At *Section 25 90 00: Air Terminal Units –Single Duct VAV*:

[25 90 00 GUIDE SEQUENCES OF OPERATION](#)

Update the Document Table with new version as follows:

[Air Terminal Units - Single Duct Variable Air Volume with Hot Water Reheat & Perimeter Heating](#)	April ~~2010~~2013	Intended for typical single duct VAV terminal units. Includes requirements for dual maximum setpoint and discharge air temperature limiting controls.

Editor's Note: Replace the document in the hyperlink above with the updated document attached below. Keep the same name in the hyperlink. Just swap out the documents. The attached document is saved with "track features" showing. The version with all the additions and deletions shall be posted in the Revisions Archive to show the changes. The final document posted on the Standards page shall show only the final text by selecting "Accept all changes in Document" under the Review tab, and then saving it prior to being swapped out.

25 90 00
SEQOP-TU-VAV w HW

END of revision

Update Commentary:

Section was updated primarily for the following reasons:

1) *To emphasize the requirement for design professionals to define all airflow setpoints by moving it to the Notes at the beginning.*
2) *To revise the reheat valve, damper and finned tube sequences to improve the stability and reliability of the control operations.*
3) *To add chemical treatment subroutines*
4) *To redefine airflow and zone hot water requests*
5) *To redefine some alarming and alarm notification classes*
6) *To fix some formatting problems.*

PENN STATE
1855

Office of Physical Plant
Energy and Engineering Division
Engineering Services

The Pennsylvania State University
Physical Plant Building
University Park, PA 16802-1118

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~~
~~Revision: 1~~
~~Rev. Date: 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, point list, and generic schematics shall be carefully reviewed and edited with respect to application-specific project requirements and proposed modifications shall be reviewed with OPP Staff. OPP has standard programming logic corresponding to this guide sequence. Clearly indicate all deviations from written sequence so that intended modifications can be made in the program. Finalized versions shall be included on the project Contract Documents.*

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. ***The Design Professional shall define all airflow setpoints required by the point list for each individual terminal, (typically by schedule).*** *The CSC shall be directed to issue an RFI to obtain documented direction from Design Professional if not otherwise scheduled.*
     a. *Occ Clg: Min/Max*
     b. *Occ Htg: Min/Max*
     c. *CO_2 Demand. Vent: Max (1)*
     d. *Occ Econ. Reset Min (1)*
     e. *Unocc Clg: Min/Max*
     f. *Unocc Htg: Min/Max*

5. ***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.***

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, custom programmable Application Controllers as specified in Div 25, Building Automation Systems (BAS), Part 2.
2. All input airflow setpoints shall be clearly defined and scheduled by Design Professional for each terminal. Refer to Point List. The CSC shall obtain 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.

3. 2. 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.
4. 3. 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:
   - 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
           - By **Space Function** Type: group according to similar use for temperature setpoints, occupancy schedules and ventilation requirements including but not necessarily limited to:
           - Auditoriums
           - Classrooms (general purpose)
           - Conference Rooms
           - Corridors and Utility spaces
           - Dining
           - Kitchens
           - Laboratories
           - Libraries
           - Offices
           - Telecomm
           - Other

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

B. RUN CONDITIONS

    1. As Scheduled: The unit shall run according to a user definable time schedule in the following modes:
        a.   Occupied Mode:
        b.   Unoccupied Mode
        c.   Holiday Mode:
    2. <u>Zone Optimal Start:</u> An adaptive optimal start algorithm shall be used to minimize the energy required and warm-up or cool-down time during the unoccupied period, necessary to achieve zone 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.) <u>Emergency Demand Limiting:</u> **Refer to current revision of the** Enterprise Utility Management System (EUMS) Equipment Control Strategies **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 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. The CSC shall be directed to issue an RFI to obtain specific values for each setpoint for each terminal from Design Professional if not otherwise scheduled.
    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.
           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:
               Designer Application Note: The occupied heating sequence below has been revised from the previous version. There were significant control stability problems associated with the 3 stages and attempts to reset specific DAT temperature vs. less stringent temperature limiting. The new sequence has been developed to address those problems while still achieving the goal of minimizing reheat AND achieving more effective heat distribution and stable control.

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.~~

    (1) On a scheduled routine for chemical treatment of the hot water piping system the associated VAV terminal units with reheat will exercise its reheat valve to 100% full travel (open) for the flushing of chemical. Note!! This schedule is "Required" to live at a Building Level Controller.

b) ~~Stage 1. From 0-33% (adj) heating output signal, the terminal unit discharge temperature shall reset from inlet air temperature to approximately zone heating setpoint (supply neutral temperature air).~~ Zone Air Damper: The zone damper control shall be able to be user selected from the following three options.

    (1) Maintain Heating Airflow at Minimum Occupied Setpoint – No DAT Limiting: By maintaining the heating airflow at minimum, the resultant leaving air temperature is allowed to increase with no controlled upper limit to satisfy zone heating setpoint

        Designer Application Note: This option should typically only be used in supply air diffuser systems that are designed to effectively mix reheated supply air that is greater than 20 degrees above zone air temperature (such as with auto-changeover diffusers that automatically discharge heated air vertically down to the floor in heating mode rather than horizontally across the ceiling), This option is not to be used with typical horizontal discharge ceiling diffusers because heated air will stay stratified at the ceiling and not effectively heat the space.

    (2) Modulate Heating Airflow from Minimum to Maximum Heating Setpoint with DAT limiting – without perimeter finned tube: The heating airflow shall be limited to minimum occupied until zone heating demand output reaches 25%, and thereafter shall modulate up to maximum heating airflow setpoints until the zone is satisfied. Concurrently, the controller shall measure discharge air temperature and limit reheat control valve to maintain the discharge air temperature within range of 20°F (adj.) +/- 5°F (adj.) above zone heating setpoint.

        Designer Application Note: This option is intended to delay the opening of the air damper until the reheat valve receives a sufficient control signal to ensure hot water flow is available to start heating the air and then modulate reheated air in proportion to the zone heating demand output- while limiting its temperature with respect to the zone temperature to achieve better mixing and avoid stratification.

    (3) Modulate Heating Airflow from Minimum to Maximum Heating Setpoint with DAT limiting – with perimeter finned tube: The heating airflow shall be limited to minimum occupied until zone heating demand output reaches 40% (ensuring the finned tube is at full heating), and thereafter shall modulate up to maximum heating airflow setpoints until the zone is satisfied. Concurrently, the controller shall measure discharge air temperature and limit reheat control valve to maintain the discharge air temperature within range of 20°F (adj.) +/- 5°F (adj.) above zone heating setpoint.

        Designer Application Note: This option is intended to delay the opening of the air damper until the perimeter finned tube is providing maximum capacity, and only then if unable to satisfy space temperature, modulate reheated air in proportion to the zone heating demand output - while limiting its temperature with respect to the zone temperature to achieve better mixing and avoid stratification.

c) Perimeter Heating Coil Valve (where applicable); From 0-~~33~~30% (adj) ~~loop signal~~zone heating demand output, the controller shall concurrently modulate the

perimeter heating coil valve from 0-100% open ((2) DO, three point floating control is acceptable).

(1) Perimeter Draft Barrier Mode: Upon reaching the space heating temperature setpoint, the perimeter heating valve will maintain a minimum control signal through an OA reset function ranging its minimum valve position from 0-50% (adj.) based on OA temperature between 60-40°F (adj.) OAT. The perimeter heating valve shall be allowed to go fully closed once space temperature rises to within 2 °F (adj) of cooling setpoint in order to avoid simultaneous heating and cooling.
Designer Application Note: This feature is intended to offset sources of local thermal discomfort due to colder surfaces and/or drafts at the perimeter without causing the zone to go back into cooling mode.

(2) On a scheduled routine for chemical treatment of the hot water piping system the associated Perimeter Hot Water control valve terminal will exercise to 100% full travel (open) for the flushing of chemical. Note!! This schedule is "Required" to live at a Building Level Controller.

b) ~~Stage 2. From 33-67% (adj) heating output signal, the terminal unit discharge temperature shall reset to a maximum of 20°F (adj.) above zone heating setpoint while maintaining minimum occupied airflow.~~

c) ~~Stage 3: From 67-100% (adj) heating output signal, the zone airflow shall modulate from the occupied minimum to 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, the unit shall operate similar as described in the <u>occupied</u> 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, <u>Building Automation Systems (BAS)</u>, Part 2, SENSORS for sensor requirements.

c. Unoccupied:

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.

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.

4. Zone Airflow Requests (used for AHU Fan SP optimized reset): shall be initially defined as described below.
    a. If zone cooling output is greater than 99% and actual/setpoint airflow ratio is less than than 95%), then send cooling (airflow) request.
    b. If zone damper is throttling closed - below 90% open and actual/setpoint airflow ratio is greater than 95%, then no cooling airflow request).

5. Zone HW Requests (used for pump DP optimized reset): shall be initially defined as follows:
    a. Due to the DAT limiting feature, the reheat valve position does not directly correspond to the zone heating PID output. Therefore the controller shall compare and determine that the reheat HW control valve output must be equal to its maximum calculated value for a minimum of 20 minutes (adj.) in order to send a HW heating request to pump system.

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.
2. Room Temperature Sensors:
    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, +/-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 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 CONTROLLER

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 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 otherwise 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 CO_2 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 CO_2 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 CO_2 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 CO_2 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) CO_2 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 CO_2 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 INTERFACE WITH BUILDING CONTROLLER

1. At a minimum, all VAV terminal units with an associated reheat coil valve and perimeter heat valve served by a hot water heat system shall be interfaced with the Building Controller to perform the Building Chemical Treatment routine as described above.

F.G.   MONITORING AND ALARMING

1. Alarms shall be provided as follows:

    a. Zone Temperature Failure (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 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 5°F (adj.) for a minimum 60 minutes (adj) continuously.
    b. VAV Terminal Unit FaultAlarming: When the associated AHU fan status is on, the following monitoring and alarm functions shall initiate a common "VAV FAULT"the following alarms displayed at the BAS workstation.   At the terminal controller level, each alarm shall be labeled independently for easy, diagnostic purposes.
        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) Reheat valve close off failure: If terminal unit reheat discharge temperature is greater than assocated AHU DAT by more than 3°F (adj.) when zone heat output is at 0% output for a minimum 30 minutes (adj) continuously.
        3) Airflow Diagnostic Alarm: When cooling output is 50% or greater,
            a) High Airflow: If the zone airflow is greater than the setpoint by 25% (adj.) a minimum 120 minutes (adj) continuously..
            b) Low Airflow: If the zone airflow is less than the setpoint by 25% (adj.) a minimum 120 minutes (adj) continuously. .
        4) Unstable PID loop: If any PID loop continues to cycle its output more than 40% of its range (adj.) 3 times (adj.) in any 60 minute internal.
    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):
            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.

Point Name	Hardware Points				Software Points					Show On Graphic
	AI	AO	BI	BO	AV	BV	Sched	Trend	Alarm	
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										×
Oper. Input: Occ./ Stndby/ Unocc/ holiday					x					x
Effective					x			x		x
Cooling Setpoint										×
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)	×							×		×
Zone Setpoint Adjust (1)	×									×
Zone Occ. Override (1)			×					×		×
Occupancy Sensor (1)			x							x
CO2 level (ppm) (1)	x									x
% Cooling Output (2)					x					
Zone Damper Position (3)		×						x		×
Airflow	×							×		×
% Airflow / Eff. Airlfow setpoint (3)					x					
Airflow Setpoints										×
Effective					x			x		x
Oper. Input:					x					
Occ Clg: Min/Max					x					
Occ Htg: Min/Max					x					
CO2 Demand. Vent: Max (1)					x					

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

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

CR   HVAC Critical (*If serving temperature sensitive, critical research space or areas with high risk of damage due to temperature extremes)
G   HVAC General
M   HVAC Maintenance

VAV TERMINAL UNIT WITH HOT WATER REHEAT & PERIMETER HEATING
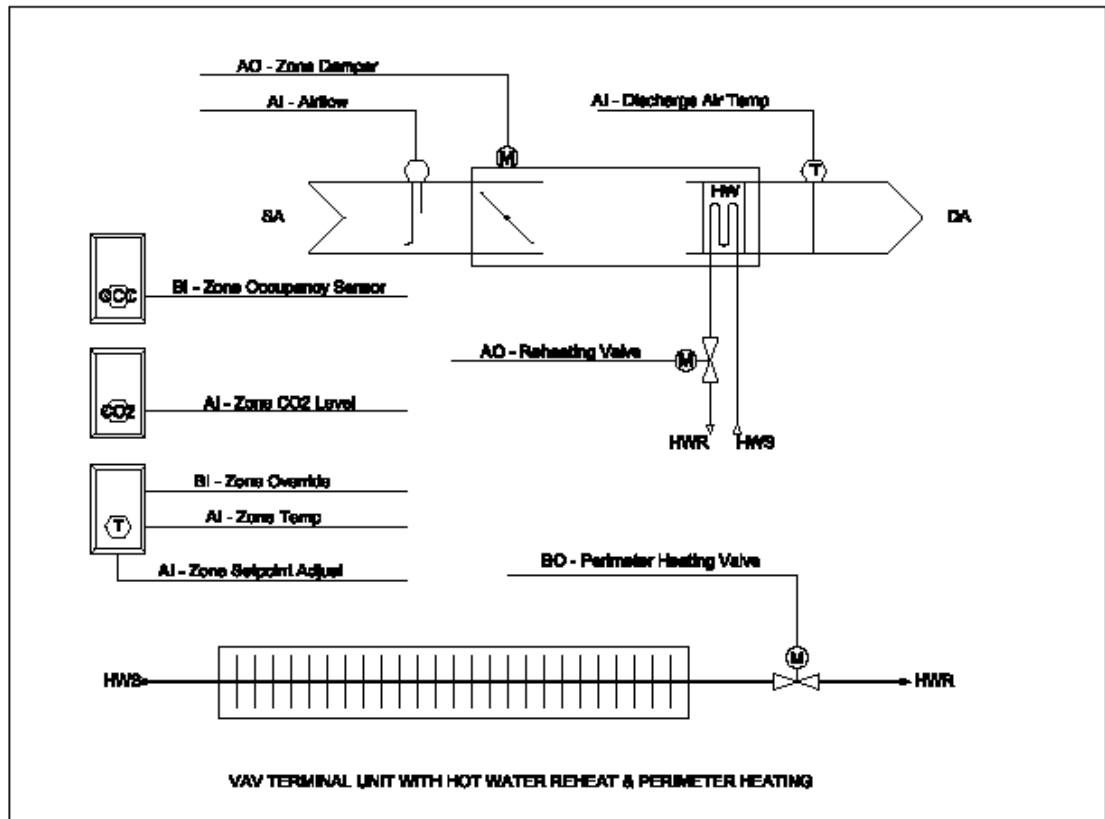
variable_air_volume_
-_terminal_unit.dwg

END