25 0520 Building Automation System (BAS) Design Criteria

1. Design Statement

    a. During the various design phases of this project, the Engineer will develop options and strategies for selection of the appropriate Building Automation System (BAS). This approach will enable the entire Design Team (Owner, Architect and Engineer) to partake in the decision making process concerning the selection of the BAS infrastructure.

    b. BAS additions or modifications shall have the following characteristics:

        i. Vendor products shall be able to integrate to Siemens Building Technologies Desigo CC software. Vetted Products:

            1. Siemens Controls Devices
            2. Distech Controls Devices
            3. AccuSpec Controls Devices
            4. Antec Controls Devices
            5. Phoenix Controls Devices

        ii. BACnet shall be the preferred communication protocol, every effort will be made to be on the IP network.

        iii. Flexibility for future changes and expansion.

        iv. Ease of maintenance.

        v. Robust design.

        vi. Cost Effectiveness

    c. BAS Commissioning:

        i. The Design Team shall provide fully integrated design documents to ensure all required Contractors are fully responsible for supporting the Commissioning activities for the proposed systems to be commissioned. All required labor hours and materials shall be included for, at a minimum but not limited to meetings, supporting documentation, field testing activities, ancillary testing equipment, off-season testing, data storage, support for 12 month warranty verification (if required), etc.

ii. The Design Team shall work with the project Commissioning Agent to incorporate all of their testing requirements into the contract specifications.

iii. 100% of Terminal devices should be commissioned

d. Every effort will be made to design, layout and install equipment and panels in locations to allow for routine preventive maintenance by providing easy access for maintenance personnel.

2. Engineers Control Drawings

a. Drawings

i. HMS Facilities to be included in Contractor scope review

ii. Unique flow diagrams with points list and sequence of operation on the drawings.

iii. HMS Facilities should approve before Construction Documents are issued

b. Point Lists

i. Point lists shall provide indication of the following:

1. Point type (AI, AO, BI, BO)

2. Tag name and description

3. Alarming requirements

4. Point naming conventions

ii. Point naming specs in section 9 of this document

c. Sequence of Operation shall be included on the drawings with the associated flow diagram.

3. Energy:

a. All Projects shall include Mapping of BMS Point to Clockworks fault detection software.

b. USGBC/LEED Criteria: Gold certifiable

c. Refer to Harvard Green Building Standard Sus, building standard

4. Codes, Standards and References

a. Massachusetts State Building Code

b. Massachusetts Electrical Code

c. National Fire Protection Association (NFPA)

i. NFPA 70 National Electrical Code

ii. NFPA 72 National Fire Alarm Code

iii. NFPA 101 Life Safety Code

d. Underwriters Laboratories (UL)

e. Factory Mutual (FM)

f. Occupational Safety and Health Administration (OSHA)

g. Environmental Protection Agency (EPA)

h. Massachusetts Department of Environmental Protection (DEP)

i. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

i. ASHRAE Guideline 36 High-Performance Sequences of Operation for HVAC Systems.

j. American National Standards Institute (ANSI)

k. Guide for The Care and Use of Laboratory Animals

5. Contractor Submittal Requirements

a. Bookmarked pdf format.

b. Specification Compliance Statement

c. Network Riser

d. Flow Diagrams

e. Sequence of Operation

f. Bill of Material (BOM)

g. Graphics

h. Electrical Load Calculations

i. Panel layouts

j. Wiring diagrams

k. Load shedding programs (Included in SOO)

l. Campus HVAC Isolation Program. (Included in SOO)

m. Morning Warm Up & Cool Down (Included in SOO)

n. Decommissioning plan for existing area to be renovated. This shall include at a minimum for approval prior to any demolition work starting: (removing deleted points/devices from programs, decommissioning Alarming)

i. Systems to be decommissioned.

ii. Communication pathways that will be interrupted shall be shown on floor plan drawings with device addresses that will be removed.

iii. Temporary communication pathways on floor plan drawings that will be required to maintain existing systems during the renovation process.

iv. Alarm list showing alarms that will need to be disabled.

v. Printouts of software code that will need to be removed.

vi. Provide report of any removed points or programming

6. Record Drawings (As-builts)

a. All items from Contractor Submittal Requirements shall be updated to final installation condition.

b. Complete alarm summary for project. (Attach critical Alarm Testing Form)

c. Controls Checkout Form

d. Listing of all BACnet addresses for project.

7. Electrical Low Voltage Wiring

a. Division 26 shall be referenced for installation requirements

b. CAT 6 Cabling for all newly installed BACNet IP devices, Conduit in Mechanical/Electrical rooms and shafts.

c. Above ceiling/in-wall

i. Animal Facility spaces

1. In wall conduit.

2. Above ceiling plenum cable provided wiring is accessible.

ii. Laboratory spaces

1. In wall plenum cable.

2. Above ceiling plenum cable provided wiring is accessible.

iii. Office/Public spaces

1. In wall plenum cable.

2. Above ceiling plenum cable provided wiring is accessible.

d. Equipment monitoring for Ultra low temp -80 freezer alarming

1. Freezer alarms should be normally closed contacts, (Open generates alarm)

ii. New wiring will include a plug type receptacle with a detachable 6' heavy duty cord that connects from the receptacle to the freezer. All in wall wiring shall terminate in a junction box and use a female receptacle plate housing.
1. Woodhead Brand BradConnectivity 1300160337 or equivalent
2. Woodhead Brand BradConnectivity 13000900463 or equivalent

8. BAS Architecture

a. Compatible with Siemens Building Technologies Desigo CC software

b. Basis of design: ASHRAE's BACnet standard

c. Controller Architecture

i. Major Mechanical Equipment (Large AHU's\EAHU's, Chiller Plants, Boiler Plants) shall be IP based controller with direct input/output capability. The controllers shall be tested and listed by the BACnet Testing Laboratory (BTL) as BACnet Building Controllers (B-BC).

ii. Small AHU's and Terminal Units shall be IP (Ethernet) based where available. Where IP is not available, MS/TP based controllers shall be provided. The controllers shall be tested and certified by the BACnet Testing Laboratory (BTL) as BACnet Advanced Application Controllers (B-AAC) or as BACnet Application Specific Controllers (B-ASC), depending on the control application.

iii. No new BACnet devices shall be configured as a BACnet Broadcast Management Device (BBMD). Each building has a BBMD already configured and this shall be utilized.

1. See HMS Facilities SharePoint Site BAS Admin Manual for BBMD Table

9. Point naming convention

a. Points shall be named with the following convention:

i. "Building Letter. Asset. Room (as needed). End Device"

ii. "Building Letter.-Asset. End Device"

iii. Examples:

Q.AHU-001.CCV Q.HAC0001.CCV	WAB Air Handler 1 Cooling Coil Valve
Q.HX-003.SP Q.HX3.SETPOINT	WAB Heat Exchanger 3 Set Point
Q.316A.FRZ.ALM Q.336.FRZ.ALM	WAB 316a Freezer Alarm WAB 336 Freezer Alarm
Q.205.COLDRM.ALM Q.506.COLDRM.ALM	WAB 205 Cold Room Alarm WAB 506 Cold Room Alarm
Q.205.COLDRM.TEMP Q.506.COLDRM.TEMP	WAB 205 Cold Room Temp WAB 506 Cold Room Temp

b. Terminal unit points will be named with the following convention preceded by the building letter:
   i. For example: "K.AH1.317.VAV2.S"
      1. Serving Air Handler be indicated by A or AH and common number (i.e. AH2, AHU2 or A12).
      2. Room number
      3. Valid Device Types:
         a. FCU – Fan Coil Unit
         b. VAV – Variable Volume Box
         c. RPC – Room Pressurization Controller

d. FHC - Fume Hood Control
e. RAD – Radiation Valve
f. Function should be indicated by:
g. S - Supply
h. R - Return / Exhaust

4. V – Valve
    a. HWV
    b. CWV
    c. RHC
    d. HHV, etc.

5. Where there are two or more of the same devices serving the same space, a number should be indicated after device type (i.e., VAV1, VAV2, etc.)
6. Add descriptor for all floor level equipment to include CMMS Asset number.

10. Points

a. Air Handling Units

i. All units with outside air connections shall have a low temperature detector (freeze-stat). (Manual reset on safeties)

ii. All units shall have a temperature Averaging sensor element after each coil.

iii. All fans shall have proof via an analog current sensor.

iv. All filters shall have proof via an analog pressure sensor.

v. All units shall have a discharge air temperature and humidity sensor.

vi. Each individual fan shall have an air flow station.

vii. Each unit shall have a discharge static pressure sensor.

1. Graphic shall be labeled with location of sensor or other critical control sensors/devices

viii. Each unit shall have a discharge duct smoke detector. (Only units over 2500 cfm) (Manual reset on safeties)

25 5000 Instrumentation and Terminal Devices

1. Sensors and Transmitters

a. Preferred Vendors: Omega, ACI, Vaisala Setra, Bapi, Kele, Belimo

2. Actuators and Operators
    a. Preferred Vendors: Belimo, Siemens, Bray
3. Valves and Dampers
    a. In critical or limited access spaces, Belimo valves shall be utilized.
    b. All valves larger than 2 inches shall be provided with position feedback.
4. Meters
    a. Refer to the HVAC section for Meters.
5. Uninterruptible Power Supplies
    a. To be Installed at all BAS panel locations
    b. Uninterruptible Power Supplies (UPS) shall be listed for Emergency Generator duty and not standard battery backup type. (UPS to provide feedback contact)
    c. UPSs should be equipped with a set of Alarm contacts wired to the BMS panel with BMS alarm built for monitoring.

25 9000 – Sequence of Operation

1. Setpoints for new construction and renovation to match most recent energy code
    a. Existing temperature parameters and sequences in adjacent areas to remain as is, unless otherwise directed.
        i. Refer to HMS BAS Master Database to confirm any Temperature and Humidity Requirements

Room Type	Set Points (OCC/UNOCC)	Temp Set Back Control Method	Air Changes per Hour (Occ/Unocc)
Toilet Rooms	Heating - 70F/ -5F Cooling - 75F/ +10F	Setback for fan only, no temp set back	Refer to latest ASHRAE or IECC code for ventilation
Closed Stairways	Heating - 65F, Cooling - 76F	None	Refer to latest ASHRAE or IECC code for ventilation
Open Stair / Main Corridors	Heating - 70F, Cooling - 75F	None	Refer to latest ASHRAE or IECC code for ventilation
Storage Rooms	Heating -65F, Cooling - 78F	None	Refer to latest ASHRAE or IECC code for ventilation

Room Type	Set Points (OCC/UNOCC)	Temp Set Back Control Method	Air Changes per Hour (Occ/Unocc)
Open Office / Reception	Heating - 70F/ -5F Cooling - 75F/ +10F	Motion	Refer to latest ASHRAE or IECC code for ventilation
Closed Offices	Heating - 70F/ -5F Cooling - 75F/ +10F	Motion	Refer to latest ASHRAE or IECC code for ventilation
Conference Rooms / Break Rooms	Heating - 70F/ -5F Cooling - 75F/ +10F	Motion	Refer to latest ASHRAE or IECC code for ventilation
Classrooms	Heating - 70F/ -5F Cooling - 75F/ +10F	Motion	Refer to latest ASHRAE or IECC code for ventilation
TMEC or Student Classrooms	Heating – 69-71F Cooling - 73-78F w/ slide control. 5F deadband required	Motion	Refer to latest ASHRAE or IECC code for ventilation
Commonly Shared spaces	Heating - 70F/ -5F Cooling - 75F/ +10F	Motion	Refer to latest ASHRAE or IECC code for ventilation
Countway Library General Stack Areas	Heating - 70F/ -5F Cooling - 75F/ +10F	Schedule	Refer to latest ASHRAE or IECC code for ventilation
Countway Rare Books	No set back, No change to existing set points. 68F	No set back, No change to existing set points.	Refer to latest ASHRAE or IECC code for ventilation
General Research Labs	Heating – 70F/67F, Cooling - 73/78F	Motion	6/4
All Temperature or Humidity Sensitive Areas - Exempt Research Labs, etc.	No set back, No change to existing set points.	No set back, No change to existing set points.	6/4
All Light Sensitive Areas - Dark Rms, etc.	Heating - 70F/ -5F Cooling - 75F/ +10F	Confirm with HMS Facilities	6/4
Animal Holding Rooms	No set back, No change to existing set points.	No set back, No change to existing set points.	8ACH Minimum Confirm with HMS Facilities
Dormitory Rooms	Heating – 69-74F Cooling - 73F-78F w/slide control. 5F deadband required	None	Refer to latest ASHRAE or IECC code for ventilation

Room Type	Set Points (OCC/UNOCC)	Temp Set Back Control Method	Air Changes per Hour (Occ/Unocc)
Gymnasium	Heating – 70F/67F, Cooling - 73/78F	Schedule	Refer to latest ASHRAE or IECC code for ventilation
Squash Courts	Heating – 70F/67F, Cooling - 73/78F	Schedule	Refer to latest ASHRAE or IECC code for ventilation
Exercise / Weight Rooms	Heating – 70F/67F, Cooling - 73/78F	Schedule	Refer to latest ASHRAE or IECC code for ventilation
Locker Rooms	Heating – 70F/67F, Cooling - 73/78F	Schedule	Refer to latest ASHRAE or IECC code for ventilation
Music Rooms	Heating – 70F/67F, Cooling - 75F/79F	Schedule	Refer to latest ASHRAE or IECC code for ventilation
Worship Rooms	Heating - 70F/ -5F Cooling - 75F/ +10F	Schedule	Refer to latest ASHRAE or IECC code for ventilation
HSDM Clinical Space	Heating - 70F/ -5F Cooling - 75F/ +10F	Schedule	6/4
Vanderbilt Clinical Space	Heating - 70F/ -5F Cooling - 75F/ +10F	Schedule	6/4
Elevators	N/A	N/A	N/A
Amphitheatre/Auditorium	Heating - 70F/ -5F Cooling - 75F/ +10F	SET ROOM	Refer to latest ASHRAE or IECC code for ventilation
Mechanical Space	Heating 65F Cooling 85F	N/A	Refer to latest ASHRAE or IECC code for ventilation
Equipment Space	TBD	TBD	Refer to latest ASHRAE or IECC code for ventilation
Kitchens	Heating - 70F/ -5F Cooling - 75F/ +10F	Motion	Refer to latest ASHRAE or IECC code for ventilation
Kitchenettes	Heating - 70F/ -5F Cooling - 75F/ +10F	Motion	Refer to latest ASHRAE or IECC code for ventilation
Dining Rooms	Heating - 70F/ -5F Cooling - 75F/ +10F	Schedule	Refer to latest ASHRAE or IECC code for ventilation

Room Type	Set Points (OCC/UNOCC)	Temp Set Back Control Method	Air Changes per Hour (Occ/Unocc)
Garages	N/A	N/A	CO/NO2 Sensors

1. General Requirements and Sequences
    a. Air Handling Units
        i. Static Pressure Reset routine is required.
        ii. Discharge Air Temperature Reset routine is required.
        iii. Campus HVAC Isolation Program:
            1. All controls for new ventilation fans supplying or exhausting air from buildings will be programmed to shut down during initiation of the campus wide Ventilation Emergency Isolation Program. HMS has a current Isolation program, and new ventilation equipment will need to be added to the sequence.
        iv. Load Shedding:
            1. Unless designated as specialty/exempt, all new / modified areas shall require a modification to the load control / load shedding program as directed by Facilities, confirmed by E&C. These spaces shall also have load shedding tested during commissioning.
    b. Central Plants
        i. Supply Temperature Reset
    c. Terminal Units
        i. Occupancy Sensors
            1. If no motion is detected during a 30-minute (adj.) duration, the setpoint shall index to the unoccupied setpoints
            2. Recommend reducing air change rates and not temperature setpoints. Based on space air change rates, it can take a long duration of time to get back to setpoint.
        ii. Load Shedding

1. Unless designated as specialty/exempt, all new / modified areas shall require a modification to the load control / load shedding program as directed by Facilities, confirmed by E&C. These spaces shall also have load shedding tested during commissioning.

2. When load shed is enabled, all terminal units listed for load shed shall index to the cooling mode. The Load Shed setpoint and the terminal unit setpoint shall be compared with the Max being set to the terminal unit active cooling setpoint.

iii. Morning Warm Up & Cool Down

1. Morning warm up and cooldown modes shall be put in place, Timing, setpoints, and sequence shall be discussed and agreed upon with Facilities Management.

iv. VAV boxes

1. CO2 Reset routine as required per energy code

2. Discharge air temperature maximum setpoint shall be 15 Deg F above the room temperature setpoint.

3. VAV boxes should include DAT sensors with reading so on BMS

v. Fan Coil Units

1. Fans shall cycle during occupied and unoccupied hours until required based on occupied and unoccupied temperature setpoints. For EC motors they shall be at minimum speed during deadband and modulate when required for heating and cooling.

2. Ceiling hung units shall have liquid high level sensor to close chilled water valve and generate an alarm.

3. FCU's boxes should include DAT sensors with reading so on BMS

vi. Radiant Panels

1. Recommend not enabling until below 45 Deg F outside air temperature for control.

2. Recommend on/off control based on low btu/ft output.

d. Smoke Control

i. Smoke control functions should be initiated by the Fire Alarm System.

1. All efforts shall be made to allow for the fire alarm system to directly control smoke evac fans.

2. To be verified during commissioning