, in whole or in part, as a specification. Do not copy the guidelines verbatim in specifications or in notes on drawings. Refer questions and comments regarding the content and use of these documents to the Dalhousie University Project Manager. The Guidelines are intended to be read in conjunction with the local codes and regulations, and in no way are to be considered as a code replacement. The codes and regulations represent the minimum acceptable standard. Where the technical design requirements differ from the building codes and other applicable codes and standards, the more stringent of the codes shall be applied.

Maintaining the Standards/Guidelines

The Design Guidelines are created and maintained by Dalhousie's Facilities Management Department. Any enquiries about the Guidelines should be directed to Facilities Management, Director of Projects, Central Services Building. Dalhousie encourages design specialists and other interested parties to provide their input and suggestions based on their experience.

Mechanical Consultant Compliance Checklist

	C	NC	NA
Section 1 – General Requirements			
01 – User Interface			
02 - Graphics			
03 - Alarm Management			
04 - Historical trending and data collection			
05 - Building Management System Naming Requirements			
06 - Control Wiring Responsibilities			
07 – Third Party Integrations			
08 – Documentation			
Pre-Construction Design			
Shop Drawings			
As Built Drawings			
9 – Occupancy Time of Day Scheduling			
10 – Utility Measurement			
11 – User Views			
12 – Units			
Section 2 – HVAC Air Handling System Controls Standard			
00 - General Air handling units			
01 – Mixed Air Variable Air Volume Unit			
A. General Notes:			
B. Sensing Points			
C. Display Requirements			
02 – 100% Outside Air Variable Air Volume Unit			
A. General Notes:			
B. Sensing Points			
C. Display Requirements			
03 – Roof Top Unit			
A. General Notes:			
B. Sensing Points			
C. Display Requirements			
D. Operating instructions			
04 – Heat Recovery Ventilation Unit			
A. General Notes:			
B. Sensing Points			
C. Display Requirements			
Section 3 – HVAC Hydronic System Controls Standard			
00- General Hydronic Systems:			
01 – Steam/Hot Water Heat Exchanger			
A. General Notes:			
B. Sensing Points			
C. Display Requirements			
D. Operating instructions			

		C	NC	NA
02 – Domestic Hot Water System				
A.	General Notes:			
B.	Sensing Points			
C.	Display Requirements			
D.	Operating Instructions			
03 – Chilled Water Systems				
A.	General Notes:			
B.	Sensing Points			
C.	Display Requirements			
D.	Operating Instructions			
04 – Glycol/Water Hot Water System				
A.	General Notes:			
B.	Sensing Points			
C.	Display Requirements			
A.	Operating Instructions			
Section 4 – HVAC Terminal Units Controls Standard				
00 - General Terminal Unit Systems:				
01 – Single Path VAV				
A.	General Notes:			
B.	Sensing Points			
C.	Display Requirements			
02 – Dual Path VAV				
A.	General Notes:			
B.	Sensing Points			
C.	Display Requirements			
03 – Fan Coil Unit				
A.	General Notes:			
B.	Sensing Points			
C.	Display Requirements			
04 – Heat Pump Unit				
A.	General Notes:			
B.	Sensing Points			
C.	Display Requirements			
D.	Controller			
05 – Baseboard/Radiant Panel				
A.	General Notes:			
B.	Sensing Points			
C.	Display Requirements			
06 – In floor Heat				
A.	General Notes:			
B.	Sensing Points			
C.	Display Requirements			

	C	NC	NA
07– Chilled Beam			
A. General Notes:			
B. Sensing Points			
C. Display Requirements			
D. Operating Instructions			
Section 5 – Miscellaneous Systems Controls Standard			
01 -Instrument Compressed Air System			
a. General Notes:			
b. Sensing Points			
c. Display Requirements			
d. Operating Instructions			
02 – Condensate Receiver Systems (Tanks)			
a. General Notes:			
b. Sensing Points			
c. Display Requirements			
d. Operating Instructions			
03 – Piping Systems consisting of mostly two-way control valves			
a. General Notes:			
b. Sensing Points			
c. Display Requirements			
d. Operating Instructions			
04 - Sump Pumping systems			
a. General Notes:			
b. Sensing Points			
c. Display Requirements			
d. Operating Instructions			
05 – Variable Frequency Drives			
a. General Notes:			
b. Hardwired Points			
c. Display Requirements via BACnet MSTP			
d. Operating Instructions			
04 – Outside Air Dry Bulb & Wet Bulb Temperature & Relative			
a. General Notes:			
Section 6 – BMS Hardware			
00 - General BMS Devices:			
01 – Supervisory Devices			
A. General			
B. Panel			
C. Communication			
02 – Field Controllers			
A. General			
B. Panel			
C. Communication Bus			

Central Services Building, 1236 Henry Street
PO Box 15000, Halifax Nova Scotia, Canada
B3H 4R2

	C	NC	NA
Section 7 – BMS End Devices			
00 - General			
01 - Actuators			
A. Damper Actuators			
B. Valve Actuators			
02 – Sensors, Transmitters, Meters, Switches, Relays			
Temperature Sensors			
Humidity Sensors			
CO2 Sensors			
Differential Pressure Transmitters			
Flow Monitoring			
Refrigerant Leak Detectors			
Status and Safety Switches			
Control Relays			
Electronic/Pneumatic Transducers			
Section 8 – Appendices			
Appendix – A - Campus Alarm Priorities			
Appendix – B – User Interface Performance Specification			
Appendix – C –Metasys Metering Standard			
1.0 Units of Measurement			
2.0 Metasys Set-Up			
3.0 Meter Labelling			
4.0 Documentation requirements			
5.0 Graphics and user views			

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Consultant Name Consultant Signature Date YYYY MM DD

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Project Manager Name Project Manager Signature Date YYYY MM DD

Note: If the Guidelines or part of cannot be attained or fulfilled (i.e. NC or NA) during the design process, the Consultant should provide reason(s) why such Guidelines are not met. Any modification or alterations to the design guidelines will need to be agreed/accepted by Facilities Management prior to inclusion in the design.

Section 1 – General Requirements

01 – User Interface

i. The guideline as currently written is based on Metasys Extended Architecture. As of November 24th 2021 any new project commencing design thereafter will be based upon Metasys Generation 4 (M4 Controllers) and Metasys User Interface (MUI). It is the responsibility of the Designer & BMS vendor to identify areas within this guideline that conflict or are not applicable with Metasys Generation 4. On a case-by-case basis, each will be presented to the University with proposed alternatives.

a. See Appendix B – User Interface for content to be included in 25 10 02 EMCS: Operation Work Station (OWS), 2.6 OWS Control Software

ii. Existing buildings.

a. Any project in a building that uses pre-Metasys generation 4 user interface that has the naming convention Metasys Guideline ver. 1 should be considered for full migration to Metasys Generation 4. BMS Vendor to provide a proposal.

b. Any project in a building that uses pre-Metasys generation 4 user interface that does not use the naming conventions from Metasys Guideline ver. 1 or newer, the BMS Vendor will collaborate with the University to provide a proposal to convert the building to Metasys Generation 4.

02 - Graphics

As of June 16, 2016, the BMS Vendor shall prepare all proposals/quotations under the following basis:

All proposals shall include the cost to develop associated system graphics based on the requirements within the Metasys Installation Standards unless the specific building's graphics are based on an earlier format in which case they shall be developed based on that format. If the building currently has no graphics, a plan and proposal to develop them shall be prepared by the BMS Contractor and submitted to the University Project Manager for approval.

The cost of the graphics shall be broken out and shall be included or not included at the discretion of the University Project Manager.

The project's scope of work from the Professional Services Provider shall reflect that graphics are to be included.

A draft of the graphics package shall be submitted for review by Peter Cherry and the Utilities Shop Supervisor prior to loading into Metasys.

Generally, the standard shall be as per the CHEB Building.

Drafts of all Graphics shall be submitted for 'Conceptual' Approval by the University in advance of initial installation.

For terminal devices, the room shall always be represented by an embossed or differently colored area. Supply and Return, or Exhaust ducts shall be shown. All Terminal devices associated with the corresponding space shall be shown.
Commands (or Outputs) shall always be shown under or above the associated device (damper, fluid valve, air valve, fan, etc). See also "Control Output labeling" section.

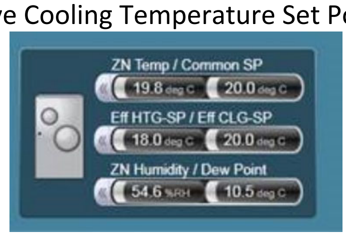
Set Points for a System shall be grouped in a Set Points Drop Down Box

Limits, Alarms, etc shall be grouped in a Settings Drop Down Box

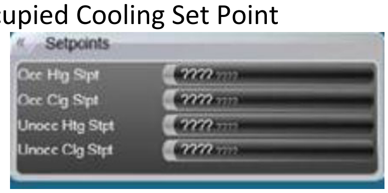
Zone Temperature Control Parameters

Regardless of the hardware technology used, the temperature control parameters for Zone or Space Temperature shall consist of the following:

Temperature
Common Temperature Setpoint
Effective Heating Temperature Set Point
Effective Cooling Temperature Set Point



Occupied Heating Set Point
Occupied Cooling Set Point
Un-Occupied Heating Set Point
Un-Occupied Cooling Set Point



If Effective Temperature Set Point is not applicable, then this specific field shall contain a text message stating “See Htg/Clg End Points”

Shall be two dimensional.

Shall be created to fit on a 23 inch Monitor, 16:9 Aspect Ratio, 1920 x 1080 Resolution.

Shall accurately reflect the “as installed” piping and/or ductwork arrangements. For clarity, that which was built rather than that which was on the Issued for Construction Drawings.

Drop Down Boxes shall Default to Collapsed when the Graphic is initially displayed, except for System Setpoints & System Settings boxes

Shall have Hot Links to the As Built Sequences of Operation

Any changes to as built sequences are to be associated with these hot links.

VAV Box Graphics

As per CHEB, plus each VAV Graphic will identify the AHU that services the specific VAV Box.

03 - Alarm Management

i. Alarms configured using the alarm priority matrix in Appendix A.
ii. Log date and time of alarm occurrence.
iii. All Critical Alarms will require operator acknowledgement.
iv. Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.
v. Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail will include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.
vi. Provide the ability to direct alarms to an e-mail address. This must be provided in addition to visible displays on user interface. Systems that use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable.
vii. All Device notifications turned off for online/offline occurrences.
viii. Any attribute of any object in the system may be designated to report an alarm.
ix. During construction, there will be no alarms enabled to the repository so as to not cloud up the alarm repository.

04 - Historical trending and data collection

i. Central repository will store trend and point history data for all physical or software points in accordance with the university trending standard.

ii. Where the architecture warrants, Local supervisory will have the capability to store multiple samples for each physical point and software variable based upon available memory, including an individual sample time/date stamp. Points may be assigned to multiple history trends with different collection parameters.

iii. Trend and change of value data will be stored within the engine and uploaded to a dedicated trend database or exported in a selectable data format via a provided data export utility. Uploads to a dedicated database will occur based upon one of the following: user-defined interval, manual command, or when the trend buffers are full. Exports will be as requested by the user or on a time-scheduled basis.

iv. The system will provide data to enable optimization capabilities including fault detection and diagnostics, advanced analytics and central plant optimization without the need of a gateway or additional hardware.

v. Provide a trend viewing utility that will have access to all database points.

vi. It will be possible to retrieve any historical database point for use in displays and reports by specifying the point name and associated trend name.

vii. The trend viewing utility will have the capability to define trend study displays to include multiple trends.

viii. Displays will be able to be single or stacked graphs with on-line selectable display characteristics, such as ranging, color, and plot style.

ix. Display magnitude and units will both be selectable by the operator at any time without reconfiguring the processing or collection of data. This is a zoom capability.

x. Display magnitude will automatically be scaled to show full graphic resolution of the data being displayed.

xi. The Display will support the user’s ability to change colors, sample sizes, and types of markers.

xii. Trend Buffers:

    xiii. Analog; Buffer Size = 48 / Transfer Setpoint = 45

    xiv. Binary/Multistate; Buffer Size = 10 / Transfer Setpoint = 9

xv. All trends from the point of initial setup shall be archived, no exceptions.

Inputs:

Shall be set up based on Change of Value and the following:

- Temperature; +/- 0.5 degrees C
  - Terminal Unit – Discharge air temperatures: +/-1.5 degrees C
- Position (Valves/Dampers) 0-100% range, 5 % change
  - Terminal Units (e.g. VAVs, DDs) – Damper actuator outputs, 10% change
- Humidity; +/- 5%
- CO2: (e.g. 500-1100 ppm, 50 ppm change)
  - Changed from 3% of range to 50 PPM for CO2
- Lighting levels; +/- 5%
- Dimming ballasts: +/- 5%
- Sash Position: +/-5%
- PRESSSURES:
  - Static Pressure: +/- 5% change of operating setpoint per the air balancer's final setpoint
    - Example – AHU supply maximum operating setpoint (per TAB) is 250 Pa, so 5% is 12.5 Pa.
  - Air Valves (e.g. GEXs, FHVs, MAVs)
    - Differential static pressures – Range (0-3" 0-750Pa) – Use 5% of expected or commissioned maximum (e.g. 5% of 500 Pa is 25 Pa)
  - Water 15 kPa change as a starting point, and after balancing adjusted to 5% of initial operating pressure setpoint per TAB.
  - Terminal Units – Air pressures not required for VAVs, DD terminals
  - Velocity Pressures
    - No trends required for terminal units
- Fluid Flow (Water, Glycol, Steam , condensate); +/- 5% of maximum flow from the Design Drawings or empirically derived peak from working knowledge of the building.
- Electrical: 5% of source capacity (e.g. 600 V, 1000 amp service = 25 KW change)
  - Motor Power
    - HP * 80% loaded * 0.746 kW/HP * 5%
      - I.e.: 15 HP * 80% * 0.746 * 5% = 0.45
- VFD frequency: +/- 5%
- Airflow:

- Central System (AHU, HRU, ERV, etc): +/- 5% change of max flow from the Design Drawings
- Terminal Unit (MAV, GEX, CAV, VAV, RH, FC, etc) Air Flow:
  - Preferable to set it up at testing phase, such that COV increment is 5% of terminal unit total maximum flow rate.
    - Preference should be set up at the testing phase.
    - This can be set up by terminal unit size, although not preferred.
    - Set at 15 L/sec
- DD terminal hot deck or cold deck flow effective setpoint:
  - As per terminal unit air flow above
- Room Offset for Pressurization Control using Flow Differential:
  - Set as 5% of room differential to minimum of 15 L/sec
  - If the Offset Set Point = 0 no action
  - If the Offset Set Point is –ve, Alarm if the Offset is + 0.25 or higher for greater than 60 seconds. Reset Alarm if value is -2.5 L/sec or less.
  - If the Offset Set Point is +ve, Alarm if the Offset is - 0.25 or lower for greater than 60 seconds. Reset Alarm if value is 2.5 L/sec or greater.
- Fume Hood Air Flow:
  - +/- 20 L/sec (Consider suggestion below, as this control is quite tight…)
  - Set as 5% of maximum air flow to minimum of 15 L/sec

- Fume Hood Face Velocity: +/- 0.05 m/s (i.e. based on fume hood face velocity setpoint of 0.50 m/s) with low and high alarms at 0.40 and 0.60 m/s respectively)
- Lighting:
  - PHOTO-CELLTrend on Change of Value (COV). 5 FC (Based on an expected maximum of 150)

<u>Outputs</u>

As all Analog Outputs are 0-100% of capacity, the COV shall be 5%

Lighting:

- DIM Trend on Change of Value (COV). 5%

Digital Outputs shall be set up based on Change of State

Set Points

Setpoints shall be trended on a change of valve or change of state basis. Any change of a setpoint shall be captured.

Totalizers

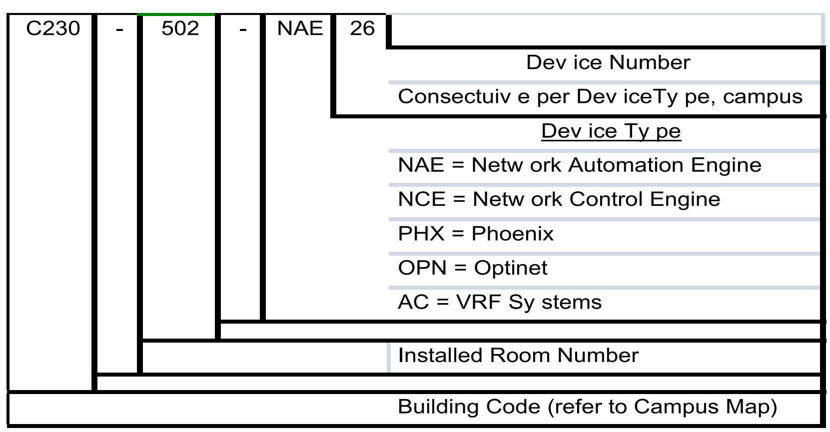
All totalizers to be time-based trends, recording the totalizer value every 90 minutes.

SPECIAL CONSIDERATIONS – FOR TUPPER BUILDING:

- Air flow risers (adding up a large number of terminal devices): +/- 10% of design maximum, or adjusted to +/-10% based on observed, measured or historical maximum.

05 - Building Management System Naming Requirements

i. IP Network Devices will be named using the University building code, an equipment specific name and a consecutive campus wide numbering scheme (ie. Number does not restart with each building). Building codes can be referenced from attached campus map or supplied by Dalhousie U (Reference Document A – Campus Map).



ii. Field level controllers will be named in two portions

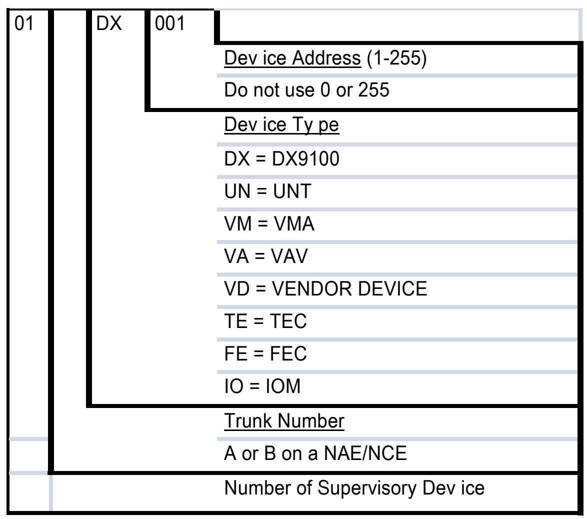
a. Descriptive Name will describe the building name and equipment type (see Reference Document B – Equipment Acronyms) served with a consecutive numbering scheme specific to the type of equipment local to the building (i.e. The fourth AHU in the building is AHU-4). Third party vendors whose equipment does not have an acronym in the Reference Document will request one of Johnson Controls and not use any default acronym without 'written' consent.

i. Naming Examples

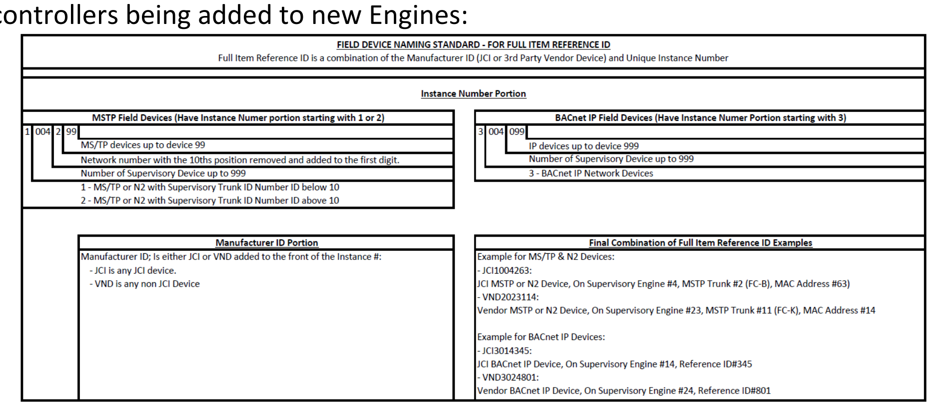
1. LSRI.AHU-1 (1st AHU in LSRI Building)
2. DOS.HRU-2 (2nd Heat Recovery Unit in DOS Building)

b. For controllers being added to existing Engines:

BMS standard name will be used for the 'expanded ID'. This name is the reference for supervisory logic, graphical binding, etc. and will incorporate the NAE, Trunk, Controller Type and MS/TP address



c. For controllers being added to new Engines:



iii. Controller Input / Output names are formed using the Universities BIM Prefixes.
   i. Point naming will be standard to existing campus installation.
   ii. When measuring gases and particles, the medium will be used in the naming.

iv. Analog Output Labelling
   a. All output values will indicate Percent of Full Capacity or Percent Fully Open using the examples below.
      - Percent of Full Capacity
         - Heating Control Valves. 0% is zero heating capacity. 75% is seventy-five percent of capacity. This would be the case regardless of the 'normal' position of the valve.
         - Cooling Control Valves. 0% is zero cooling capacity. 75% is seventy-five percent of capacity. This would be the case regardless of the 'normal' position of the valve.
         - Variable Speed Drive commands or feedback. 100% is full speed/capacity
         - Heat Exchanger Steam Control Valves. 100% is full open/steam flow capacity
         - Heat Recovery Valves. 0% is zero heat recovery system capacity. 75% is seventy-five percent of heat recovery system capacity.
         - Bypass Valve. 0% is zero bypass, 100% is one hundred percent bypass

      - Percent Fully Open
         - Air Volume Dampers
         - Outdoor Air Only.
         - Outdoor, Return & Exhaust Air combination
         - Exhaust, Return Air combination, referring to Exhaust Damper position
         - Face and Bypass combination, referring to Face Damper position
         - Bypass Air (central fume hood exhaust systems)

        For combinations, the Percent of Full Open is in reference to the first device in the label. For example, with "Outdoor, Return & Exhaust" the Percent Full Open would be in reference to the Outdoor damper, 25% means that it is 25% open, the Return is 75% open and the Exhaust is 25% open.

06 - Control Wiring Responsibilities

i. 120 V Power for supervisory & field controller equipment supplied by Division 25 will be the responsibility of Division 26. Terminal equipment controllers will be powered by a 24 V power source by Division 25, whose central 120 V is supplied by Div 26. Locations to be predetermined by BMS/Engineer.

ii. All control wiring below 50 volts for equipment supplied by Division 25 will be the responsibility of Division 25.

iii. All other control wiring required for 50 volts below or above for equipment not supplied by division 25 will be the responsibility of the division that supplied said equipment unless explicitly noted on a drawing detail.

	Project Type			
Scope of Work	**New Construction***	**P&S Retrofit External Contractors***	**P&S Retrofit DU FM Trades**	**Energy Performance Contract**
Control Panel Power (120 V)	Elec Division	Elec Division	JCI	JCI
Wiring for Mechanical Supplied Equipment	See Notes above	See Notes above	Dal FM	JCI
Data System for Control Panels				
Backbone (Copper)	Elec Division	Elec Division	JCI	JCI
Horizonal Distribution (Copper)	Elec Division	Elec Division	JCI	JCI
Active Equipment (switches, gateways, routers, UPS's and wireless access points)	Dal ITS	Dal ITS	Dal ITS	Dal ITS
Passive Equipment (device wall plates, jacks, patch panels, racks, cable management)	Elec Division	Elec Division	JCI	JCI
Terminations	Dal ITS	Dal ITS	Dal ITS	Dal ITS
Patch Cords	Dal ITS	Dal ITS	Dal ITS	Dal ITS
VFD Power Wiring	Elec Division	Elec Division	Dal FM	JCI

* JCI to validate that this scope of work is in this division and advise the University and the Electrical Engineer, in writing, that it is not there.

iv. LAN Connection

a. No Hubs or Routers are permitted to be connect to the network. Use of Managed Switches must be approved by University ITS in advance of use.

b. To obtain a connection to the University LAN, follow the Building Service Device Network Connection Process. This process is obtained from the FM Project Manager.

c. Each IP Device location will have two University LAN connection ports; Port A is for the controller and Port B is a service port.

d. The service port will be configured for the building VLAN XX. Technicians whose laptops have been registered (all laptops are registered with roaming enable) will have internet access and then by running the University issued VPN client, access to BMS. Roaming allows any registered device to get a free IP address anywhere, except for restricted/firewalled VLANs.

e. The field port, adjacent to the Network Device, will always be installed in a 6 x 6 hinged cover electrical box c/w a dual MDVO grey receptacle (Belden PN: AX101063). Blue patch cord(s) will be run from the 6 x 6 box to the Network Device.

f. Devices will comply with university BACnet standards.

g. Temporary network wiring. The objective is to have no temporary network wiring. As such construction sequencing is expected to be such that the University's network is available early in the construction process for building devices. How this is to occur should be discussed and documented during the design process.

07 – Third Party Integrations

Division 01 Guideline, 35 13.01 to 13.03 deals with third party equipment that has a microprocessor-based controller whose information is to be integrated into the campus' Building Management System (BMS); Johnson Controls Metasys for Halifax campuses and Delta Controls enteliWEB for Bible Hill.

Division 1 Guideline, General Requirements, Section 8B deals with the process of defining what objects are to be integrated into the BMS.

The University has completed several Third-Party integrations. The BMS Contractor shall consult with the University Project Manager to determine if integration of specific equipment on the project has been done before and if it has request the details.

Third-Party Integration equipment shall share its information in Metric Units

08 – Documentation

Pre-Construction Design

BMS contractor shall ensure that their equipment panels as well as those of any subcontractor or supplier are shown on the Construction Drawings.

BMS Contractor shall ensure that their VSDs as well as those of any subcontractor or supplier are shown on the Construction Drawings.

Shop Drawings

All drawings and sequences of operation are to have a date and revision number on each page. After Training, the revision number will change to As-Builts-r00, and going forward if any modifications take place after as-builts, then the –r00 will become –r01, -r02 (and the date will change), etc.

Cover Page

Each Project's cover page shall have the following Checklist:

- Critical Alarm Review and Documentation
- Global Outside Air Temperature Assignment
- DAL-UNIV Text User Views
- AHU Safety Shut Down/Lockout
- Trending Based on COV/OS

As each item is completed by the BMS Contractor, it shall be checked on so that the As Built version looks like:

- ✓ Critical Alarm Review and Documentation
- ✓ Global Outside Air Temperature Assignment
- ✓ DAL-UNIV Text User Views
- ✓ AHU Safety Shut Down/Lockout
- ✓ Trending Based on COV/OS

Room Schedule

Shall be submitted in both PDF and Excel Spreadsheet formats.

Terminal devices serviced by AHU's shall have the AHU which services them identified on the Metasys Graphic and in the Room Schedule Spreadsheet.

Air Flow

Units shall be metric

Occupied & Unoccupied Min & Max Flows to be identified.

Shop Drawings shall be submitted in electronic, and hard copy.

Product Literature shall be submitted in electronic format only.

Wiring

Cable Jacket and Conductor Colors (BMS Contractor to provide Beldon and Anixter part numbers for insertion)

24V – Grey Jacket (Black & White conductors)
N2 – Green Jacket (Red, Black and White conductors)
SA – Brown Jacket (Black, White, Blue, Red Conductors)
FC (MSTP) - Blue Jacket (Black, White, Blue conductors)
LAN – CAT 6 Blue Jacket

Where not identified herein, install as per Johnson Controls HVAC Controls Cable and Wiring Standards book (Standard Version, Not Premium), except if any UTP 4-pair cable is used, it shall be in a Green Jacket.

Conduit Markings

Controls related conduit shall be identified by junction box covers that are painted Red/White cut diagonally

Panel Labeling

Control Panel

Building.BMS Contractor Panel-[Floor Number][Panel Number] ---> C230.JCP-B01 (DOS Building, Johnson Controls Panel, Level 1, Panel 1)

Transformer (Power) Panel

Building.Transformer Panel-[Floor Number][Panel Number] ---> C230.TXP-403 (DOS Building, Transformer Panel, Level 4, Panel 3)

Electronic Submissions shall include one PDF file of all documents, book marked for ease of navigation. Sections shall be labeled “Section X – Section Description that is in the Table of Contents”.

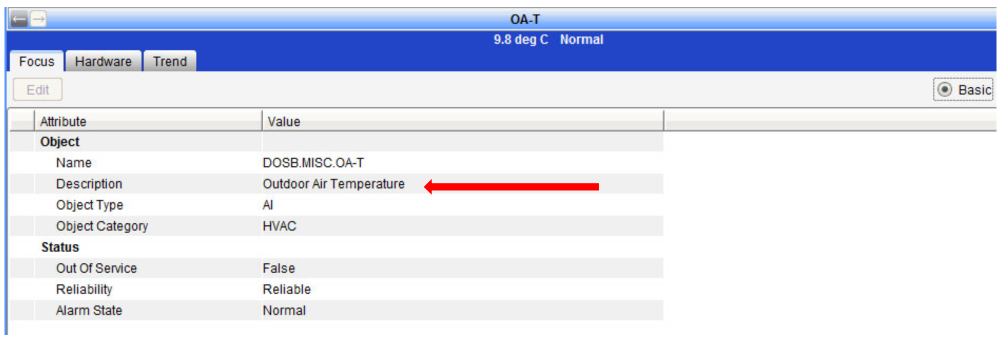
All supporting documents such as PDFs, Excel Spreadsheets, Word for Window documents, Viso, etc. files that were used to create the single PDF file shall be provided as Supporting Documentation, if requested by the University.

Server, Router and Repeater locations shall be documented on the shop drawings.

Sensor Locations

The location of special sensors as selected by the design team must be documented on the shop drawings, on the specific systems’ Metasys Graphic and Metasys Object’s Description Field. A special sensor is defined as one that is not part of a Primary System and/or not located in the mechanical room of its associated Primary System. Examples:

- Differential Pressure Sensors, air or water/fluid
- Any sensor located outside of a mechanical room or in a strange place within the mechanical room
- Outdoor air sensors.



Each 24 Volt power panel shall have a schedule on the inside of the panel door that reflects which 120 Volt power circuit it is connected to (Panel Label and Circuit Number) and field devices it provides power to. If the 24 Volt power panel's wiring is not shielded from the door, or the door is not large enough to adhere the drawing, the drawings shall be in the closest control panel that has these features. All of these schedules shall be included in the Shop Drawings.

Maximum fan volume design capacity (Supply, Return, and associated Exhaust) shall be documented on the control drawings.

All SOO documents shall have a Revision Number and Revision Date

Each Primary System (AHU, HX, Cooling, Heating, etc) shall have its own specific Engineering Drawing and Sequence of Operation, no typical drawings for multiple systems. Terminal applications and miscellaneous monitoring can be grouped on a single drawing and associated Sequence of Operation.

Each System Drawing shall include all details associated with it. There shall not be multiple drawings. For example, if an AHU has an associated ERV (Energy Recovery Unit) 'both' shall be shown on one drawing. Exceptions are to be reviewed and agreed to in advance with the University.

All designs shall have an internal BMS Contractor Peer Review. The date, reviewer's name and contact information shall be documented on the cover sheet of the drawing package.

- If a System has an associated **Variable Speed (or Frequency) Drive**, regardless of who supplied it, the Sequence of Operation shall document the VSD's, as commissioned, minimum speed and note that 'although the control system's command may be 0% the drive is still operating its minimum speed of X%, Y Hz'.
- University standards for VSDs are:
  - Pumps 20% (12 Hz)
  - Fan Motors in the System's airstream 15% (9 Hz)
  - Fan Motors outside the System's airstream 20% (12 Hz)
- Shop Drawings shall include a VSD Schedule if one or more are supplied by BMS Contractor. Headings shall include but not be limited to:

  Associated System
  Service (Device within the System)
  Controls Reference Drawing
  Model Number
  HP
  Voltage
  LINE Filter (Yes/No)
  LOAD Filter (Yes/No)
  Communications Card
  Enclosure
  Bypass (Yes/No)
  Minimum Speed (% and Hz)
  Comments

As Built Drawings

After the Systems have been Tested and Verified, Tested, Adjusted and Balanced, Functional Performance Tested, Training has been provided and Fine Tuned by the University, a final set of As Built Drawings shall be prepared. This set of records shall document all of the time of day schedules, set points, settings, sequences of operation, etc. that have resulted from these activities. As required, all Relinquish Default or Default Values shall be updated to reflect present values such that in the event of a power interruption or controller reload the values as derived from the activities above shall remain.

After Training, the revision number will change to As-Builts-r00, and going forward if any modifications take place after as-builts, then the –r00 will become –r01, -r02 (and the date will change), etc

This set shall accurately reflect the "as installed" piping and/or ductwork arrangements. For clarity, that which was actually built rather than that which was on the Issued for Construction Drawings.

Unbound References

At end of a project, confirm that there are no Unresolved "Unbound References" listed in the project's associated Supervisory Controllers.

9 – Occupancy Time of Day Scheduling

As a minimum, one TOD schedule will be created for each Floor and/or Zone within a floor.

If there are specific groups, or departments, within a floor (for example 3) there would be a minimum of three (3) TOD schedules for that floor. Examples:

Classrooms
Program Spaces:

International Centre
Residence
Welcome & Recruitment
Counselling & Psychological Services
Shared Counselling & Health Srvs
Student Health Promotion
Student Health Services
Library
Clinics

There should be distinct schedules for "Multiple Floor – Special Purpose Area" as has done with CHEB and LMU;

Lobby/Atrium
Building Services (AV Rooms, Equipment Rooms, Communications Rooms, Electrical Rooms, Mech Rooms, Storage Rooms)
General Services (Garage, Bike Storage/Showers)
Public Spaces (Entrances, Corridors, Hallways, Vestibules, Washrooms, Stairwells)

Consult the Project's Manager with any questions or suggestions that arise

All schedules should be linked to/reference the single Holiday Calendar located in NCE-24 HOLIDAY CALENDAR.

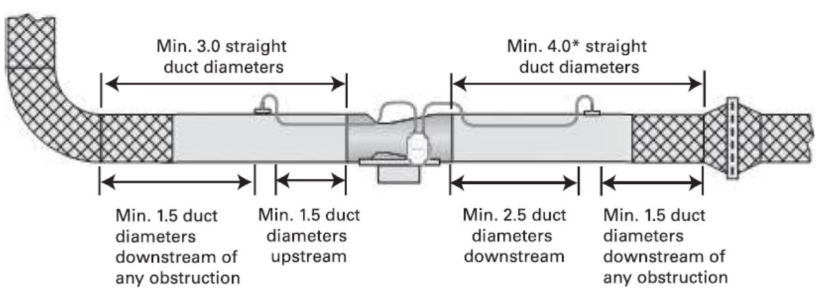
10 – Utility Measurement

Every new building or building expansion shall, as a minimum, have the following Utility Meters included in the Project's scope of work:

Main Electrical Meter – Via ION Enterprise OPC Integration
Main Water Meter – Halifax Regional Water Commission shall supply the Revenue Meter and the Signal Duplicator. Controls shall carry the cost of the Signal Duplicator and facilitate its purchase & installation.
Main Condensate Return Meter
Main Hot Water Meter, if applicable and is the primary source of heating.
Main Chilled Water Meter, if applicable and is the primary source of cooling.
Renewable Energy System Meter – This is applicable to 'any' project.

The designer is responsible for creating an installation detail for each application of air or fluid flow measurement where in the required upstream and downstream equivalent pipe or duct dimensions are shown for the technology specified. Further, the designer is responsible for indicating on the ventilation or piping drawings where each meter is to be installed. In so doing validating that the location has the required installation dimensional requirements.

The following is an example of what shall be specified and drawn for for venturi air valves:



The technology of meter for each of the above applications is to be as per this document. Any alternatives are to be submitted to the University Project Manager for approval by the University's Utilities Manager.

Condensate Meters shall be used for steam usage measurement applications.

Taking GPM values, convert them to US Gallons over a chosen time period and totalize them.

Convert totalized gallons of condensate to lbs of condensate. 1 US Gal x 8.33 lbs/US Gal = lbs of condensate.

If you have one lb of condensate, then you have consumed (condensed) one lb of steam. The vapor has become the liquid.

The energy consumed is the energy in one lb of steam at 15 psi (actually lower but also variable depending on control valve position so we will simply stick with 15 PSI which we know is what most Campus PRVs are delivering) minus the energy in one lb of condensate at 0 psi or atmosphere. 1164 – 180 = 984 BTU/lb

Convert this value to kWh by multiplying it by 0.000293 kWh/BTU

So one us gallon of condensate = 8.33 x 984 x 0.000293 kWhs or 2.40 kWhs

When metering condensate, you must watch out for reverse flows. What is often seen is the check valves that are [put] in place after the condensate tank often leak. This results in a backflow of water back into the condensate tank. To solve this, the positive and negative totalizers or the net totalizer need to be read. If both are not read, some of the same liquid ends up being metered twice.

Utility Water Meter signal duplicator

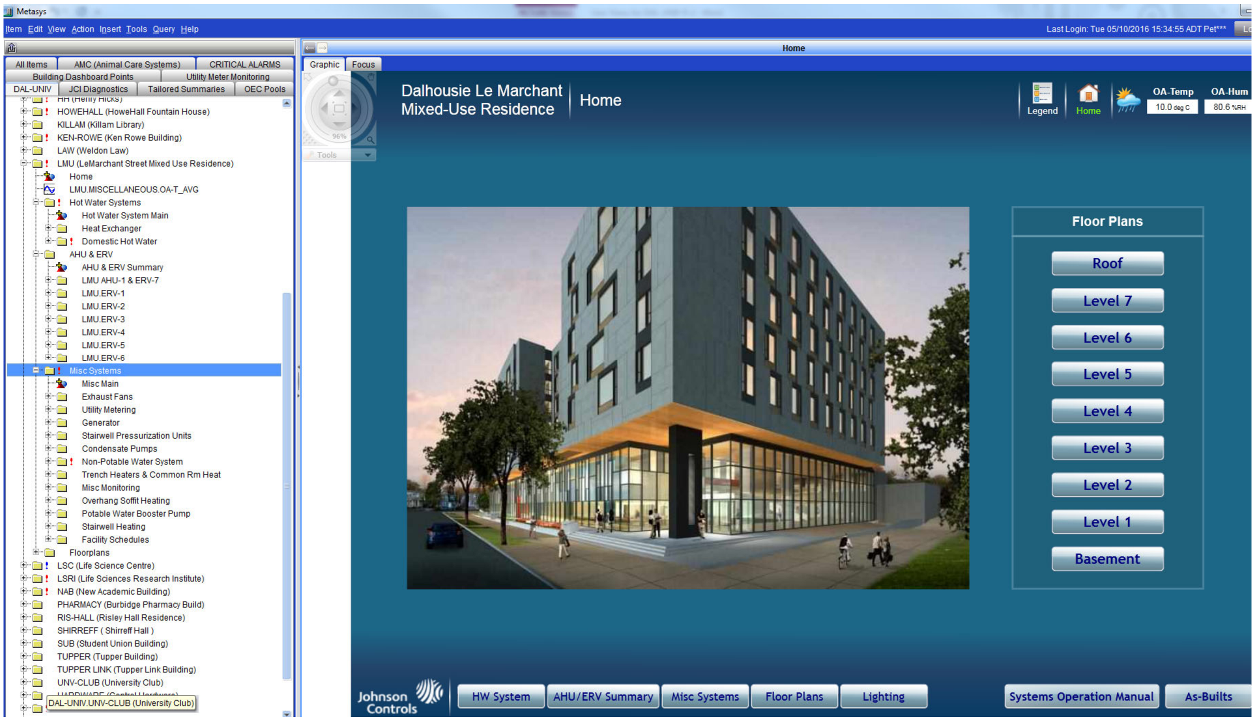
- 4 – 20 mA signal
    - Arrange for signal duplicator via Halifax Regional Water Commission, Corey Whalen, Supervisor of Metering, coreyw@halifaxwater.ca, 902 490-5472, 902 441-1145 (Cell)

See also Appendix C – Metasys Metering Standard.

11 – User Views

All Objects on the System or Room Graphic, as a minimum, shall be included in the associated Text User View in the DAL-UNIV Tab.

1. Organize/Order Folders in alignment with the System Type Links and Floor Plans Link (which will always be on the RHS of the last System Type Link) along the Bottom of the building's Home Graphic.
2. Then order the Sub Folders in alignment with the System Type Link Graphic



3. Then by System in the following format and order:

   Will be fashioned so all the collective points for an associated System are available on one view for ease of troubleshooting. In the below we have provided <u>typical expectations</u>, using an AHU as an example.

   All points without command (inputs only), will be listed at the very top of the user view.

   - Unit enable
   - Global OAT
   - (Building name)OAT
   - RA CO2

The next available information will list any Status alarms

- SF status alarm
- RF status Alarm
- Freeze protection alarm

Then we would like to see process variable, variable set point and if applicable associated alarms, in the order of the process flow (Air, fluid, etc)

- Mixed air temperature
  - MAT
  - MAT SP
- Return air temperature
  - RAT
  - RAT SP
- Discharge air temperature
  - DAT
  - DAT SP

- Damper positions
- Heating/cooling control points
- Static Pressure control points
- VFD status (as applicable)
- Schedules
- Reset schedules

Below is an acceptable example for an ERV unit.

LMU.ERV-4 - Style B

Summary

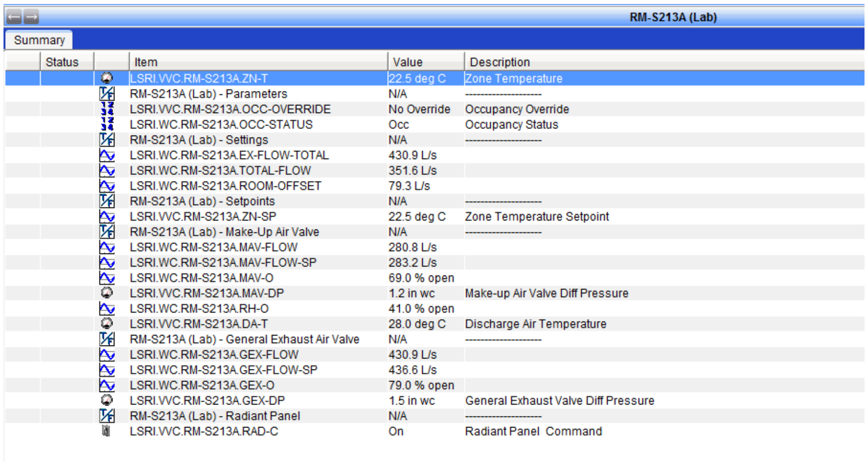
Status	Item	Value	Description
	---- Global Variables ----	N/A	-------------------
	LMU.ERV-4.OA-T (Global Share)	6.2 deg C	Outdoor Air Temperature
	---- Alarms & Resets ----	N/A	-------------------
	LMU.ERV-4.SYS-RESET-REQ	Normal	System Reset Required
	LMU.ERV-4.SYS-RESET	Off	CS Input (Enum)
	LMU.ERV-4.LT-A	Normal	Low Temperature Alarm
	LMU.ERV-4.SF-FAULT	No Fault	Supply Fan Fault Code
	LMU.ERV-4.SF-RESET	Off	Supply Fan Reset Drive Fault
	LMU.ERV-4.EF-FAULT	No Fault	Exhaust Fan Fault Code
	LMU.ERV-4.EF-RESET	Off	Exhaust Fan Reset Drive Fault
	---- Parameters & Setpoints ----	N/A	-------------------
	LMU.ERV-4.OCC-SCHEDULE	Occupied	Occupancy Schedule
	LMU.ERV-4.OCC-OVERRIDE	Not Set	Occupancy Override
	LMU.ERV-4.EFF-OCC	Occupied	Effective Occupancy
	LMU.ERV-4.UNITEN-MODE	Enable	Unit Enable Mode
	LMU.ERV-4.EF-OFFSET	100.0 %	Exhaust Fan Speed Offset
	LMU.ERV-4.SF-KWH	3,738 kWh	Supply Fan Kilowatt Hours
	LMU.ERV-4.EF-KWH	2,604 kWh	Exhaust Fan Kilowatt Hours
	---- Inputs & Outputs ---- (As the...	N/A	-------------------
	LMU.ERV-4.OAFILT-DP	19 Pa	Outside Air Filter Differential Pressure
	LMU.ERV-4.SF-C	On	Supply Fan Command
	LMU.ERV-4.SF-S	On	Supply Fan Status
	LMU.ERV-4.SF-O	62.8 %	Supply Fan Output
	LMU.ERV-4.HRFBD-O	100 %	HR Face & Bypass Damper Output
	LMU.ERV-4.HR-T	15.3 deg C	Heat Recovery Temperature
	LMU.ERV-4.HRLL-SP	2.0 deg C	Heat Recovery Low Limit Setpoint
	LMU.ERV-4.HTG-O	0 %	Heating Valve Output
	LMU.ERV-4.DA-T	17.6 deg C	Discharge Air Temperature
	LMU.ERV-4.DAT-SP	16.6 deg C	Discharge Air Temperature Setpoint
	LMU.ERV-4.DA-P	15 Pa	Discharge Air Static Pressure
	LMU.ERV-4.DAP-SP	16 Pa	Discharge Air Static Pressure Setpoint
	LMU.ERV-4.EF-C	On	Exhaust Fan Command
	LMU.ERV-4.EF-S	On	Exhaust Fan Status
	LMU.ERV-4.EF-O	62.8 %	Exhaust Fan Output
	LMU.ERV-4.EAFILT-DP	19 Pa	Exhaust Air Filter Differential Pressure
	LMU.ERV-4.EAHR-T	11.2 deg C	Exhaust Air Heat Recovery Temperature
	LMU.ERV-4.EA-T	21.5 deg C	Exhaust Air Temperature

4. Floor Plans Folder

Building Level Folders shall be in the visual order of the Floor Plans Graphic

So as an example for DOS, the Level Folders should be listed identical to the Floor Plan Graphic. Roof first and then down to Level 1

Under each Building Level Folder should be a Folder for each room, listed in numerical order which contains everything associated with the room that is on the Metasys BMS, (including third party integrated objects), delineated as follows:



RM-S213A (Lab)

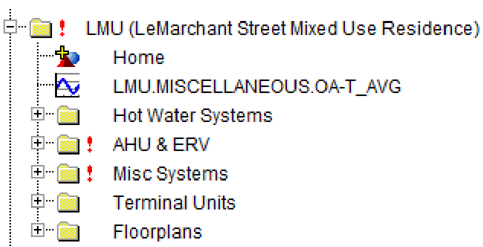
Summary

Status		Item	Value	Description
		LSRI.VVC.RM-S213A.ZN-T	22.5 deg C	Zone Temperature
		RM-S213A (Lab) - Parameters	N/A	-------------------
		LSRI.VVC.RM-S213A.OCC-OVERRIDE	No Override	Occupancy Override
		LSRI.WC.RM-S213A.OCC-STATUS	Occ	Occupancy Status
		RM-S213A (Lab) - Settings	N/A	-------------------
		LSRI.WC.RM-S213A.EX-FLOW-TOTAL	430.9 L/s	
		LSRI.WC.RM-S213A.TOTAL-FLOW	351.6 L/s	
		LSRI.WC.RM-S213A.ROOM-OFFSET	79.3 L/s	
		RM-S213A (Lab) - Setpoints	N/A	-------------------
		LSRI.VVC.RM-S213A.ZN-SP	22.5 deg C	Zone Temperature Setpoint
		RM-S213A (Lab) - Make-Up Air Valve	N/A	-------------------
		LSRI.WC.RM-S213A.MAV-FLOW	280.8 L/s	
		LSRI.WC.RM-S213A.MAV-FLOW-SP	283.2 L/s	
		LSRI.WC.RM-S213A.MAV-O	69.0 % open	
		LSRI.VVC.RM-S213A.MAV-DP	1.2 in wc	Make-up Air Valve Diff Pressure
		LSRI.WC.RM-S213A.RH-O	41.0 % open	
		LSRI.VVC.RM-S213A.DA-T	28.0 deg C	Discharge Air Temperature
		RM-S213A (Lab) - General Exhaust Air Valve	N/A	-------------------
		LSRI.WC.RM-S213A.GEX-FLOW	430.9 L/s	
		LSRI.WC.RM-S213A.GEX-FLOW-SP	436.6 L/s	
		LSRI.WC.RM-S213A.GEX-O	79.0 % open	
		LSRI.VVC.RM-S213A.GEX-DP	1.5 in wc	General Exhaust Valve Diff Pressure
		RM-S213A (Lab) - Radiant Panel	N/A	-------------------
		LSRI.VVC.RM-S213A.RAD-C	On	Radiant Panel Command

Separate Folder(s) for specialty systems such as Lighting, is permissible, with advanced permission from the Project Manager, & Supervisor of the Utilities Shop.

5. System Types. For each System Type in the building, BMS Vendor shall consult with the University in terms of what will be placed on the Graphic and in the User View. Replication of previously installed System Types, as practical, is expected as the starting point.

The OAT that is used for control sequences in the building shall be in the User View for the building. Placed as per LMU:



12 – Units

The BMS contractor shall use Metric units. All third party or integrated equipment shall use Metric Units

Section 2 – HVAC Air Handling System Controls Standard

This section is an overview of minimum control requirements for typical systems connected to the Building Management System, including configuration and display requirements.

00 - General Air handling units

I. All Units must have a system reset feature which is triggered and manual intervention is required. Example: when a LT-A is triggered (if installed) Alarms will trigger that a reset is required as well.

- Low Temperature Safety Switch (LT-A)
- High Static Pressure Safety Switch
- Supply Fan VSD is in Fault mode
- Return Fan VSD is in Fault mode
- Fan command Status mismatch
- Any other Safety is Tripped

II. All Air handling units will be “Schedule Ready”, the schedule objects will be linked to BMS:
   a. Occupancy Schedule (OCC-SCHEDULE).
   b. Effective Occupancy (EFF-OCC).
   c. Occupancy Override (OCC-OVER).

III. All air handling units that receive their heating from steam/hot water will have a Low temperature sensing device installed requiring field reset.
   a. Glycol heat will not require a field reset, the unit will be software shutdown and require manual reset through BAS if the DAT is below 6 C for 15 mins.

IV. Further to a regular shutdown all air handling units will have a maintenance shut down which shuts down the entire unit and turns off all associated control outputs.

V. All Variable air volume units will have “Trim and Respond” logic for control of static pressure setpoints. Type of Trim & Respond will depend on the type of terminal equipment; VAV Box PRESS-REQ or Analog Value; Damper Position or Pressure Drop across air valve(s).

VI. All air handling units must have a slow ramp time upon startup.

VII. All AHU Graphics to be reviewed prior to completion to ensure necessary minimum deliverables are met.

VIII. All Air handling units with humidity control, must have the humidity control sequence interlocked with air flow through the unit. Humidifiers should have mechanical air flow safeties as well.

IX. Variable frequency drives controlling air handling unit speeds will have the UnderTorque feature enable so a broken belt can be revealed/alarmed.

X. All discharge air temperature resets shall be based on Trim & Respond of the VAV controller where available. Otherwise, any alternative method needs to be discussed and approved by the University.

XI. All Sequence variances from standard will be sent to Project Manager and Utilities Manager for review during the Design Stage of the project and include the designer.

01 – Mixed Air Variable Air Volume Unit

A. General Notes:

I. CO2 reset of outdoor air damper will be based on feedback from a PID loop.

II. All cooling or heating will be free/recovery before mechanical.

III. When the Supply fan capacity is greater than 10% more than the return fan, De-coupled outside air strategies will be used. There shall be an analog output for each; Outdoor Air Damper, Exhaust/Return Air Damper. The outdoor air damper shall open fully when the Unit is operating in Occupied mode. The Outdoor Air and the Exhaust/Return damper signals shall be 0% if the AHU operates to maintain temperature condition(s) when the serviced area is Unoccupied. The Unit will have a minimum position of 0% for the Exhaust/Return air damper control output.

IV. When the OAT is below 5 C, the Unit will start up and remain in recirculation until its control stabilizes for 15 minutes prior to opening outside air dampers.

B. Sensing Points

I. Must have discharge air temperature sensor (DA-T).

II. Must have mixed air temperature sensor (MA-T)

III. Must have Low limit temperature sensor, hard wired to the fan controls and BMS (LT-A). If the heating medium is glycol/water 40% or greater the LT-A is not to be installed. In lieu of it, if the discharge temperature is less than 7 C for 5 minutes the BMS will generate an alarm.

IV. Must have Discharge air humidity sensor (DA-H).

V. Must have Return Air Temperature sensor (RA-T).

VI. Must have Return air CO2 sensor (RA-CO2).

VII. Must have Return air humidity (RA-H).

VIII. Must have Discharge air pressure sensor, installed 2/3 down the duct (DA-P). Exact location to be requested of the Engineer in writing prior to installation.

IX. Flow sensors as per necessary LEED requirements. (**-F).

C. Display Requirements

I. Unit Enable/Maintenance Switch
II. Occupancy Schedule
III. Supply Fan output.
IV. Return fan output.
V. Damper outputs.
VI. Valve outputs.
VII. Tuning Reset (All PIDS).
VIII. All Inputs
IX. All outputs.

02 – 100% Outside Air Variable Air Volume Unit

A. General Notes:

I. All cooling or heating will be free/recovery before mechanical.
II.

B. Sensing Points

I. Must have discharge air temperature sensor (DA-T).
X. Must have Low limit temperature sensor, hard wired to the fan controls and BMS (LT-A). If the heating medium is glycol/water 40% or greater the LT-A is not to be installed. In lieu of it, if the discharge temperature is less than 7 C for 5 minutes the BMS will generate an alarm.
II. Must have Discharge air humidity sensor (DA-H).
III. Must have Exhaust Air Temperature sensor (EA-T).
IV. Must have Exhaust air CO2 sensor (EA-CO2).
V. Must have Exhaust air humidity (EA-H).
VI. Must have Discharge air pressure sensor, installed 2/3 down the duct (DA-P). Exact location to be requested of the Engineer in writing prior to installation.
VII. Must have Exhaust Air Pressure Sensor (EA-P).
VIII. Flow sensors, air or fluid, when specified must include a detail on the piping or ventilation drawings indicating required up and down stream straight runs for ability to accurately measure. (**-F).

C. Display Requirements

I. Maintenance Switch.
II. Occupancy Schedule
III. Supply Fan output.
IV. Return fan output.

V. Damper outputs.
VI. Valve outputs.
VII. All Inputs
VIII. All outputs.

03 – Roof Top Unit

A. General Notes:
  I. All cooling or heating will be free/recovery before mechanical.
  II. The construction documents will specify the panel space required for BMS controls.
    a. Space will be provided for BMS Controller. Area & depth to be coordinated by the Engineer.
    b. Resident BMS will be the primary means of unit control.
    c. Panels will be specified to have heating and/or ventilation, as necessary, for the equipment intended to be within them.
    d. Separation of 24 volts and >120 volts required.

B. Sensing Points
  XI. Must have discharge air temperature sensor (DA-T).
  XII. Must have mixed air temperature sensor (MA-T)
  XIII. Must have Low limit temperature sensor, hard wired to the fan controls and BMS (LT-A). If the heating medium is glycol/water 40% or greater the LT-A is not to be installed. In lieu of it, if the discharge temperature is less than 7 C for 5 minutes the BMS will generate an alarm.
  XIV. Must have Discharge air humidity sensor (DA-H).
  XV. Must have Return Air Temperature sensor (RA-T).
  XVI. Must have Return air CO2 sensor (RA-CO2).
  XVII. Must have Return air humidity (RA-H).
  XVIII. Must have Discharge air pressure sensor, installed 2/3 down the duct (DA-P). Exact location to be requested of the Engineer in writing prior to installation.
  XIX. Flow sensors, air or fluid, when specified must include a detail on the piping or ventilation drawings indicating required up and down stream straight runs for ability to accurately measure. (**-F).

C. Display Requirements
  I. Maintenance Switch.
  II. Occupancy Schedule
  III. Supply Fan output.

- IV. Return fan output.
- V. Damper outputs.
- VI. Valve outputs.
- VII. All Inputs.
- VIII. All outputs.

D. Operating instructions

- I. CO2 reset of outdoor air damper will be based on a PID loop.
  - a. All Roof Top Unit Sequences will be submitted to the Office of Sustainability and Utilities Manager for review.

04 – Heat Recovery Ventilation Unit

A. General Notes:

- I. All cooling or heating will be free/recovery before mechanical.

B. Sensing Points

- I. Must have discharge air temperature sensor (DA-T).
- II. Must have Low limit temperature sensor, hard wired to the fan controls and BMS (LT-A).
- III. Must have Return Air Temperature sensor (RA-T).

C. Display Requirements

- I. Maintenance Switch.
- II. Occupancy Schedule
- III. All Inputs
- IV. All outputs.

Section 3 – HVAC Hydronic System Controls Standard

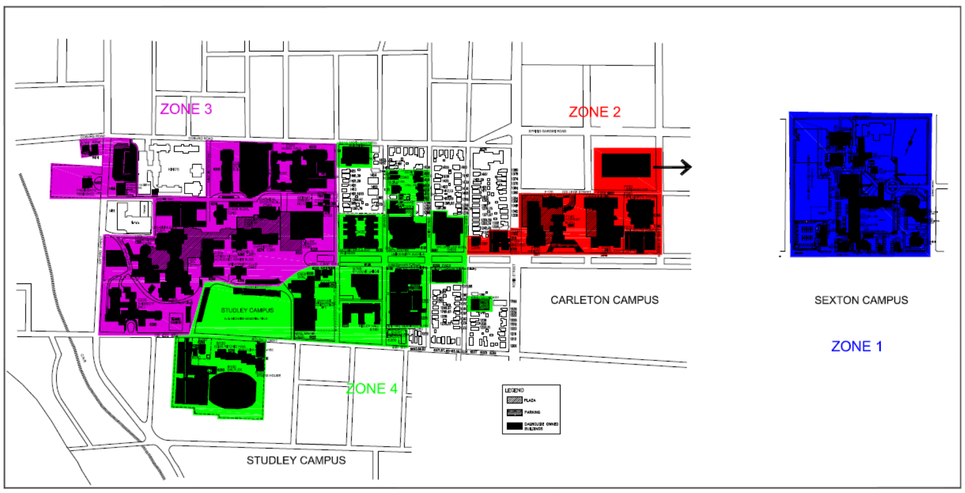
This section is an overview of minimum control requirements for typical systems connected to the Building Management System, including configuration and display requirements.

00- General Hydronic Systems:

I. All source-heating valves interlocked (via pump status) with a verification flow through the mechanical exchanger.

II. Duty Stand-by systems will alternate based on the following schedule:

Zone Number (see appendix)	Rotation Day
1	Thursday – 8:30 am
2	Tuesday – 8:30 am
3	Wednesday – 8:30 am
4	Thursday – 8:30 am



III. Tertiary chilled water pumps shall be interlocked with the central plant pumps located in the CSB, operating only when the distribution pumps are on.

IV. All hydronic systems will have trim and respond temperature reset based on valve position in the field.

V. All hydronic systems will have supply and return temperature sensors on all heating loops served.

VI. All hydronic systems will have their controlled valves scanned and the Min & Max values provided, including trends and displayed on the Systems graphic.

VII. Each Distribution Pump set will have its own Outdoor Air Temperature and/or other Parameter, Enable/Disable Set Point.

   a. Example: Monitoring of associated system control valves for a “Call” for heat or cooling will being the associated system into "Enable" mode.

VIII. All Sequence variances from standard will be sent to Project Manager and Utilities Manager for review via the formal construction chain of communication. Final solutions should also be submitted to the construction team.

IX. All hydronic systems will be installed with a pressure sensor, adjacent to the make-up fluid system entry, to sense system operating pressure.

X. Where 1/3, 2/3 valves are utilized the sequence will be as follows:

(0 - 33% load) the smallest of the two valves modulates from closed to fully open

(33-66% load) once the small valve is fully open, the largest of the two valves begins to modulate open, and simultaneously, the small valve closes, follows the inverse signal

(66 - 100% load) once the large valve is fully open, and small valve fully closed; the large valve remains fully open, and the small valve begins to modulate from closed to fully open.

01 – Steam/Hot Water Heat Exchanger

A. General Notes:

I. During start up (HWS-T is 10 Deg C lower than HWS-SP), the steam/hot water heating valve will warm up very slowly; the valve output will be limited to a ramp time of 20 minutes

B. Sensing Points

I. Must have heat exchanger entering temperature (HWR-T)

II. Must have heat exchanger leaving temperature (HWS-T).

III. Load side differential pressure

IV. System operating pressure.

V. All Pump Statuses (defined as amps above a preset min value and the VFD Status, if applicable, indicates operating).

VI. High Pressure Steam (100 PSI +) to Hot Water Heat Exchangers shall have the following aux points:

a. Loss of pneumatic control air pressure indication
b. Loss of steam pressure indication

C. Display Requirements

I. Maintenance Switch.

II. All Inputs

III. All outputs.

D. Operating instructions

Duty/Standby Heat Exchanger systems shall have a single 1/3, 2/3 capacity steam control valve "set". The valve "set" shall be sized for the full capacity requirements of one HX.

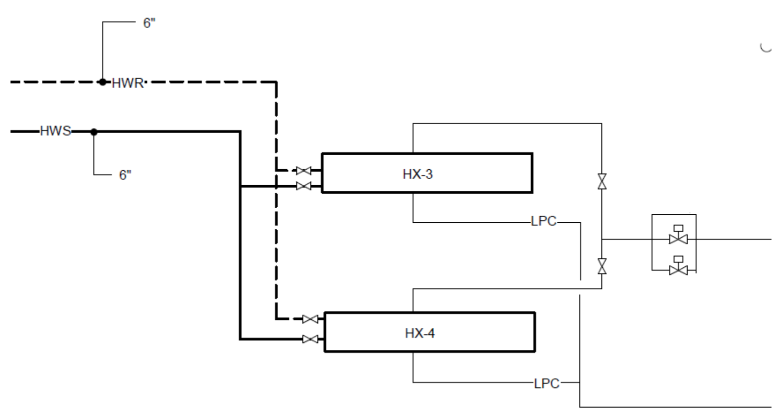
The "set" shall consist of two Normally Closed steam control valves (one sized for 33% of the design steam flow and the other 66%. Spring ranges (or pilot positioners) shall be such that the Control Output Standard, above, can be applied.

- Each of valves will be controlled with an individual controller Analog Output

In the event that one of the two HXs is taken out of service, the valve "set" and remaining HX shall provide the required design heating capacity.

Note in the sequence of operation that it is the intent that both HXs, under normal conditions, will be operate simultaneously, hence approximate 50% of the design fluid flow through each.

In the event that one HX was to fail, the remaining one has the required design heating capacity and in order to obtain it, the failed HX will have to be hydronically isolated.



02 – Domestic Hot Water System

A. General Notes:

I. The system shall not utilize another hot fluid system in a manner that requires it to provide a minimum hot fluid temperature to generate a sufficient domestic hot water temperature without prior University Project Manage approval.

II. During start up(DHWS-T is 10 Deg C lower than DHWS-SP),, the steam/hot water heating valve will warm up very slowly; the valve output will be limited to a ramp time of 20 minutes
III. A temperature of 60 degrees is required for a period of 1 hour in the system per week.

B. Sensing Points
I. Must have heat exchanger entering temperature
II. Must have heat exchanger leaving temperature
III. If there is a tank, the tank temperature must be included. Mechanical Engineer to specify a thermal well in the tank for this.
IV. The building return temperature must be included. Location is at the return to the central system.
V. All Pump Statuses (defined as feedback from a current switch, not a transmitter).

C. Display Requirements
I. Maintenance Switch.
II. All Inputs
III. All outputs.

D. Operating Instructions

03 – Chilled Water Systems

A. General Notes:
I. All Chiller Integrations via BACnet IP, connection behind Dalhousie VPN with chiller software tested functional prior to turn over to operations.

B. Sensing Points
I. Must have Chiller entering temperature
II. Must have Chiller leaving temperature
III. All Pump Statuses.
IV. Cooling Tower Return Temperature
V. Cooling Tower Entering Temperature
VI. Cooling Tower Leaving Temperature
VII. Chiller Alarm Points integrated.
VIII. Load side differential pressure.

C. Display Requirements
I. Maintenance Switch.

II. All Inputs
III. All outputs.

D. Operating Instructions

New chillers vs. connecting to existing systems, heat pump VRF packages. All of these shall have a BACnet integration into Metasys.

When central plant chilled water is utilized and tertiary pumps are installed at the facility, these pumps shall be interlocked for operation through the BMS with the main loop circulator pumps (CHW 101A and 101B) commands in the central Plant.

04 – Glycol/Water Hot Water System

A. General Notes:

I. There shall be a dedicated Heat Exchanger set for all AHU Glycol Heating and/or Pre-Heat Coils in a building or complex. In lieu of this arrangement the University's preference is that Glycol Heating or Pre-Heat Coil Control Valves shall be three-way constant flow arrangement complete with dedicated coil circulating pump.
Glycol system temperature to be reset based on load valve conditions. The temperature will be reset with the intention of getting each valve as open as possible.

B. Sensing Points

I. Must have Glycol Supply Temperature
II. Must have Glycol Return temperature
III. All Pump Statuses (defined as amps above a preset min value and the VFD Status, if applicable, indicates operating).
IV. System operating pressure.
V. System differential pressure.

C. Display Requirements

I. Maintenance Switch.
II. All Inputs
III. All outputs.

A. Operating Instructions

I. For the dedicated Heat Exchanger set for all AHU Glycol Heating and/or Pre-Heat Coils in a building or complex. This Heat Exchanger Set's Supply Fluid Temperature setpoint shall be varied as follows:

Upon initial startup or after all Air Handling Units have been shut down for more than 4 hours, the Hot Water Supply Temperature Setpoint will be the midpoint between the minimum and maximum hot water temperature range of 45 - 75 Deg C, initially (each adjustable).

As each Air Handling Unit is started up, a 'startup time delay' of 15 minutes (adj) is triggered to allow for control settling. After this time delay has expired the AHU Heating Valve will be considered operational for the sequence below.

When an AHU is not operational, its associated heating valve will not be considered.

If the heating system is enabled and no heating valves are operational the Hot Water Supply Temperature Setpoint will remain at its last value until one or more valves become operational again.

If any associated AHU heating control valve is less than 50% (adj) for a period of 20 minutes (adj), the Hot Fluid Supply Temperature Setpoint is lowered by 3 Deg.C (adj). This action will continue to occur at the same time period as long as a heating valve is less than 50% capacity.

The Heat Exchanger Set Graphic will have a link to a graphic which will display all AHU Heating Coil Control Valve Positions in a summary table.

If any associated AHU heating valve is greater than 90% (adj) for a period of 20 minutes (adj), the Hot Fluid Supply Temperature Setpoint is increased by 3 Deg.C (adj). This action will continue to happen at the same time period as long as a heating valve is greater than 90% capacity.

Valves that are greater than 90% capacity take precedence over valves that are less than 50% capacity in terms of the Hot Fluid Supply Temperature Setpoint

Section 4 – HVAC Terminal Units Controls Standard

An overview of the minimum sensing and display point requirements for a typical Terminal Unit system connected to the building management system.

00 - General Terminal Unit Systems:

I. All terminal units with air heating or cooling, as well as dual duct boxes will have a Discharge air temperature sensor.

II. Velocity Air Pressure sensors shall be installed with tee and cap for calibration purposes.

III. The Perimeter device: Finned Tubed Floor Radiation, Ceiling Radiant Heating Panel, etc., shall always be the first stage of heating when combined with other heating devices such as Air Reheat Coils, Heating Chilled Beams, etc.

IV. Public space is defined as a space that more than two people have access to the setpoint dial of the Space Temperature Controller, with the following exceptions:
   - i. Meeting Rooms
   - ii. Private offices/Office Suites

V. Space Temperature Controllers/ Sensors will conform to the following (All labelled to show system connected to):
   - a. “Public spaces” will receive a wall sensor or controller that has <u>no</u> ability to adjust setpoint from the space sensor. A network setpoint will be set to a default of 22 deg C unless otherwise stated.
   - b. “Classroom spaces” will have a wall sensor that has <u>no</u> ability to adjust setpoint. between 19 deg C and 25 deg C, from the network only.
   - c. “Utility Spaces” will receive a protective cover over the sensor to sense mechanical room temperature setpoints. The Utility space will be set to a starting setpoint of 26 deg C for cooling and 18 deg C for heating.

VI. Non-Public Spaces:
   - a. Will receive a Space Temperature Controller/Sensor that <u>has</u> ability to adjust the temperature setpoint
     - i. Set the Local Zone Control Temperature Setpoint to a default of 22ºC ± 2 ºC. There should be no ability for the occupant to vary from this range.
   - b. BMS Contractor to inquire with the University Project Manager whether or not any exceptions are required or permitted.

VII. TEC controllers will only be utilized with the permission of the University’s Utilities manager.
   - a. Where a TEC terminal unit controller is installed, it shall be configured for both heating and cooling regardless of what is physically connected to it.

   b. All TECs shall be set to Lockout Level = 1, to achieve only the ability for the local user to change the temperature set point between 20 – 24 C.

VIII. Control of unit heaters, cabinet unit heaters, and ventilation fans. The preference is these devices are controlled by side loops on local controllers. As a last resort, a TEC, with the permission of the University's Utilities Manager, may be used for remote applications such as bathrooms or vestibules where a controller with surplus connections is not close or practical from a cost point of view.

01 – Single Path VAV

A. General Notes:

I. All modulating outputs will read 100% as fully open.

II. All binary outputs will read on for 1 and off for 0 in binary.

III. Auto calibrate feature must always be turned on.

B. Sensing Points

I. Must have Zone temperature sensor

II. Must be complete with cross flow sensor or accepted alternative for special circumstances.

III. Discharge Air Temperature Sensor in cases where there is a reheat coil.

C. Display Requirements

I. All Inputs

II. All outputs.

III. All Mapped Set points

02 – Dual Path VAV

A. General Notes:

I. All modulating outputs will read 100% as fully open.

II. All binary outputs will read on for 1 and off for 0 in binary.

III. Auto calibrate feature will always be turned on.

B. Sensing Points

I. Must have Zone temperature sensor

II. Where possible, cross flow sensing devices installed on hot deck and cold deck.

III. Discharge Air Temperature Sensor

IV. Air flow

   a. Hot Deck Flow
   b. Cold Deck Flow

c. Calculated Total Flow

C. Display Requirements
I. All Inputs
II. All outputs.
III. All Mapped Set points

03 – Fan Coil Unit

A. General Notes:
I. 100% on modulating outputs will represent full capacity. (Heating valve/cooling valve).
II. All binary outputs will read on for 1 and off for 0 in binary.

B. Sensing Points
I. Must have Zone temperature sensor
II. Supply Fan status, via manufacturer provided dry contact from their fan circuitry. Mechanical Engineer needs to specify this.
III. Discharge Air Temperature Sensor

C. Display Requirements
I. All Inputs
II. All outputs.
III. All Mapped Set points

04 – Heat Pump Unit

A. General Notes:
I. 100% on modulating outputs will represent full capacity.
II. All binary outputs will read on as on and off as off.

B. Sensing Points
I. Must have Zone temperature sensor
II. Discharge Air Temperature Sensor
III. Unit Amps (HP-AMPS). On a case-by-case basis a decision on this object or not will be made.
IV. Trend of which provides:
a. fan status
b. filter cleanliness status
c. Compressor status.

C. Display Requirements
   I. All Inputs
   II. All outputs.
   III. All Mapped Set points

D. Controller
   I. TEC's are permitted only where it's configuration 'exactly' matches the Heat Pump it will be connected to.

05 – Baseboard/Radiant Panel

A. General Notes:
   I. All modulating outputs will read 100% as full capacity.
   II. All binary outputs will read ON for 1 and OFF for 0 in binary.

B. Sensing Points
   I. Must have Zone temperature sensor

C. Display Requirements
   I. All Inputs
   II. All outputs.
   III. All Mapped Set points

06 – In floor Heat

A. General Notes:
   I. All modulating outputs will read 100% as full capacities.
   II. All binary outputs will read ON for 1 and OFF for 0 in binary.

B. Sensing Points
   I. Must have Zone temperature sensor
   II. No slab sensors permitted.

C. Display Requirements
   I. All Inputs
   II. All outputs.

07– Chilled Beam

A. General Notes:
   I. All modulating outputs will read 100% as full capacities.
   II. All binary outputs will read ON for 1 and OFF for 0 in binary.

B. Sensing Points
   I. Must have Zone temperature sensor
   II. Must Have zone humidity and dew point

C. Display Requirements
   I. All Inputs
   II. All outputs.

D. Operating Instructions
   I. Chilled Beams

The primary air handling system shall maintain a 2°C zone air temperature dew point offset below the surface temperature of the chilled beam's coil to avoid condensing and dripping into the space.

In Active Chilled Beam systems, use the primary air system to offset the space latent load and maintain the indoor dew point at or below 12.5°C (adjustable) to prevent condensation. In addition, the water temperature delivered to the chilled beams shall be maintained between 15°C (both adjustable), sufficiently above the dew point of the space at a differential of 2°C.

The Temperature and humidity sensors in each zone are used to calculate the dew point in that zone. A temperature re-set, or dehumidification control sequence, is then established at the air handling system serving the zones to ensure that as the highest zone dew point approaches the chilled water temperature supplied to the chilled beams in the zone, the amount of dehumidification being done at the main AHU is increased to limit the risk of condensation.

CHEB's SOOs shall be used for projects with Chilled Beams

Section 5 – Miscellaneous Systems Controls Standard

01 -Instrument Compressed Air System

a. General Notes:

I. Without express approval of the University' Project Manager and the University's Utilities Manager, the central campus compressed air system shall always be used; Studley, Carlton, Sexton.

II. All facilities serviced with compressed air shall be equipped with a main PRV which shall be referred to the "Initial source" component.

III. All PRV's shall be equipped with bypass piping and valve arrangement to allow for maintenance and calibration. These installations shall be complete with the necessary isolation valves and a properly sized needle valve for modulation. The bypass arrangement shall include the necessary pressure indicators to allow manual operation of the compressed air feed.

IV. System Pressure monitoring shall be required, analog value, and installed downstream of all PRV's. Consultant to show a detail of this on the mechanical drawings.

V. If a building specific compressor is installed, the central system compressor shall be the Duty device. Once a week, the building specific Standby compressor will be automatically put into service for two hours to exercise it and ensure it remains operational via automatic air valves.

b. Sensing Points

I. System Pressure AI.

c. Display Requirements

I. All Inputs

II. All outputs.

d. Operating Instructions

I. None

02 – Condensate Receiver Systems (Tanks)

a. General Notes:

I. None

b. Sensing Points

I. Each Pump Status via current sensing relay(s)

II. High High Level Tank Alarm for connection to BMS

c. Display Requirements

I. All Inputs

II. All outputs.

d. Operating Instructions

II. None

03 – Piping Systems consisting of mostly two-way control valves

a. General Notes:
   I. No piping bypasses with two-way pressure control valves are permitted
   II. VSD shall be capable of operating between 20 – 110 %.
   III. Differential Pressure sensor shall be installed as per this guideline. Consultant to specify the location on the project drawings.

b. Sensing Points
   I. As per applicable hydronic system

c. Display Requirements
   I. All Inputs
   II. All outputs.

d. Operating Instructions
   I. If the VSD command is equal to or less than 30 % (18 Hz on the VSD), reset the fluid temperature to cause an increase in flow

04 - Sump Pumping systems

a. General Notes:

b. Sensing Points
   I. Individual Pump Status from pump controller, which is to be specified by the consultant in the sump pump controller specification.
   II. High High Level Alarming from dry, normally closed, contact in pump control panel.

c. Display Requirements
   I. All Inputs
   II. All outputs.

d. Operating Instructions
   I. High High level alarming will generate a critical alarm

05 – Variable Frequency Drives

a. General Notes:
   I. This guideline is based on Johnson Controls VFDs. Use of other equipment must be reviewed by the University and approved by the Project Manager and Utilities Manager.

b. Hardwired Points
   a. Start/Stop
   b. Status
   c. Speed Command

c. Display Requirements via BACnet MSTP
   I. All Inputs, as a minimum, amperage.
   II. All outputs

d. Operating Instructions

I. Setup

a. Setup of a new VFD:

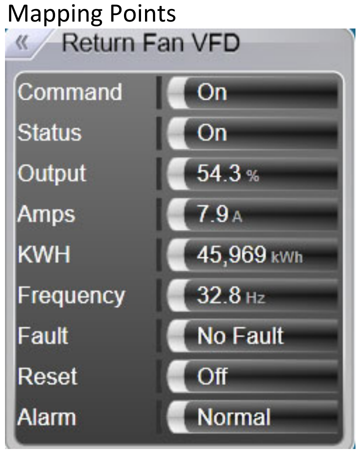
b. Enter in all of the Motor Nameplate Parameters.

- Set the MSTP BUS Communication Address (ensure VFD is physically labeled with MSTP bus address)
- Verify communication with the VFD to the controller.
- Ensure cooling fan is set to cycle with internal temperature.

c. Min VFD Settings:

- Pumps: 12 Hz (20%)
- Fans: 9 Hz (15%)

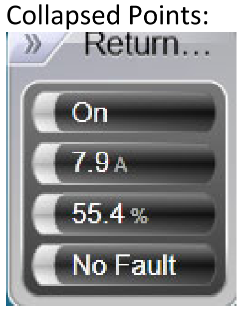
d. VFD Mapping Points



HOA Status

e. Metasys GGT Graphics VFD Points

- Collapsed Points:



04 – Outside Air Dry Bulb & Wet Bulb Temperature & Relative Humidity Sharing

a. General Notes:

I. Studley, Carlton & Sexton campuses; Outside Air Temperature for, any control sequence that requires it will be determined by the average of four sensors located in the following buildings:
   a. Chemistry Extension → 33ADX028
   b. Weldon Law → 29AFA037
   c. Daltech Campus → NCE-23, SEXTON.B-BUILDING, COMP-SERVICES (23BFE011)
   d. DOSB → C230-502-NAE30, MISC-PH (30AFE012)

II. The average calculation logic will exist in the NAE with the lowest numeric designation for each building. (ie: Each engine will calculate the average individually).

III. In the event of sensor becoming unreliable or unavailable, it shall not be used in the calculation. If no sensors are available, use the last reliable value until one becomes available.

IV. Agricultural Campus; Outdoor Air Temperature & Humidity shall use the transmitters for MacRae Library. No new Outdoor Air Temperature or Humidity transmitters are to be installed on new projects.

Section 6 – BMS Hardware

00 - General BMS Devices:

I. All BMS devices will be included in As-Built drawing spreadsheet.

II. LAN Connection

a. To obtain a connection to the University LAN, follow the Building Service Device Network Connection Process. This process is obtained from the FM Project Manager.

b. Each IP Device location will have two University LAN connection ports; Port A is for the Engine/Controller/Integrator/Device and Port B is a service port.

c. The service port will be configured for the building VLAN XX. Technicians whose laptops have been registered (all laptops are registered with roaming enable) will have internet access and then by running the University issued VPN client, access to BMS. Roaming allows any registered device to get a free IP address anywhere, except for restricted/firewalled VLANs.

d. The field port, adjacent to the Network Device, will always be installed in a 6 x 6 hinged cover electrical box c/w a dual MDVO grey receptacle (Belden PN: AX101063) to be mounted no higher than 6'. Blue patch cord(s) will be run from the 6 x 6 box to the Network Device.

III. Devices will comply with university BACnet standards. University Design Guidelines - Div 01(a) – General Requirements 2020 09 21 (2) or later. See 01 35 13. 01,02,03 for BACnet Requirements.

01 – Supervisory Devices

A. General

I. Approval required by the Utility Operations Team to add any supervisory device to the building management system.

II. Supervisory device naming as per Section 05 - Building Management System Naming Requirements of this document.

III. When a new device is added, the Dalhousie Topology must be updated to contain the new IP device.

B. Panel

I. Panel must be a keyed panel.

II. 24 volt transformer integral to the panel.

III. Labelling requirements:

a. System Name

b. Controller ID.

c. Circuit ID.
d. Room ID.

C. Communication
I. All Supervisory Devices must be IP based.

02 – Field Controllers

A. General
I. Control panels do <u>not</u> require key access.
II. Vendor devices controlling chillers etc. will be BACNET IP.
III. No “N2 only” devices shall be acceptable.
IV. Main mechanical system Controllers will provide “growth” ability. (Example: Controls panel should have empty space for at least 1 IOM controller to be added in future. Special circumstances can be accommodated.

B. Panel
I. Full size panel: 24-volt transformer integral to the panel.
II. Terminal Control voltage can be centralized; locations must be noted in As-Built drawings.
III. Labelling requirements:
a. System Name
b. Controller ID.
c. Circuit ID.
d. Panel ID.

C. Communication Bus
I. Any field busses that require a repeater will have the location of the repeater clearly indicated in BMS and Riser Spreadsheet: Physical location & between what devices to be noted on MSTP riser layout spreadsheet.
II. All communication diagnostics and commissioning must be completed before hand over of the final product.
III. The location of terminal strips and or other connections outside of a control panel will be clearly indicated on the As-built drawings.
IV. Communication cabling layout will be supplied with As-built speadsheet for reference and troubleshooting with end user.
V. For MSTP bus, there will be no continuity to shield at time of handover.
VI. All MSTP communication bus must be installed in a “Daisy chain” configuration.

Section 7 – BMS End Devices

00 - General

01 - Actuators

A. Damper Actuators

I. The BMS Contractor will furnish all damper actuators. The BMS contractor will size all damper actuators.
II. Damper actuators will be 24 volt powered unless otherwise approved.
III. Analog control signal to be 0-10 Vdc.
IV. Damper Actuators on outside air dampers will fail shut so that the inner coils of the air-handling unit undertake no risk.
V. Terminal Unit Actuators will fail last position.
VI. Actuators will be electric in all applications.
VII. BMS modulating signal output representative 0-100%. 100% being fully open.
VIII. BMS Binary signal output representative, Close/Open.

B. Valve Actuators

I. The BMS Contractor will furnish all Valve actuators. The BMS contractor will size all valve actuators.
II. Valve actuators will be 24 volt powered unless otherwise approved.
III. Analog control signal to be 0-10 Vdc.
IV. Valve actuators on heat exchangers will fail closed so that the heat exchanger does not experience damage due to overheating.
V. Valve actuators on perimeter heat will fail open so that the building envelope is protected.
VI. Terminal Unit Actuators will fail last position.
VII. Actuators will be electric in all applications.
VIII. BMS signal output representative 0-100%. 100% being fully open.
IX. BMS binary signal output representative, Close/Open.
X. Actuators on Steam systems will be mounted at a 45 degree offset.

02 – Sensors, Transmitters, Meters, Switches, Relays

I. General Requirements

1. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements. Exact OEM equivalents of specified sensors and transmitters shall be acceptable if clearly identified in submittals and approved by the University Project Manager.

Temperature Sensors

1. **General Requirements**
   a. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
   b. The temperature sensor shall be of the resistance type and shall be two-wire 1000 ohm nickel RTD. Two-wire 1000 ohm platinum RTD and/or thermistor sensors of 10,000 or 2,250 ohms resistance may be substituted based on the application but requires approval by the University's Utilities Manager.
2. **Room Temperature Sensors**
   a. Room sensors shall be constructed for either surface or wall box mounting. Room sensors shall have the following options when specified:
      i. Setpoint
      ii. Momentary override request for activation of after-hours operation
3. **Room Temperature Sensors with Integral Display**
   a. Room sensors shall be constructed for either surface or wall box mounting. Room sensors shall have an integral LCD display and the following capabilities when specified:
      i. Display room air temperatures
      ii. Display and adjust room comfort setpoint
      iii. Display and adjust fan operation status
      iv. Setpoint override request via setpoint adjust dial or buttons
      v. Timed override request via occupancy override with status indication for activation of after-hours setpoint operation
      vi. Toggle between Degrees F and Degrees C
      vii. Toggle between temperature and humidity where specified
4. **Thermowells**
   a. Thermowells shall be stainless steel for potable water otherwise copper.
   b. When thermowells are required, the sensor and well shall be supplied as a complete assembly, including wellhead and sensor.
   c. Thermowells shall be pressure rated and constructed in accordance with the system working pressure.
   d. Thermowells and sensors shall be mounted in a direct mount (no adapter) offering faster installation or 1/2" NFT saddle and allow easy access to the sensor for repair or replacement.
   e. Thermowells constructed of 316 stainless steel shall comply with Canadian Registration Number (CRN) pressure vessel rating.
5. **Outside Air Sensors**
   a. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall be provided with a solar shield and mounted on the North side of the building.

b. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.

c. Temperature transmitters shall be of NEMA 3R (IP54) or NEMA 4 (IP65) construction and rated for ambient temperatures.

d. The outdoor sensor shall be capable of being mounted on a roof, pole or side of a building utilizing its preassembled mounting bracket.

e. Outside air relative humidity sensors 0-100% full range of accurate measurement. Operating temperature -4 to 140°F (-20 to 60°C).

f. Outside air temperature sensors operating temperature range -40 to 140°F, +/- .55°F (+/- .3°C).

6. Duct Mount Sensors

a. On insulated ducting, insulation shall not interfere with access to the sensors. Sensor & conduit to be installed prior to duct insulation. This construction sequence is required to be specified by the design Team.

b. Duct mount sensors shall mount in an electrical box through a hole in the duct, positioned to provide ease of accessibility for repair or replacement.

c. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.

d. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be provided.

7. Averaging Sensors

a. For ductwork greater in any dimension than 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.

b. For plenum applications, such as mixed air temperature measurements, a continuous averaging sensor or a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.

c. Capillary supports at the sides of the duct shall be provided to support the sensing string.

d. All Averaging Temperature Sensors shall be 6 m (20’). One 6 m (20’) Averaging Temperature Sensor can be used to cover up 3 m2 (or 32 ft2) of air duct cross section. For areas greater than 3 m2, additional sensors need to be engineered; a total of two will require an additional input on the controller, a total of three will require two additional inputs on the controller, four can be accommodated by field wiring. Separate Analog Inputs shall be averaged to provide the Mixed Air Temperature object’s system value.

8. Acceptable Manufacturers: Johnson Controls, Minco.

Humidity Sensors

1. The sensor shall be a solid-state type, relative humidity sensor of the Thin Film Capacitance or Bulk Polymer Design. The sensor element shall resist service contamination.

2. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.

3. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. 3% between 20% and 80% RH at 77°F unless specified elsewhere.
4. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R (IP54) or NEMA 4 (IP65) enclosure with sealtite fittings.
5. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.
6. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.
7. Acceptable Manufacturers: Johnson Controls and Vaisala.

CO^2 Sensors

1. CO_2 sensors shall NOT have Liquid Crystal Display (LCD)
2. The CO_2 sensor shall transmit the information back to the controller via jumper selectable 0-20mA, 4-20mA & 0-10 VDC output signals:
   a. The CO_2 sensors shall provide a maximum output current of 25mA; Maximum output voltage of 12.5V.
   b. The CO2 sensors shall be FCC compliant to CFR47 Part 15 subpart B Class A.
3. The CO_2 sensors shall be available with:
   a. CO_2 response time (0-63%) of 1 minute
   b. Less than 0.083% of full scale/°F temperature dependence of CO2 output
   c. Long term CO2 stability ±5% of full scale for 5 years
   d. CO2 measurement accuracy of ±(40ppm + 2.0% of reading)
   e. CO2 non-linearity of less than 1.0% of full scale
4. The CO_2 sensors may include the following items:
   a. Relay output module
   b. Analog temperature module with linear 0-10 VDC output for 32-122F

Differential Pressure Transmitters

1. General Air and Water Pressure Transmitter Requirements:
   a. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.
   b. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.
   c. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.
   d. A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.
2. Low Differential Water Pressure Applications (0 – 10 PSI):

a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of flow meter differential pressure or water pressure sensing points.

b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:

i. .01-10 PSI input differential pressure range

ii. 4-20 mA output

iii. Maintain accuracy up to 20 to 1 ratio turndown

iv. Reference Accuracy: +0.2% of full span

Acceptable Manufacturers: Setra and Mamac.

3. Medium to High Differential Water Pressure Applications (Over 10 PSI):

a. The differential pressure transmitter shall meet the low-pressure transmitter specifications with the following exceptions:

i. Differential pressure range 0 to 100 PSI

ii. Reference Accuracy: +1% of full span (includes non-linearity, hysteresis, and repeatability)

Acceptable Manufacturers: Setra and Mamac.

Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.

4. Building Differential Air Pressure Applications (-249 kPa to +249 kPa):

a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.

b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:

i. -1.00 to +1.00 WC input differential pressure ranges. (Select range appropriate for system application)

ii. 4-20 mA output

iii. Maintain accuracy up to 20 to 1 ratio turndown

iv. Reference Accuracy: +0.2% of full span

Acceptable Manufacturers: Johnson Controls or approved equal

5. Low Differential Air Pressure Applications (0” to 2.5” WC):

a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.

b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications.

i. (0.00 - 1.00” to 5.00”) WC input differential pressure ranges (select range appropriate for system application)

ii. 4-20 mA, 0-5 VDC, 0-10 VDC output

iii. Maintain accuracy up to 20/1 ratio turndown

iv. Reference Accuracy: +0.25%, or 0.5% of full span

Acceptable Manufacturers: Johnson Controls and Ruskin

6. Medium Differential Air Pressure Applications (5” to 21” WC):

a. The pressure transmitter shall be similar to the Low Air Pressure Transmitter, except that the performance specifications are not as severe. Differential pressure transmitters shall be provided that meet the following performance requirements.

i. Zero & span: (c/o F.S./Deg. F): .04% including linearity, hysteresis and repeatability

ii. Accuracy: 1% F.S. (best straight line) Static Pressure Effect: 0.5% F.S. (to 100 psig.)

iii. Thermal Effects: <+.033 F.S./Deg. F. over 40°F to 100°F (calibrated at 70°F.)

Acceptable manufacturers: Johnson Controls and Ruskin

Flow Monitoring

1. Air Flow Monitoring

a. Fan Inlet Air Flow Measuring Stations

i. At the inlet of each fan and near the exit of the inlet sound trap, airflow sensors shall be provided that shall continuously monitor the fan air volumes or velocity pressure.

ii. Each sensor shall be surface mount type. Unit shall be capable of monitoring and reporting the airflow and temperature at each fan inlet location through two or four sensing circuits. If a static pressure manifold is used, it shall incorporate dual offset static tips on the opposing sides of the averaging manifold so as to be insensitive to flow-angle variations of as much as + 20° in the approaching air stream.

iii. Devices creating fan performance degradation, resulting in additional energy consumption, caused from pressure drop associated with probes or mounting apparatus in the center of the fan inlet are not allowed. The device shall not induce a significant pressure drop, nor shall the sound level within the duct be amplified by its singular or multiple presence in the air stream. Sensor circuit casings shall be constructed of U.L. 94 flame rated high impact ABS and include a stainless steel thermistor cap that maintains the precise calibrated flow over the heated and ambient measurement points.

Acceptable manufacturers: Ebtron, Johnson Controls, Air Monitor Corp., Tek-Air Systems, Inc., or Dietrich Standard

b. Single Probe Air Flow Measuring Sensor

i. The single probe airflow-measuring sensor shall be duct mounted with an adjustable sensor insertion length of up to eight inches. The transmitter shall produce a 4-20 mA or 0-10 VDC signal linear to air velocity. The sensor shall be a thermal dispersion and utilize temperature sensor and a heated thermistor. The sensor pair shall measure the air temperature and airflow velocity.

c. Duct Air Flow Measuring Stations

i. Furnish and install, at locations shown on plans or as in accordance with schedules, an equalized air measuring probe system piped to a high performance pressure transducer or an electronic type airflow temperature measuring station.

ii. Each device shall be designed and built in order to comply with, and provide results in accordance with, accepted practice as defined for system testing in the ASHRAE Handbook of fundamentals, as well as in the Industrial Ventilation Handbook.

iii. Assembly shall be AMCA tested and capable of measuring a range from 70 to 5,000 FPM (22 to 1524 MPM).

iv. Equalized air measuring assembly shall measure to ±3% average and consist of 6063T5 extruded aluminum step sensing blade(s) with anodized finish, plenum-rated polyethylene pressure tubing, brass barbed fittings, mounting hardware and a glass-on-silicone capacitance sensor pressure transducer capable of measuring up to five field-selectable pressure ranges up to 2.5 in. WC.

v. The transducer shall be accurate to ±0.5%, or 0.25% of full scale and be contained in a National Electrical Manufacturer’s Association (NEMA) 4 (IP-65) enclosure. Transducer shall be factory mounted and piped to high and low pressure ports through fittings made of brass.

vi. All sensor tubing shall terminate in solid brass barbed fittings.

vii. Total and static pressure manifolds shall terminate with external ports for connection to control tubing. An identification label shall be present on each unit casing, listing model number, size, area, and airflow capacity.

viii. Air straightener shall be provided for sizes over 17 square feet (1.6 sq meter).

ix. Airflow measuring station assemblies shall be fabricated of galvanized steel or aluminum casing of appropriate thickness for slip fits or with 90 Deg. connecting flanges in configuration and size equal to that of the duct into which it is mounted. Each station shall be complete with an air directionalizer and parallel cell profile suppressor (3/4” maximum cell) across the entering air stream and mechanically fastened to the casing in such a way to withstand velocities up to 5000 feet per minute.

x. Electronic air measuring station shall be capable of monitoring and reporting the airflow and temperature at each measuring location through one or more measuring probes containing multiple sensor points and a control transmitter that outputs a 4-20 mA linear signal.

xi. Probe(s) shall be constructed of an airfoil shaped aluminum extrusion containing the sensor circuit(s).

xii. Each sensor circuit shall consist of coated thermistors, for temperature and velocity, mounted to a Printed Circuit Board (PCB). Multiplexer board shall be encased to prevent moisture damage.

xiii. Control transmitter shall be capable of processing independent sensing points and shall operate on a fused 24 VAC supply.

xiv. Control transmitter shall feature a 16 x 2 character alphanumeric LCD screen, digital offset/gain adjustment, continuous performing sensor/transmitter diagnostics, and a visual alarm to detect malfunctions.

xv. Installation Considerations

a. The precise location that adheres to the installation requirements of the equipment shall be provided by the designer. In its absence the location shall be requested by a RFI.

b. The maximum allowable pressure loss through the Flow and Static Pressure elements shall not exceed .04” WC at 1000 feet per minute, or .11” WC at 2000 feet per minute. Each unit shall measure the airflow rate within an accuracy of plus 3-5% as determined by AMCA.

c. Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct. Station flanges shall be 1.5 inches to facilitate matching connecting ductwork.

d. Where control dampers are provided as part of the airflow measuring station, parallel blade precision controlled volume dampers integral to the station and complete with actuator, and linkage shall be provided.

e. Stations shall be installed in strict accordance with the manufacturer’s published requirements, and in accordance with ASME Guidelines affecting non-standard approach conditions.

xvi. All air measuring devices shall be tested according to AMCA Standard 610.

Acceptable manufacturers: Johnson Controls, Air Monitor Corp., Tek-Air, Ruskin, and Dietrich Standard.

d. Static Pressure Traverse Probe

i. Duct static traverse probes shall be provided where required to monitor duct static pressure. The probe shall contain multiple static pressure sensors located along exterior surface of the cylindrical probe.

Acceptable manufacturers: Cleveland Controls

2. Water Flow Monitoring

i. Domestic water flow monitoring will be performed by using tricon-e pulse duplicators that are hooked to the Municipal water meter. All duplicators and meters installed as per manufacturer best practices; exceptions communicated to the University Utilities Manager for Approval.

a. Sub domestic water flow metering will be performed with turbine flow meters direct connected to the incumbent BMS.

3. Thermal Flow Monitoring

i. Main hot water heating/Chilled Water/Glycol meters for a building will be electromagnetic type with integral microprocessor-based electronics. The meter shall have an accuracy of 0.25%. Meters installed as per manufacturer best practices, exceptions communicated to the University Utilities Manager for Approval.

a. Sub heating/Chilled water/glycol meters within the building will be turbine flow meters direct connected to the incumbent BMS.

ii. Condensate flow metering shall be ultrasonic strap on type sensors to allow for future changes. Meters installed as per manufacturer best practices, exceptions communicated to the University Utilities Manager for Approval.

Acceptable manufacturers: Onicon, Dwyer, Endress Hauser, Other alternatives., if approved by the University Project Manager.

Refrigerant Leak Detectors

1. The refrigerant leak detector shall be a standalone device and shall provide SPDT switch contacts to directly energize the refrigeration room exhaust ventilation fans. The detector shall include a sensor or sensors connected to a control panel. Two relay contacts at the control panel shall provide trouble and alarm indication to the Building Management System. The alarm relay contact shall also directly energize the exhaust fans.
2. The refrigerant leak detector shall sense the type of refrigerant used in the specified chillers. Multiple sensors shall be required to detect different refrigerants and/or provide proper sensing coverage for the area of the refrigeration room.

   Acceptable manufacturers: Johnson Controls, MSA Instruments, Honeywell.

Status and Safety Switches

1. General Requirements
   a. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the Building Management System (BMS) when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.
2. Air Flow Switches
   a. Differential pressure flow switches shall be bellows actuated mercury switches or snap acting micro-switches with appropriate scale range and differential adjustment for intended service.

   Acceptable manufacturers: Johnson Controls, Cleveland Controls
3. Air Pressure Safety Switches
   a. Air pressure safety switches shall be of the manual reset type with SPDT contacts rated for 2 amps at 120VAC.
   b. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.

   Acceptable manufacturers: Johnson Controls, Cleveland Controls
4. Water Flow Switches
   a. Water flow switches shall be equal to the Johnson Controls P74.
5. Low Temperature Limit Switches
   a. The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.
   b. The sensing element shall be a minimum of 20 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.
   c. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.

One 6 m (20') Air Temperature Low Limit can be used to cover up 3 m^2 (or 32 ft^2) of air duct cross section. Thereafter, a second Low Limit shall be used for the next 3 m^2 (or 32 ft^2), and so on. Second or subsequent Low Limits shall be wired in series with the first.

The low temperature limit switch shall be equal to Johnson Controls A70.

Control Relays

1. Control Pilot Relays
   a. Control pilot relays shall be of a modular plug-in design or unibody.
   b. Mounting Bases shall be snap-mount.
   c. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
   d. Contacts shall be rated for 10 amps at 120VAC.
   e. Relays shall have an integral indicator light and check button.

   Acceptable manufacturers: Johnson Controls, Lectro, RIB

Electronic/Pneumatic Transducers

1. Electronic to Pneumatic transducers shall provide:
   a. Output: 3-15 psig
   b. Input: 0-10 VDC
   c. Manual output adjustment
   d. Pressure gauges; one for the main air in the panel and another for each EP's output.

   Acceptable manufacturers: Johnson Controls, Mamac

Section 8 – Appendices

Appendix – A - Campus Alarm Priorities

Because of the Universities size, the ability to segment alarms is paramount to the success of the operations.

The alarm priorities will be reviewed in detail prior to implementing any alarms.

In general, follow the following matrix:

Central Services Building, 1236 Henry Street
PO Box 15000, Halifax Nova Scotia, Canada
B3H 4R2

Object Type	Object Description		Reference					Status	Alarm/Warning Thresholds		Single Setpoint Mode	Engineering Values				Alarm Setup							
		CRITICAL	Alarm Extension Name	Description	Object Type	Event Enable	Report Delay	Alarm Enabled	High Alarm Limit	Low Alarm Limit	Setpoint Reference	Differential	High Warning Offset	Low Warning Offset	Reference Delay Time	Alarm Ack Required	Alarm Priority	Warning Ack Required	Warning Priority	Normal Ack Required	Normal Priority	Alarm Message Text	Additional Notes
*-A,-ALARM,-F,-FAULT	General Alarm or Fault from Binary or Multistate Input	NO	“Point Name”.Alarm	Blank	Multistate Alarm	NO	60	TRUE	N/U	N/U	N/U	N/U	N/U	N/U	N/U	FALSE	100	N/A	N/A	FALSE	200	*Equipment Name* General Alarm/Fault	
*-A,-ALARM,-F,-FAULT	General Alarm or Fault from Binary or Multistate Input	YES	“Point Name”.Alarm	Blank	Multistate Alarm	YES	10	TRUE	N/U	N/U	N/U	N/U	N/U	N/U	N/U	TRUE	151	N/A	N/A	TRUE	200	*Equipment Name* General Alarm/Fault	
SAV_GEX-FH-DP	Medium Press - Air Valve Diff Pressure Alarm	NO	“Point Name”.Alarm	Blank	Analog Alarm	NO	30	TRUE	750 Pa	150Pa	Blank	20 Pa	Blank	Blank	N/U	FALSE	100	N/A	N/A	FALSE	200	Air Valve Pressure Alarm	
SAV_GEX-FH-DP	Medium Press - Air Valve Diff Pressure Alarm	YES	“Point Name”.Alarm	Blank	Analog Alarm	YES	30	TRUE	750 Pa	150 Pa	Blank	20 Pa	Blank	Blank	N/U	TRUE	151	N/A	N/A	TRUE	200	Air Valve Pressure Alarm	
ZN-CO	Carbon Monoxide	YES	“Point Name”.Alarm	Blank	Analog Alarm	YES	0	TRUE	50 ppm	Blank	Blank	5 ppm	N/U	N/U	N/U	TRUE	151	FALSE	N/A	TRUE	200	Zone Carbon Monoxide Alarm	
ZN-CO2	Carbon Dioxide	NO	“Point Name”.Alarm	Blank	Analog Alarm	NO	1800	TRUE	1000 ppm	Blank	Blank	100 ppm	N/U	N/U	N/U	FALSE	100	FALSE	N/A	FALSE	200	Zone Carbon Dioxide Alarm	
ZN-CO2	Carbon Dioxide	YES	“Point Name”.Alarm	Blank	Analog Alarm	YES	600	TRUE	1000 ppm	Blank	Blank	100 ppm	N/U	N/U	N/U	TRUE	151	FALSE	N/A	TRUE	200	Zone Carbon Dioxide Alarm	
ZN-NO2	Nitrogen Dioxide	YES	“Point Name”.Alarm	Blank	Analog Alarm	YES	0	TRUE	50 ppm	Blank	Blank	5 ppm	N/U	N/U	N/U	TRUE	151	FALSE	N/A	TRUE	200	Zone Nitrogen Dioxide Alarm	
ZN-T	Zone Temperature	NO	“Point Name”.Alarm	Blank	Analog Alarm	NO	1800	TRUE	30 DegC	10 DegC	Blank	2 DegC	N/U	N/U	N/U	FALSE	100	FALSE	N/A	FALSE	200	Zone Temperature Alarm	
ZN-T	Zone Temperature - Critical Spaces	YES	“Point Name”.Alarm	Blank	Analog Alarm	YES	600	TRUE	30	10	Blank	2 DegC	N/U	N/U	N/U	TRUE	151	FALSE	N/A	TRUE	200	Zone Temperature Alarm	
ZN-H	Zone Humidity	NO	“Point Name”.Alarm	Blank	Analog Alarm	NO	1800	TRUE	60 %RH	25 %RH	Blank	5 %RH	N/U	N/U	N/U	FALSE	100	FALSE	N/A	FALSE	200	Zone Humidity Alarm	
ZN-H	Zone Humidity - Critical Spaces	YES	“Point Name”.Alarm	Blank	Analog Alarm	YES	600	TRUE	60 %RH	25 %RH	Blank	5 %RH	N/U	N/U	N/U	TRUE	151	FALSE	N/A	TRUE	200	Zone Humidity Alarm	
FILT-DP, PFILT-DP	AHU Filter Differential Pressure (MERV 8)- Analog Input	NO	“Point Name”.Alarm	Blank	Analog Alarm	NO	32,400	TRUE	188 Pa*	Blank	Blank	5 Pa	N/U	N/U	N/U	FALSE	100	FALSE	N/A	FALSE	200	AHU Dirty Filter Alarm	
FILT-DP, PFILT-DP	AHU Filter Differential Pressure (MERV 8) - Analog Input	YES	“Point Name”.Alarm	Blank	Analog Alarm	YES	600	TRUE	188 Pa*	Blank	Blank	5 Pa	N/U	N/U	N/U	TRUE	151	FALSE	N/A	TRUE	200	AHU Dirty Filter Alarm	
FILT-S	Filter Differential Pressure Status - Binary Input	NO	“Point Name”.Alarm	Blank	Multistate Alarm	NO	1800	TRUE	N/U	N/U	N/U	N/U	N/U	N/U	N/U	FALSE	100	N/A	N/A	FALSE	200	AHU Dirty Filter Alarm	
FILT-S	Filter Differential Pressure Status - Binary Input	YES	“Point Name”.Alarm	Blank	Multistate Alarm	NO	1800	TRUE	N/U	N/U	N/U	N/U	N/U	N/U	N/U	TRUE	151	N/A	N/A	TRUE	200	AHU Dirty Filter Alarm	
RA-H	Process Humidity with Setpoint Target	NO	“Point Name”.Alarm	Blank	Analog Alarm	NO	1800	TRUE	85% RH	Blank	RAH-SP	5% RH	10% RH	30% RH	30 Seconds	FALSE	100	N/A	120	FALSE	200	Return Air Humidity Alarm	
RA-H	Process Humidity with Setpoint Target	YES	“Point Name”.Alarm	Blank	Analog Alarm	YES	600	TRUE	85% RH	Blank	RAH-SP	5% RH	10% RH	30% RH	30 Seconds	TRUE	151	TRUE	151	TRUE	200	Return Air Humidity Alarm	
LT-A	Low Limit Alarm - Binary Input	NO	“Point Name”.Alarm	Blank	Multistate Alarm	NO	1800	TRUE	N/U	N/U	N/U	N/U	N/U	N/U	N/U	FALSE	100	N/A	N/A	FALSE	200	Low Limit Alarm	
LT-A	Low Limit Alarm - Binary Input	YES	“Point Name”.Alarm	Blank	Multistate Alarm	YES	600	TRUE	N/U	N/U	N/U	N/U	N/U	N/U	N/U	TRUE	151	N/A	N/A	TRUE	200	Low Limit Alarm	
*-S	Motor Running Status, with Command Reference	NO	“Point Name”.Alarm	Blank	Multistate Alarm	NO	1800	TRUE	N/U	N/U	N/U	N/U	N/U	N/U	N/U	FALSE	100	N/A	N/A	FALSE	200	Motor Status Mismatch Alarm	
*-S	Motor Running Status, with Command Reference	YES	“Point Name”.Alarm	Blank	Multistate Alarm	YES	600	TRUE	N/U	N/U	N/U	N/U	N/U	N/U	N/U	TRUE	151	N/A	N/A	TRUE	200	Motor Status Mismatch Alarm	
*-DP	Process Control Diff Press, with Setpoint Target	NO	“Point Name”.Alarm	Blank	Analog Alarm	NO	1800	TRUE	N/U	N/U	DP-SPT	10 Pa	25 Pa	25 Pa	30 Seconds	FALSE	100	N/A	120	FALSE	200	Differential Pressure Alarm	
*-DP	Process Control Diff Press, with Setpoint Target	YES	“Point Name”.Alarm	Blank	Analog Alarm	YES	600	TRUE	N/U	N/U	DP-SPT	10 Pa	25 Pa	25 Pa	30 Seconds	TRUE	151	TRUE	151	TRUE	200	Differential Pressure Alarm	
*-F,-FLOW	Process Flow, with Setpoint Target	NO	“Point Name”.Alarm	Blank	Analog Alarm	NO	1800	TRUE	N/U	N/U	FLOW-SPT	10 LPS	25 LPS	25 LPS	30 Seconds	FALSE	100	FALSE	120	FALSE	200	Flow Alarm	
*-F,-FLOW	Process Flow, with Setpoint Target	YES	“Point Name”.Alarm	Blank	Analog Alarm	YES	600	TRUE	N/U	N/U	FLOW-SPT	10 LPS	25 LPS	25 LPS	30 Seconds	TRUE	151	TRUE	151	TRUE	200	Flow Alarm	
*-LVL	Fluid High/Low Level Alarm - Analog Input	NO	“Point Name”.Alarm	Blank	Analog Alarm	NO	1800	TRUE	User Defined	User Defined	Blank	N/U	N/U	N/U	N/U	FALSE	100	FALSE	N/A	FALSE	200	Fluid Level Alarm	
*-LVL	Fluid High/Low Level Alarm - Analog Input	YES	“Point Name”.Alarm	Blank	Analog Alarm	YES	600	TRUE	User Defined	User Defined	Blank	N/U	N/U	N/U	N/U	TRUE	151	TRUE	N/A	TRUE	200	Fluid Level Alarm	
*-LVL	Fluid High/Low Level Alarm - Binary Input	NO	“Point Name”.Alarm	Blank	Multistate Alarm	NO	1800	TRUE	N/U	N/U	N/U	N/U	N/U	N/U	N/U	FALSE	100	N/A	N/A	FALSE	200	Fluid Level Alarm	
*-LVL	Fluid High/Low Level Alarm - Binary Input	YES	“Point Name”.Alarm	Blank	Multistate Alarm	YES	600	TRUE	N/U	N/U	N/U	N/U	N/U	N/U	N/U	TRUE	151	N/A	N/A	TRUE	200	Fluid Level Alarm	
*-O	Valve or Damper Fully Open Alarm	NO	“Point Name”.Alarm	Blank	Analog Alarm	NO	10800	TRUE	90% Open	Blank	Blank	2% Open	N/U	N/U	N/U	FALSE	100	N/A	N/A	FALSE	200	AHU Cooling Valve Open Above 90% for >3 Hrs	
*-O	Valve or Damper Fully Open Alarm	YES	“Point Name”.Alarm	Blank	Analog Alarm	YES	1800	TRUE	90% Open	Blank	Blank	2% Open	N/U	N/U	N/U	TRUE	151	N/A	N/A	TRUE	200	AHU Cooling Valve Open Above 90% for >30 Mins	
*-P	Fluid or Air Pressure, with Setpoint Target	NO	“Point Name”.Alarm	Blank	Analog Alarm	NO	1800	TRUE	N/U	N/U	PRESSURE-SPT	User Defined	N/U	N/U	N/U	FALSE	100	N/A	120	FALSE	200	High/Low Pressure Alarm	
*-P	Fluid or Air Pressure, with Setpoint Target	YES	“Point Name”.Alarm	Blank	Analog Alarm	YES	600	TRUE	N/U	N/U	PRESSURE-SPT	User Defined	N/U	N/U	N/U	TRUE	151	TRUE	151	TRUE	200	High/Low Pressure Alarm	
HD-T	AHU Hot Deck Temperature, High Alarm	NO	“Point Name”.Alarm	Blank	Analog Alarm	NO	120	TRUE	70 DegC	N/U	Blank	5 DegC	N/U	N/U	120 Seconds	FALSE	100	FALSE	N/A	FALSE	200	AHU Hot Deck High Temperature Alarm	Alarm to be Suppressed when Unit is Off
HD-T	AHU Hot Deck Temperature, High Alarm	YES	“Point Name”.Alarm	Blank	Analog Alarm	YES	120	TRUE	70 DegC	N/U	Blank	5 DegC	N/U	N/U	120 Seconds	TRUE	151	FALSE	N/A	TRUE	200	AHU Hot Deck High Temperature Alarm	Alarm to be Suppressed when Unit is Off
CD-T	AHU Cold Deck Temperature, Low Alarm	NO	“Point Name”.Alarm	Blank	Analog Alarm	NO	120	TRUE	N/U	8 DegC	Blank	3 DegC	N/U	N/U	120 Seconds	FALSE	100	FALSE	N/A	FALSE	200	AHU Cold Deck Low Temperature Alarm	Alarm to be Suppressed when Unit is Off
CD-T	AHU Cold Deck Temperature, Low Alarm	YES	“Point Name”.Alarm	Blank	Analog Alarm	YES	120	TRUE	N/U	8 DegC	Blank	3 DegC	N/U	N/U	120 Seconds	TRUE	151	FALSE	N/A	TRUE	200	AHU Cold Deck Low Temperature Alarm	Alarm to be Suppressed when Unit is Off
HD-P	AHU Hot Deck Pressure, High Alarm	NO	“Point Name”.Alarm	Blank	Analog Alarm	NO	60	TRUE	550 Pa	N/U	Blank	25 Pa	N/U	N/U	120 Seconds	FALSE	100	FALSE	N/A	FALSE	200	AHU Hot Deck High Pressure Alarm	Alarm to be Suppressed when Unit is Off
HD-P	AHU Hot Deck Pressure, High Alarm	YES	“Point Name”.Alarm	Blank	Analog Alarm	YES	60	TRUE	550 Pa	N/U	Blank	25 Pa	N/U	N/U	120 Seconds	FALSE	151	FALSE	N/A	FALSE	200	AHU Hot Deck High Pressure Alarm	Alarm to be Suppressed when Unit is Off
CD-P	AHU Cold Deck Pressure, High Alarm	NO	“Point Name”.Alarm	Blank	Analog Alarm	NO	60	TRUE	550 Pa	N/U	Blank	25 Pa	N/U	N/U	120 Seconds	FALSE	100	FALSE	N/A	FALSE	200	AHU Cold Deck High Pressure Alarm	Alarm to be Suppressed when Unit is Off
CD-P	AHU Cold Deck Pressure, High Alarm	YES	“Point Name”.Alarm	Blank	Analog Alarm	YES	60	TRUE	550 Pa	N/U	Blank	25 Pa	N/U	N/U	120 Seconds	FALSE	151	FALSE	N/A	FALSE	200	AHU Cold Deck High Pressure Alarm	Alarm to be Suppressed when Unit is Off
RA-CO2	Return Air Carbon Dioxide, with Setpoint Target	NO	“Point Name”.Alarm	Blank	Analog Alarm	NO	1800	TRUE	N/U	N/U	RACO2-SPT	100 ppm	200 ppm	1000 ppm	300 Seconds	FALSE	100	TRUE	120	FALSE	200	Return Air Carbon Dioxide Alarm	
RA-CO2	Return Air Carbon Dioxide, with Setpoint Target	YES	“Point Name”.Alarm	Blank	Analog Alarm	YES	600	TRUE	N/U	N/U	RACO2-SPT	100 ppm	200 ppm	1000 ppm	300 Seconds	TRUE	151	TRUE	151	TRUE	200	Return Air Carbon Dioxide Alarm	
*-T	Process Temperature, with Setpoint Reference	NO	“Point Name”.Alarm	Blank	Analog Alarm	NO	1800	TRUE	N/U	N/U	*T-SPT	2	User Defined	User Defined	120 Seconds	FALSE	100	FALSE	127	FALSE	200	Temperature Alarm	
*-T	Process Temperature, with Setpoint Reference	YES	“Point Name”.Alarm	Blank	Analog Alarm	YES	600	TRUE	N/U	N/U	*T-SPT	2	User Defined	User Defined	120 Seconds	TRUE	151	TRUE	151	TRUE	200	Temperature Alarm	
*SYS-RESET-REQ	System Reset Request	NO	“Point Name”.Alarm	Blank	Multistate Alarm	YES	10	TRUE	N/U	N/U	N/U	N/U	N/U	N/U	N/U	FALSE	100	N/A	N/A	FALSE	200	"System Reset Required"	
*SYS-RESET-REQ	System Reset Request	YES	“Point Name”.Alarm	Blank	Multistate Alarm	YES	10	TRUE	N/U	N/U	N/U	N/U	N/U	N/U	N/U	TRUE	151	N/A	N/A	TRUE	200	"System Reset Required"	
LEAK DETECTION	Leak Detection Alarm - Binary Input	YES	“Point Name”.Alarm	Blank	Multistate Alarm	YES	10	TRUE	N/U	N/U	N/U	N/U	N/U	N/U	N/U	TRUE	151	N/A	N/A	TRUE	200	Leak Detection Alarm	

Appendix – B – User Interface Performance Specification

The following content shall be used/replace all other content in MNS Section 25 10 02 EMCS: Operation Work Station (OWS), Part 1, 2.6 OWS Control Software:

> "Shall be Johnson Controls Metasys Revision 12 with MUI, or higher."

Appendix – C –Metasys Metering Standard

Metasys Metering Standard

OCTOBER 2016 REV1.0

DALHOUSIE UNIVERSITY
Inspiring Minds

Author(s):

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Table of Contents

1.0 Units of Measurement

Meters that are tracking the same utility in separate buildings must use the identical units of measurement to provide comparable data within the utility.

Below is list of utility meter types with compulsory units;

Electricity	Kilowatts	(kW)
	Kilowatt hours	(kWh)
Water	Litres/Min	(l/M)
Condensate	Gallons/Min	(GPM)
Chilled Water	Kilowatts	(kW)
	Kilowatt hours	(kWh)
Hot Fluid (Water, Glycol/Water)	Kilowatt	(kW)
	Kilowatt hours	(kWh)
Steam	Lbs/hour	(lb/hr)
Solar Thermal (air or Water)	Kilowatt hours	(kWh)

2.0 Metasys Set-Up

Each utility meter will require a trend (of its flow rate), totalization and a trend of the totalization to be created. This allows the user to capture data for trend analysis on a short-term basis and capture usage over longer periods of time.

Background:

Analog Totalization and how it makes its calculation.

The Analog Totalization object integrates analog attribute values over time, records the usage of any consumable monitored by an analog Input Reference attribute. Some examples of consumables are electricity, steam, and chilled water. The formula used in generating an analog totalization value is:

Present Value (New) = Present Value (Old) + [(Input Reference value x Period) / (TimeFactor x ScaleFactor)]

The equation has two variables that are related to time; Time Factor and Period.

where: TimeFactor	= 1	for TimeBase of seconds
	= 60	for TimeBase of minutes
	= 3600	for TimeBase of hours

(Example: If Input Reference value is in units of gallons per minute, the TimeBase is minutes and Time Factor is 60.)

And: Period (or Update Interval in CCT for the FECs) should be set to 1 second (100/100ths) for Utility Meters (Under Hardware Setup, change Filter Setup to Custom, and Process ID to Other in order to modify the Update Interval). In this manner the above calculation will run every second. Note that although this occurs, a user will not be able to see this progression from the User Interface as it does not update at this same frequency from the NAE.

As an example:

Present Value (old) to be 200 gallons

Input Reference value to be 20 gallons/min

Period (Update Interval) is one second (1 second), as set up in the field controller

TimeFactor to be 60 (Just set to Timebase to Minutes in the Totalization Extension as timefactor is a reference name for an internal calculation)

ScaleFactor to be 1

Then Present Value (New) = 200 + (20 gal/min x 60 seconds) / (60 seconds/minute x 1) = 200.3333 gallons

Field Controller Analog Input Point for Utility Meters:

The controller's Update Interval for any Utility Meter Input Point should be one second to assure high accuracy.

Trend:

Buffer Size	This parameter deals with the amount of local storage that is kept on the local supervisory controller engine through which the object is passed to the Metasys system. In long-term trending, it's important to strike a balance between the local controller buffer size and the interval of data transfer between the controller and the Metasys server.	100
Sample Interval	This parameter deals with the interval of recording for a trend (in seconds), it is highly recommended to keep this interval as high as possible (long an interval) to keep the number of samples recorded per hour across the whole Metasys system as low as it can be while still gathering meaningful data. If this value is set to 0, the trend will default to recording on a Change of Value.	0
Client COV Increment	If the value of interest changes by this set amount, then a trend will record. Like the sample interval, be careful about the size of the COV increment, as this can quickly result in a comparatively high frequency trend.	As per Trending Standard
Repository Enabled	This parameter will allow for historical (indefinite) storage, by uploading the local engine's trend storage to the central ADX server historical database. There is a limit to the total number of data samples transferred to the ADX server per hour, so be mindful if tis historical repository is a must have, or a nice to have.	enable
Transfer Set Point	This parameter relates to an initiation of the Engine's upload to the ADX server. Once the trend buffer reaches this defined value, a request is made at the ADX to download the Engine's local trend buffer in a batch. The ability for the ADX to keep on top of all the Engines' requests for upload is based on network latency, so it is recommended to keep this value at 80-90% of the local buffer size, and to ensure that the sample interval is kept long. Low sample intervals, low COV increments, small buffer sizes and small transfer set points can Tax the Metasys network, which could lead to performance issues or connections lost. High sample intervals, high COV increments, reasonable buffer sizes and reasonable transfer set points are the best approach to long term trending. A balance must be struck between the number of samples stored locally (on Engine memory, which is finite) and the number of data transfers (where network latency comes into play).	5

Totalization:

The totalization parameters should always be set up in metasys as per below.

- Enabled: true
- Time base: to match the identified units of measure within this standard..
- Scale factor:1
- Totalize Limit: 0
- Low cut off value: 0
- Rollover: false

Electrical meters on Campus shall have the totalized consumption provided from the field device and integrated into Metasys

Totalization Trending:

Totalization trends should be time based and 5400 sec (or 90 min) as Metasys has a limitation of only able to display 6000 data points in a trend long and there are those at the university who want to see a whole year's worth of data.

3.0 Meter Labelling

To ensure all meter trends and totalization extensions are identifiable, all meters will be labelled as indicated below. This enables easy transfer from Metasys to other platforms.

Within the focus tab of the device within Metasys, provide the following information:

Name

All metering devices shall follow the below naming convention.

- **BldgID/ System served/Abbreviation**
  - **Bldg ID: Dalhousie unique building identifier number.**
    - Obtain the Building ID from the University's Project Manager. In the case of a "Multiple" meter the Building ID will the building in which the meter is located.

- **<u>System Served (Main descriptor of metering purpose)</u>**
  - Multiple Steam Meter (used to identify a Steam Meter for Multiple facilities)
    - MSM
  - Primary Steam meter(Used to identify main Steam meter for a facility)
    - PSM
    - Note this may be a virtual or calculated meter based on a MSM minus a PSM or another MSM. Example; PSM(Tupper) = MSM(Tupper Tunnel) – MSM(Sexton DPS – PSM (LSRI)
  - Steam Sub Meter(Used whenever a meter is downstream of a primary)
    - SSM
  - Multiple Condensate Meter (Used to identify condensate return from Multiple facilities)
    - MCM
  - Primary Condensate Meter (Used to identify main condensate return from facility)_
    - PCM
    - Note this may be a virtual or calculated meter based on a MCM minus a PCM or another MCM. Example; PCM(LSC) = PCM(Biology) + PCM(Ocean) – PCM (DOS)
  - Secondary Condensate meter (used to identify a secondary consumption of steam within a facility).
    - SCM
  - Main Electrical Meter (Used to identify primary meter for facility)
    - MEM
  - Electrical Sub Meter (Used in a facility when a meter is located downstream of a primary meter.
    - ESM
  - Multiple Domestic Water (Used to identify a water meter for Multiple facilities)
    - MDW
  - Primary Domestic water (Used to identify primary meter for facility)
    - PDW
    - Note this may be a virtual or calculated meter based on a MDW minus a PDW or another MDW. Example; PDW(LSC) = MSM(LSC Ocean) – PDW(DOS)

        - Secondary Domestic water (Used in a facility when a meter is located downstream of a primary meter).
            - SDW
        - Primary Chilled water(Used to identify primary meter for facility)
            - PCHW
        - Secondary Chilled Water (Used in a facility when a meter is located downstream of a primary meter).
            - SCHW
        - Solar Thermal Air
            - STA
        - Solar Thermal Water
            - STW
        - Hot Fluids
            - Water
                - HFW
            - Glycol
                - HFG
    - **Abbreviation (Acronym of system served- Acronym of Unit of Measure)**

        - Below are several examples of the abbreviations to be inserted in the field
            - PSM-LBHR (Primary Steam meter-Pounds per hour)
            - ESM-KWH (Electrical Sub Meter- Kilowatt hours)
            - STA-KWH (Solar Thermal air- Kilowatt Hours)

- **<u>Sample Naming conventions</u>**
    - F200- PRIMARY ELECTRICAL METER-MEM/KWH
        - Would Represent the Tupper building main electrical meter measure in KWH

Item reference

- The all item references field within the engineering values on the focus tab shall ensure the abbreviation used in the naming convention is populated within.

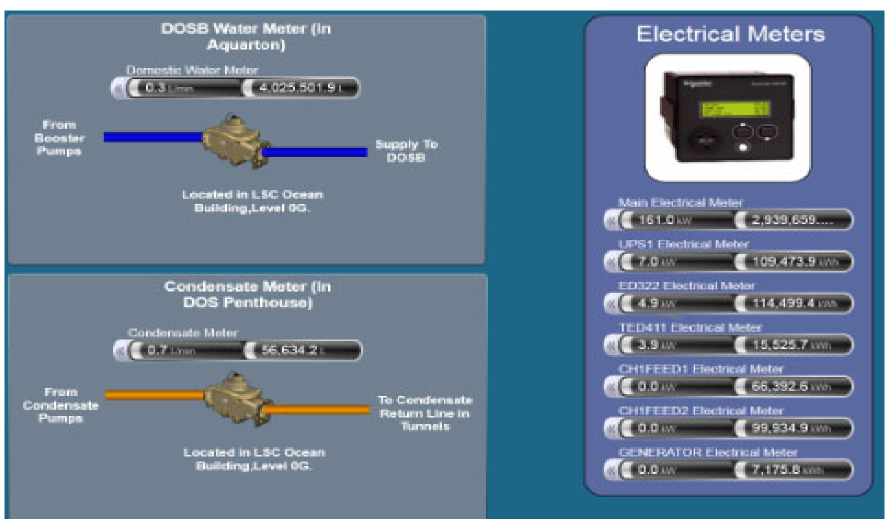
4.0 Documentation requirements

- With all new meter installations, there is a necessity to update the master metering spreadsheet (stored on O:\Facilities\Shared\Office of Sustainability\Energy Management Information Systems), with all the necessary information as identified within the spreadsheet.

5.0 Graphics and user views

- All metering installations shall be captured under the DAL_UNIV tab under the meters folder. Each device shall be allocated to the applicable folder within. The device format shall be consistent with the below examples.
- All metering devices shall be represented as a functional graphic link on the main page for the facility under “misc systems”.

  - For consistency purposes the below sample graphics is being provided, which are to be considered the standard of acceptance. All graphics submittals shall be reviewed by Dalhousie operations prior to being finalized.



- The below screen shot represents the hierarchy tree within Metasys. All new meters shall reside with the applicable folder in the tree identified below.