Spring 5-2019

259000 - Building Automation System Control Sequences

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SECTION 25 9000 – BUILDING AUTOMATION SYSTEM CONTROL SEQUENCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes sequences of operations for the control of all building mechanical systems. These sequences apply to all equipment controlled by the BAS system and may be applicable to "stand alone" equipment as well.

1.2 RELATED SECTIONS FOUND ELSEWHERE

A. Refer to Chapter 5, Division 250000 – Building Automation System for BAS system requirements.

B. Refer to Chapter 5, Division 26, Section 265100 for lighting control requirements. See Chapter 5, Division 00, Section 000000.0.A.0

1.3 NOTES TO DESIGNERS

A. Preliminary control sequences should be submitted for review early in the design process as possible. Draft sequences are expected as part of the Design Development submission. Thorough, complete and well written control sequences are essential for a high performing building to reach its full potential.

B. UNH prefers that the control sequences are located in the specifications as part of the BAS controls section or as a stand-alone section. If the sequences are located on the drawings they should be on a single dedicated controls drawing. (The sequences shall not be written in all caps.)

C. Control and monitoring of all equipment shall be via the BAS unless explicitly noted otherwise.

D. BACnet, Modbus and other manufacturer communication gateways shall not be used without prior approval from UNH Energy. When they are approved for use, they should be used primarily for monitoring. All critical control and alarm points should be hardwired when a communication gateway is used.

E. All equipment needs to be uniquely named or labeled. For example a building may not have two "AHU-1" or "FC-1" units.

F. Active dehumidification is not permitted without prior approval from UNH. If dehumidification is allowed due to special requirements of a space, then the system must have a reheat coil after the cooling coil. Dehumidification sequences may not be used without reheat available because sub-cooling of the space will occur.

PART 2 - SEQUENCES OF OPERATION

2.1 TABLE OF CONTENTS

2.2 General Sequence Notes

A. Alarms

1. Certain conditions shall be programmed to trigger an alarm on the BAS system. Alarm levels shall be defined from level 5 through level 8.

a. Alarm Level 5 (AlmLev5_OutofBand) – These are the least critical alarms. Examples of alarm conditions that should be assigned to level 5 include general space temperatures out of range, terminal unit fan status that does not match command (inverse status), etc.

b. Alarm Level 6 Serious (AlmLev6_Serious) - These may be used for temperatures out of band for more critical spaces such as labs.

c. Alarm Level 6 Window switches (AlmLev6_Window) – These alarms are used for window switches only.

d. Alarm Level 7 Urgent (AlmLev7_Urgent) – These are shown in yellow on the alarm screen. An example of this alarm is a hot or chilled water temperature out of range.

e. Alarm Level 8 Dispatch (AlmLev8_Dispatch) – These are shown in red on the alarm screen and trigger a notification to the UNH Dispatch center.

2.3 Space Temperature Setpoints

A. Room temperature control with the capability of automatic unoccupied setpoint shift shall be provided for all spaces with heating and/or air conditioning. Wall mounted individual room temperature sensors are preferred. Zone temperature sensors controlling several rooms shall not be allowed unless pre-approved by the University and all rooms in each zone have equal heating and cooling load characteristics and equal functional uses.

B. Perimeter radiation or local fan coil units shall be used to maintain night setback temperatures, rather than turning on large air handling systems when only a few rooms need unoccupied mode heating. An individual temperature control sensor shall be provided for each room for unoccupied heating control. Zone control for heating is not acceptable for unoccupied heating control.

C. Each temperature sensor shall have a push button override button programmed for two hour intervals of delivered heating when the system is in the night, weekend or holiday setback program. All temperature sensors in offices shall have setpoint adjustment sliders.

D. Space Temp Sensors serving classrooms, break rooms, toilet rooms, common/corridor areas, mechanical rooms, electrical rooms and other spaces that are normally un-occupied shall not have manual set-point slide adjustment or push-button override features.

E. Occupied Hours
1. During the occupied hours, spaces will be heated to keep temperatures from going below 68° F.
2. During the occupied hours, spaces will be cooled to keep temperatures from going above 78° F (for spaces with mechanical cooling).

F. Unoccupied Hours
1. During the unoccupied hours, spaces will be heated to keep temperatures from going below 55° F.
2. During the unoccupied hours, spaces will be cooled to keep temperatures from going above 90° F when in the heating mode.

G. Push-Button Override shall set space set points to the occupied mode. Push-Button Override will not start any air handling equipment.

H. Exceptions to these temperature targets will be permitted only in laboratories, experimental areas, animal areas, or other spaces where there is a demonstrated work

requirement for maintaining higher, lower, or more consistent temperatures. These exceptions shall be discussed and clearly documented early in the design process.

2.4 Cabinet Unit Heaters / Unit Heaters (CUH / UH)

A. During the occupied period, if the space temperature falls below the occupied heating setpoint, the heating control valve shall open and after a 1 minute delay the fan shall stop. When the heating setpoint is satisfied, the valve shall close and the fan shall shut off.

B. During the unoccupied period, if the space temperature falls below the unoccupied heating setpoint, the heating control valve shall open and after a 1 minute delay the fan shall stop. When the heating setpoint is satisfied, the valve shall close and the fan shall shut off.

C. Additional notes:
   1. If the hot water supply temperature is below 100 F, the valve shall remain closed and the fan shall remain off.
   2. Mechanical aquastats shall not be used. The fan and control valve shall be controlled by separate digital outputs.

2.5 Fin-tube radiation (FTR)

A. During the occupied period, if the space temperature falls below the occupied heating setpoint, the heating control valve shall modulate open. On a rise in temperature the valve shall modulate closed.

B. During the unoccupied period, if the space temperature falls below the unoccupied heating setpoint, the heating control valve shall modulate open. On a rise in temperature the valve shall modulate close.

C. When outside air temperature (OAT) is below 20 F, FTR valve shall open for 5 minutes every 4 hours. This is a freeze protection measure.

D. Additional notes:
   1. For all dual temperature systems, if the hot water supply temperature is below 100 F, the valve shall remain closed.
   2. This sequence applies to zones where the FTR is the only source of heating. Refer to other sections of this standards for applications that include VAV boxes or other terminal units.

2.6 Window Switches

A. Window switch and associated components shall be controlled by the BAS. Switches shall be used to set the rooms to the unoccupied set points. For VAV boxes, the box will go to the minimum position and the reheat valve shall remain closed.

B. Each switch (or switches for multiple operable windows in same room) and contact wiring shall be installed in a closed loop configuration with an input of “ON” in closed position and “OFF” in open position.

C. When window switch registers an “ON” signal (closed), occupied/unoccupied temperature set point shall resume.

D. The BAS shall generate a Level 8 Dispatch alarm if window switch signal registers a “OFF” signal, outdoor air temperature is below 30°F, and the room is below 60 °F. The BAS shall generate a Level 6 Dispatch alarm if window switch signal registers an “OFF” signal and outdoor air temperature is above 85°F for 6 hours.

2.7 BUILDING HEATING HOT WATER LOOP CONTROL (DISTRICT HOT WATER HEATING)

A. Heating hot water is available to campus buildings from approximately October 1st to May 20th (actual dates vary slightly from year to year).

B. Each building shall have a manual summer/winter switch connected as an input to the BAS. The switch shall be in the “winter” position when hot water is available and “summer” position when hot water is not available. When the switch is in the winter mode the HW pumps shall be off and the heating control valve will remain closed.

C. All buildings shall have a minimum of two hot water pumps for each heating loop for redundancy.

D. When the outside air temperature is below the heating lockout temperature setpoint of 60 F, the lead hot water pump shall be enabled to run and the standby pump shall be off. On a failure of the lead pump, the standby pump shall be enabled to run and a (Level 7) alarm shall be generated. The lead pump shall be rotated every Wednesday morning.

E. When enabled the lead pump shall modulate via a variable frequency drive to maintain the loop differential pressure setpoint
   1. Where “smart” pumps with integral speed controls are used the pumps should be set up in the proportional pressure control mode, or the mode determined by the manufacturer to provide the greatest energy savings.

   2. In all cases the differential pressure sensor shall be installed at the 2/3 point in the piping and a 2-10VDC signal shall be provided to the pumps so that the standard remote differential pressure control sequence described above can be enabled in the future.

F. The hot water control valve shall modulate to maintain the hot water supply temperature setpoint according to the following reset schedule.

OAT	HWS Setpoint
20 F	180 F
60 F	140 F

2.8 AIR HANDLING SYSTEMS

A. General Notes: Air handing units (AHU's) come in countless configurations depending on application. These applications may include ventilation, heating, cooling, VAV or single zone as well as energy recovery options that may include enthalpy wheels or fixed plate exchangers, bypass dampers, etc (NOTE THAT ALL VENTILATION UNITS MUST HAVE ENERGY RECOVERY – REFER TO SECTION 230000). Given these variations it is not possible to provide a standard sequence for every configuration of unit. The following sections provide guidance on individual AHU functions or components and should be included in the design sequences as applicable.

B. Economizer Control (Mixing dampers) – TBD

C. Fan and bypass / heating control - TBD

D. Energy recovery - TBD

E. Wheels - TBD

F. Run-around loops - TBD

G. Fixed plate - TBD

H. Demand controlled Ventilation (DCV): Optimize ventilation rates in the space by measuring carbon dioxide (CO2) levels in the space.

1. Locate CO2 sensors in the space rather than in the return ductwork when possible for easier access and maintenance.

2. Outside air (OA) CO2 sensors are not allowed. OA CO2 is assumed to be 400 ppm.

3. When return air or room CO2 level is less than 1000 ppm, the outside air and relief air dampers modulate down to a low of 5% outside air. When the return air CO2 level is 950 ppm or more, the outside air quantity modulates up to the maximum scheduled outside air quantity, on a linear scale between 950 ppm and 1,600 ppm (adjustable) differential. (Where an OA airflow station is not provided, OA damper position shall be modulated between damper position setpoints determined during balancing that correspond to design minimum and maximum OA ventilation rates.)

I. Fan speed controls - *TBD*