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Minor change to correct format problem or typographical errors
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Revision Log Entry Required

Description of Change: Add a new document describing the sequences of operation necessary to accomplish the HVAC functions of the Enterprise Utility Management System (EUMS).

This document was added for the following reasons:

1. To develop and document the integration of EUMS goals with the Building Automation System, including:
 - a. Generate revenue by shifting electrical grid loads from high cost times to lower cost times.
 - b. Minimize adverse effects on each utility's supply system caused by excessive load increases over short periods.
 - c. Create a system that will enable quick load shedding on each utility in the event of a utility supply failure to minimize adverse affects in critical research areas.
2. To develop and document the execution of this integration.

Copy of changes sent via email also
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SEQUENCE OF OPERATION GUIDELINE

Enterprise Utility Management System (EUMS) Equipment Control Strategies

Document: EUMS Eqmt Cntrl Strategies rev0 2009-06-08
Revision: 0
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EUMS System Overview:

The "Enterprise Utility Management System" at Penn State University is a hardware and software system that incorporates pieces of all the disparate building automation systems, utility monitoring and controls systems along with energy analysis and billing systems. Several functions of this system require control of individual pieces of HVAC equipment within the University's facilities. This document is intended to describe the sequences of operation necessary to accomplish the HVAC functions of the EUMS System.

The primary goals of these HVAC functions are to 1. Generate revenue by shifting electrical grid loads from high cost times to lower cost times, 2. Minimize adverse effects on each utility's supply system caused by excessive load increases over short periods, and 3. Create a system that will enable quick load shedding on each utility in the event of a utility supply failure to minimize adverse affects in critical research areas.

In the EUMS system, the Iron server is the supervisory device that passes commands to Johnson Controls Metasys Network Automation Engines via web services. The Johnson Controls Network Automation Engine then issues the commands to the individual buildings via the BACnet protocol by utilizing a combination of BACnet Analog and Binary Variables. To accomplish this, the building level controller shall have a section of programming containing master Analog and Binary Variables that receive commands from the Johnson Controls Network Automation Engine and redistributes these commands to the appropriate field level devices in the building based on the tactic number or mode. All commanded tactics and modes except sub-cooling are mutually exclusive and shall be accomplished by utilizing a simultaneously commanded pair of BACnet analog variables. The use of a pair will minimize the probability of inadvertent execution of any mode due to network communication errors. In addition, the emergency modes will require an additional BACnet binary value to ensure that the emergency demand limiting sequences only occur when commanded.

Demand Response Tactics: AV Pair values 0-18.

The Demand Response tactics are executed only in spaces where the occupant voluntarily provides permission. The equipment program will therefore require a mechanism to enable and disable these tactics from being executed.

EUMS#0: Normal Operation, Zone set points: 70 deg. Heating, 75 deg. Cooling (AV pair value = 0).

EUMS#1 Tactic: Set point shift +/- 1 deg (AV pair value = 1).

The command for EUMS#1 tactic shall be received from the Johnson Controls Metasys Network Automation Engine. The commanded analog variable pair shall be utilized in the program at the building level to shift the field level device (VAV, FNC, RHT, etc.) zone Heating and Cooling set points -1 degree and +1 degree respectively when the AVs receive a value of 1, until another command from the Itron system is received.

EUMS#2 Tactic: Set point shift +/- 2 deg (AV pair value = 2).

The same Analog Variable pair used in EUMS#1 shall be utilized in the program at the building level to shift the field level device (VAV, FNC, RHT, etc.) zone Heating and Cooling set points -2 degrees and +2 degrees respectively when the AVs receive a value of , until another command from the Itron system is received..

EUMS#3-26 Tactics: These tactics are for future use (AV pair values = 3-26).

EUMS Tactic #27 – 30 (Daily startup procedure)

These tactics are used while the building equipment is in the unoccupied mode based upon the equipment's individual schedule. The tactics' functions are to cycle the equipment through transition modes to minimize drastic load changes on the utilities due to the transition of the HVAC equipment from the unoccupied state to the occupied state.

EUMS#27 Tactic: Unoccupied mode (AV pair values = 27)

The same Analog Variable pair used in EUMS#1 shall be utilized in the program at the building level to place associated primary equipment and field devices in the unoccupied mode when the equipment's individual schedule is unoccupied. The unoccupied set points shall be 60 deg. Heating and 85 deg. Cooling.

EUMS#28 Tactic: Place all equipment in Transition Mode (AV pair value = 28).

The same Analog Variables pair used in EUMS#1 shall be utilized in the program at the building level to place associated primary equipment and field devices in the Transition mode until another command is received from the Itron system or the equipment's individual schedule reaches it's occupied time. In the Transition mode, field devices shall be set to Unoccupied mode with zone temperature set-points reset to occupied temperature set-points(70 deg. Heating, and 75 deg. Cooling). The fan or fans serving these areas shall run based on a request for heating or cooling . During this time, primary equipment such as VAV fans, etc. shall operate without ventilation air (Minimum Outside Air = 0) until the AV pair = 29. Economizer control shall be enabled when outside air enthalpy conditions are met.

EUMS#29 Tactic: Place all equipment in Occupied Mode (AV pair value = 29).

The same Analog Variable pair used in EUMS#1 shall be utilized in the program at the building level to place associated primary equipment and field devices in the Occupied mode until another

command is received from the Itron system or the equipment's individual schedule reaches its occupied time. Once the schedule meets normal occupancy start-up, AV 29 shall be ignored and the equipment will follow the normal occupancy schedule. Economizer control shall be enabled when outside air enthalpy conditions are met.

Overview: Emergency Response (AV pair values = 30-59).

Emergency Response Tactics apply to all spaces available for demand response and also apply to non-critical spaces such as general purpose classrooms, etc. depending on the severity of the emergency. There are three different types of emergency response tactics, electrical, steam, and chilled water. These tactics are designed to provide incremental reduction steps to reduce demand on a utility supply system in the advent of an emergency such as a loss of a boiler in the steam plant. Since these reductions may adversely affect normal operations in the facilities, there is an additional BACnet binary value that must be commanded along with the analog value pair for these tactics to be executed in the buildings. The emergency demand level sequences are described following the tactics and are equipment type specific.

Electrical Emergency Demand Reduction Tactics: EUMS Commands AV 30-39.

Electrical Emergency Demand Reduction Tactic 30: (AV pair values= 30).

The programming shall place all equipment that will affect electrical demand and is identified to participate in the demand response program to "Emergency Electrical Demand Level 1".

Electrical Emergency Demand Reduction Tactic 31: (AV pair values= 31).

The programming shall place all equipment that will affect electrical demand and is identified to participate in the demand response program to "Emergency Electrical Demand Level 2".

Electrical Emergency Demand Reduction Tactic 32: (AV pair values=32).

The programming shall place all equipment that will affect electrical demand and is identified to participate in the demand response program to "Emergency Electrical Demand Level 2" and program all other non-critical spaces except classrooms to "Emergency Electrical Demand Level 1".

Electrical Emergency Demand Reduction Tactic 33: (AV pair values= 33).

The programming shall place all equipment that will affect electrical demand and is identified to participate in the demand response program to "Emergency Electrical Demand Level 2" and program all other non-critical spaces except classrooms to "Emergency Electrical Demand Level 2".

Electrical Emergency Demand Reduction Tactic 34: (AV pair values= 34).

The programming shall place all equipment that will affect electrical demand and is identified to participate in the demand response program to "Emergency Electrical Demand Level 2" and program all other non-critical spaces including classrooms to "Emergency Electrical Demand Level 1".

Electrical Emergency Demand Reduction Tactic 35: (AV pair values= 35).

The programming shall place all equipment that will affect electrical demand and is identified to participate in the demand response program to "Emergency Electrical Demand Level 2" and program all other non-critical spaces including classrooms to "Emergency Electrical Demand Level 2".

Electrical Emergency Demand Reduction Tactic 36: (AV pair values= 36).

The programming shall place all equipment that will affect electrical demand and is identified to participate in the demand response program to "Emergency Electrical Demand Level 3" and program all other non-critical spaces including classrooms to "Emergency Electrical Demand Level 2".

Electrical Emergency Demand Reduction Tactic 37: (AV pair values= 37).

The programming shall place all equipment that will affect electrical demand and is identified to participate in the demand response program to "Emergency Electrical Demand Level 3" and program all other non-critical spaces including classrooms to "Emergency Electrical Demand Level 3".

Electrical Emergency Demand Reduction Tactic 38: (AV pair values= 38).

The programming shall place all equipment that will affect electrical demand and is identified to participate in the demand response program to "Emergency Electrical Demand Level 4" and program all other non-critical spaces including classrooms to "Emergency Electrical Demand Level 3".

Electrical Emergency Demand Reduction Tactic 39: (AV pair values= 39).

The programming shall place all equipment that will affect electrical demand and is identified to participate in the demand response program to "Emergency Electrical Demand Level 4" and program all other non-critical spaces including classrooms to "Emergency Electrical Demand Level 4".

Steam Emergency Demand Reduction Tactics: EUMS Commands AV 40-49.

Steam Emergency Demand Reduction Tactic 40: (AV pair values= 40).

The programming shall place all equipment that will affect Steam demand and is identified to participate in the demand response program to "Emergency Steam Demand Level 1".

Steam Emergency Demand Reduction Tactic 41: (AV pair values= 41).

The programming shall place all equipment that will affect Steam demand and is identified to participate in the demand response program to "Emergency Steam Demand Level 2".

Steam Emergency Demand Reduction Tactic 42: (AV pair values= 42).

The programming shall place all equipment that will affect Steam demand and is identified to participate in the demand response program to "Emergency Steam Demand Level 2" and program all other non-critical spaces except classrooms to "Emergency Steam Demand Level 1".

Steam Emergency Demand Reduction Tactic 43: (AV pair values= 43).

The programming shall place all equipment that will affect Steam demand and is identified to participate in the demand response program to "Emergency Steam Demand Level 2" and program all other non-critical spaces except classrooms to "Emergency Steam Demand Level 2".

Steam Emergency Demand Reduction Tactic 44: (AV pair values= 44).

The programming shall place all equipment that will affect Steam demand and is identified to participate in the demand response program to "Emergency Steam Demand Level 2" and program all other non-critical spaces including classrooms to "Emergency Steam Demand Level 1".

Steam Emergency Demand Reduction Tactic 45: (AV pair values= 45).

The programming shall place all equipment that will affect Steam demand and is identified to participate in the demand response program to "Emergency Steam Demand Level 2" and program all other non-critical spaces including classrooms to "Emergency Steam Demand Level 2".

Steam Emergency Demand Reduction Tactic 46: (AV pair values= 46).

The programming shall place all equipment that will affect Steam demand and is identified to participate in the demand response program to "Emergency Steam Demand Level 3" and program all other non-critical spaces including classrooms to "Emergency Steam Demand Level 2".

Steam Emergency Demand Reduction Tactic 47: (AV pair values= 47).

The programming shall place all equipment that will affect Steam demand and is identified to participate in the demand response program to "Emergency Steam Demand Level 3" and program all other non-critical spaces including classrooms to "Emergency Steam Demand Level 3".

Steam Emergency Demand Reduction Tactic 48: (AV pair values= 48).

The programming shall place all equipment that will affect Steam demand and is identified to participate in the demand response program to "Emergency Steam Demand Level 4" and program all other non-critical spaces including classrooms to "Emergency Steam Demand Level 3".

Steam Emergency Demand Reduction Tactic 49: (AV pair values= 49).

The programming shall place all equipment that will affect Steam demand and is identified to participate in the demand response program to "Emergency Steam Demand Level 4" and program all other non-critical spaces including classrooms to "Emergency Steam Demand Level 4".

Chilled Water Emergency Demand Reduction Tactics: EUMS Commands AV 50-59.

Chilled Water Emergency Demand Reduction Tactic 50: (AV pair values= 50).

The programming shall place all equipment that will affect Chilled Water demand and is identified to participate in the demand response program to "Emergency Chilled Water Demand Level 1".

Chilled Water Emergency Demand Reduction Tactic 51: (AV pair values= 51).

The programming shall place all equipment that will affect Chilled Water demand and is identified to participate in the demand response program to "Emergency Chilled Water Demand Level 2".

Chilled Water Emergency Demand Reduction Tactic 52: (AV pair values= 52).

The programming shall place all equipment that will affect Chilled Water demand and is identified to participate in the demand response program to "Emergency Chilled Water Demand Level 2" and program all other non-critical spaces except classrooms to "Emergency Chilled Water Demand Level 1".

Chilled Water Emergency Demand Reduction Tactic 53: (AV pair values= 53).

The programming shall place all equipment that will affect Chilled Water demand and is identified to participate in the demand response program to "Emergency Chilled Water Demand Level 2" and program all other non-critical spaces except classrooms to "Emergency Chilled Water Demand Level 2".

Chilled Water Emergency Demand Reduction Tactic 54: (AV pair values= 54).

The programming shall place all equipment that will affect Chilled Water demand and is identified to participate in the demand response program to "Emergency Chilled Water Demand Level 2" and program all other non-critical spaces including classrooms to "Emergency Chilled Water Demand Level 1".

Chilled Water Emergency Demand Reduction Tactic 55: (AV pair values= 55).

The programming shall place all equipment that will affect Chilled Water demand and is identified to participate in the demand response program to "Emergency Chilled Water Demand Level 2" and program all other non-critical spaces including classrooms to "Emergency Chilled Water Demand Level 2".

Chilled Water Emergency Demand Reduction Tactic 56: (AV pair values= 56).

The programming shall place all equipment that will affect Chilled Water demand and is identified to participate in the demand response program to "Emergency Chilled Water Demand Level 3" and program all other non-critical spaces including classrooms to "Emergency Chilled Water Demand Level 2".

Chilled Water Emergency Demand Reduction Tactic 57: (AV pair values= 57).

The programming shall place all equipment that will affect Chilled Water demand and is identified to participate in the demand response program to "Emergency Chilled Water Demand Level 3" and program all other non-critical spaces including classrooms to "Emergency Chilled Water Demand Level 3".

Chilled Water Emergency Demand Reduction Tactic 58: (AV pair values= 58).

The programming shall place all equipment that will affect Chilled Water demand and is identified to participate in the demand response program to "Emergency Chilled Water Demand Level 4" and program all other non-critical spaces including classrooms to "Emergency Chilled Water Demand Level 3".

Chilled Water Emergency Demand Reduction Tactic 59: (AV pair values= 59).

The programming shall place all equipment that will affect Chilled Water demand and is identified to participate in the demand response program to "Emergency Chilled Water Demand Level 4" and program all other non-critical spaces including classrooms to "Emergency Chilled Water Demand Level 4".

Emergency Demand Levels

Equipment guidelines

1. VAV air handling system.
 - a. VAV air handler emergency steam strategies for air handler with no face and bypass dampers.
 - i. Emergency Steam Demand Level 1 – Normal operation
 - ii. Emergency Steam Demand Level 2 –Close outdoor air damper in occupied mode. Note: If exhaust fan is associated, turn it off if appropriate.
 - iii. Emergency Steam Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Steam Demand Level 4 - Place unit in unoccupied mode of operation.
 - b. VAV air handler emergency steam strategies for air handler with face and bypass dampers.
 - i. Emergency Steam Demand Level 1 – Normal operation
 - ii. Emergency Steam Demand Level 2 –Close outdoor air damper in occupied mode. Open air stream to full face damper and modulate heat valve to maintain set-point (Note: not dependent on outdoor air temperature). Note: If exhaust fan is associated, turn it off if appropriate.
 - iii. Emergency Steam Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Steam Demand Level 4 - Place unit in unoccupied mode of operation.
 - c. VAV air handler emergency electrical strategies
 - i. Emergency Electrical Demand Level 1 – Normal operation
 - ii. Emergency Electrical Demand Level 2 – Normal operation
 - iii. Emergency Electrical Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Electrical Demand Level 4 - Place unit in unoccupied mode of operation.
 - d. VAV air handler emergency chilled water strategies
 - i. Emergency Chilled Water Demand Level 1 – Normal operation
 - ii. Emergency Chilled Water Demand Level 2 – Normal operation
 - iii. Emergency Chilled Water Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Chilled Water Demand Level 4 - Place unit in unoccupied mode of operation.
 - e. VAV terminal units emergency steam strategies
 - i. Emergency Steam Demand Level 1 – Decrease room Heating set-point by 2 degrees (Adjustable).
 - ii. Emergency Steam Demand Level 2 – Decrease room Heating set-point by 4 degrees (Adjustable).
 - iii. Emergency Steam Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Steam Demand Level 4 - Place unit in holiday mode of operation. Zone setpoints will be shifted +/- 20 deg. from Standard zone occupied setpoints.
 - f. VAV terminal units emergency electrical strategies
 - i. Emergency Electrical Demand Level 1 – Increase room Cooling set-point by 2 degrees (Adjustable).
 - ii. Emergency Electrical Demand Level 2 – Increase room Cooling set-point by 4 degrees (Adjustable).
 - iii. Emergency Electrical Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Electrical Demand Level 4 - Place unit in holiday mode of operation. Zone setpoints will be shifted +/- 20 deg. from Standard zone occupied setpoints.
 - g. VAV terminal units emergency chilled water strategies
 - i. Emergency Chilled Water Demand Level 1 – Increase room Cooling set-point by 2 degrees (Adjustable).
 - ii. Emergency Chilled Water Demand Level 2 – Increase room Cooling set-point by 4 degrees (Adjustable).
 - iii. Emergency Chilled Water Demand Level 3 – Place unit in unoccupied mode of operation.

- iv. Emergency Chilled Water Demand Level 4 - Place unit in holiday mode of operation. Zone setpoints will be shifted +/- 20 deg. from Standard zone occupied setpoints.

2. Fan coil units with no outdoor air
 - a. Fan coil emergency steam strategies
 - i. Emergency Steam Demand Level 1 – Decrease room Heating set-point by 2 degrees (Adjustable).
 - ii. Emergency Steam Demand Level 2 – Decrease room Heating set-point by 4 degrees (Adjustable).
 - iii. Emergency Steam Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Steam Demand Level 4 - Place unit in holiday mode of operation. Zone setpoints will be shifted +/- 20 deg. from Standard zone occupied setpoints.
 - b. Fan coil emergency electrical strategies
 - i. Emergency Electrical Demand Level 1 – Increase room Cooling set-point by 2 degrees (Adjustable)
 - ii. Emergency Electrical Demand Level 2 – Increase room Cooling set-point by 4 degrees (Adjustable).
 - iii. Emergency Electrical Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Electrical Demand Level 4 - Place unit in holiday mode of operation. Zone setpoints will be shifted +/- 20 deg. from Standard zone occupied setpoints.
 - c. Fan coil emergency chilled water strategies
 - i. Emergency Chilled Water Demand Level 1 – Increase room Cooling set-point by 2 degrees (Adjustable).
 - ii. Emergency Chilled Water Demand Level 2 – Increase room Cooling set-point by 4 degrees (Adjustable).
 - iii. Emergency Chilled Water Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Chilled Water Demand Level 4 - Place unit in holiday mode of operation. Zone setpoints will be shifted +/- 20 deg. from Standard zone occupied setpoints.

3. Fan coil units with outdoor air
 - a. Fan coil with outdoor air emergency steam strategies
 - i. Emergency Steam Demand Level 1 – Decrease room Heating set-point by 2 degrees (Adjustable).
 - ii. Emergency Steam Demand Level 2 – Decrease room Heating set-point by 4 degrees (Adjustable). Note: If exhaust fan is associated, turn it off if appropriate.
 - iii. Emergency Steam Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Steam Demand Level 4 - Place unit in holiday mode of operation. Zone setpoints will be shifted +/- 20 deg. from Standard zone occupied setpoints.
 - b. Fan coil with outdoor air emergency electrical strategies
 - i. Emergency Electrical Demand Level 1 – Increase room Cooling set-point by 2 degrees (Adjustable).
 - ii. Emergency Electrical Demand Level 2 – Increase room Cooling set-point by 4 degrees (Adjustable).
 - iii. Emergency Electrical Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Electrical Demand Level 4 - Place unit in holiday mode of operation. Zone setpoints will be shifted +/- 20 deg. from Standard zone occupied setpoints.
 - c. Fan coil with outdoor air emergency chilled water strategies
 - i. Emergency Chilled Water Demand Level 1 – Increase room Cooling set-point by 2 degrees (Adjustable).
 - ii. Emergency Chilled Water Demand Level 2 – Increase room Cooling set-point by 4 degrees (Adjustable) and close outdoor air damper. Note: If exhaust fan is associated, turn it off if appropriate.
 - iii. Emergency Chilled Water Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Chilled Water Demand Level 4 - Place unit in holiday mode of operation. Zone setpoints will be shifted +/- 20 deg. from Standard zone occupied setpoints.

4. Single zone heat and ventilation unit with economizer, no mechanical Cooling, and no face and bypass damper.
 - a. Single zone unit's emergency steam strategies
 - i. Emergency Steam Demand Level 1 – Decrease room Heating set-point by 2 degrees (Adjustable).
 - ii. Emergency Steam Demand Level 2 – Decrease room Heating set-point by 4 degrees (Adjustable) and close outdoor air damper. Note: If exhaust fan is associated, turn it off if appropriate.
 - iii. Emergency Steam Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Steam Demand Level 4 - Place unit in holiday mode of operation. Zone setpoints will be shifted +/- 20 deg. from Standard zone occupied setpoints.
 - b. Single zone unit's emergency electrical strategies
 - i. Emergency Electrical Demand Level 1 – No action, normal operation.
 - ii. Emergency Electrical Demand Level 2 – No action, normal operation.
 - iii. Emergency Electrical Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Electrical Demand Level 4 – Place unit in holiday mode of operation. Zone setpoints will be shifted +/- 20 deg. from Standard zone occupied setpoints.
 - c. Single zone unit's emergency chilled water strategies
 - i. Emergency Chilled Water Demand Level 1 – No action, normal operation.
 - ii. Emergency Chilled Water Demand Level 2 – No action, normal operation.
 - iii. Emergency Chilled Water Demand Level 3 – No action, normal operation.
 - iv. Emergency Chilled Water Demand Level 4 – No action, normal operation.

5. Single zone heat and ventilation unit with economizer, no mechanical Cooling, and with face and bypass damper.
 - a. Single zone unit's emergency steam strategies
 - i. Emergency Steam Demand Level 1 – Decrease room Heating set-point by 2 degrees (Adjustable).
 - ii. Emergency Steam Demand Level 2 – Decrease room Heating set-point by 4 degrees (Adjustable) and close outdoor air damper. Open air stream to full face damper and modulate heat valve to maintain set-point (Note: not dependent on outdoor air temperature). Note: If exhaust fan is associated, turn it off if appropriate.
 - iii. Emergency Steam Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Steam Demand Level 4 - Place unit in holiday mode of operation. Zone setpoints will be shifted +/- 20 deg. from Standard zone occupied setpoints.
 - b. Single zone unit's emergency electrical strategies
 - i. Emergency Electrical Demand Level 1 – No action, normal operation.
 - ii. Emergency Electrical Demand Level 2 – No action, normal operation.
 - iii. Emergency Electrical Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Electrical Demand Level 4 – Place unit in holiday mode of operation. Zone setpoints will be shifted +/- 20 deg. from Standard zone occupied setpoints.
 - c. Single zone unit's emergency chilled water strategies
 - i. Level 0 – normal operation - Room set-points shall be 70 degrees for Heating and 75 degrees for Cooling.
 - ii. Emergency Chilled Water Demand Level 1 – No action, normal operation.
 - iii. Emergency Chilled Water Demand Level 2 – No action, normal operation.
 - iv. Emergency Chilled Water Demand Level 3 – No action, normal operation.
 - v. Emergency Chilled Water Demand Level 4 – No action, normal operation.

6. Single zone heat and ventilation unit with economizer, mechanical Cooling coil, and no face and bypass damper.
 - a. Single zone unit's emergency steam strategies
 - i. Emergency Steam Demand Level 1 – Decrease room Heating set-point by 2 degrees (Adjustable).
 - ii. Emergency Steam Demand Level 2 – Decrease room Heating set-point by 4 degrees (Adjustable) and close outdoor air damper. Note: If exhaust fan is associated, turn it off if appropriate.
 - iii. Emergency Steam Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Steam Demand Level 4 - Place unit in holiday mode of operation. Zone setpoints will be shifted +/- 20 deg. from Standard zone occupied setpoints.
 - b. Single zone unit's emergency electrical strategies
 - i. Emergency Electrical Demand Level 1 – Increase room Cooling set-point by 2 degrees (Adjustable).
 - ii. Emergency Electrical Demand Level 2 – Increase room Cooling set-point by 4 degrees (Adjustable).
 - iii. Emergency Electrical Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Electrical Demand Level 4 – Place unit in holiday mode of operation. Zone setpoints will be shifted +/- 20 deg. from Standard zone occupied setpoints.
 - c. Single zone unit's emergency chilled water strategies
 - i. Emergency Chilled Water Demand Level 1 – Increase room Cooling set-point by 2 degrees (Adjustable).
 - ii. Emergency Chilled Water Demand Level 2 – Increase room Cooling set-point by 4 degrees (Adjustable) and close outdoor air damper. Note: If exhaust fan is associated, turn it off if appropriate.
 - iii. Emergency Chilled Water Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Chilled Water Demand Level 4 - Place unit in holiday mode of operation. Zone setpoints will be shifted +/- 20 deg. from Standard zone occupied setpoints.

7. Single zone heat and ventilation unit with economizer, mechanical Cooling coil, and with face and bypass damper.
 - a. Single zone unit's emergency steam strategies
 - i. Emergency Steam Demand Level 1 – Decrease room Heating set-point by 2 degrees (Adjustable).
 - ii. Emergency Steam Demand Level 2 – Decrease room Heating set-point by 4 degrees (Adjustable) and close outdoor air damper. Open air stream to full face damper and modulate heat valve to maintain set-point (Note: not dependent on outdoor air temperature). Note: If exhaust fan is associated, turn it off if appropriate.
 - iii. Emergency Steam Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Steam Demand Level 4 - Place unit in holiday mode of operation. Zone setpoints will be shifted +/- 20 deg. from Standard zone occupied setpoints.
 - b. Single zone unit's emergency electrical strategies
 - i. Emergency Electrical Demand Level 1 – Increase room Cooling set-point by 2 degrees (Adjustable).
 - ii. Emergency Electrical Demand Level 2 – Increase room Cooling set-point by 4 degrees (Adjustable).
 - iii. Emergency Electrical Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Electrical Demand Level 4 – Place unit in holiday mode of operation. Zone setpoints will be shifted +/- 20 deg. from Standard zone occupied setpoints.
 - c. Single zone unit's emergency chilled water strategies
 - i. Emergency Chilled Water Demand Level 1 – Increase room Cooling set-point by 2 degrees (Adjustable).
 - ii. Emergency Chilled Water Demand Level 2 – Increase room Cooling set-point by 4 degrees (Adjustable) and close outdoor air damper. Note: If exhaust fan is associated, turn it off if appropriate.
 - iii. Emergency Chilled Water Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Chilled Water Demand Level 4 - Place unit in holiday mode of operation. Zone setpoints will be shifted +/- 20 deg. from Standard zone occupied setpoints.

8. Single zone heat and ventilation unit with economizer, dx Cooling, and no face and bypass damper.
 - a. Single zone dx unit's emergency steam strategies
 - i. Emergency Steam Demand Level 1 – Decrease room Heating set-point by 2 degrees (Adjustable).
 - ii. Emergency Steam Demand Level 2 – Decrease room Heating set-point by 4 degrees (Adjustable) and close outdoor air damper. Note: If exhaust fan is associated, turn it off if appropriate.
 - iii. Emergency Steam Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Steam Demand Level 4 - Place unit in holiday mode of operation. Zone setpoints will be shifted +/- 20 deg. from Standard zone occupied setpoints.
 - b. Single zone dx unit's emergency electrical strategies
 - i. Emergency Electrical Demand Level 1 – Increase room Cooling set-point by 2 degrees (Adjustable).
 - ii. Emergency Electrical Demand Level 2 – Increase room Cooling set-point by 4 degrees (Adjustable) and close outdoor air damper. Note: If exhaust fan is associated, turn it off if appropriate.
 - iii. Emergency Electrical Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Electrical Demand Level 4 - Place unit in holiday mode of operation. Zone setpoints will be shifted +/- 20 deg. from Standard zone occupied setpoints.
 - c. Single zone dx unit's emergency chilled water strategies
 - i. Emergency Chilled Water Demand Level 1 – No action, normal operation.
 - ii. Emergency Chilled Water Demand Level 2 – No action, normal operation.
 - iii. Emergency Chilled Water Demand Level 3 – No action, normal operation.
 - iv. Emergency Chilled Water Demand Level 4 – No action, normal operation.

9. Single zone heat and ventilation unit with economizer, dx Cooling, and with face and bypass damper.
 - a. Single zone dx unit's emergency steam strategies
 - i. .
 - ii. Emergency Steam Demand Level 1 – Decrease room Heating set-point by 2 degrees (Adjustable).
 - iii. Emergency Steam Demand Level 2 – Decrease room Heating set-point by 4 degrees (Adjustable) and close outdoor air damper. Open air stream to full face damper and modulate heat valve to maintain set-point (Note: not dependent on outdoor air temperature). Note: If exhaust fan is associated, turn it off if appropriate.
 - iv. Emergency Steam Demand Level 3 – Place unit in unoccupied mode of operation.
 - v. Emergency Steam Demand Level 4 - Place unit in holiday mode of operation. Zone setpoints will be shifted +/- 20 deg. from Standard zone occupied setpoints.
 - b. Single zone dx unit's emergency electrical strategies
 - i. Emergency Electrical Demand Level 1 – Increase room Cooling set-point by 2 degrees (Adjustable).
 - ii. Emergency Electrical Demand Level 2 – Increase room Cooling set-point by 4 degrees (Adjustable) and close outdoor air damper. Note: If exhaust fan is associated, turn it off if appropriate.
 - iii. Emergency Electrical Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Electrical Demand Level 4 - Place unit in holiday mode of operation. Zone setpoints will be shifted +/- 20 deg. from Standard zone occupied setpoints.
 - c. Single zone dx unit's emergency chilled water strategies
 - i. Emergency Chilled Water Demand Level 1 – No action, normal operation.
 - ii. Emergency Chilled Water Demand Level 2 – No action, normal operation.
 - iii. Emergency Chilled Water Demand Level 3 – No action, normal operation.
 - iv. Emergency Chilled Water Demand Level 4 – No action, normal operation.
10. Univent equipment
 - a. Emergency demand limiting sequences shall be the same as single zone units.

11. Cabinet heaters

- a. Cabinet heater's emergency steam strategies
 - i. Emergency Steam Demand Level 1 – Decrease room Heating set-point by 2 degrees (Adjustable).
 - ii. Emergency Steam Demand Level 2 – Decrease room Heating set-point by 4 degrees (Adjustable).
 - iii. Emergency Steam Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Steam Demand Level 4 - Place unit in holiday mode of operation. Zone setpoints will be shifted +/- 20 deg. from Standard zone occupied setpoints.
- b. Cabinet heater's emergency electrical strategies
 - i. Emergency Electrical Demand Level 1 – Shift Decrease room Heating set-point by 2 degrees (Adjustable).
 - ii. Emergency Electrical Demand Level 2 – Decrease room Heating set-point by 4 degrees (Adjustable).
 - iii. Emergency Electrical Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Electrical Demand Level 4 - Place unit in holiday mode of operation. Zone setpoints will be shifted +/- 20 deg. from Standard zone occupied setpoints.
- c. Cabinet heater's emergency chilled water strategies
 - i. Emergency Chilled Water Demand Level 1 – No action, normal operation.
 - ii. Emergency Chilled Water Demand Level 2 – No action, normal operation.
 - iii. Emergency Chilled Water Demand Level 3 – No action, normal operation.
 - iv. Emergency Chilled Water Demand Level 4 – No action, normal operation.

12. Exhaust fans – Note: If exhaust fans are sequenced to follow an air handler's status, follow the air handler sequence. For toilet and general exhaust fans, provide the following sequence.
 - a. Exhaust fan's emergency steam strategies
 - i. Emergency Steam Demand Level 1 – No action, normal operation.
 - ii. Emergency Steam Demand Level 2 – No action, normal operation.
 - iii. Emergency Steam Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Steam Demand Level 4 – Place unit in unoccupied mode of operation.
 - b. Exhaust fan's emergency electrical strategies
 - i. Emergency Electrical Demand Level 1 – Place unit in unoccupied mode of operation.
 - ii. Emergency Electrical Demand Level 2 – Place unit in unoccupied mode of operation.
 - iii. Emergency Electrical Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Electrical Demand Level 4 – Place unit in unoccupied mode of operation.
 - c. Exhaust fan's emergency chilled water strategies
 - i. Emergency Chilled Water Demand Level 1 – No action, normal operation.
 - ii. Emergency Chilled Water Demand Level 2 – No action, normal operation.
 - iii. Emergency Chilled Water Demand Level 3 – Place unit in unoccupied mode of operation.
 - iv. Emergency Chilled Water Demand Level 4 – Place unit in unoccupied mode of operation.
13. Chilled water supply from campus chilled water loop.
 - a. Chilled water supply's emergency steam strategies
 - i. Emergency Steam Demand Level 1 – No action, normal operation.
 - ii. Emergency Steam Demand Level 2 – No action, normal operation.
 - iii. Emergency Steam Demand Level 3 – No action, normal operation.
 - iv. Emergency Steam Demand Level 4 – No action, normal operation.
 - b. Chilled water supply's emergency electrical strategies
 - i. Emergency Electrical Demand Level 1 – No action, normal operation.
 - ii. Emergency Electrical Demand Level 2 – No action, normal operation.
 - iii. Emergency Electrical Demand Level 3 – No action, normal operation.
 - iv. Emergency Electrical Demand Level 4 – Shut chilled water pumps off and close chilled water valves from campus loop if it is a non-critical facility.
 - c. Chilled water supply's emergency chilled water strategies
 - i. Emergency Chilled Water Demand Level 1 – No action, normal operation.
 - ii. Emergency Chilled Water Demand Level 2 – No action, normal operation.
 - iii. Emergency Chilled Water Demand Level 3 – No action, normal operation.
 - iv. Emergency Chilled Water Demand Level 4 – Shut chilled water pumps off and close chilled water valves from campus loop if it is a non-critical facility.
14. Primary Heating system.
 - a. No emergency strategy is to be employed.

EUMS Zone Sub-Cooling

Additionally, a sub-cooling strategy shall be defined to operate based on a BACnet binary value and analog value commanded by the Johnson Controls Network Automation Engine. The analog value shall be the cooling set-point and the binary value shall be the enable.

EUMS Occupied VAV Sub-Cooling:

When enabled, the VAV shall remain in occupied mode to maintain required damper position with the room cooling set-point equal to the analog value as commanded from the Johnson Controls Network Automation Engine. When disabled, the room set-point shall be returned to its normal operating value.

EUMS Occupied FNC Sub-Cooling:

When enabled, the FNC shall run in normal occupied mode on a call for Cooling with the room cooling set-point equal to the analog value as commanded from the Johnson Controls Network Automation Engine. When disabled, the room set-point shall be returned to its normal operating value.

EUMS Pre-Occupied Sub-Cooling:

EUMS Pre-Occupied VAV Sub-Cooling:

When enabled, the VAV shall remain in unoccupied mode with the room cooling set-point equal to the analog value as commanded from the Johnson Controls Network Automation Engine. When disabled, the room set-point shall be returned to its normal operating value. In addition, the heating setpoint shall be shifted an equal amount from standard occupied setpoint to prevent simultaneous cooling and heating. (ex. Subcooling Setpoint = 72 deg. F., then Heating Setpoint = 67 deg. F.)

EUMS Pre-Occupied FNC Sub-Cooling:

When enabled, the FNC shall run in normal unoccupied mode on a call for Cooling with the room cooling set-point equal to the analog value as commanded from the Johnson Controls Network Automation Engine. The FNC shall only be cycled on when there is a need for cooling. When disabled, the room set-point shall be returned to its normal operating value. In addition, the heating setpoint shall be shifted an equal amount from standard occupied setpoint to prevent simultaneous cooling and heating. (ex. Subcooling Setpoint = 72 deg. F., then Heating Setpoint = 67 deg. F.)

EUMS Pre-Occupied ACF Sub-Cooling:

When enabled, the fan shall be cycled on to maintain occupied discharge air temperature set point on a call for cooling. The Outside Air Damper shall remain closed to ensure Outside Air Humidity doesn't impact the space humidity and energy usage during the Sub-Cooling strategy. Economizer control shall be enabled when outside air enthalpy conditions are met. When normal occupancy mode is met, the fan shall return to its normal operating mode.

EUMS Chilled Water Rebound Prevention

In addition to the EUMS tactics above, the following sequences shall be incorporated into the HVAC equipment sequences to prevent sudden increases in loads on the campus chilled water supply system.

Unoccupied to Occupied:

When any field device that uses chilled water changes from an unoccupied to occupied state, the chilled water valve or Cooling damper position shall be limited to ramp open at 3.33% (adjustable) per minute from its present position or some other means shall be employed to prevent chilled water valves and cooling dampers from opening quickly. This shall be performed every time the equipment transitions from the unoccupied to occupied mode.

EUMS Demand Response and Demand Limiting:

Anytime a field device transitions from a higher demand response or demand limiting strategy to a lower one, the chilled water valve or Cooling damper position shall be limited by ramping open at 3.33% (adjustable) per minute from its present position or some other means shall be employed to prevent chilled water valves and cooling dampers from opening quickly.

EUMS Holiday Temperature Setback

To achieve additional energy savings on Holidays, the Johnson Controls Network Automation Engine will command a BACnet binary value that shall cause the building BAS system to shift each of its space temperature set-points an additional +/- 10 degrees from their unoccupied set-point values. The building automation systems shall be programmed with mechanisms that will allow disabling this feature both at a building level and at an individual space level.