At Section 25 90 00, replace the November 2008 version of the following embedded document:

Air Terminal Units - Single Duct Variable Air Volume with Hot Water Reheat & Perimeter Heating — November 2008

with the new version, and update the Version Date. The new version is attached. Deletions are struck through, and new text is double underlined.

END of revision

Update Commentary:

Section was updated primarily for the following reasons:

1) Upgrades to technical sequences, point list, and schematic drawings for improved operation, energy savings and monitoring/alarming.
2) Added general clarifications and notes to design/construction teams.
3) Corrections of typographical errors

PENNSTATE

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SEQUENCE OF OPERATION GUIDELINE

AIR TERMINAL UNITS – SINGLE DUCT VARIABLE AIR VOLUME with HOT WATER REHEAT & PERIMETER HEATING

Document: SEQOP-TU-VAV w HWRHT+PERHTG rev1~~SEQOP-TU-VAV w HWRHT+PERHTG rev0 2008-11-11~~
Revision: ~~0~~1
Rev. Date: ~~November 11, 2008~~ March 5, 2010

Notes:

1. *This sequence is intended to provide the Design Professional with a basic guideline of minimum requirements for typical VAV Air Terminal Units. Sequence shall be carefully reviewed and edited with respect to application-specific project requirements and proposed modifications shall be reviewed with OPP Staff.*

2. *The intent is for this section to be inserted into the Part 4, "Sequence of Operation" section of the BAS Specification.*

3. *Consider the use of zone occupancy sensors for "standby" mode. Coordinate with Electrical/Lighting design for dual use.*

4.x Air Terminal Units – Variable Air Volume with Hot Water Reheat and Perimeter Heating (where applicable)

A. GENERAL:

1. Air terminal units shall be pressure independent, single duct vav with hot water reheat coils (where scheduled) with ~~ddc~~ DDC, custom programmable Application C~~c~~ontrollers as specified in Div 25, Building Automation Systems (BAS), Part 2.
2. All ~~Minimum Occupied and Unoccupied, heating maximum and cooling maximum~~ input airflow setpoints~~s~~ shall be ~~set as~~ clearly defined and scheduled by Design Professional for each terminal. Refer to Point List. The CSC shall o~~O~~btain documented direction via RFI from Design Professional if not otherwise scheduled.

NOTE: Design Professional, TAB Agency and CSC shall coordinate design, system setup adjustments and automatic control efforts to determine the most energy-efficient strategy to allow for and direct the total AHU system minimum air with fans at minimum speed. The goal is to assure that cumulative minimum airflow in the zone distribution system at any given time is adequately matched to the minimum that will be supplied by the AHU fan(s) operating at minimum speed and within stable fan conditions determined from analysis of the installed manufacturer's fan operating characteristic curve and actual field conditions. Refer to 25 90 00, Air-Handling Units - Variable Air Volume, FAN CONTROL, regarding optimizing minimizing fan speeds per specific application requirements in the field.

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3. The BAS shall perform the following VAV terminal unit control strategies and provide the points as required for the specified monitoring and diagnostics.
   a. Setpoint control - the BAS shall edit the operating mode, airflow setpoints, damper and valve positions, zone space temperature setpoint of each vav box. All setpoints shall be operator adjustable. Individual zone setpoint and control logic shall reside at the zone level, and not be dependent upon the BAS for control. In the event of communication loss, the box will continue to control to current setpoints.

b.Grouping: Terminal units in the communications network and through software shall be logically grouped together via naming conventions and/or "tree" organization. The grouping shall make it intuitive and easy for the operator to read/write global/common points and/or commands to all similar units within a group. The BAS shall be able to modify the grouping of VAV terminal units via the User Interface. Grouping shall at a minimum be based on the following categories, in descending order from most general to most specific:

1)4. General: Terminal units shall be logically grouped together in the communications network and through software. These groups shall make it possible for the operator to send a common command to all units in a group to operate in the same mode. The BAS shall be able to modify the grouping VAV terminal units via the User Interface.

2)Grouping shall at a minimum be based on the following categories:

α)• By **AHU source**: (refer to requirements under "Terminal Unit Interface with AHU"

o By **Building Floor Level**

▪ By **Heating Method**: Reheat only or Reheat with Perimeter Radiation

β)• By **Space Function** Type: group according to similar use for temperature setpoints, occupancy schedules and ventilation requirements including but not necessarily limited to:

(1)• Auditoriums
(2)• Classrooms (general purpose)
(3)• Conference Rooms
(4)• Corridors and Utility spaces
(5)• Dining
(6)• Kitchens
(7)• Laboratories
(8)• Libraries
(9)• Offices
(10)• Telecomm
(11)• Other

c)By **Priority Level** of control/operational sensitivity
(1)Very High: Life Safety driven, maintaining pressure relationships and or other conditions with no flexibility.
(2)High: Research and zones requiring very tight tolerances with little or no flexibility
(3)Medium: General comfort conditions that have some flexibility or only have to be maintained during normal occupied periods.
(4)Low: Zones that allow relatively wide range of operating conditions
(5)Very Low: Non-critical, non-occupied, non-temperature sensitive

d)By **Distribution Method** of zone heating
(1)Terminal Unit Reheat coil only
(2)Terminal Unit Reheat coil with perimeter heat

e)By **Primary Utility Source** for zone heating:
(1)Campus Steam
(2)Electric (if electric resistance used in lieu of hot water)
(3)Other (if fuel fired, stand-alone heating plant)

3)a. Control vendor must provide a sample of this group organization in the submittal package for approval.

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B. RUN CONDITIONS

1. As Scheduled: The unit shall run according to a user definable time schedule in the following modes:
   a. Occupied Mode: ~~The unit shall maintain~~
      ~~1)A 75°F (adj.) cooling setpoint~~
      ~~2)A 70°F (adj.) heating setpoint.~~
   ~~b.Standby Mode (where applicable with zone occupancy sensors): The unit shall operate in the range of unoccupied airflow setpoints, but maintain "standby" temperature setpoints as follows:~~
      ~~1)A 77°F (adj.) cooling setpoint.~~
      ~~2)A 68°F (adj.) heating setpoint.~~
   ~~c.~~b. Unoccupied Mode ~~(night setback): The unit shall maintain~~
      ~~1)A 85°F (adj.) cooling setpoint.~~
      ~~2)A 60°F (adj.) heating setpoint.~~
   c. Holiday Mode:
      ~~3)A 50°F (adj.) HOLIDAY heating setpoint.~~
2. Zone Optimal Start: ~~The unit shall use an~~ An adaptive optimal start algorithm shall be used ~~for morning start-up. This algorithm shall~~to minimize the energy required and ~~unoccupied~~ warm-up or cool-down ~~time~~period during the unoccupied period, ~~while still~~necessary to achiev~~e~~ing zone ~~comfort conditions~~occupied temperature setpoints by the start of scheduled occupied period. The learning adaptive algorithm shall compare the zone temperature to its setpoint at beginning of scheduled occupied period and shall automatically adapt the heating or cooling response time for the next unoccupied period. The initial default starting time remaining until occupancy shall be 60 minutes (adj.) Emergency Demand Limiting: **Refer to current revision of the** Enterprise Utility Management System (EUMS) Equipment Control Strategies~~Enterprise Utility Management System (EUMS) Control Sequence~~ **in Division 25,** 25 90 00 GUIDE SEQUENCES OF OPERATION **on the Standards web page for specific requirements. Apply portions associated with VAV terminals.**

C. ZONE TEMPERATURE AND AIRFLOW CONTROL (DUAL ~~MAXIMUM~~SETPOINTS)

1. Temperature Setpoints: Provide operator definable, independent heating and cooling temperature setpoints separated by a deadband, along with other requirements in accordance with 25 00 00 INTEGRATED AUTOMATION, Building Automation Systems (BAS), "Space Temperature Control".
   a. Initial setpoint values shall be in accordance with 23 00 10 Systems Selection and Application, .02 Design Conditions for the occupied, unoccupied and holiday modes and/or as otherwise defined for specific application by design professional.
2. Airflow Setpoints: Provide operator definable, independent heating and cooling airflow setpoints, for each operating mode. Refer to description below and point list.
~~1.~~3. The unit shall maintain zone temperature and airflow setpoints by controlling the terminal unit air damper and zone heating valve(s) via the following:
   a. Occupied:
      1) When zone temperature is greater than its cooling setpoint, the zone damper shall modulate between the minimum occupied airflow (adj.) and the maximum cooling airflow (adj.) until the zone is satisfied. Hot water valve is closed.
      2) When the zone temperature is between the cooling setpoint and the heating setpoint, the zone damper shall control to its minimum occupied airflow (adj.). Hot water valve is closed.
         a) For AHU's with economizer function, refer to minimum occupied airflow reset described under 'Terminal Unit Interface with AHU' below.

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3) When zone temperature is less than its heating setpoint, the controller shall enable heating to maintain the zone setpoint in stages intended to minimize reheat energy and thermal stratification in zone as follows:
   a) Reheating Coil Valve: The hot water valve shall be modulated using heating PID output to increase the discharge air temperature up to its maximum setpoint to maintain zone space temperature. Only if space temperature cannot be maintained with reheat DAT at maximum shall air damper be modulated open from heating min cfm to heating max cfm in occupied mode. Note that directly controlling the hot water valve from the zone temperature alone is not acceptable since it will not allow the discharge air temperature to limited to prevent stratification.
   ~~a)~~b) Stage 1. From 0-33% (adj) ~~loop~~ heating output signal, the ~~heating loop output shall reset the~~ terminal unit discharge temperature shall reset from inlet air temperature to approximately zone heating setpoint (supply neutral temperature air).
      (1) Perimeter Heating Coil Valve (where applicable); From 0-33% (adj) loop signal, the controller shall concurrently modulate the perimeter heating coil valve from 0-100% open ((2) DO, three point floating control is acceptable).
   ~~b)~~c) Stage 2. From 33-67% (adj) ~~loop~~heating output signal, the ~~heating loop output shall reset the~~ terminal unit discharge temperature shall reset to a maximum of 20°F (adj.) above zone heating setpoint while maintaining minimum occupied airflow.
   Stage 3: From 67-100% (adj) ~~loop~~ heating output signal, the ~~heating loop output shall reset the~~ zone airflow ~~setpoint~~ shall modulate from the occupied minimum ~~occupied~~ to ~~the~~ maximum heating airflow setpoints. The discharge air temperature shall not exceed 20°F (adj.) above zone heating setpoint.

b. Standby Mode (where applicable with zone occupancy sensors): During regularly scheduled occupied period, if the zone occupancy sensor does not sense actual occupancy, t~~T~~he unit shall operate similar as described in the ~~un~~occupied mode, with the following exceptions:
   1) Maintain room temperature setpoints at a 0 to +/-3°F (adj.) offset from occupied cooling/heating setpoints, respectively. If not otherwise defined, default offset shall be +/-2°F.
   2) Minimum heating and cooling airflow setpoints shall reset to zero (adj.) (i.e. damper closed).
   3) At the start of each regularly scheduled occupied mode, the occupancy sensor/standby mode shall be inhibited for the first 60 minutes (adj). This shall enable the terminal unit to maintain at least the minimum occupied airflow setpoint to provide a fresh ventilation air "flush" of the zone during that initial period.
   4) The occupancy sensor shall NOT revert to the zone terminal "occupied" mode if temporary occupancy is sensed during the regularly scheduled unoccupied period.
   5) Coordinate with Div 26 Electrical, Interior Lighting work to turn off lights when no occupancy is sensed during regularly scheduled occupied period and to turn lights on when occupancy is sensed during regularly scheduled unoccupied periods.
   6) Sensitivity and time delays on make/break settings shall be adjusted within the occupancy sensor itself. Refer to Section Div 25, Building Automation Systems (BAS), Part 2, SENSORS for sensor requirements.

~~b.~~c. Unoccupied:
   ~~1) Similar to Occupied mode except that temperature and airflow setpoints shall control to Unoccupied values (unless noted otherwise – i.e. if standby mode is provided).~~

   1) VAV units shall cycle between min unoccupied-max heat/cool modes during unoccupied periods while allowing for wider temperature offset ranges above and below setpoints. The intent is to allow the associated air handling unit(s) not to have to run continuously during the normally unoccupied period but rather cycle only as needed to keep zones within an acceptable temperature range.

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a) Apply +/- 3 degree (adjustable) allowable "drift" from unoccupied heating and cooling setpoints as described below.

b) Cooling: A zone would not initiate a cooling demand request until the zone temperature has gone 3 degrees above its unoccupied setpoint. At that point, once enough cooling request re-activate the associated AHU, the zone damper would operate in "max cool" mode (at unoccupied cooling maximum airflow setpoint) until space reaches 3 degrees below unoccupied space temperature setpoint. Then zone controller shall revert to no cooling request and damper shall close to minimum unoccupied cooling airflow setpoint until cycle repeats.

c) Heating: Where it exists, perimeter radiant heating shall be used to maintain unoccupied heating septoints as much as possible. A zone would not initiate a heating demand request until the zone temperature has gone 3 degrees below its unoccupied setpoint. At that point, once enough heating requests re-activate the associated AHU, the zone damper would operate in "max heat" mode (unoccupied heating maximum airflow setpoint and reheating valve(s) would open to 100%) until space reaches 3 degrees above unoccupied space temperature setpoint. Then zone controller shall revert to no heating request and damper shall close to minimum unoccupied heating airflow setpoint until cycle repeats.

d) Once associated AHU is enabled from heating or cooling requests, all VAV zones with zone termperatures that are below the upper heating or above the lower cooling drift effective setpoints shall operate as described above until there are no longer any heating or cooling requests and then the AHU shall cycle off, and the cycle shall repeat.

2) An inhibit feature on the timed override control shall be included which shall prevent sending cooling or heating requests and/or otherwise enabling associated AHU if zone temperature is within +/-3°F (adj.) of last previous occupied cooling/heating setpoints respectively when local override button is activated.

~~2.Reheating Coil Valve: The hot water valve shall be modulated using a PI control loop to maintain the discharge temperature at the setpoint. Note that directly controlling the hot water valve from the zone temperature PI loop is not acceptable since it will not allow the discharge air temperature to be under control and limited to prevent stratification.~~

D. ZONE SENSORS

1. General: Temperature sensors and Humidity, CO2, Occupancy sensors (if present) shall be as specified in Div 25, Building Automation Systems (BAS), Part 2, SENSORS.

~~1.~~2. Room Temperature Sensors: ~~Shall include Zone Setpoint Adjustment and Occupancy Override, except when placed in Public Spaces.~~

a. Zone Setpoint Adjustment (where present): The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor. Range shall be user defined at BAS, +/-~~1~~0°F (adj.) initial.

b. Zone Unoccupied Override (where present): A timed local override control shall allow an occupant to override the schedule and place the unit into the mode of maintaining occupied temperature setpoints for a ~~2~~ 1 hour (adj.) period of time. At the expiration of this time, control of the unit shall automatically return to the schedule.

c. In zones that have 2 or more termperature sensors, the BAS operator shall be able to easily select (globally and individually) between min-average-max comparative control functions. The default shall be set for average unless noted otherwise for specific application.

E. TERMINAL UNIT INTERFACE WITH AHU

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1. At a minimum, all VAV terminal units served by an AHU shall be interfaced with associated VAV AHU controller to perform the following functions.
   a. Zone occupancy schedule (user ~~defined~~ adjustable from graphic interface) shall normally automatically select the Occupied or Unoccupied operating mode of air handling unit.
      1) Activation of timed override switch on zone thermostats (if present) shall only reset zone heating and cooling temperature setpoints to "occupied" values, but ~~shall not affect~~ otherwise ~~scheduled Unoccupied operating mode of~~ air handling unit shall continue to cycle in "Unoccupied" mode (minimum OA ventilation shall remain closed) to meet heating and cooling requests.
      2) If occupancy schedules are not otherwise defined as part of the contract documents, control vendor shall submit an RFI to obtain these values and implement them prior to acceptance and turnover of system.
   b. Duct static pressure reset as described in Fan Control section.
   c. AHU Discharge air temperature setpoint –optimized and Demand Limiting as described in the Discharge Temperature Control section of AHU.
   d. When AHU is in economizer mode (if furnished), minimum occupied airflow setpoint on VAV terminals shall be automatically reset based on percentage of outside air above design minimum.
      1) As percentage of OA increases at AHU (with minimum OA damper at 100% and as economizer damper position increases from 0-100%), minimum occupied airflow setpoint at terminal units shall proportionately reset lower from design min to absolute minimum to maintain required minimum fresh air ventilation. The absolute minimum value shall be the greater of the following:
         a) The minimum that the terminal unit's airflow sensor can accurately control to, or
         b) The code required minimum OA ventilation rate for the zone (assuming the AHU is in 100% OA mode (to be determined and defined by design professional).
      2) If values above are not scheduled or otherwise defined as part of the contract documents, control vendor shall submit an RFI to obtain these values and implement them prior to acceptance and turnover of system.
      3) Resetting shall occur based on increments of 10% change of value of economizer damper position.
   e. Demand Based Ventilation CO2 Control: When present, coordinate with the associated section in the most current revision of the VAV AHU sequence for multiple zone systems.
      1) Mulitple Zone Systems: During occupied mode, Demand Ventilation controls shall monitor spaces with CO2 sensors. The Demand Ventilation Controls shall first increase zone minimum airflow to satisfy ventilation requirements, and then increase the outdoor air rate at the air handler as described in the following sequence.
         a) At the zone: Upon a rise in zone CO2 concentration above setpoint, the minimum occupied airflow setpoint at the zone VAV terminal shall first be reset from the design minimum up to a ventilation override maximum value (adj).
         b) At the Air Handler: Upon continued call for ventilation (based on continued rise in critical zone CO2 concentration with VAV terminal at ventilation override maximum setpoint, then increase the minimum outdoor air rate (or damper position) from absolute minimum to design minimum.
         c) CO2 setpoints at zone level are dependent on type of space use. If values above are not scheduled or otherwise defined as part of the contract documents, control vendor shall submit an RFI to obtain these values and implement them prior to acceptance and turnover of system.
      2) As an alternate to individual CO2 zone sensors, a system that periodically samples air qualtity in multiple zones through a common air quality measurement device ("Aircuity" or equivalent) may be applied to achieve similar Demand Based Ventilation Control.

F. ~~TERMINAL UNIT DIAGNOSTICS~~ MONITORING AND ALARMING

~~1.General Control System Malfunctions:~~

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~~a.If zone temperature sensor input fails above its high range, unit shall control at its maximum cooling cfm setpoint. If sensor input fails below its low range, unit shall control to its minimum occupied cfm setpoint and the heating valve shall open.~~
~~1)In both cases above, a diagnostic message shall be displayed at BAS workstation.~~
~~b.If flow-measuring system fails, unit shall automatically convert to a pressure dependent, damper position based algorithm. Diagnostic message shall be displayed at BAS workstation.~~
~~c.If zone temperature setpoint potentiometer on zone sensor fails, unit shall automatically control to programmed occupied setpoints. Diagnostic message shall be displayed at BAS workstation.~~
~~d.If communications are lost, controller shall continue to operate in the current mode of operation. All setpoints shall be retained in nonvolatile memory. If communications are not restored within 15 minutes, unit shall automatically initiate a reset-recalibrate.~~

~~2.~~1. ~~Other Diagnostic~~ Alarms shall be provided as follows:

a. ~~Room~~ Zone Temperature Failure~~off setpoint~~ (at any time, any AHU mode this shall be alarmed separately from common terminal unit faults)~~:~~
   1) High Zone Temp: If the zone temperature is greater than the cooling setpoint by ~~2~~5°F (adj.) for a minimum 60 minutes (adj) continuously.
   2) Low Zone Temp: If the zone temperature is less than the heating setpoint by ~~3~~5°F (adj.) for a minimum 60 minutes (adj) continuously.

b. VAV Terminal Unit Fault: When the associated AHU fan status is on, the following monitoring and alarm functions shall initiate a common "VAV FAULT" alarm displayed at the BAS workstation. At the terminal controller level, each alarm shall be labeled independently for easy, diagnostic purposes.

~~b.Discharge Air Temperature off setpoint:~~
   1) High Discharge Air Temp: If the terminal unit discharge air temperature is greater than 110°F (adj.)~~.~~ for a minimum 30 minutes (adj) continuously.
   ~~2)Low Discharge Air Temp: If the terminal unit discharge air temperature is less than 40°F (adj.).~~
   ~~3)~~2)Reh~~H~~eat valve ~~leaking through~~close off failure: If terminal unit reheat discharge temperature is greater than ~~inlet~~ assocated ~~(~~AHU ~~discharge~~DAT~~)~~ by more than 3°F (adj.) when zone heat output is at 0% output for a minimum 30 minutes (adj) continuously.
   ~~c.~~3) Airflow ~~off setpoint~~Diagnostic Alarm: When cooling output is 50% or greater,
      ~~1)~~a)High Airflow: If the zone airflow is greater than the setpoint by 25% (adj.) a minimum 120 minutes (adj) continuously..
      ~~2)~~b)Low Airflow: If the zone airflow is less than the setpoint by 25% (adj.) a minimum 120 minutes (adj) continuously. .
   ~~d.Unstable PID loop:~~
   ~~1)~~4)Unstable PID loop: If any PID loop continues to cycle its output ~~beyond 30-70%~~more than 40% of its range (adj.) 3 times (adj.) ~~or more per hour~~in any 60 minute internal.
   ~~e.Check Unit for "Right Sizing":~~

c. Commissioning Alarms: A "CX" alarm shall be initiated for any of the following:
   1) "Check Sizing" Alarm: If the unit controller stays in 100% cooling or heating for more than 4 hours (adj.), indicating potential for undersizing of capacity.
   2) High CO2 Alarm: Where Demand Based Ventilation CO2 Control is present, the following alarm shall be generated at the operator work station.
      a) High Zone Carbon Dioxide Concentration: If the highest zone CO2 concentration is greater than 10% (adj.) above setpoint for more than 30 min (adj) with critical zone minimum airflow reset to ventilation override max and AHU OA damper at full design minimum.
   3) Occupancy Sensor Alarm (when present):

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a) Falsely Occupied: Alarm if zone occupancy sensor output shows continuously occupied for more than 24 (adj.) consecutive hours, regardless of scheduled occupancy mode.
b) Falsely Unoccupied: Alarm if zone occupancy sensor output shows continuously unoccupied for more than 36 (adj) consecutive hours, accumulated only during scheduled occupied periods.

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	Hardware Points				Software Points					
Point Name	AI	AO	BI	BO	AV	BV	Sched	Trend	Alarm	Show On Graphic
Run Conditions										x
Schedule							x			Indirect, via link
Mode: Optimal Start / Occupied / Standby (1) / Unoccupied / Occ. Override (1)					x			x		x
EUMS Value (1)					x			x		x
Heating Setpoint										x
Oper. Input: Occ./ Stndby/ Unocc/ holiday					x					x
Effective					x			x		x
Cooling Setpoint										x
Oper. Input: Occ./ Stndby/ Unocc/ holiday					x					x
Effective					x			x		x
CO2 Setpoint (1)					x					x
Unocc Drift Setpoint					x					
Zone Sensors										
Zone Temp (2)	x							x		x
Zone Setpoint Adjust (1)	x									x
Zone Occ. Override (1)			x					x		x
Occupancy Sensor (1)			x							x
CO2 level (ppm) (1)	x									x
% Cooling Output (2)					x					
Zone Damper Position (3)		x						x		x
Airflow	x							x		x
% Airflow / Eff. Airlfow setpoint (3)					x					
Airflow Setpoints										x
Effective					x			x		x
Oper. Input:					x					
Occ Clg: Min/Max					x					
Occ Htg: Min/Max					x					
CO2 Demand. Vent: Max (1)					x					

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	Hardware Points				Software Points					
Point Name	AI	AO	BI	BO	AV	BV	Sched	Trend	Alarm	Show On Graphic
Occ Econ. Reset Min (1)					x					
Unocc Clg: Min/Max					x					
Unocc Htg: Min/Max					x					
Reheat Discharge Air Temp	×							×		×
~~Zone Damper~~	-	~~×~~	-	-	-	-	-	-	-	~~×~~
%Heating Output (total)					x					
Reheating Valve %		×						×		×
Perimeter Heating Valve (1)		× (4)		x (4)				×		×
~~Zone Override~~	-	-	~~×~~	-	-	-	-	~~×~~	-	~~×~~
~~Airflow Setpoint~~	-	-	-	-	~~×~~	-	-	~~×~~	-	~~×~~
~~Heating Mode~~	-	-	-	-	-	~~×~~	-	~~×~~	-	-
~~Schedule~~	-	-	-	-	-	-	~~×~~	-	-	-
~~Heating Setpoint~~	-	-	-	-	-	-	-	~~×~~	-	~~×~~
~~Cooling Setpoint~~	-	-	-	-	-	-	-	~~×~~	-	~~×~~
Alarms										
~~High~~ Zone Temp: Hi / Lo									× (A1)* or (A2)	x
~~Low Zone Temp~~	-	-	-	-	-	-	-	-	~~×~~	-
VAV Fault									× (A2)	x
High Reheat Discharge Air Temp								x	~~×~~x	
Reheat Valve close off failure								x	x	
Airflow HI / LO								x	x	
Unstable PID								x	x	
Commissioning (CX)									X (A3)	
Check Sizing								x	x	
High CO2								x	x	
~~Low Discharge Air Temp~~	-	-	-	-	-	-	-	-	~~×~~	-
~~Diagnostics~~									~~×~~	
~~**Totals**~~		~~**3**~~	~~**1**~~	~~**0**~~	~~**1**~~	~~**1**~~	~~**1**~~	~~**10**~~	~~**5**~~	~~**11**~~

~~**Total Hardware (8)**~~ ~~**Total Software (18)**~~

Notes:
(1) Only enable when present in specific application

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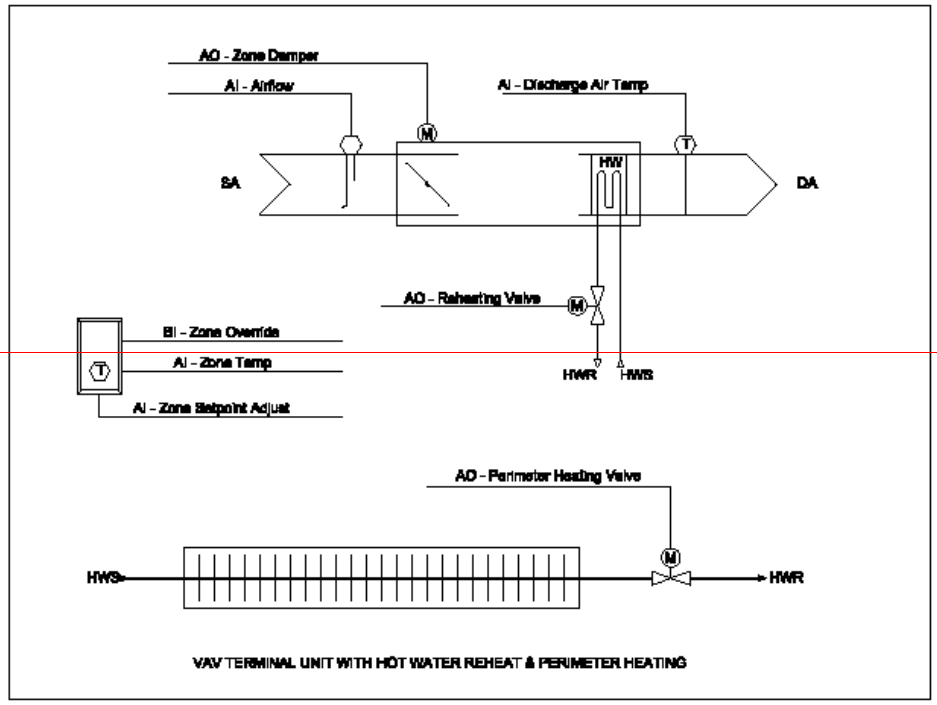
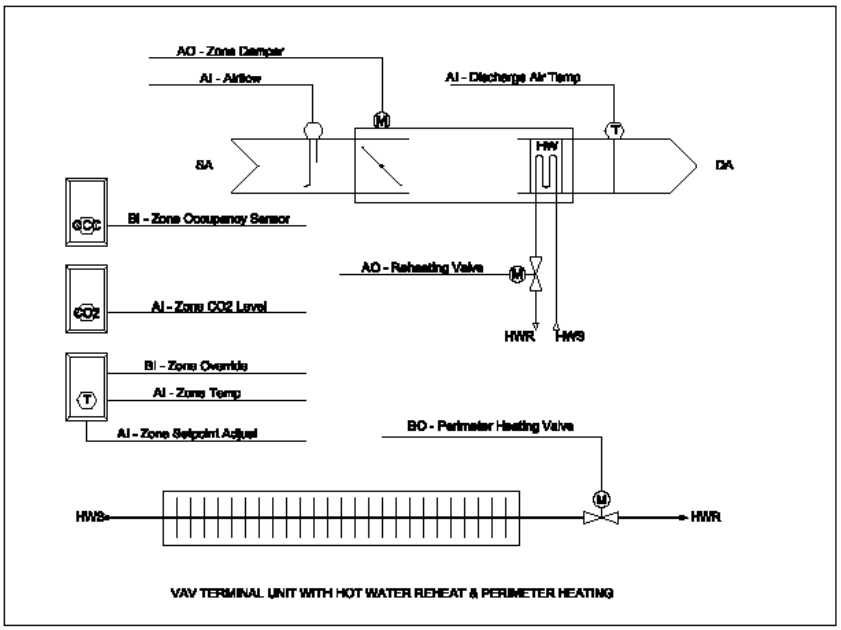
(2) Required link for interface to associated AHU for DAT reset
(3) Required link for interface to associated AHU for supply s.p. reset
(4) Proportional modulating control for perimeter heat can be either (AO) or (2) BO three point floating

Alarm Notification Class: (Refer to Div 25, Building Automation Systems (BAS), "Alarms")
The following default alarm notification classes are suggested unless application warrants more critical level. Coordinate project specific requirements with OPP Environmental Services and implement them prior to acceptance and turnover of system.
(A1) Critical (*If serving temperature sensitive, critical research space or areas with high risk of damage due to temperature extremes)
(A2) Maintenance
(A3) Commissioning



VAV TERMINAL UNIT WITH HOT WATER REHEAT & PERIMETER HEATING



VAV TERMINAL UNIT WITH HOT WATER REHEAT & PERIMETER HEATING

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