

AUTOMATIC TEMPERATURE CONTROL SYSTEM REPLACEMENT AT OAK VIEW ELEMENTARY SCHOOL

5400 Sideburn Rd
Fairfax, VA 22032

(FAIRFAX COUNTY PUBLIC SCHOOLS)

CONTRACT # MMB-074-24

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PROJECT TITLE

AUTOMATIC
TEMPERATURE
CONTROL
SYSTEM
REPLACEMENT

**OAK VIEW
ELEMENTARY
SCHOOL**

5400 Sideburn Rd
Fairfax, VA 22032

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DATE 4/3/2024

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REVISIONS

<u>NO.</u>	<u>DATE</u>	<u>DESCRIPTION</u>

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COVER SHEET

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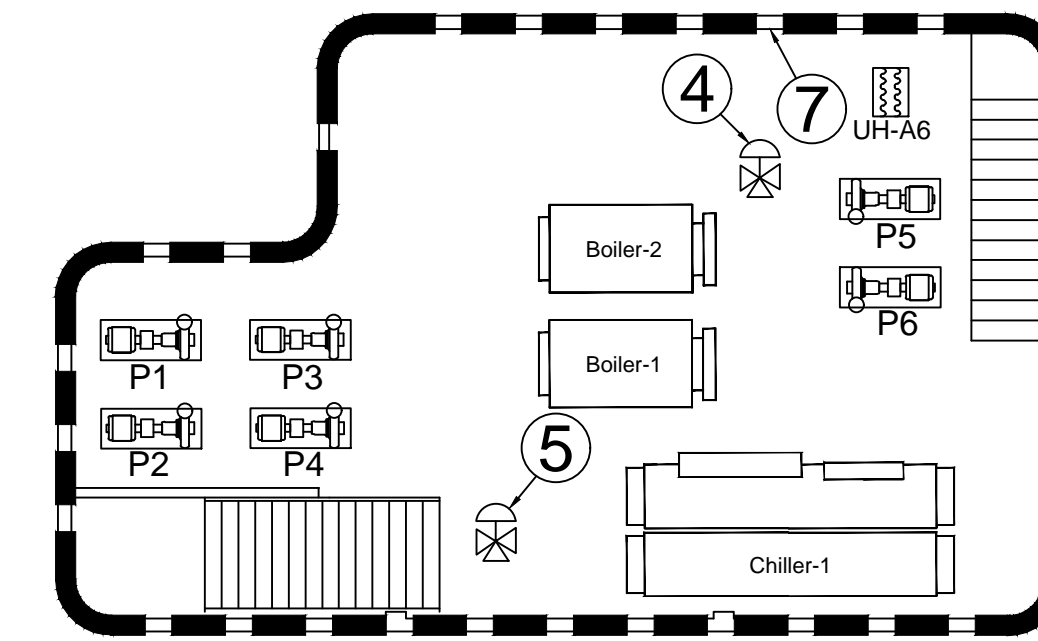
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ZONED FLOOR 1 PLAN AND HVAC LAYOUT

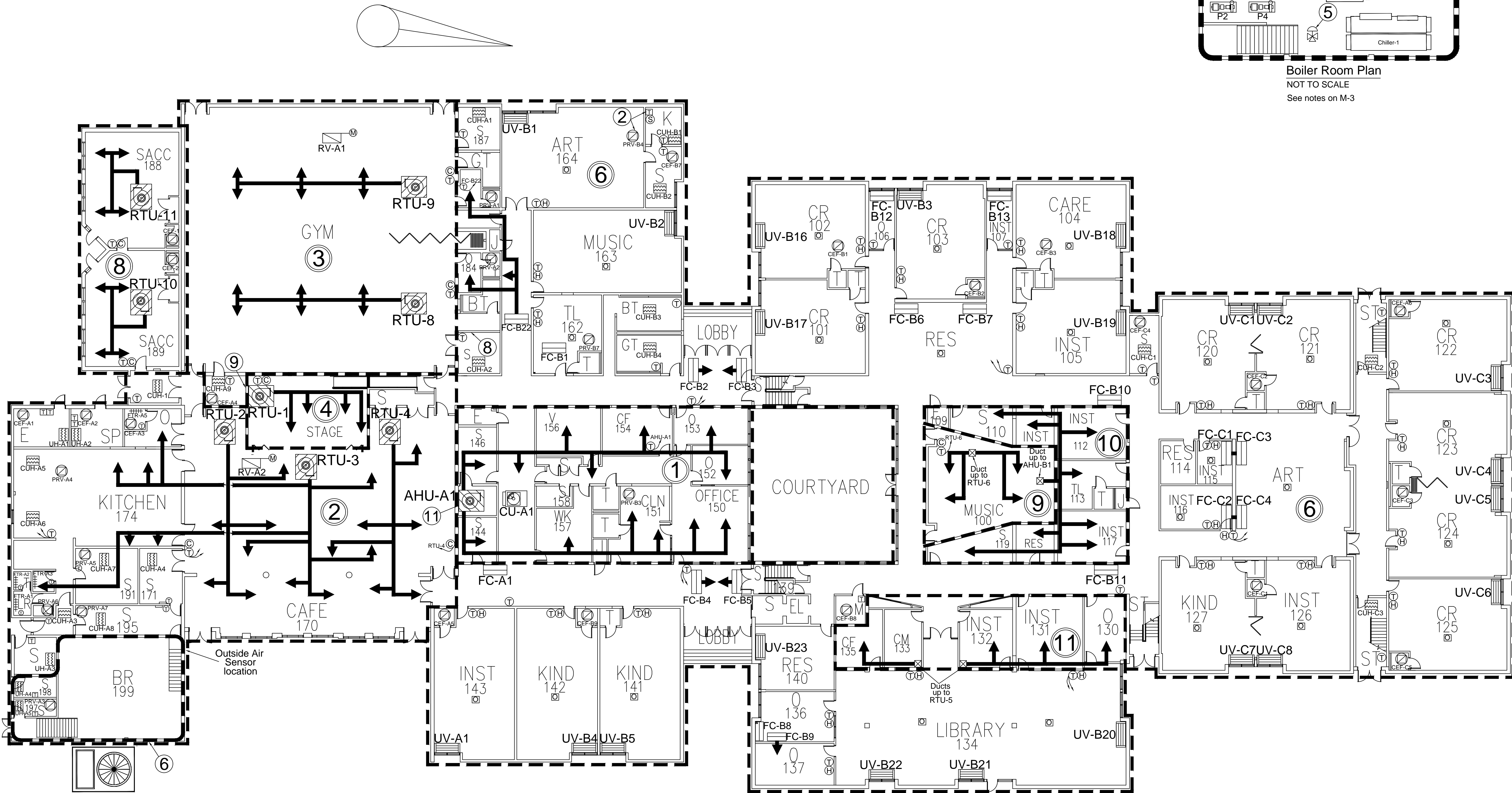
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Boiler Room Plan

NOT TO SCALE

See notes on M-3



FIRST FLOOR PLAN

PROJECT TITLE

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ZONED FLOOR 2
PLAN AND HVAC
LAYOUT

DRAWING NUMBER

ZONES - AREA SERVED

- 1 - ADMIN OFFICES
- 2 - CAFETERIA/KITCHEN
- 3 - GYMNASIUM
- 4 - STAGE
- 5 - CLASSROOM 228
- 6 - CLASSROOMS
- 7 - CLASSROOMS
- 8 - SACC
- 9 - MUSIC ROOM 100
- 10 - VARIOUS SPACES
- 11 - LIBRARY OFFICES

EQUIPMENT CONTROLLED BY BAS

- AHU - A1; PRV - B3
- RTU - 2, 3, 4; CEF - A3, PRV - A5, A6, A7; CUH - 1, A3, A4, A5, A6, A7, A8
- RTU - 8, 9; PRV - A1, A2; CUH - A1, A2, A9
- RTU - 1
- RTU - 7
- CEF - A5, A6, B1, B2, B3, B7, B9, C1, C2, C3, C4, C5; PRV - A1, A2, B6, B7, C1; CUH - A1, A2, B1, B2, B3, B4, C1, C2, C3
- CEF - C6, C7; PRV - B1, B2, B5, C2, C3, C4; CUH - B5, B6, B7, B8, C4
- RTU - 10, 11; CEF - 1, 2
- RTU - 6
- AHU - B1
- RTU - 5

MAIN HOT WATER SYSTEM SERVES ZONES 1, 2, 6, 7, 10
ACTIVATE CHILLER-1 FOR ZONES 6, 7

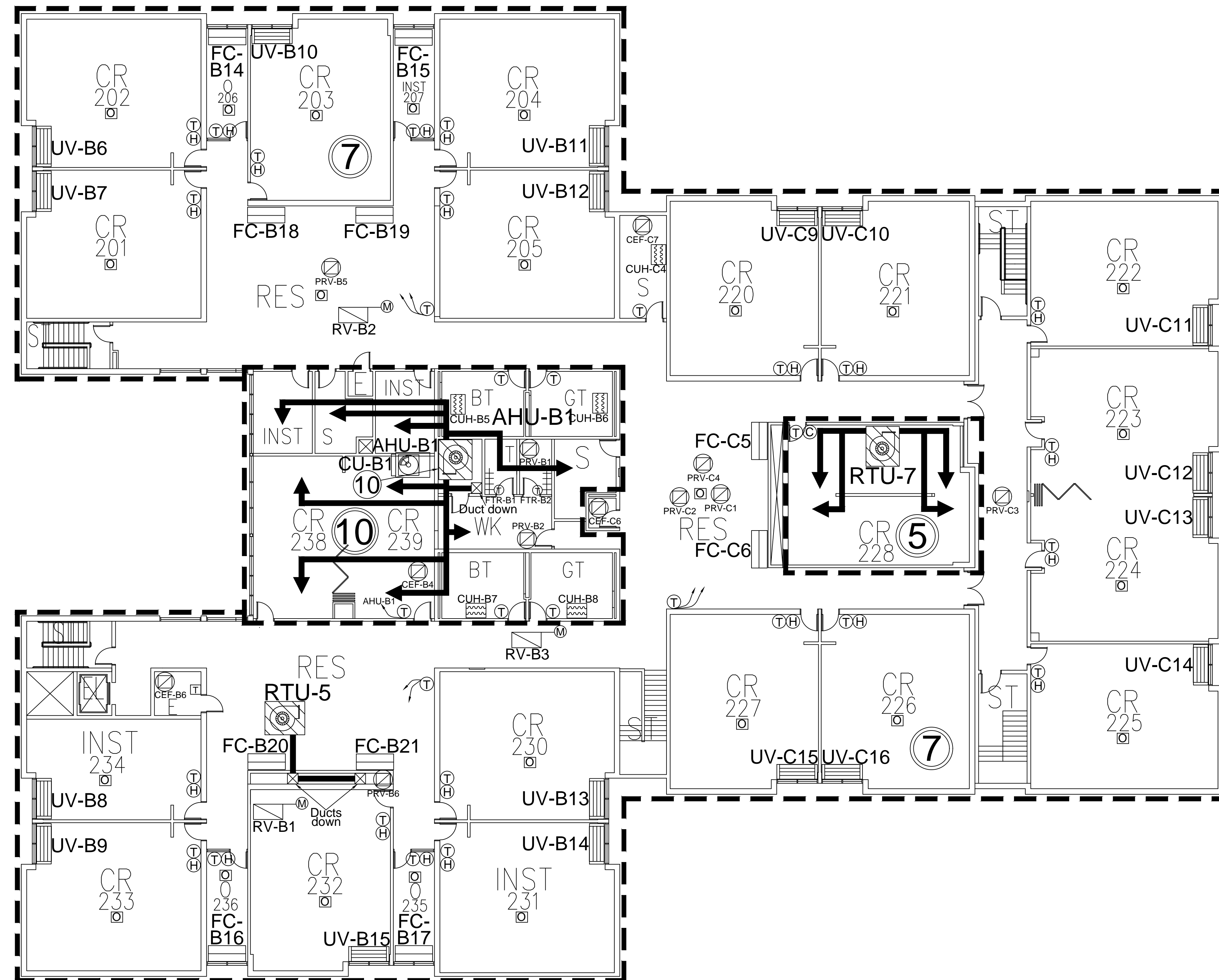
SYMBOLS AND ABBREVIATIONS

- RTU - ROOF TOP UNIT
- UV - UNIT VENTILATOR
- FC - FAN COIL UNIT
- PRV - POWER ROOF VENTILATOR; CEF - CEILING EXHAUST FAN
- CUH/UH - CABINET UNIT HEATER/UNIT HEATER
- BAS - BUILDING AUTOMATION SYSTEM
- SPACE TEMPERATURE SENSOR (BAS)
- LINE VOLTAGE THERMOSTAT
- CO2 - CARBON DIOXIDE SENSOR
- OCCUPANCY SENSOR
- ① ZONE - HVAC CONTROL ZONE NUMBER
- SPACE HUMIDITY SENSOR (BAS)
- FTR - FINNED TUBE RADIATOR
- MRV - RELIEF VENT WITH MOTORIZED DAMPER

Project Notes:

- ① For all exhaust fans controlled by BAS and LVT: keep existing wall switch in place if applicable.
- ② Install line voltage motor rated on/off switch in parallel with new LVT to control PRV- B4 on wall in kiln room, install necessary power conductors and conduit; remove existing control relay and complete power circuit
- ③ For all equipment controlled by LVT: provide and install new LVT, EMT conduit, and power conductors from LVT up to the breaker if necessary; remove existing BAS control relay, complete power circuit
- ④ Replace existing 3-way HW mixing valve and actuator with new valve and electronic spring return actuator.
- ⑤ Replace existing 3-way condenser water diverting valve and actuator with new valve and electronic spring return actuator.
- ⑥ Provide and install new cooling tower single point power control panel with a VFD at the indicated location. The panel shall conform to section 2.13 of 15905 Variable Frequency Drive specification. Replace existing disconnect with new.
- ⑦ Install control panels for Hot Water System and Chilled Water System, RTUs - 1, 2, 3, 4 at the indicated location.
- ⑧ Install control panels for RTUs - 8, 9 at the indicated location.
- ⑨ Install control panel for RTUs - 10, 11 at the indicated location.
- ⑩ Install control panels for AHU - B2; RTUs - 5, 6, 7 at the indicated location.
- ⑪ Install control panels for AHU - A1 at the indicated location.
- ⑫ Connect each RTU and Main Plant Ethernet network controller to a designated FCPS WAN Ethernet port on the drop provided and installed by FCPS adjacent to control panels at the locations indicated herein.
- ⑬ Contractor shall make information regarding MAC addresses pertinent to controllers installed within each control panel available within the panel.

- ⑭ All the work during the school year shall be performed after school hours. The start time for evening shifts will vary based on a particular school's release time. Contractor's and subcontractor's personnel shall work weekly 5-day 8-hour schedules. The approval of 4-day 10-hour workweek may be requested in writing to the FCPS project manager, but the approval is not guaranteed.



SECOND FLOOR PLAN

PROJECT TITLE

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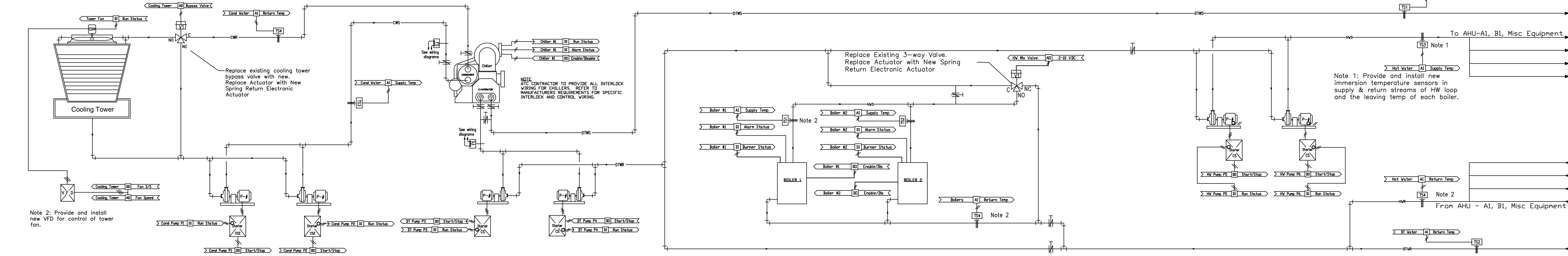
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DRAWING TITLE

CENTRAL PLANT

DRAWING NUMBER

M-4



Central Hot Water Heating System and Chilled Water System Control Sequence

General: BAS shall control the dual temperature water system which includes water cooled Chiller, two Boilers, two dual temperature water pumps, two condenser water pumps, two hot water pumps, main three way hot water mixing valve, cooling tower bypass valve, and a cooling tower fan with speed control, and provide monitoring and diagnostic information for management purposes.

Cooling/Heating Mode Enable: Cooling mode and heating mode shall be enabled manually by the system operator at the operator interface via a virtual point, and shall require an appropriate level password to perform this function. The BAS shall prevent both modes from being on simultaneously, but both modes may be off simultaneously. Upon enabling either mode, the following message shall appear on the screen: "WARNING - You are enabling a mode change. Ensure that all proper valves and devices have been placed in the proper position and checked prior to the mode change." This message must be acknowledged prior to the BAS enabling the changeover.

Temperature Safety: BAS shall not allow a mode change from heating to cooling until the dual temperature return temperature falls below the temperature safety setpoint of 95°F (adj.).

Dual Temperature Water Pump Control

- 1) Lead primary pump shall run continuously whenever Hot Water System or Chilled Water System is enabled.
- 2) BAS shall prove operation of the pump however, the request for the pump shall stay active while it is failed. Upon failure of the lead pump, the lag pump shall be started.
- 3) In cooling mode, the lead pump shall continue to run for 3 minutes (adj.) after the cooling system has been disabled.
- 4) The lead/lag pump sequence shall rotate weekly
- 5) Log Total Runtime Hours for each pump by monitoring the pump's run status. The Runtime Hours variables shall be operator resettable

Condenser Water Pump Control

- 1) When the Chilled water system is enabled, the lead condenser water pump shall start and run continuously.
- 2) BAS shall prove operation of the pump. If, after 30 seconds, the pump fails to start, the BAS shall generate a failure alert and start the lag condenser water pump. However, the request for the failed pump shall stay active (as well as the alarm) until the pump can be serviced.
- 3) The pump shall continue to run for 3 minutes (adj.) after the chiller has shut down.
- 4) Log Total Runtime Hours for each Pump by monitoring the pump's run status. The Runtime Hours variables shall be Operator Resettable.
- 5) The lead/lag pump sequence shall rotate weekly

HW Pump Control

- 1) Lead pump shall run continuously whenever the hot water system is enabled.
- 2) BAS shall prove operation of the pump. If, after 30 seconds (adj.), the pump fails to start or fails at any time after, the BAS shall generate an alarm and start the lag pump.
- 3) The lead pump shall continue to run for 3 min. (adj.) after the heating system has been disabled. The pumps shall remain off for at least three minutes before being allowed to restart.
- 4) The lead/lag pump sequence shall rotate weekly.
- 5) Log Total Runtime Hours for each pump by monitoring the pump's run status. The Runtime Hours variables shall be operator resettable

Chilled Water System Enable/Disable:

- 1) Chilled Water System shall be Enabled when Cooling mode is enabled AND outside air temperature is above 60°F (adj.) (with a 5°F differential (adj.)) AND when any cooling request is received continuously for 5 min (adj.) OR whenever manually enabled by the operator at the operator interface via a graphic icon.

Chiller Start Sequence

- 1) On a request for the Chilled System to start and proof of DT Pump status AND CW Pump Status, the BAS shall Enable the Chiller to start.
- 2) BAS shall monitor the Chiller status and the Chiller panel alarm point and if the alarm point is active, generate a "Chiller Failure" alarm message. Also, the BAS shall monitor DT Supply Temperature and shall generate an Alarm if the DT Temp stays above 50°F (adj.) for at least 20 minutes while the Chiller is enabled.

Chiller Stop Sequence

- 1) When the Chiller is no longer needed, the BAS shall remove the Enable command and allow it to stop under its own control. The Chiller must remain off for at least five minutes before being allowed to restart.
- 2) If a loss of dual temperature or condenser water pump status is detected, the Chiller shall be immediately shut down.

Chilled Water Temperature Control

- 1) The chilled water temperature shall be controlled by the individual Chiller.

Cooling Tower Fan & Bypass Valve Control

- 1) Tower Bypass control - BAS shall monitor the condenser water supply (CWS) temp (from tower) and reset the tower bypass valve proportionally as follows: 100% bypass at 65°F (adj.) and below to 0% bypass (100% to tower) at 75°F (adj.) and above.
- 2) Tower Fan Control - On a rise in condenser water supply temp above the CWS setpoint of 80°F (adj.), the tower fan shall be activated. Tower Fan VFD speed shall be modulated in a PID loop to maintain a CWS setpoint of 82°F (adj.). On a fall in CWS of 4°F below the CWS setpoint, the tower fan shall be cycled off.
- 3) When the chiller is not Enabled by BAS, the cooling tower fan shall be commanded off.
- 4) Log Total Runtime Hours for the cooling tower fan by monitoring the run status.

Hot Water System Enable:

- 1) Hot Water System shall be enabled when Heating mode is enabled AND the outside air temperature is below the Heat Lockout setp of 55°F (adj.) (with a 5°F differential (adj.)) AND when 1 (adj.) heating request is received continuously for 5 min (adj.).
- 2) OR whenever Heating mode is enabled AND the outside air temperature is below the continuous 24/7 run setp of 38°F (adj.).
- 3) OR whenever manually overridden locally on site or remotely from FCPS Energy Management central office by an operator with the appropriate password level.

Boiler Start Sequence

- 1) Whenever the Hot Water System is Enabled, the BAS shall Enable the boilers regardless of the status of the hot water pumps.

Boiler Stop Sequence

- 1) When boilers are no longer needed, the BAS shall Disable the boilers and allow them to stop under their own controls

Proof Of Boiler Operation

- a) BAS shall prove the operation of the boilers via boiler alarm points. When a boiler is assessed as failed, an alarm shall be annunciated. The following conditions shall result in the assessment that the boiler has failed:
 - 1) Closure of boiler failure input

Heating Water Temperature Control

- a) BAS shall reset the leaving hot water supply of the 3-way mixing valve to maintain heating water supply as follows: The heating water supply setpoint shall be reset with outdoor air temperature with all values being adjustable. The setpoint shall be reset from 120°F at or above 60°F to 180°F at or below 20°F.
- b) BAS shall modulate the 3-way mixing valve normally open to boilers. The mixing valve output shall be limited via a ramp restrictor to open and close within adjustable rate limits of 15 minutes for full stroke. N.O. mixing valve shall modulate based on the lower output of the following two loops.
 1. Via a direct acting PID loop to maintain hot water temperature at setpoint.
 2. Via a direct acting PID loop to maintain hot water minimum return temperature of 110°F (adj.)

Hardwired Points

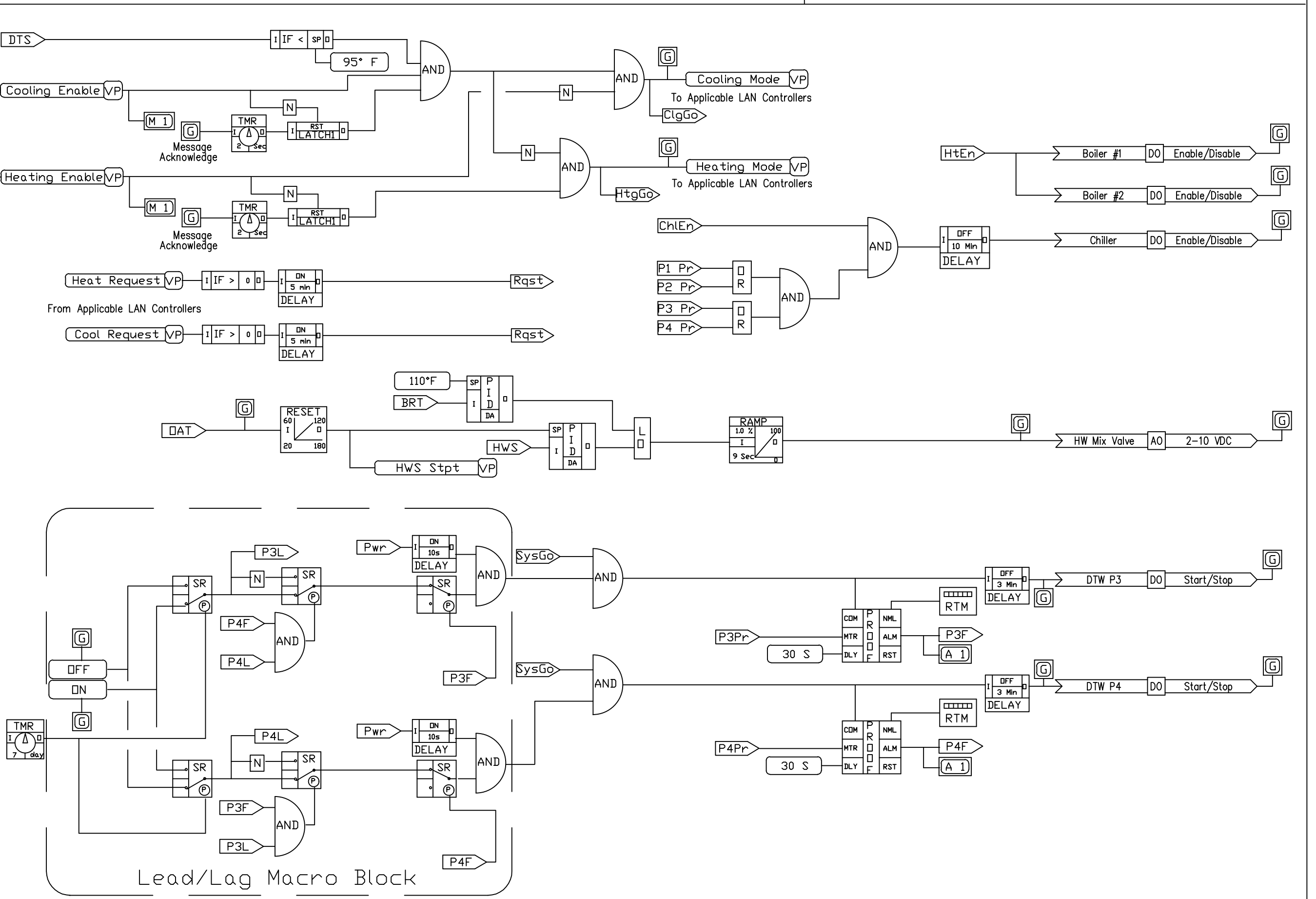
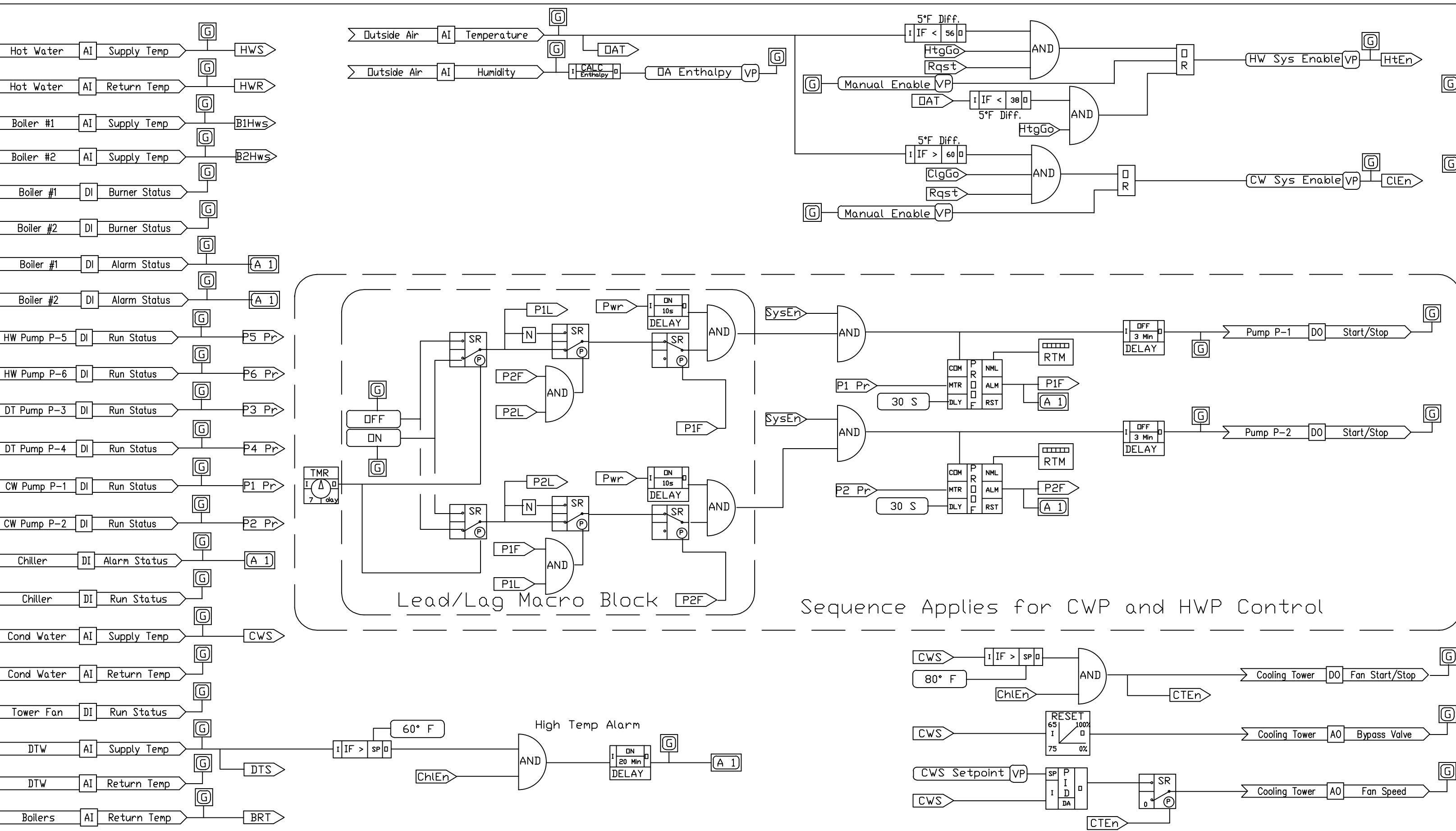
Universal Inputs (Sensors):	Digital Outputs (Control):
1. Chiller Run Status	1. Chiller Enable/Dis
2. DTW Supply Temperature	2. DTW Pump P-3 S/S
3. DTW Return Temperature	3. DTW Pump P-4 S/S
4. Chiller Alarm Status	4. Cond Pump P-1 S/S
5. DT Pump P3 Run Status	5. Cond Pump P-2 S/S
6. DT Pump P4 Run Status	6. Cooling Tower Fan S/S
7. Cooling Tower Fan Status	7. Boiler #1 Enable
8. Clg Twr Leaving (Sup)/Temp	8. Boiler #2 Enable
9. Clg Twr Entering (Ret)/Temp	9. HW Pump P-5 Start/Stop
10. Cond Pump P1 Run Status	10. HW Pump P-6 Start/Stop
11. Cond Pump P2 Run Status	
12. Boiler #1 Burner Status	Analog Outputs (Control):
13. Boiler #2 Burner Status	1. Main HW 3-Way Valve
14. Boiler #1 Alarm Status	2. Cooling Tower Bypass Valve
15. Boiler #2 Alarm Status	3. Tower Fan VFD Control
16. HW Supply Temperature	
17. HW Return Temperature	
18. HW Pump P5 Run Status	
19. HW Pump P6 Run Status	
20. Boiler #1 Supply Temp	
21. Boiler #2 Supply Temp	
22. Boilers Return Temperature	
23. Outside Air Temperature	
24. Outside Air Humidity	

Virtual Points

Software Flags (Binary Var.) & Setpoints (Analog Var.)

1. Summer/Winter Mode	16. Cond Lead Pump
2. CHW System Enable	17. Cond Pump P1 Fail Flag
3. DTW Lead Pump	18. Cond Pump P2 Fail Flag
4. DTW Pump P3 Fail Flag	19. Cond Pump P1 Runtime (Hrs)
5. DTW Pump P4 Fail Flag	20. Cond Pump P2 Runtime (Hrs)
6. DTW Pump P3 Runtime (Hrs)	21. CHW H Temp Alarm Setp
7. DTW Pump P4 Runtime (Hrs)	22. Chiller Runtime Hours
8. Boiler System Enable	23. Cooling Request
9. HW Lead Pump	24. OA CHW System Enable Setpoint
10. HW Pump P5 Fail Flag	25. OA HW System Enable Setpoint
11. HW Pump P6 Fail Flag	26. OA Htg Continuous Run Setp
12. HW Pump P5 Runtime (Hrs)	27. Heating Request
13. HW Pump P6 Runtime (Hrs)	28. Hot Water Supply Temp Setpoint
14. HW Low Temp Alarm Setp	29. Temperature Safety Setpoint
15. Outside Air Enthalpy (Calculated)	

All Above Points Shall be displayed on System Graphic
Summer/Winter Mode shall be displayed on graphic as read only point
All Above Points Shall be Accessible by User
All Above Points Shall be Trended



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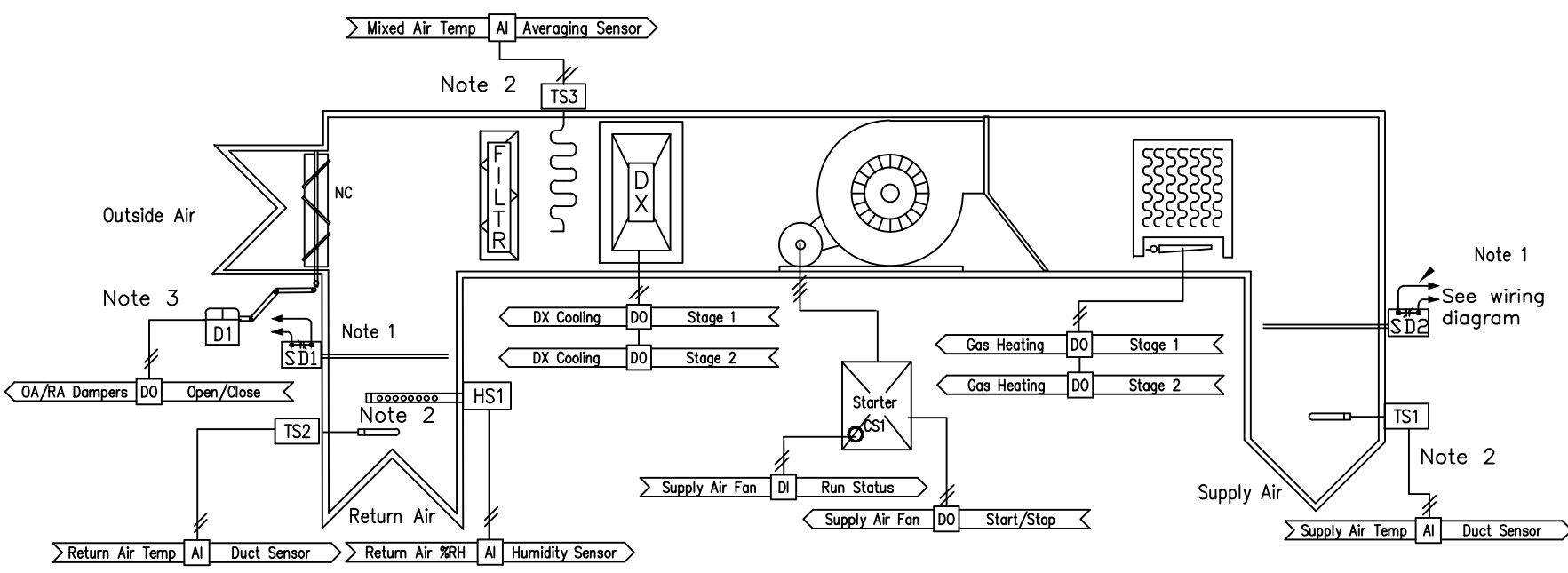
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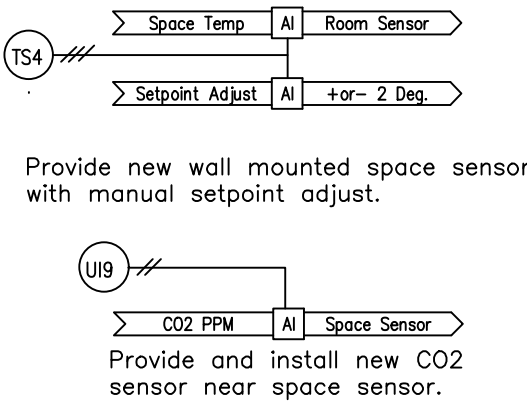
RTU-1, 3, 6, 7 CONTROL DIAGRAMS

DRAWING NUMBER

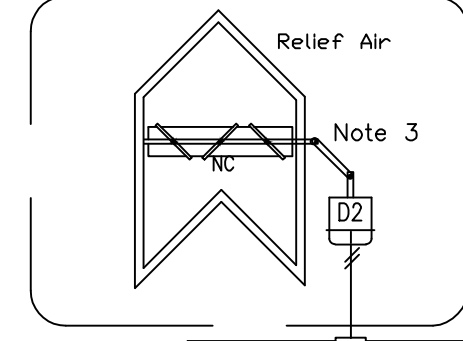
M-5



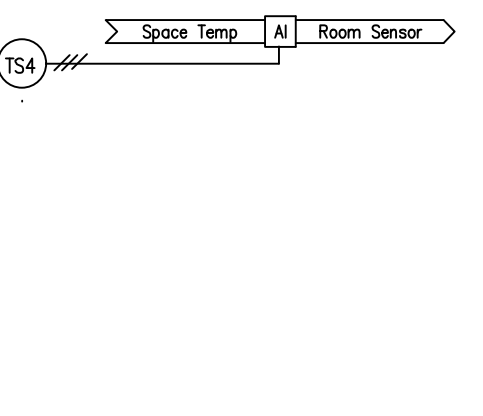
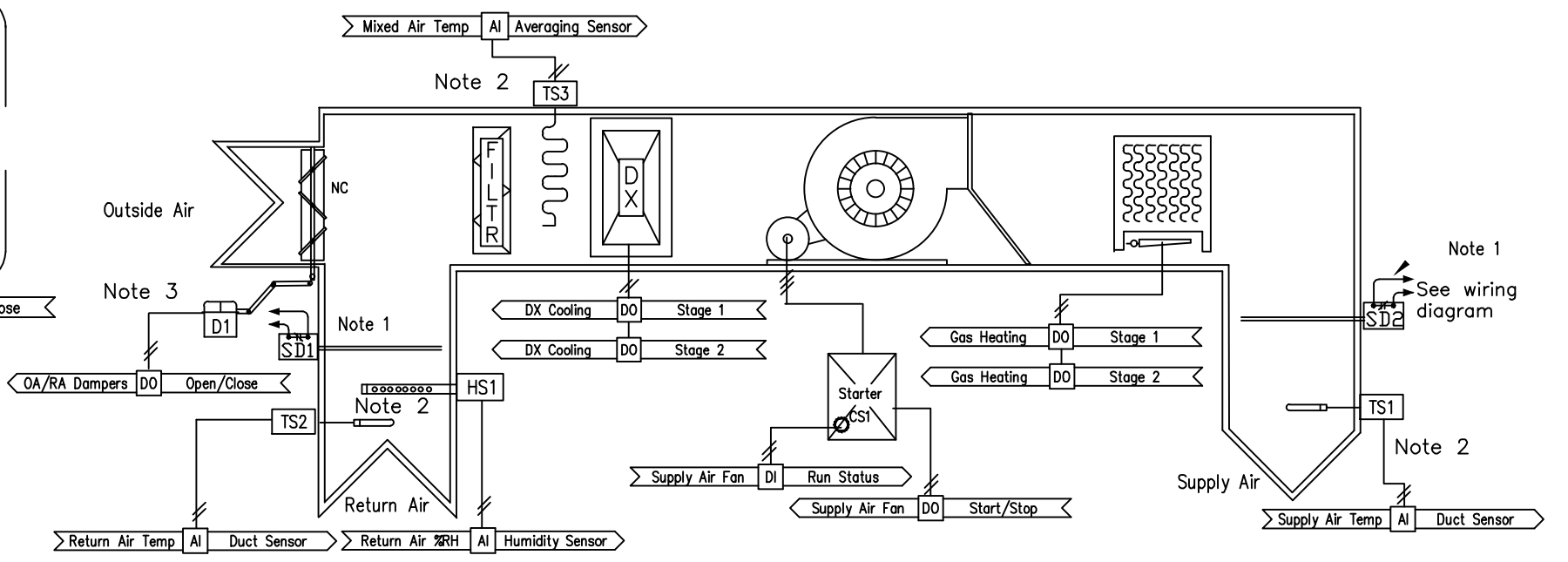
Note 3: Replace damper actuators with new electronic actuators. Clean & lubricate damper linkage, set minimum position and verify proper operation of dampers.
Note 2: Provide and install new Return & Supply Air temperature & Return Air humidity duct sensors and Mixed Air averaging sensor.
Note 1: Confirm (or rewire) interlock through existing Safety devices to shut down unit Fan(s). Wire associated unit control devices such as actuators & relays to go to their setback (or FAIL) positions whenever the Supply Fan is Off - OA damper closed, DX cooling off & gas heat off.



Provide new wall mounted space sensor with manual setpoint adjust.
Provide and install new CO2 sensor near space sensor.



Note 3: Replace damper actuators with new electronic actuators. Clean & lubricate damper linkage, set minimum position and verify proper operation of dampers.
Note 2: Provide and install new Return & Supply Air temperature & Return Air humidity duct sensors and Mixed Air averaging sensor.
Note 1: Confirm (or rewire) interlock through existing Safety devices to shut down unit Fan(s). Wire associated unit control devices such as actuators & relays to go to their setback (or FAIL) positions whenever the Supply Fan is Off - OA damper closed, DX cooling off & gas heat off.



Note 3: Replace damper actuators with new electronic actuators. Clean & lubricate damper linkage, set minimum position and verify proper operation of dampers.
Note 2: Provide and install new Return & Supply Air temperature & Return Air humidity duct sensors and Mixed Air averaging sensor.
Note 1: Confirm (or rewire) interlock through existing Safety devices to shut down unit Fan(s). Wire associated unit control devices such as actuators & relays to go to their setback (or FAIL) positions whenever the Supply Fan is Off - OA damper closed, DX cooling off & gas heat off.

RTU w/DX, Gas Heat, Min OA & CO2 Control Sequence

General: This unit shall have its own Control Module and be fully controlled by the BAS. The unit control logic strategies shall include:

- a) Scheduled Occupancy
- b) Sequenced heating and cooling control
- c) Outside air intake control based on CO2 levels
- d) Night (unoccupied) setback

Supply Air Fan Control: The BAS shall control the starting and stopping of the supply air fan as follows:

- 1 - During the scheduled Occupied period the unit fan shall be commanded to run continuously.
- 2 - BAS shall monitor fan status and generate an alarm if the fan fails to start as commanded after a 30 second delay or fails anytime thereafter. However the request for the failed fan shall remain active until the unit can be serviced. The BAS shall use the fan status to accumulate resettable runtime.
- 3 - The unit fan shall be commanded Off when:
 - a) the Occupied period is over AND the unit is not heating or cooling to maintain night Setup/Setback setpoints
 - 4 - Once the Fan is shut down it must remain off for at least 3 minutes (Adj.) prior to being restarted (note: Minimum Off, Not Delay Start).
 - 5 - The unit may be overridden On or Off via operator command from a remote central location or by the BAS controller on site or BAS graphics.

Min OA Damper control: BAS shall control OA damper as follows:

- 1 - When the Unit is de-energized the OA damper shall be commanded to its closed position.
- 2 - When the Unit is energized to maintain unoccupied setpoints, the damper shall remain closed.
- 3 - During the occupied period AND when the space CO2 level rises above the setpoint of 500ppm (adj.), the OA damper shall be commanded open to its preset minimum position.
- 4 - The OA Damper shall close if the mixed air temperature falls below 48°F.

Space Temperature Control: Control space temperature by cycling the heating/cooling on the unit as needed. Three operator adjustable setpoints shall apply. Occupied Cooling (74°F), unoccupied setback heating (55°F), and unoccupied setup cooling (85°F). These three values shall be the only values changed by the operator to adjust space temperatures. The Occupied Heating setpoint shall be the Cooling Setpoint minus 3°F.

Heating Section: On a fall in space temperature below the heating setpoint, the BAS shall activate the 1st stage of gas heat. When the temperature rises to above the heating setpoint plus 1°F the heat shall de-activate. If the space temp falls to 1°F below the heating setpoint the BAS shall activate the 2nd stage of gas heat. On a rise in space temp to above the heating setpoint the 2nd stage heat shall de-activate. There shall be a minimum of five minute intervals between activating and de-activating the heating stages.

Cooling Section: On a rise in space temperature above the cooling setpoint and the outside air temperature is above the DX cooling lockout setpoint (55°F OA (adj.)), the BAS shall activate the 1st stage compressor. When the temperature falls one degree below the cooling setpoint the cooling shall be de-activated. If the temperature rises to above 1°F of the cooling setpoint the 2nd stage shall be activated. On a fall in space temp to below the cooling setpoint the 2nd stage shall be de-activated. There shall be a minimum of five minute intervals between activating and de-activating the cooling stages.

Unoccupied Setback: During the Unoccupied period:
1 - Heating and cooling shall be commanded off and the OA damper shall close.
2 - After a two minute delay the supply fan shall be commanded off.
3 - The unit fan, heating and cooling shall be cycled as needed to maintain unoccupied setpoints. Above heat/cool sequences shall apply.

Associated Exhaust Fans: BAS shall command associated Exhaust Fans to run continuously during the Occupied period.

Hardwired Points

Universal Inputs (Sensors):

1. Supply Fan Status
2. Space Temp
3. Setpoint Adjust
4. Supply Air Temperature
5. Stage 2 Cooling
6. Mixed Air Temperature
7. Return Air Humidity
8. CO2 Sensor

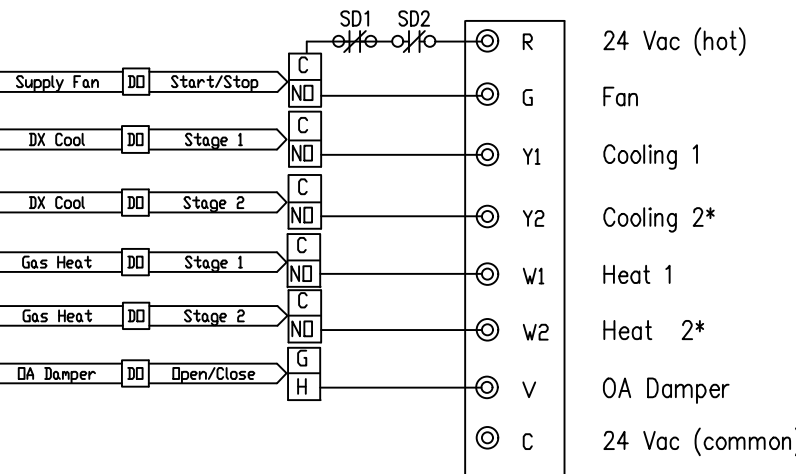
Virtual Points

- Software Flags & Setpoints
1. Unit Start Signal
 2. Occupied Mode (Sched)
 3. Clg Setpoint (74°F Adj)
 4. Htg Setp (Clg Setp-3)
 5. Adjusted Space Setpoint
 6. Night Setback (55°F Adj)
 7. Night Setup (85°F Adj)

Above Points to be Displayed on RTU Graphic

All Above Points Shall be Accessible by User

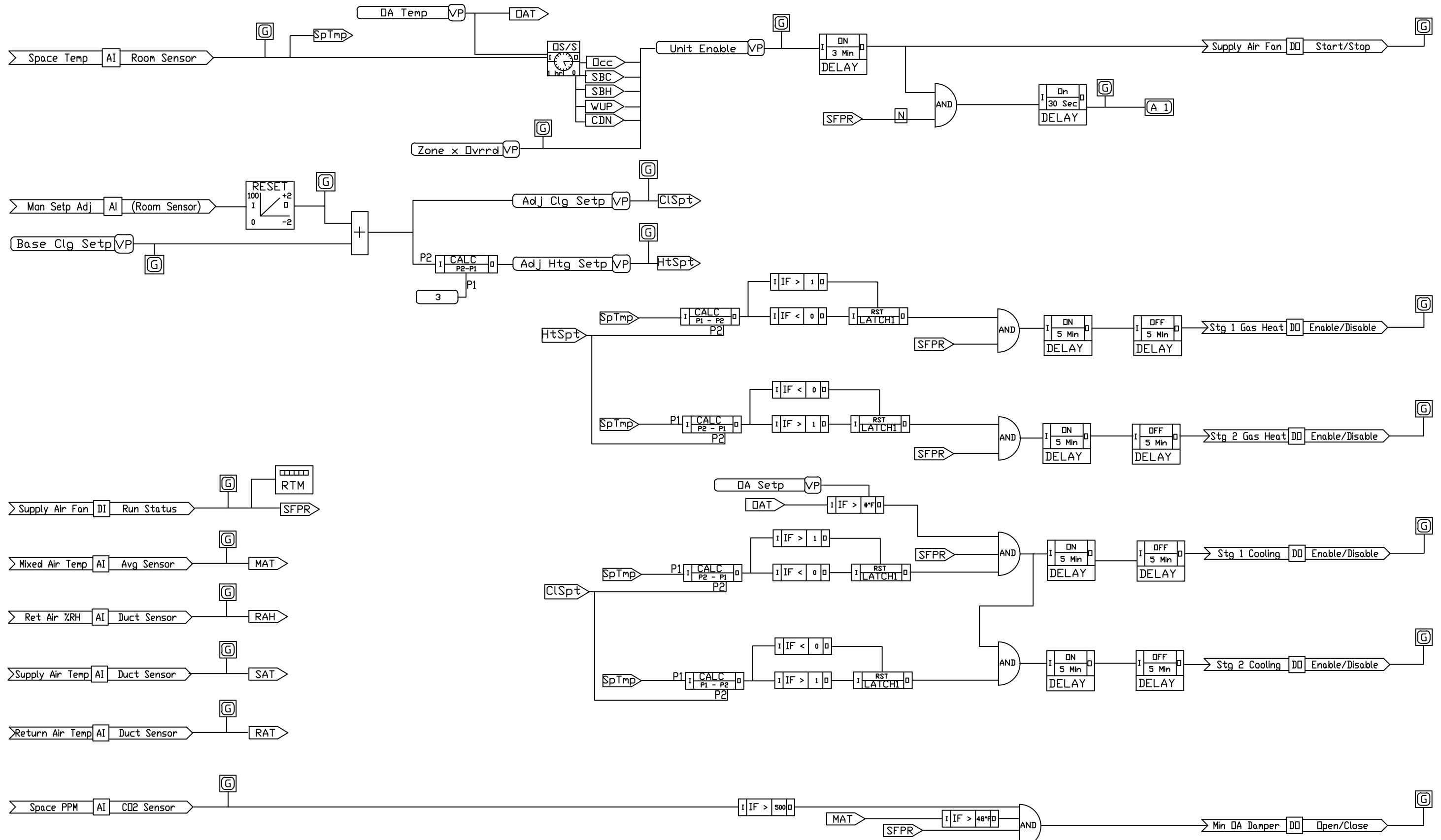
All Above Points Shall be Trended



RTU TERMINAL STRIP
Interface board terminal strip by unit manufacturer

* Provide number of stages as required

WIRING DIAGRAMS



RTU-1, 3, 6, 7

ROOFTOP UNIT W /DX CLG/GAS HEAT/MIN OA/CO2

RTU w/DX, Gas Heat, Min OA Control Sequence

General: This unit shall have its own Control Module and be fully controlled by the BAS. The unit control logic strategies shall include:

- a) Scheduled Occupancy
- b) Sequenced heating and cooling control
- c) Night (unoccupied) setback

Supply Air Fan Control: The BAS shall control the starting and stopping of the supply air fan as follows:

- 1 - During the scheduled Occupied period the unit fan shall be commanded to run continuously.
- 2 - BAS shall monitor fan status and generate an alarm if the fan fails to start as commanded after a 30 second delay or fails anytime thereafter. However the request for the failed fan shall remain active until the unit can be serviced. The BAS shall use the fan status to accumulate resettable runtime.
- 3 - The unit fan shall be commanded Off when:
 - a) the Occupied period is over AND the unit is not heating or cooling to maintain night Setup/Setback setpoints
 - 4 - Once the Fan is shut down it must remain off for at least 3 minutes (Adj.) prior to being restarted (note: Minimum Off, Not Delay Start).
 - 5 - The unit may be overridden On or Off via operator command from a remote central location or by the BAS controller on site or BAS graphics.

Min OA Damper: BAS shall control OA damper as follows:

- 1 - When the Unit is de-energized the OA damper shall be commanded to its closed position.
- 2 - When the Unit is energized to maintain unoccupied setpoints, the damper shall remain closed.
- 3 - During the Occupied period, the OA damper shall be commanded open to its preset minimum position.
- 4 - The OA damper shall close if the mixed air temperature falls below 48°F.
- 5 - The RF damper shall open and close together with the OA damper

Space Temperature Control: Control space temperature by cycling the heating/cooling on the unit as needed. Three operator adjustable setpoints shall apply. Occupied Cooling (74°F), unoccupied setback heating (55°F), and unoccupied setup cooling (85°F). These three values shall be the only values changed by the operator to adjust space temperatures. The Occupied Heating setpoint shall be the Cooling Setpoint minus 3°F.

Heating Section: On a fall in space temperature below the heating setpoint, the BAS shall activate the 1st stage of gas heat. When the temperature rises to above the heating setpoint plus 1°F the heat shall de-activate. If the space temp falls to 1°F below the heating setpoint the BAS shall activate the 2nd stage of gas heat. On a rise in space temp to above the heating setpoint the 2nd stage heat shall de-activate. There shall be a minimum of five minute intervals between activating and de-activating the heating stages.

Cooling Section: On a rise in space temperature above the cooling setpoint and the outside air temperature is above the DX cooling lockout setpoint (55°F OA (adj.)), the BAS shall activate the 1st stage compressor. When the temperature falls one degree below the cooling setpoint the cooling shall be de-activated. If the temperature rises to above 1°F of the cooling setpoint the 2nd stage shall be activated. On a fall in space temp to below the cooling setpoint the 2nd stage shall be de-activated. There shall be a minimum of five minute intervals between activating and de-activating the cooling stages.

Unoccupied Setback: During the Unoccupied period:
1 - Heating and cooling shall be commanded off and the OA damper shall close.
2 - After a two minute delay the supply fan shall be commanded off.
3 - The unit fan, heating and cooling shall be cycled as needed to maintain unoccupied setpoints. Above heat/cool sequences shall apply.

Associated Exhaust Fans: BAS shall command associated Exhaust Fans to run continuously during the Occupied period.

Hardwired Points

Universal Inputs (Sensors):

1. Supply Fan Status
2. Supply Air Temperature
3. Return Air Temperature
4. Mixed Air Temperature
5. Return Air Humidity
6. Space Temperature

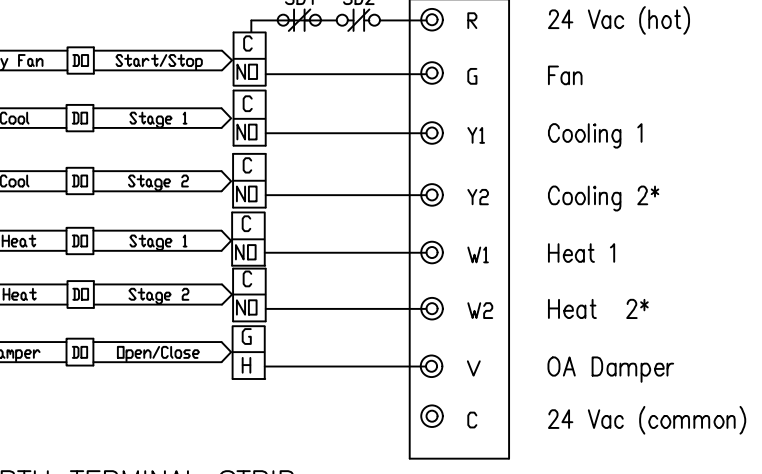
Virtual Points

- Software Flags & Setpoints
1. Unit Start Signal
 2. Occupied Mode (Sched)
 3. Clg Setpoint (74°F Adj)
 4. Htg Setp (Clg Setp-3)
 5. Night Setback (55°F Adj)
 6. Night Setup (85°F Adj)
 7. Supply Fan Fail Alarm

Above Points to be Displayed on RTU Graphic

All Above Points Shall be Accessible by User

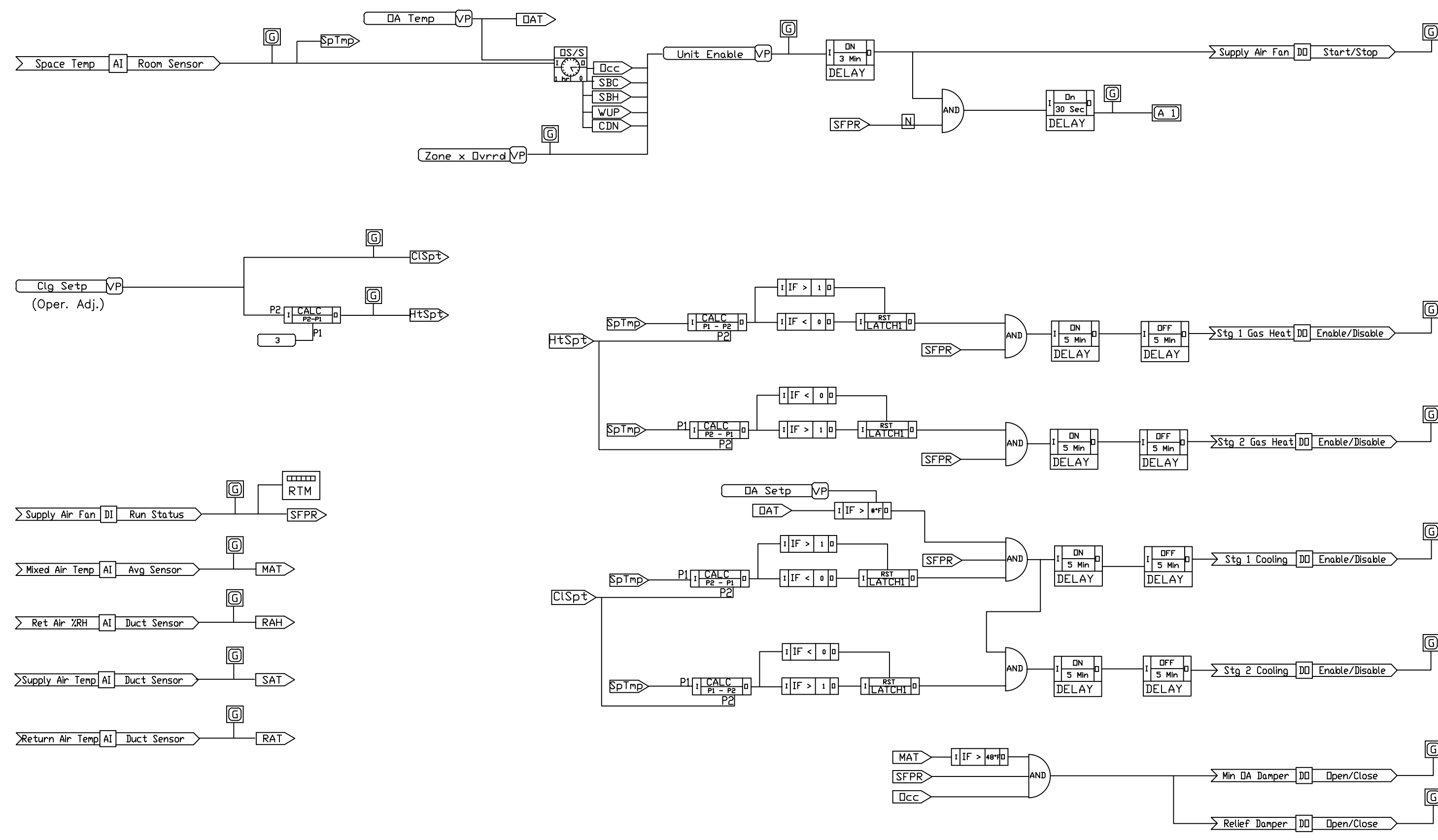
All Above Points Shall be Trended



RTU TERMINAL STRIP
Interface board terminal strip by unit manufacturer

* Provide number of stages as required

WIRING DIAGRAMS



RTU-3

ROOFTOP UNIT W /DX CLG/GAS HEAT/MIN OA

PROJECT TITLE

AUTOMATIC TEMPERATURE CONTROL SYSTEM REPLACEMENT

OAK VIEW ELEMENTARY SCHOOL

5004 Sideburn Rd
Fairfax, VA 22032

DRAWN SM

CHECKED

DATE 4/3/2024

PROJECT # MMB-074-24

REVISIONS

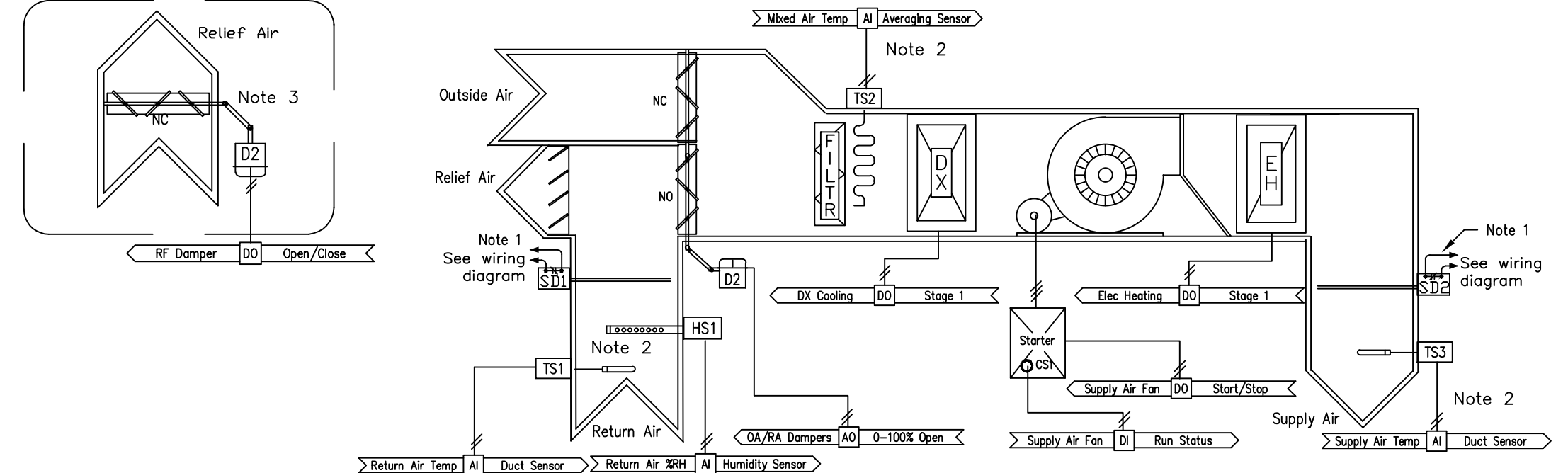
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DRAWING TITLE

RTU-2, 4, 8, 9
CONTROL DIAGRAMS

DRAWING NUMBER

M-6



Note 3: Replace damper actuators with new electronic actuators. Clean & lubricate damper linkage, set minimum position and verify proper operation of dampers.

Note 2: Provide and install new Return & Supply Air temperature & Return Air humidity duct sensors and Mixed Air averaging sensor.

Note 1: Confirm (or rewire) interlock through existing Safety devices to shut down unit Fan(s). Wire associated unit control devices such as actuators & relays to go to their setback (or FAIL) positions whenever the Supply Fan is Off - OA damper closed, DX cooling off, etc.

RTU w/DX, Electric Heat Economizer & CO2 Control Sequence

General: This unit shall have its own Control Module and be fully controlled by the BAS. The unit control logic strategies shall include:

- Scheduled Occupancy
- Sequenced heating and cooling control
- Outside air intake and exhaust control based on CO2 levels
- Night (unoccupied) setback

Supply Air Fan Control: The BAS shall control the starting and stopping of the supply air fan as follows:

- During the scheduled Occupied period the unit fan shall be commanded to run continuously.
- BAS shall monitor fan status and generate an alarm if the fan fails to start as commanded after a 30 second delay or fails anytime thereafter. However the request for the failed fan shall remain active until the unit can be serviced. The BAS shall use the fan status to accumulate resettable runtime.
- The unit fan shall be commanded Off when:
 - the Occupied period is over AND the unit is not heating or cooling to maintain night Setup/Setback setpoints
 - Once the Fan is shut down it must remain off for at least 3 minutes (Adj.) prior to being restarted (note: Minimum Off, Not Delay Start).
 - The unit may be overridden On or Off via operator command from a remote central location or by the BAS controller on site or BAS graphics.

Mixed Air Dampers w/ CO2 Control: BAS shall control these dampers as follows:

- When the Unit is de-energized the dampers shall be commanded to their setback positions - Outside Air (OA) damper closed and Return Air (RA) damper open.
- During the Unoccupied period when the Unit is energized to maintain unoccupied setpoints the dampers shall remain in their setback positions.
- During the Occupied period, the CO2 rises above the minimum occupied setpoint of 500ppm (adj.), the Unit's OA damper shall be opened 5X. On a continued rise in CO2, the OA damper shall open proportionally to its (operator adjustable) design minimum position (ref. AHU/RTU Data Dwg M-1) when the CO2 reaches or exceeds 1100ppm (adj.). The BAS shall override this CO2 control sequence as necessary to maintain a low limit mixed air temp of 48F.
- On a call for Cooling and if enthalpy conditions allow, the OA damper shall be modulated open as needed to satisfy cooling needs (ref. Economizer section).
- The RA dampers shall track the OA damper proportionately.
- The RF damper shall open if OA air damper in either RTU opens beyond 10X.

Space Temperature Control: Control space temperature by cycling the heating/cooling on the unit as needed. Three operator adjustable setpoints shall apply. Occupied Cooling (74F), unoccupied setback heating (55F), and unoccupied setup cooling (85F). These three values shall be the only values changed by the operator to adjust space temperatures. The Occupied Heating setpoint shall be the Cooling Setpoint minus 3F.

Heating Section: On a fall in space temperature below the heating setpoint, the BAS shall activate the 1st stage of electric heat. When the temperature rises to above the heating setpoint plus 1F the heat shall de-activate.

Cooling Section: On a rise in space temperature above the cooling setpoint and the outside air temperature is above the DX cooling lockout setpoint (55F OA (adj.)), the BAS shall activate the 1st stage compressor. When the temperature falls one degree below the cooling setpoint the cooling shall be de-activated.

Economizer Section: On a call for Cooling And if the OA Enthalpy is less than 28 btu/lb (adj.) And the OA Enthalpy is less than the unit's RA Enthalpy, the OA damper shall be modulated open to maintain a mixed air temp setpoint of 52F based on the needs of the space but not lower than 48F.

Unoccupied Setback: During the Unoccupied period:

- Heating and cooling shall be commanded off and the OA damper shall close.
- After a two minute delay the supply fan shall be commanded off.
- The unit fan, heating and cooling shall be cycled as needed to maintain unoccupied setpoints. Above heat/cool sequences shall apply.

Associated Exhaust Fans: BAS shall command associated Exhaust Fans to run continuously during the Occupied period.

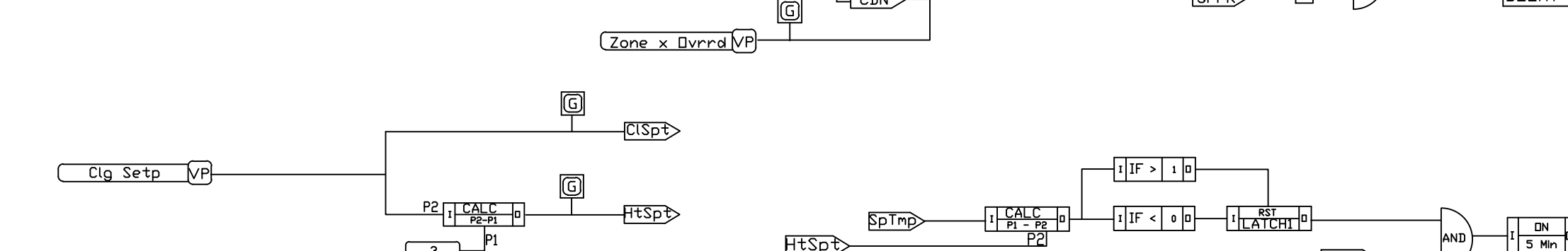
Hardwired Points

Universal Inputs (Sensors):	Digital Outputs (Control):
1. Supply Fan Status	1. Supply Fan Start/Stop
2. Supply Air Temperature	2. Stage 1 Cooling
3. Return Air Temperature	3. Stage 1 Gas Heat
4. Mixed Air Temperature	4. RF Damper
5. Return Air Humidity	
6. Space Temperature	
7. CO2 Sensor	

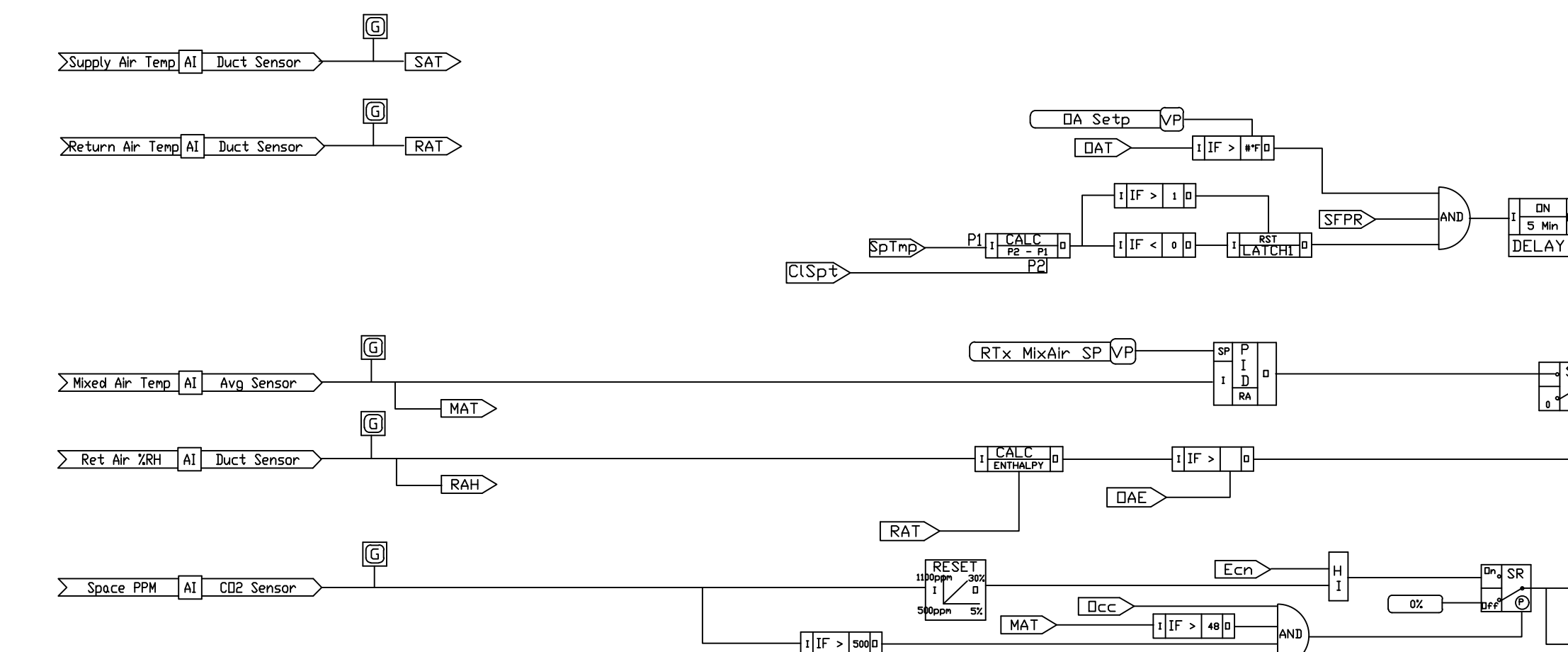
Virtual Points

Software Flags & Setpoints	Analog Outputs (Control):
1. Unit Start Signal	1. OA/RA Dampers
2. Occupied Mode (Sched)	
3. Clg Setpoint (74F Adj)	
4. Htg Setp (Clg Setp-3)	
5. Night Setback (55F Adj)	
6. Night Setup (85F Adj)	
7. Supply Fan Fail Alarm	
8. CO2 Min Setpoint	
9. CO2 Max Setpoint	

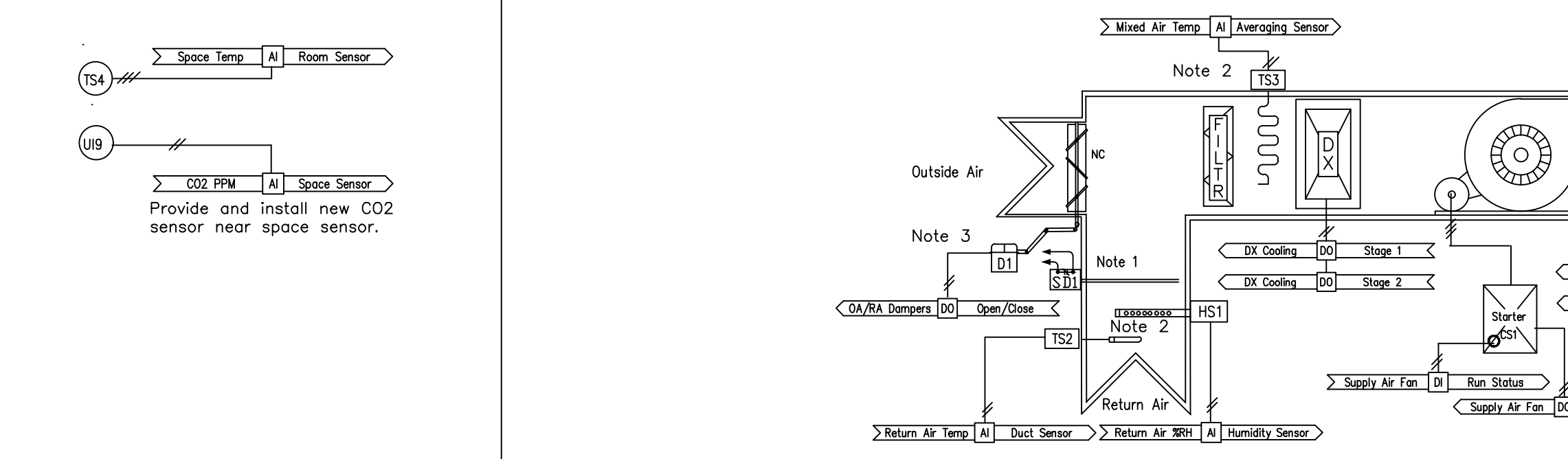
Above Points to be Displayed on RTU Graphic
All Above Points Shall be Accessible by User
All Above Points Shall be Trended



WIRING DIAGRAMS



RTU-8, 9
ROOFTOP UNIT W/DX CLG/ELEC HEAT/ECONOMIZER/CO2



Note 3: Replace damper actuators with new electronic actuators. Clean & lubricate damper linkage, set minimum position and verify proper operation of dampers.

Note 2: Provide and install new Return & Supply Air temperature & Return Air humidity duct sensors and Mixed Air averaging sensor.

Note 1: Confirm (or rewire) interlock through existing Safety devices to shut down unit Fan(s). Wire associated unit control devices such as actuators & relays to go to their setback (or FAIL) positions whenever the Supply Fan is Off - OA damper closed, DX cooling off & gas heat off.

RTU w/DX, Gas Heat Min OA & CO2 Control Sequence

General: This unit shall have its own Control Module and be fully controlled by the BAS. The unit control logic strategies shall include:

- Scheduled Occupancy
- Sequenced heating and cooling control
- Outside air intake control based on CO2 levels
- Night (unoccupied) setback

Supply Air Fan Control: The BAS shall control the starting and stopping of the supply air fan as follows:

- During the scheduled Occupied period the unit fan shall be commanded to run continuously.
- BAS shall monitor fan status and generate an alarm if the fan fails to start as commanded after a 30 second delay or fails anytime thereafter. However the request for the failed fan shall remain active until the unit can be serviced. The BAS shall use the fan status to accumulate resettable runtime.
- The unit fan shall be commanded Off when:
 - the Occupied period is over AND the unit is not heating or cooling to maintain night Setup/Setback setpoints
 - Once the Fan is shut down it must remain off for at least 3 minutes (Adj.) prior to being restarted (note: Minimum Off, Not Delay Start).
 - The unit may be overridden On or Off via operator command from a remote central location or by the BAS controller on site or BAS graphics.

Mixed Air Dampers w/ CO2 Control: BAS shall control these dampers as follows:

- When the Unit is de-energized the OA damper shall be commanded to its closed position.
- When the Unit is energized to maintain unoccupied setpoints, the damper shall remain closed.
- During the occupied period AND when the space CO2 level rises above the setpoint of 500ppm (adj.), the OA damper shall be commanded open to its preset minimum position.
- The OA Damper shall close if the mixed air temperature falls below 48F.

Space Temperature Control: Control space temperature by cycling the heating/cooling on the unit as needed. Three operator adjustable setpoints shall apply. Occupied Cooling (74F), unoccupied setback heating (55F), and unoccupied setup cooling (85F). These three values shall be the only values changed by the operator to adjust space temperatures. The Occupied Heating setpoint shall be the Cooling Setpoint minus 3F.

Heating Section: On a fall in space temperature below the heating setpoint, the BAS shall activate the 1st stage of gas heat. When the temperature rises to above the heating setpoint plus 1F the heat shall de-activate. If the space temp falls to 1F below the heating setpoint the BAS shall activate the 2nd stage heat shall de-activate. There shall be a minimum of five minute intervals between activating and de-activating the heating stages.

Cooling Section: On a rise in space temperature above the cooling setpoint and the outside air temperature is above the DX cooling lockout setpoint (55F OA (adj.)), the BAS shall activate the 1st stage compressor. When the temperature falls one degree below the cooling setpoint the cooling shall be de-activated. If the temperature rises to above 1F of the cooling setpoint the 2nd stage shall be activated. On a fall in space temp to below the cooling setpoint the 2nd stage shall be de-activated. There shall be a minimum of five minute intervals between activating and de-activating the cooling stages.

Unoccupied Setback: During the Unoccupied period:

- Heating and cooling shall be commanded off and the OA damper shall close.
- After a two minute delay the supply fan shall be commanded off.
- The unit fan, heating and cooling shall be cycled as needed to maintain unoccupied setpoints. Above heat/cool sequences shall apply.

Associated Exhaust Fans: BAS shall command associated Exhaust Fans to run continuously during the Occupied period.

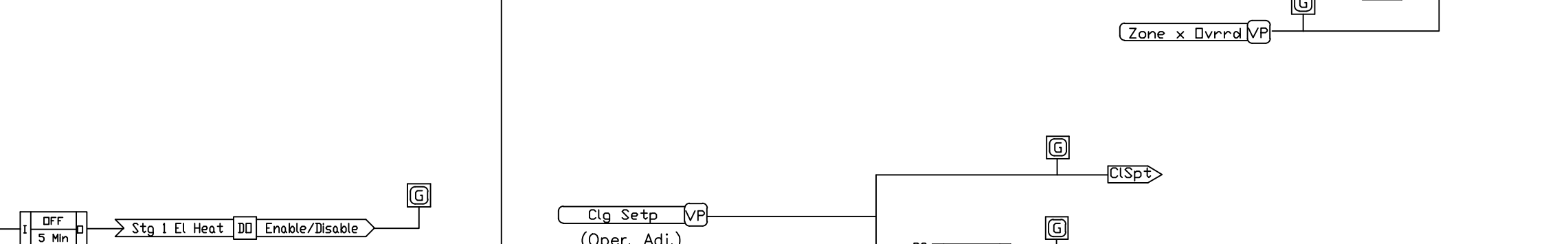
Hardwired Points

Universal Inputs (Sensors):	Digital Outputs (Control):
1. Supply Fan Status	1. Supply Fan Start/Stop
2. Stage 1 Cooling	2. Stage 1 Cooling
3. Stage 1 Gas Heat	3. Stage 1 Gas Heat
4. RF Damper	4. RF Damper

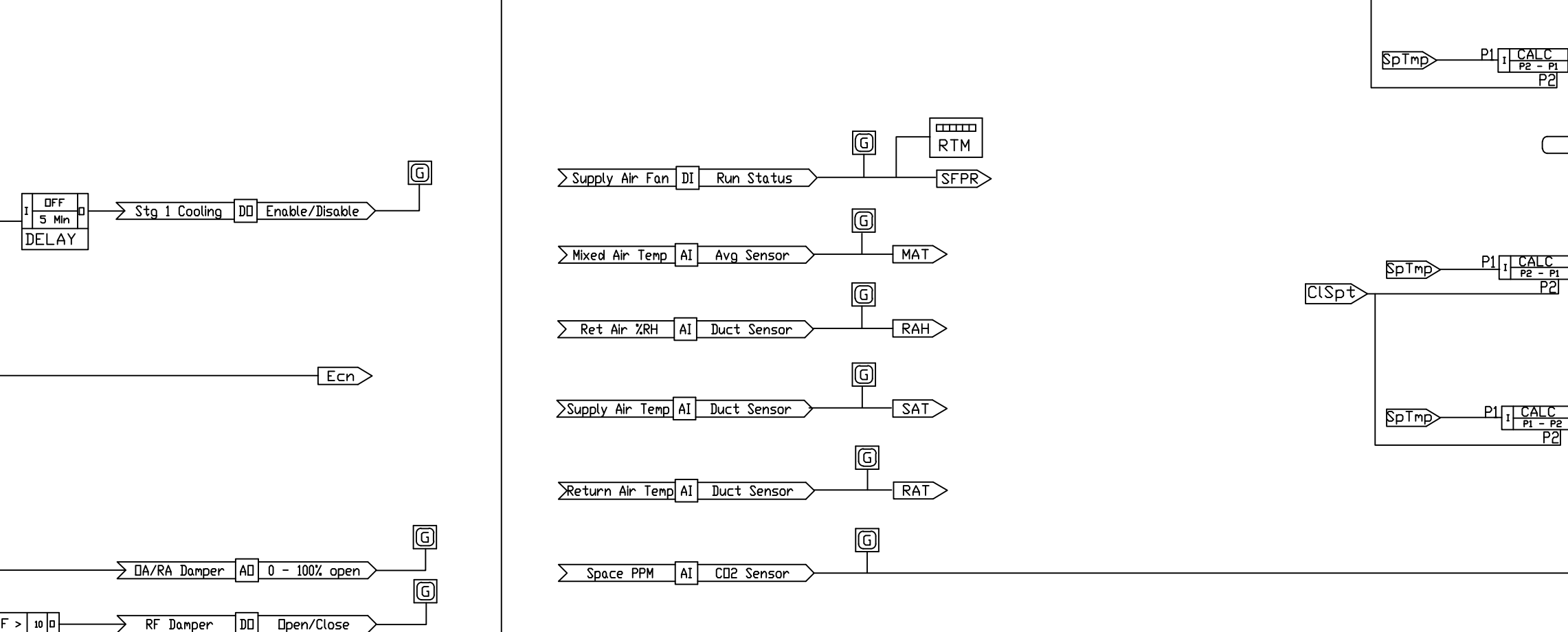
Virtual Points

Software Flags & Setpoints	Analog Outputs (Control):
1. Unit Start Signal	7. Supply Fan Fail Alarm
2. Occupied Mode (Sched)	8. CO2 Min Setpoint
3. Clg Setpoint (74F Adj)	9. CO2 Max Setpoint
4. Htg Setp (Clg Setp-3)	
5. Night Setback (55F Adj)	
6. Night Setup (85F Adj)	

Above Points to be Displayed on RTU Graphic
All Above Points Shall be Accessible by User
All Above Points Shall be Trended



WIRING DIAGRAMS



RTU-2, 4
ROOFTOP UNIT W/DX CLG/GAS HEAT/MIN OA/CO2

PROJECT TITLE

AUTOMATIC TEMPERATURE CONTROL SYSTEM REPLACEMENT

OAK VIEW ELEMENTARY SCHOOL

5004 Sideburn Rd, Fairfax, VA 22032

DRAWN SM

CHECKED

DATE 4/3/2024

PROJECT # MMB-074-24

REVISIONS

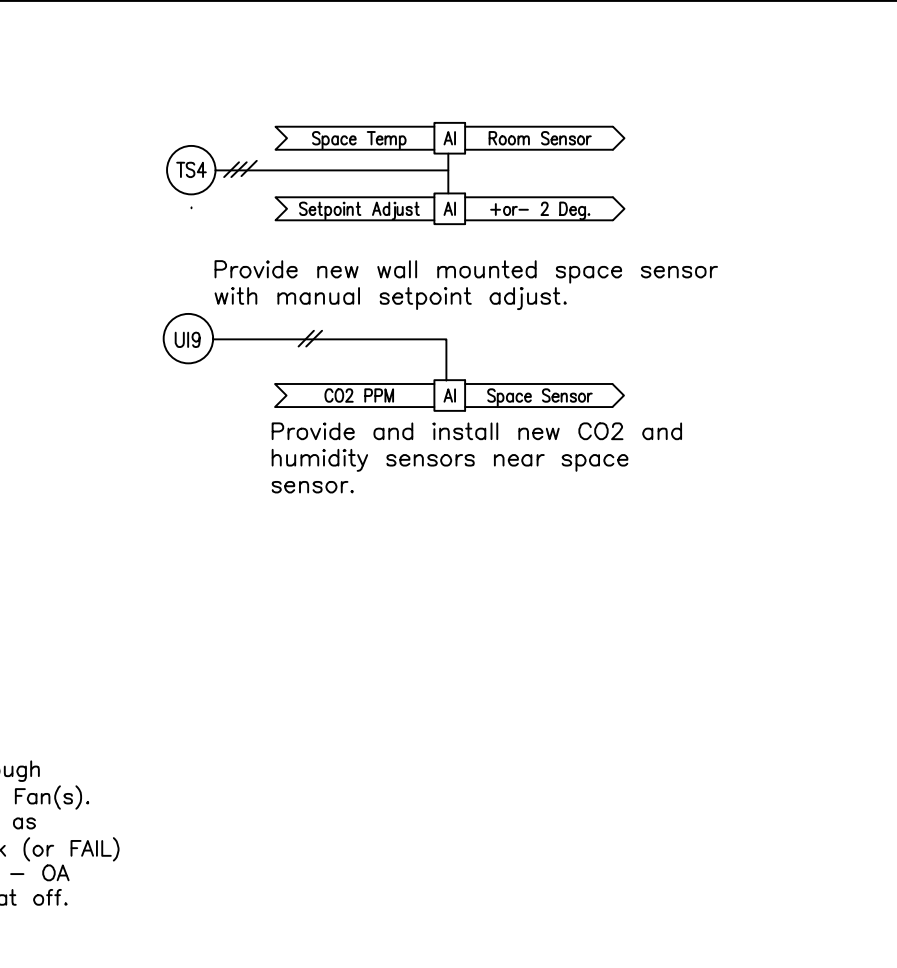
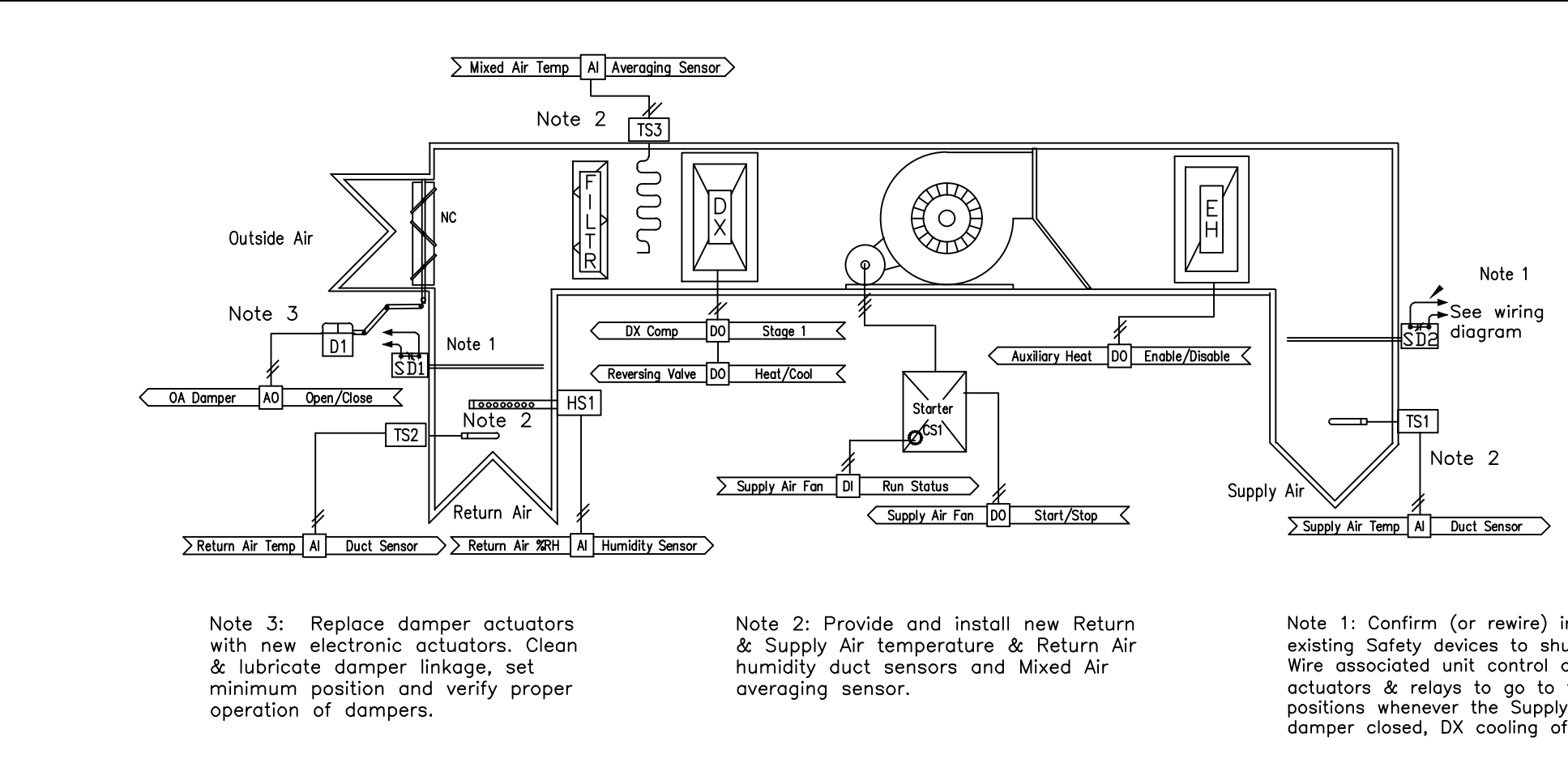
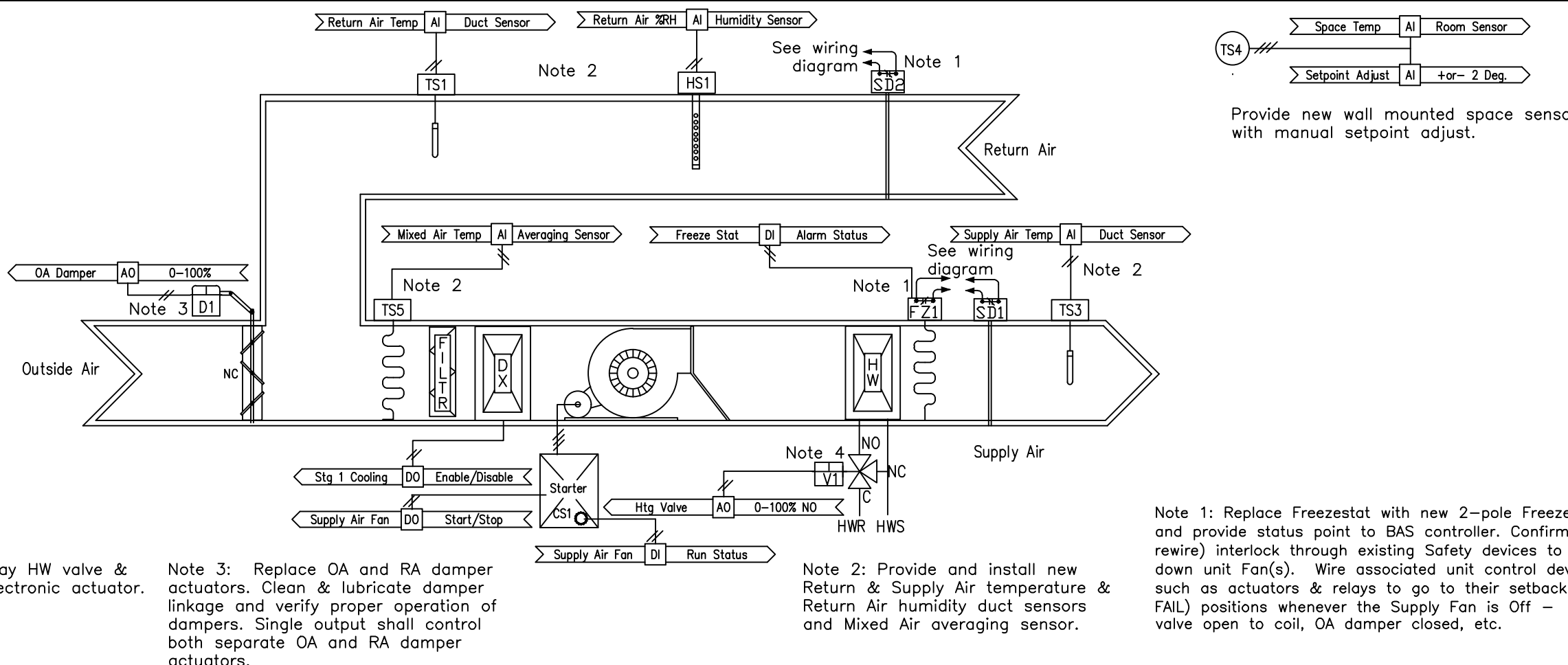
NO.	DATE	DESCRIPTION

DRAWING TITLE

AHU- A1, B1; RTU- 10, 11 CONTROL DIAGRAMS

DRAWING NUMBER

M-7



Constant Volume AHU w/HW Heat/DX Cooling & Min OA

General: This unit shall have its own Control Module and be fully controlled by the BAS. The unit control logic strategies shall include:
a) Scheduled Occupancy
b) Sequenced heating and cooling control
c) Night (unoccupied) setback

Supply Air Fan Control: The BAS shall control the starting and stopping of the supply air fan as follows:
1 - During the scheduled Occupied period the unit fan shall be commanded to run continuously.
2 - BAS shall monitor fan status and generate an alarm if the fan fails to start as commanded after a 30 second delay or fails anytime thereafter. However the request for the failed fan shall remain active until the unit can be serviced. The BAS shall use the fan status to accumulate resettable runtime.
3 - The unit fan shall be commanded Off when:
a) The Occupied period is over AND the unit is not heating or cooling to maintain night Setup/Setback setpoints
4 - Once the Fan is shut down it must remain off for at least 3 minutes (Adj.) prior to being restarted (note: Minimum Off, Not Delay Start).
5 - The unit may be overridden On or Off via operator command from a remote central location or by the BAS controller on site or BAS graphics.

Min OA Damper: BAS shall control OA damper as follows:
1 - When the Unit is de-energized the OA damper shall be commanded to its closed position.
2 - When the Unit is energized to maintain unoccupied setpoints, the damper shall remain closed.
3 - During the Occupied period, the OA damper shall be commanded open to its preset minimum position.
4 - The OA damper shall close if the mixed air temperature falls below 48F.

Space Temperature Control: Control space temperature by cycling the heating/cooling on the unit as needed. Three operator adjustable setpoints shall apply. Occupied Cooling (74F), unoccupied setback heating (55F) and unoccupied setup cooling (85F). These three values shall be the only values changed by the operator to adjust space temperatures. The Occupied Heating setpoint shall be the Cooling Setpoint minus 3F.

Heating Section: N.O. heating valve shall modulate simultaneously in a PID loop to maintain applicable space temperature setpoints within a 2F throttling range. No other control loops except those indicated on the logic diagram shall control the valve. In heating mode, the BAS shall maintain the supply air temperature no less than 52F (Adj.).

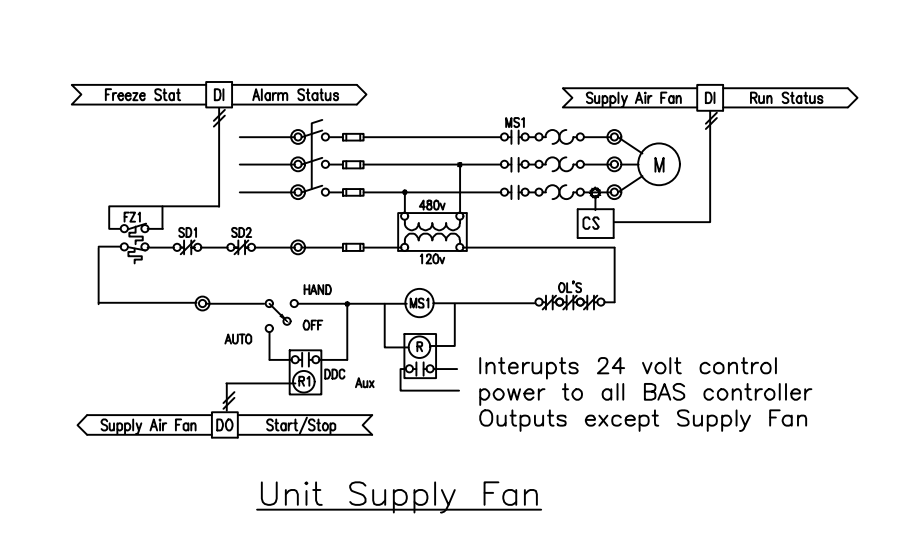
Cooling Section: On a rise in space temperature above the cooling setpoint and the outside air temperature is above the DX cooling lockout setpoint (55F OA (adj.)), the BAS shall activate the 1st stage compressor. When the temperature falls one degree below the cooling setpoint the cooling shall be de-activated.

Unoccupied Setback: During the Unoccupied period:
1 - Heating and cooling shall be commanded off and the OA damper shall close.
2 - After a two minute delay the supply fan shall be commanded off.
3 - The unit fan, heating and cooling shall be cycled as needed to maintain unoccupied setpoints. Above heat/cool sequences shall apply.

Associated Exhaust Fans: BAS shall command associated Exhaust Fans to run continuously during the Occupied period.

Hardwired Points

- Universal Inputs (Sensors):**
- Supply Fan Status
 - Space Temp
 - Setpoint Adjust
 - Supply Air Temperature
 - Return Air Temperature
 - Mixed Air Temperature
 - Return Air Humidity
 - Freeze Stat Alarm
- Digital Outputs (Control):**
- Supply Fan Start/Stop
 - Stage 1 Cooling
 - OA Damper
- Analog Outputs (Control):**
- Hot Water Valve
 - Supply Air Fan Run Status
 - Supply Fan Fail Alarm
- Virtual Points**
- Software Flags & Setpoints**
- Unit Start Signal
 - Occupied Mode (Sched)
 - Clg Setpoint (74F Adj)
 - Htg Setp (Clg Setp-3)
 - Adjusted Space Setpoint
 - Night Setback (55F Adj)
 - Night Setup (85F Adj)
- Above Points to be Displayed on RTU Graphic
All Above Points Shall be Accessible by User
All Above Points Shall be Trended



WIRING DIAGRAMS

RTU Heat Pump, Min OA & CO2 Control Sequence

General: This unit shall have its own Control Module and be fully controlled by the BAS. The unit control logic strategies shall include:
a) Scheduled Occupancy
b) Sequenced heating and cooling control
c) Outside air intake control based on CO2 levels
d) Night (unoccupied) setback

Supply Air Fan Control: The BAS shall control the starting and stopping of the supply air fan as follows:
1 - During the scheduled Occupied period the unit fan shall be commanded to run continuously.
2 - BAS shall monitor fan status and generate an alarm if the fan fails to start as commanded after a 30 second delay or fails anytime thereafter. However the request for the failed fan shall remain active until the unit can be serviced. The BAS shall use the fan status to accumulate resettable runtime.
3 - The unit fan shall be commanded Off when:
a) The Occupied period is over AND the unit is not heating or cooling to maintain night Setup/Setback setpoints
4 - Once the Fan is shut down it must remain off for at least 3 minutes (Adj.) prior to being restarted (note: Minimum Off, Not Delay Start).
5 - The unit may be overridden On or Off via operator command from a remote central location or by the BAS controller on site or BAS graphics.

Min OA Damper control: BAS shall control OA damper as follows:
1 - When the Unit is de-energized the OA damper shall be commanded to its closed position.
2 - When the Unit is energized to maintain unoccupied setpoints, the damper shall remain closed.
3 - During the occupied period AND when the space CO2 level rises above the setpoint of 500ppm (adj.), the OA damper shall be commanded open to its preset minimum position.
4 - The OA Damper shall close if the mixed air temperature falls below 48F.

Space Temperature Control: Control space temperature by cycling the heating/cooling on the unit as needed. Three operator adjustable setpoints shall apply. Occupied Cooling (74F), unoccupied setback heating (55F), and unoccupied setup cooling (85F). These three values shall be the only values changed by the operator to adjust space temperatures. The Occupied Heating setpoint shall be the Cooling Setpoint minus 3F.

Heating Section: On a fall in space temperature 1F below the heating setpoint, the BAS shall activate the 1st stage compressor. When the temperature rises to the heating setpoint the heat shall de-activate. If the space temp falls to 2F below the heating setpoint the BAS shall activate the auxiliary heat. On a rise in space temp to the heating setpoint minus 2F the 2nd stage compressor shall de-activate. There shall be a minimum of five minute intervals between activating and de-activating the heating stages. When the space temperature falls 3F below the heating setpoint, the BAS shall activate the auxiliary heat. On a rise in space temperature to the heating setpoint minus 2F the auxiliary heat shall deactivate.

Cooling Section: On a rise in space temperature 1F above the cooling setpoint and the outside air temperature is above the DX cooling lockout setpoint (55F OA (adj.)), the BAS shall activate the 1st stage compressor. When the temperature falls below the cooling setpoint the cooling shall be de-activated.

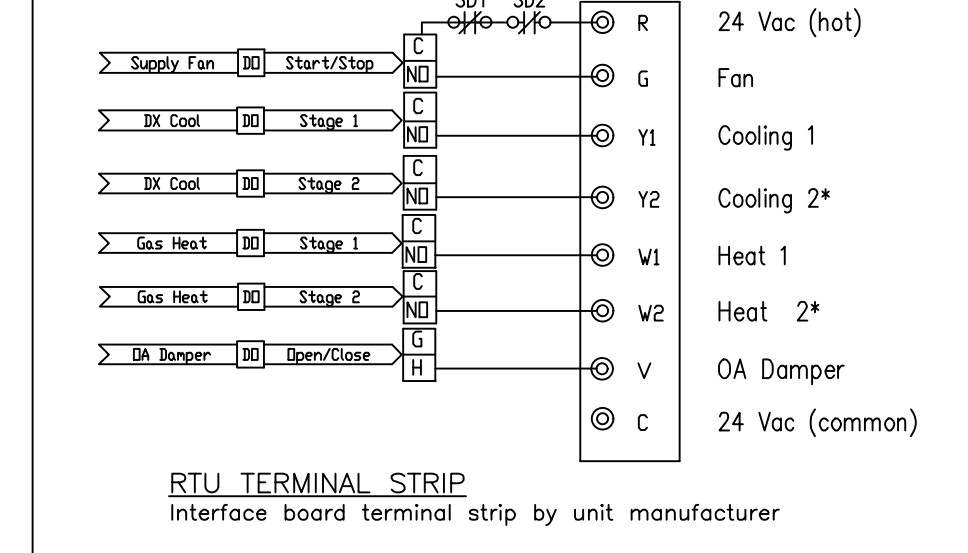
Reversing Valve: On a rise in space temperature above the cooling setpoint, the BAS shall energize the reversing valve. When the temperature falls 1F below the cooling setpoint the reversing valve shall be de energized.

Unoccupied Setback: During the Unoccupied period:
1 - Heating and cooling shall be commanded off and the OA damper shall close.
2 - After a two minute delay the supply fan shall be commanded off.
3 - The unit fan, heating and cooling shall be cycled as needed to maintain unoccupied setpoints. Above heat/cool sequences shall apply.

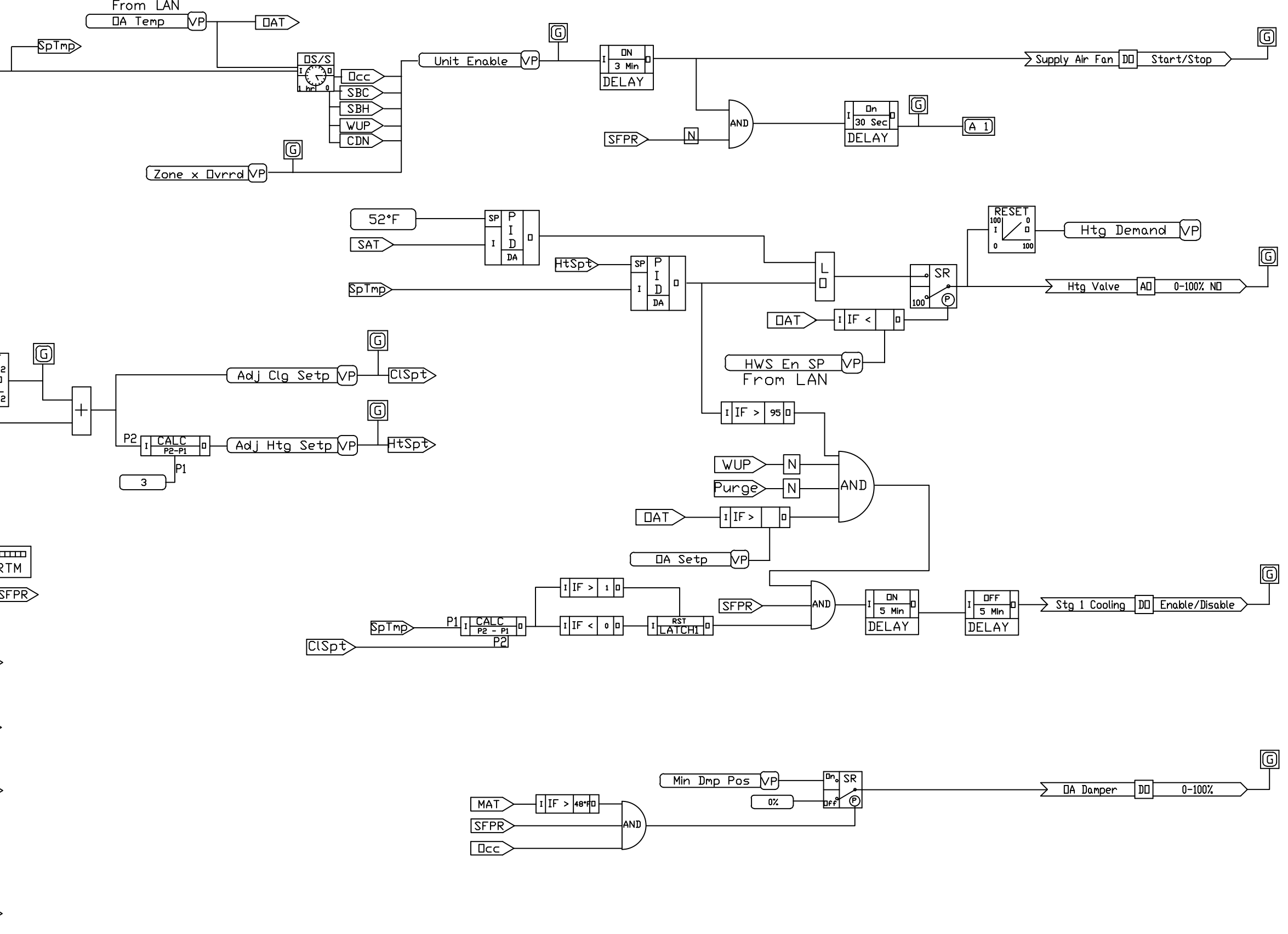
Associated Exhaust Fans: BAS shall command associated Exhaust Fans to run continuously during the Occupied period.

Hardwired Points

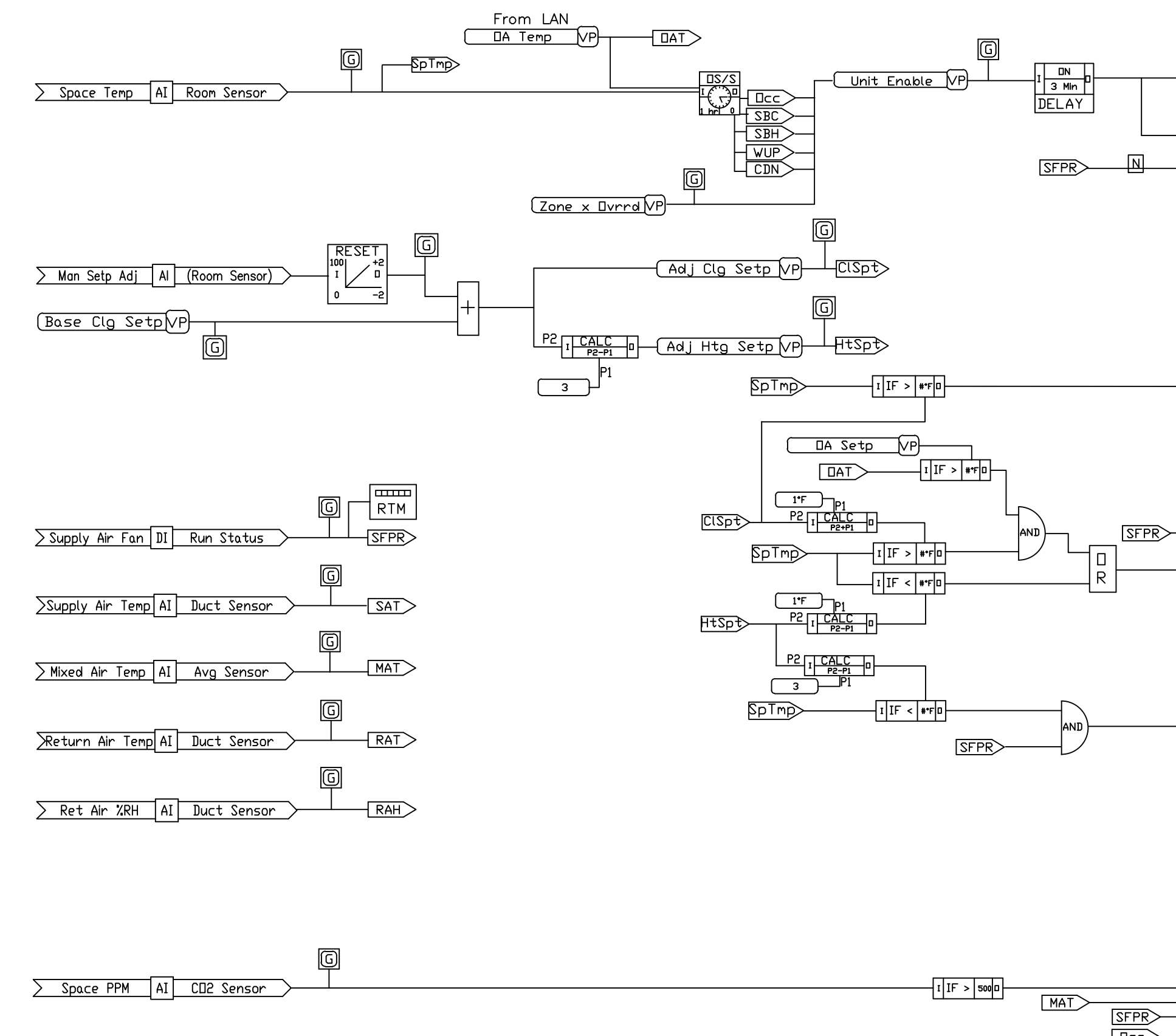
- Universal Inputs (Sensors):**
- Supply Fan Status
 - Space Temp
 - Setpoint Adjust
 - Supply Air Temperature
 - Return Air Temperature
 - Mixed Air Temperature
 - Return Air Humidity
 - CO2 Sensor
- Digital Outputs (Control):**
- Supply Fan Start/Stop
 - Reversing Valve
 - Stage 1 Compressor
 - Auxiliary Heat
 - OA Damper
 - Supply Fan Run Status
 - Supply Fan Start/Stop
 - Supply Fan Fail Alarm
 - Damper CO2 Setpoint
- Analog Outputs (Control):**
- Hot Water Valve
 - Supply Air Fan Run Status
 - Supply Fan Fail Alarm
- Virtual Points**
- Software Flags & Setpoints**
- Unit Start Signal
 - Occupied Mode (Sched)
 - Clg Setpoint (74F Adj)
 - Htg Setp (Clg Setp-3)
 - Adjusted Space Setpoint
 - Night Setback (55F Adj)
 - Night Setup (85F Adj)
- Above Points to be Displayed on RTU Graphic
All Points shall be accessible by user
All Above Points Shall be Trended



WIRING DIAGRAMS



AHU-A1, B1
CONSTANT VOLUME AHU W / HW HEATING, DX COOLING & ECONOMIZER



RTU-10, 11
ROOFTOP UNIT HEAT PUMP W/ MIN OA & CO2 SENSOR

PROJECT TITLE

AUTOMATIC TEMPERATURE CONTROL SYSTEM REPLACEMENT

OAK VIEW ELEMENTARY SCHOOL

5400 Sideburn Rd
Fairfax, VA 22032

DRAWN SM

CHECKED

DATE 4/3/2024

PROJECT # MMB-074-24

REVISIONS

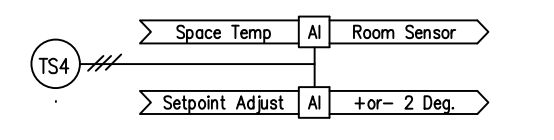
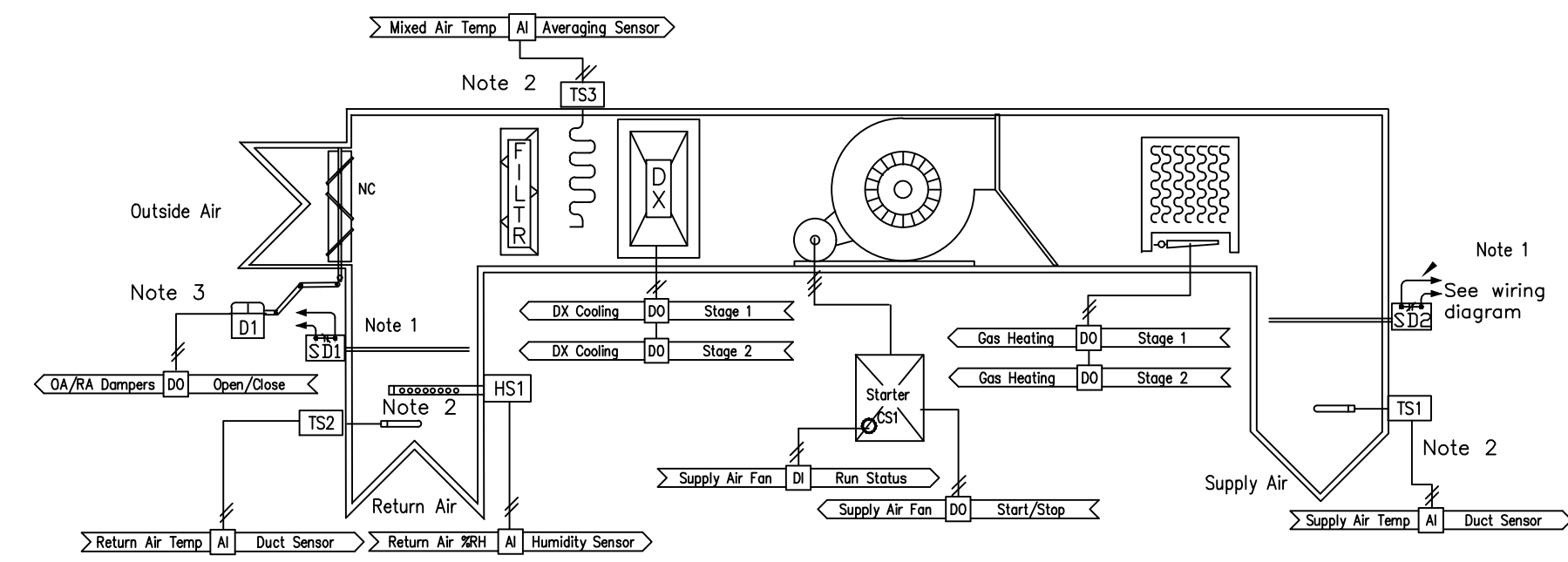
NO.	DATE	DESCRIPTION

DRAWING TITLE

RTU- 5 CONTROL DIAGRAM

DRAWING NUMBER

M-8



Provide new wall mounted space sensor with manual setpoint adjust.

- Note 3: Replace damper actuators with new electronic actuators. Clean & lubricate damper linkage, set minimum position and verify proper operation of dampers.
- Note 2: Provide and install new Return & Supply Air temperature & Return Air humidity duct sensors and Mixed Air averaging sensor.
- Note 1: Confirm (or rewire) interlock through existing Safety devices to shut down unit Fan(s). Wire associated unit control devices such as actuators & relays to go to their setback (or FAIL) positions whenever the Supply Fan is Off - OA damper closed, DX cooling off & gas heat off.

RTU w/DX, Gas Heat & Min OA Control Sequence

General: This unit shall have its own Control Module and be fully controlled by the BAS. The unit control logic strategies shall include:
a) Scheduled Occupancy
b) Sequenced heating and cooling control
c) Night (unoccupied) setback

Supply Air Fan Control: The BAS shall control the starting and stopping of the supply air fan as follows:
1 - During the scheduled Occupied period the unit fan shall be commanded to run continuously.
2 - BAS shall monitor fan status and generate an alarm if the fan fails to start as commanded after a 30 second delay or fails anytime thereafter. However the request for the failed fan shall remain active until the unit can be serviced. The BAS shall use the fan status to accumulate resettable runtime.
3 - The unit fan shall be commanded Off when:
a) The Occupied period is over AND the unit is not heating or cooling to maintain night Setup/Setback setpoints
4 - Once the Fan is shut down it must remain off for at least 3 minutes (Adj.) prior to being restarted (note: Minimum Off, Not Delay Start).
5 - The unit may be overridden On or Off via operator command from a remote central location or by the BAS controller on site or BAS graphics.

Min OA Damper: BAS shall control OA damper as follows:
1 - When the Unit is de-energized the OA damper shall be commanded to its closed position.
2 - When the Unit is energized to maintain unoccupied setpoints, the damper shall remain closed.
3 - During the Occupied period, the OA damper shall be commanded open to its preset minimum position.
4 - The OA damper shall close if the mixed air temperature falls below 48°F.
5 - The RA damper shall open and close together with the OA damper

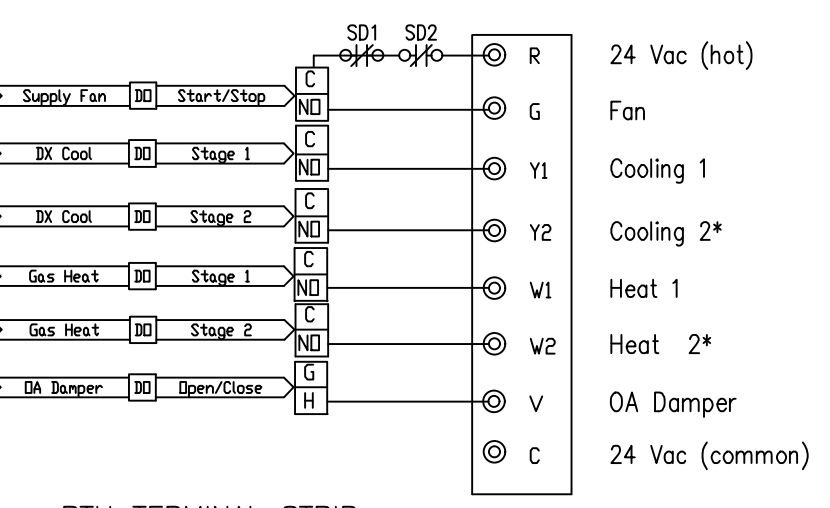
Space Temperature Control: Control space temperature by cycling the heating/cooling on the unit as needed. Three operator adjustable setpoints shall apply. Occupied Cooling (74°F), unoccupied setback heating (55°F), and unoccupied setup cooling (85°F). These three values shall be the only values changed by the operator to adjust space temperatures. The Occupied Heating setpoint shall be the Cooling Setpoint minus 3°F.

Heating Section: On a fall in space temperature below the heating setpoint, the BAS shall activate the 1st stage of gas heat. When the temperature rises to above the heating setpoint plus 1°F the heat shall de-activate. If the space temp falls to 1°F below the heating setpoint the BAS shall activate the 2nd stage of gas heat. On a rise in space temp to above the heating setpoint the 2nd stage heat shall de-activate. There shall be a minimum of five minute intervals between activating and de-activating the heating stages.

Cooling Section: On a rise in space temperature above the cooling setpoint and the outside air temperature is above the DX cooling lockout setpoint (55°F OA (adj.)), the BAS shall activate the 1st stage compressor. When the temperature falls one degree below the cooling setpoint the cooling shall be de-activated. If the temperature rises to above 1°F of the cooling setpoint the 2nd stage shall be activated. On a fall in space temp to below the cooling setpoint the 2nd stage shall be de-activated. There shall be a minimum of five minute intervals between activating and de-activating the cooling stages.

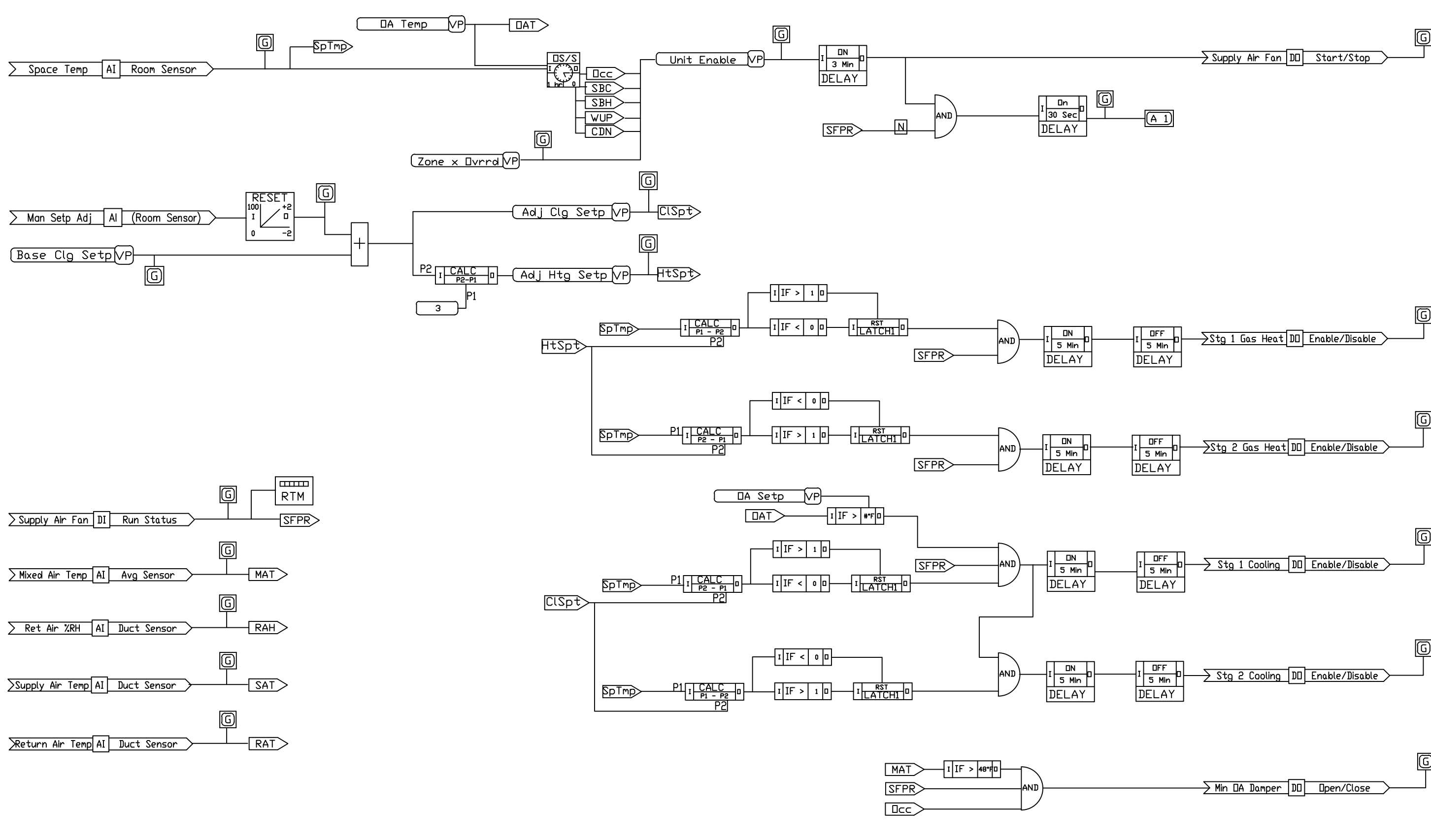
Hardwired Points

- | | |
|------------------------------------|-----------------------------------|
| Universal Inputs (Sensors): | Digital Outputs (Control): |
| 1. Supply Fan Status | 1. Supply Fan Start/Stop |
| 2. Space Temp | 2. Stage 1 Cooling |
| 3. Setpoint Adjust | 3. Stage 2 Cooling |
| 4. Supply Air Temperature | 4. Stage 1 Gas Heat |
| 5. Return Air Temperature | 5. Stage 2 Gas Heat |
| 6. Mixed Air Temperature | 6. OA Damper |
| 7. Return Air Humidity | |
-
- | | |
|-----------------------------|----------------------------------|
| Virtual Points | Analog Outputs (Control): |
| 1. Unit Start Signal | 7. Supply Fan Fail Alarm |
| 2. Occupied Mode (Sched) | |
| 3. Clg Setpoint (74°F Adj) | |
| 4. Htg Setp (Clg Setp-3) | |
| 5. Adjusted Space Setpoint | |
| 6. Night Setback (55°F Adj) | |
| 7. Night Setup (85°F Adj) | |
- Above Points to be Displayed on RTU Graphic
All Above Points Shall be Accessible by User
All Above Points Shall be Trended



RTU TERMINAL STRIP
Interface board terminal strip by unit manufacturer
* Provide number of stages as required

WIRING DIAGRAMS



RTU-5
ROOFTOP UNIT W /DX CLG/GAS HEAT/MIN OA

PROJECT TITLE

AUTOMATIC TEMPERATURE CONTROL SYSTEM REPLACEMENT

OAK VIEW ELEMENTARY SCHOOL

5400 Sideburn Rd,
Fairfax, VA 22032

DRAWN SM

CHECKED

DATE 4/3/2024

PROJECT # MMB-074-24

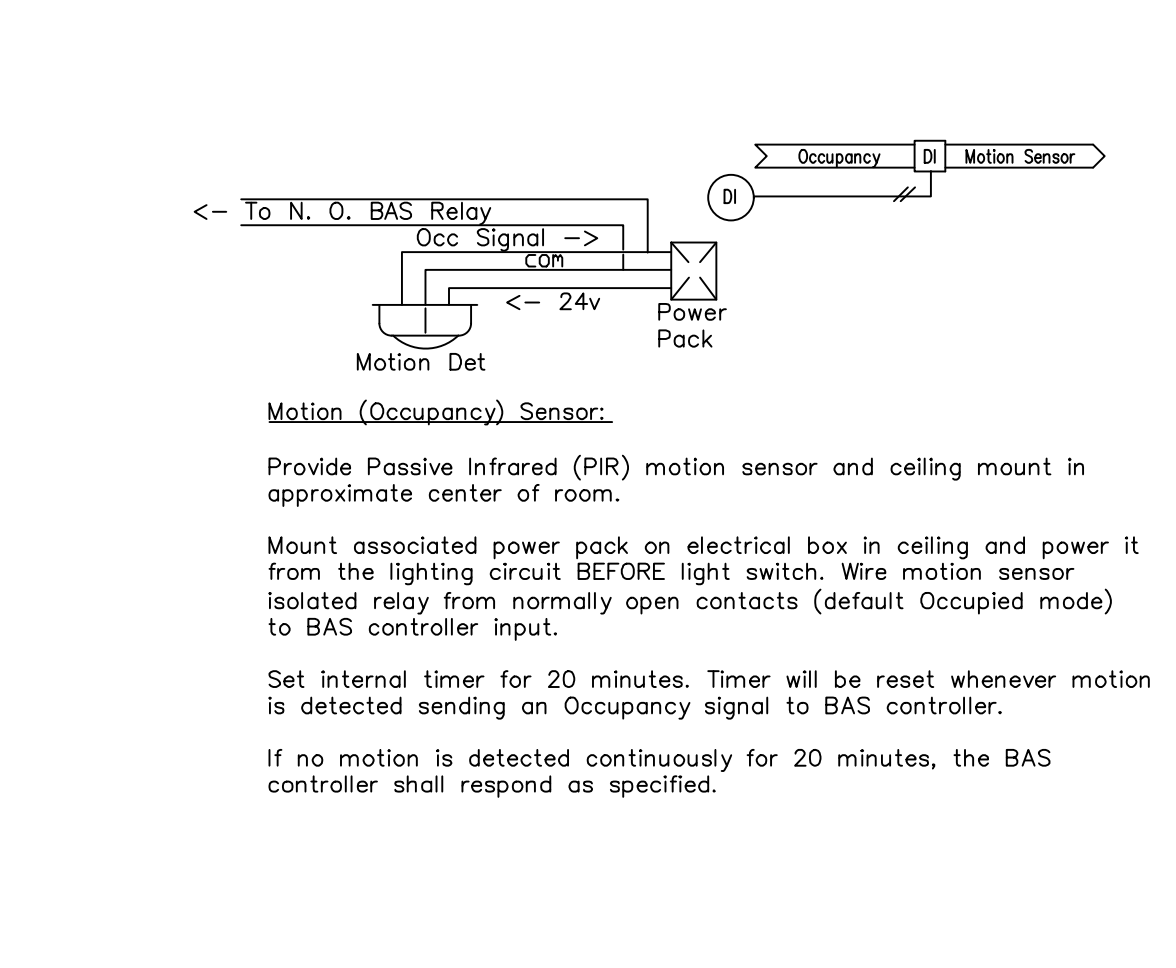
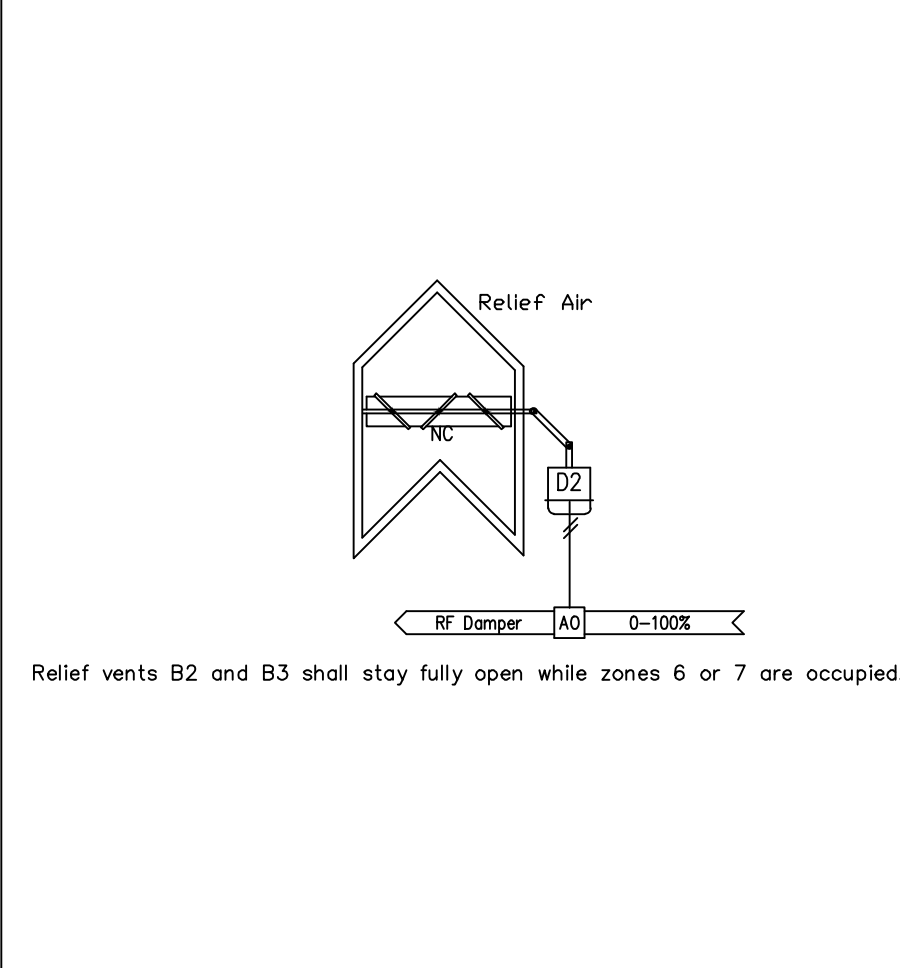
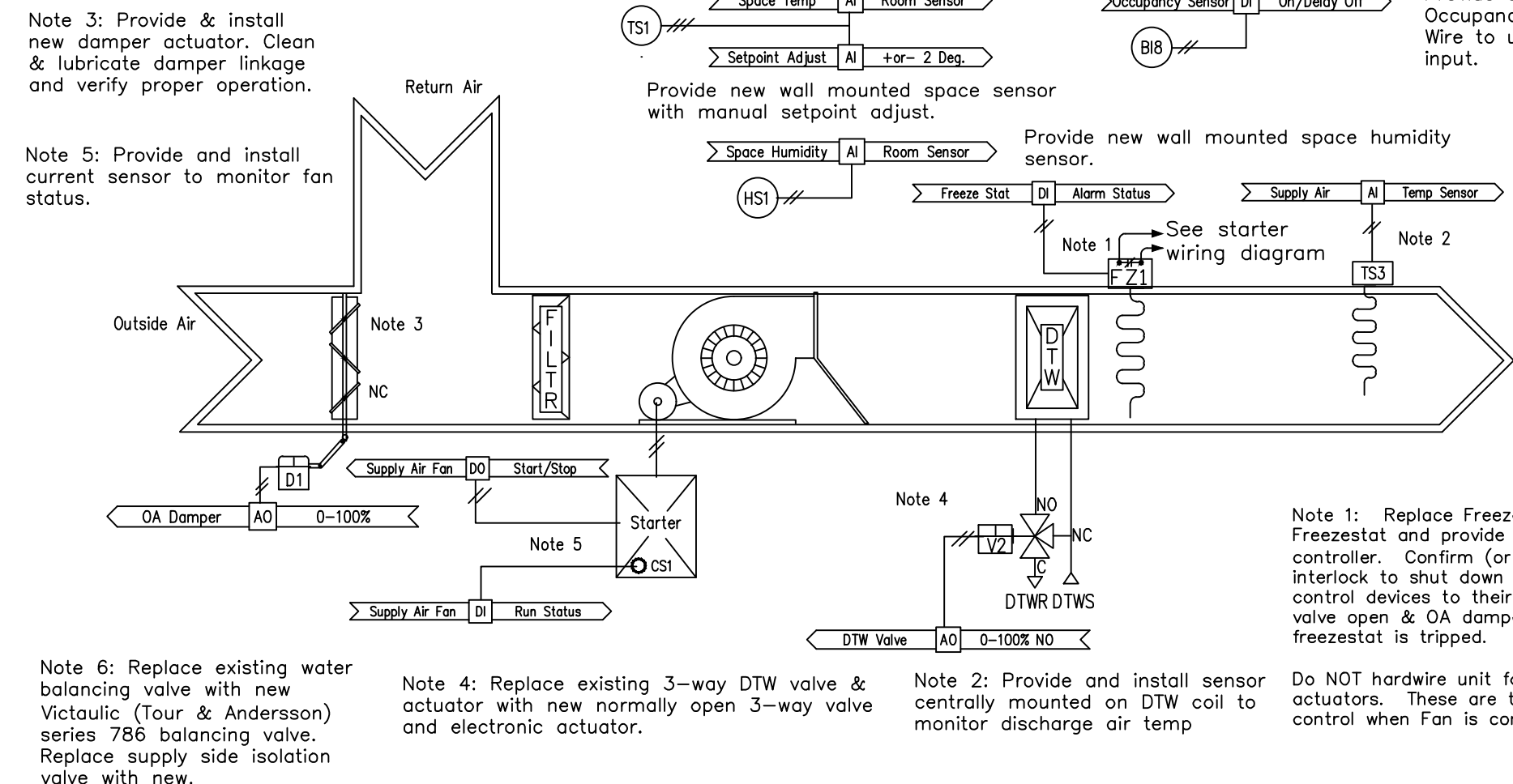
REVISIONS

NO.	DATE	DESCRIPTION

DRAWING TITLE

UV, FCU & MISC EQUIPMENT CONTROL DIAGRAMS

DRAWING NUMBER



Unit Vent & FCU w/DTW Coil & Min OA Damper

General: Each unit will have its own Control Module and be fully controlled by the BAS. The unit control logic strategies shall include:

- Scheduled occupancy
- Sequenced heating and cooling control
- Night (unoccupied) Setback

Supply Air Fan: The BAS shall control the starting and stopping of the supply air fan as follows:

- The unit fan shall run continuously during the scheduled Occupied period (Or the zone override is active)
- BAS shall prove fan operation and use the status indication to accumulate runtime. The BAS shall generate an Alarm if the fan fails to start after a 30 second delay or fails anytime thereafter. However the request for the failed fan shall remain active (as well as the Alarm) until the unit can be serviced and the Alarm is acknowledged.
- The unit fan shall be commanded Off when:
 - The Occupied period is over AND the unit is not heating or cooling to maintain night Setup/Setback setpoints.
 - Once the Fan is shut down it must remain off for at least 2 minutes.
 - The unit may be overridden On or Off via operator command from a remote central location.

Mode of Operation: BAS shall index the unit ventilator in either heating or cooling mode based on the indexed mode of the associated water system.

Outside Air Damper: BAS shall control the Outside Air (OA) Damper as follows:

- When the Unit is de-energized, the OA Damper shall remain in its closed position.
- When the Unit is energized for Night Setback, the OA damper shall remain closed.
- When the zone is in scheduled Occupied, the Occupancy sensor is active, and the supply air temperature is higher than 46F the BAS shall open the OA Damper to a preset minimum position determined by air balancer.

Space Temperature Control: Control space temperature by modulating the heating & cooling on the Unit as needed. The space temperature setpoints shall be as follows:

Two operator adjustable setpoints shall apply. Occupied Cooling (74F), setback heating (55F), and setup cooling (85F). These values shall be changed by the operator to adjust space temperatures. The Occupied Heating setpoint shall be the Cooling Setpoint minus 3F. The actual Occupied setpoints shall be offset +or- 2F by a manual adjuster on the room sensor.

Valve: N.O. dual temperature valve shall modulate in a cooling or heating PI loop respectively based on the indexed mode to maintain applicable space temperature setpoints within a 2F throttling range. No other control loops except those indicated on the logic diagram shall control the valve. In heating mode, the BAS shall maintain the supply air temperature no less than 48F.

Requests: This unit shall issue a "request" as follows:

- A "heat request" shall be issued whenever the heating PID output is at 5% or below
- A "cool request" shall be issued whenever the cooling PID output is at 5% or below

Unoccupied Setback: During the (scheduled) Unoccupied period the DTW Valve shall close. If, during this period, the space temperature falls below the night setback setpoint, the unit fan shall run with the DTW valve fully open until the space temp rises to at least 2F above the NSB setpoint.

Unoccupied Setup: During the (scheduled) Unoccupied period the DTW valve shall close. If, during this period, the space temperature rises above the night setup setpoint, the unit fan shall run with the DTW valve fully open until the space temp drops to at least 1F below the NSU setpoint.

Hardwired Points

Universal Inputs (Sensors):

- Space Temperature
- Setpoint Adjust
- Supply Air Temp
- Freeze Stat
- Occupancy Sensor
- Fan Status
- Space Humidity

Digital Outputs (Control):

- Supply Fan Start/Stop

Analog Outputs (Control):

- Dual Temperature Water Valve
- OA Damper Control

Virtual Points

- Unit Start Signal
- Occupied
- Cooling Setp (74F Adj)
- Heating Setp (Clg Setp - 3)
- Adjusted Space Setpoint
- Night Setback (55F Adj)
- Night Setup (85F Adj)
- Heat/Cool Mode

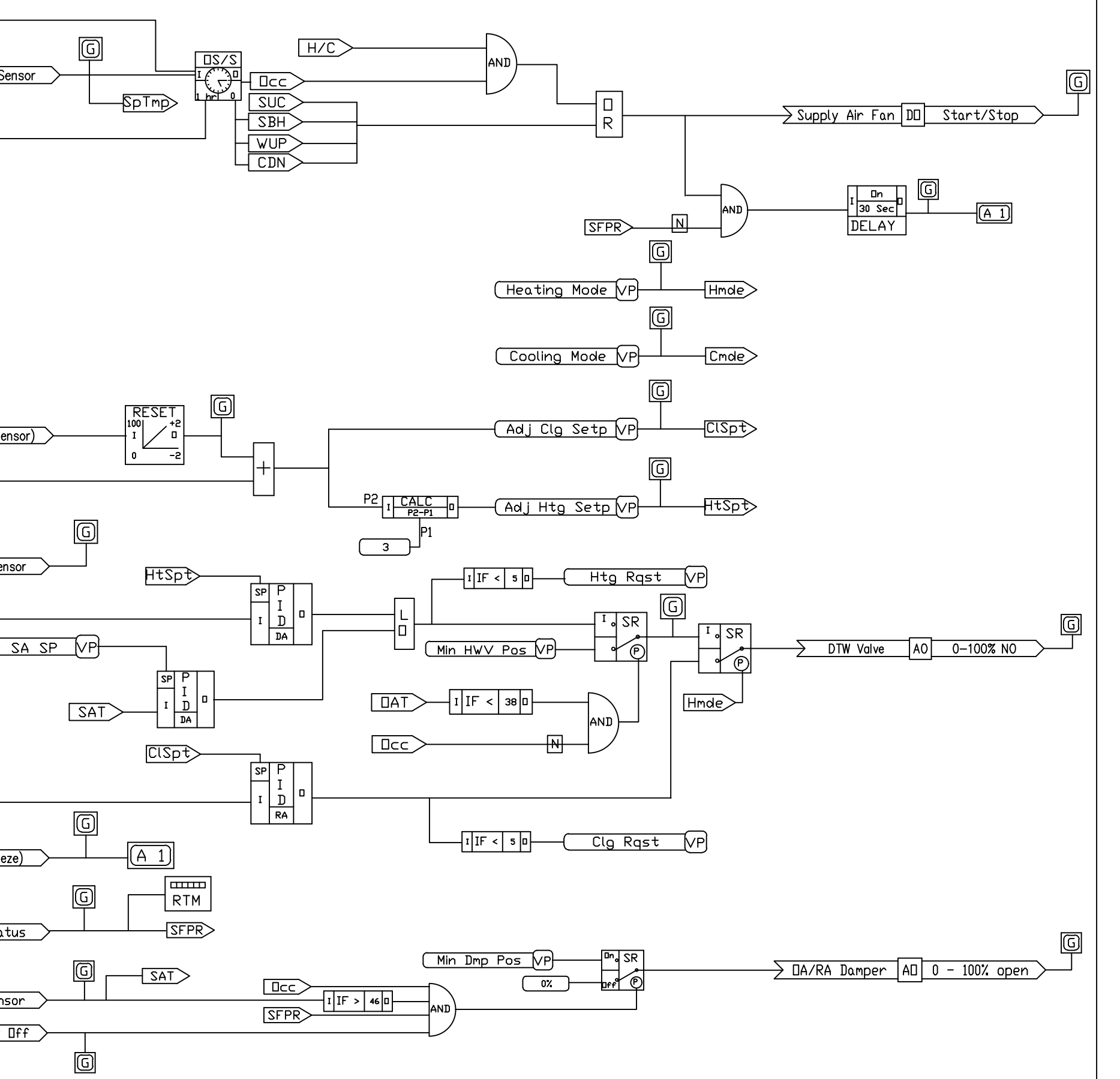
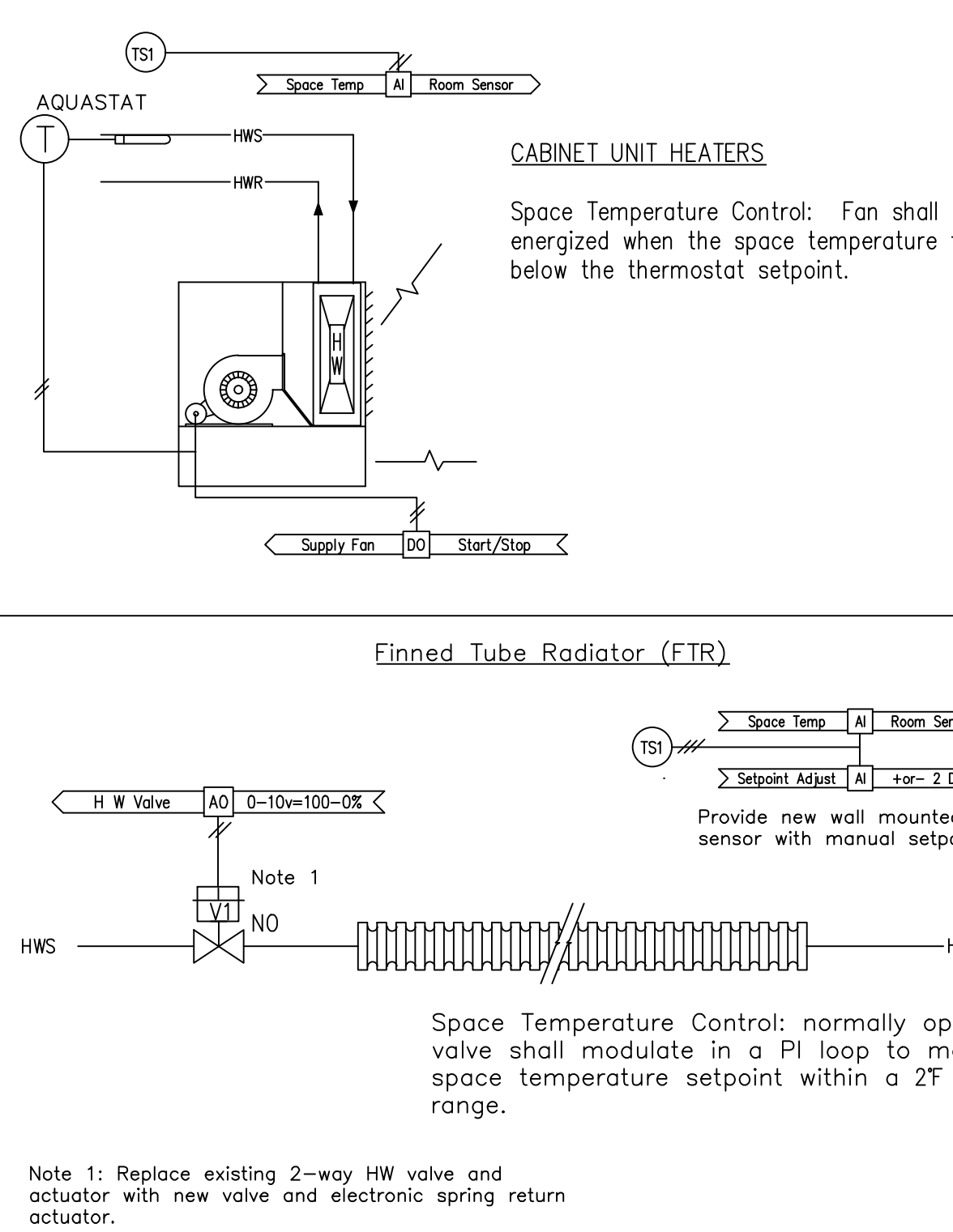
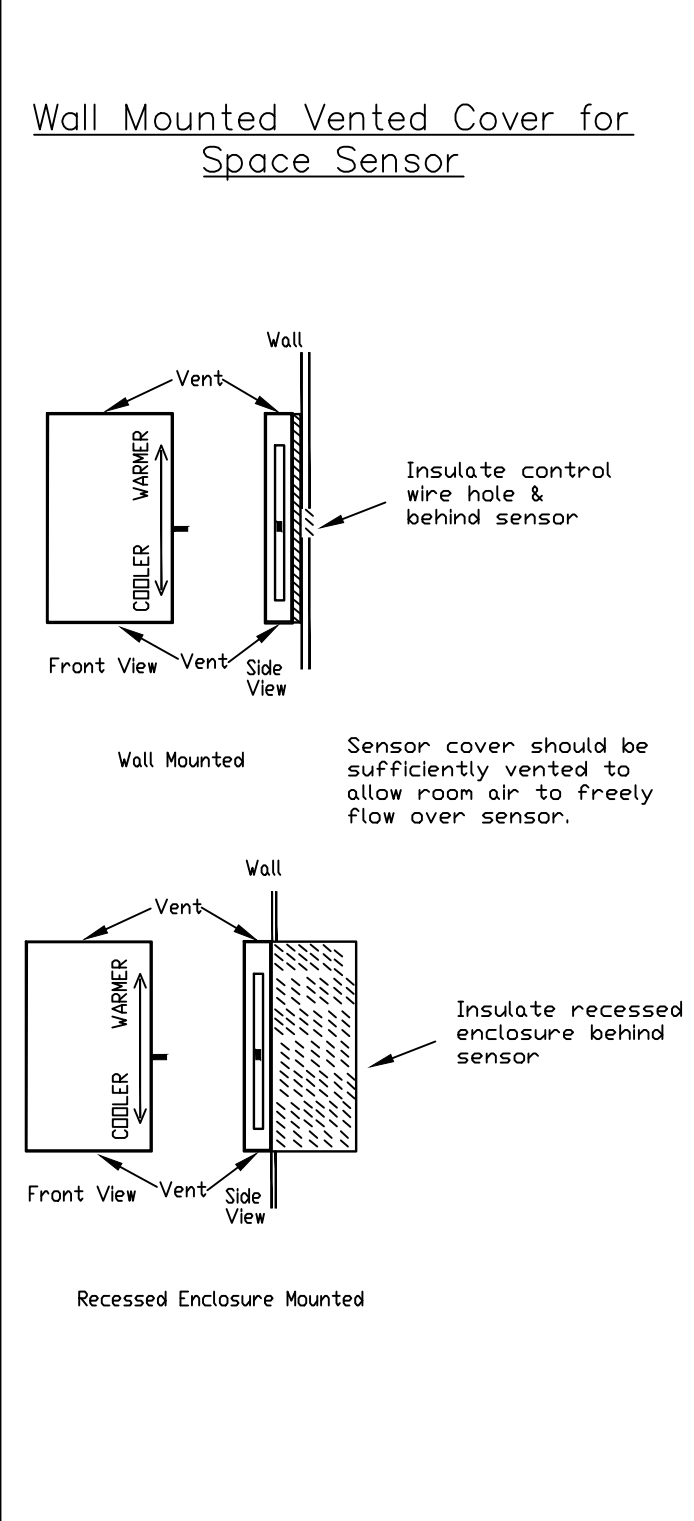
Above Points to be Displayed on Unit Graphic
All Above Points Shall be Accessible by User
All Above Points Shall be Trended

Unit Fan & Actuators

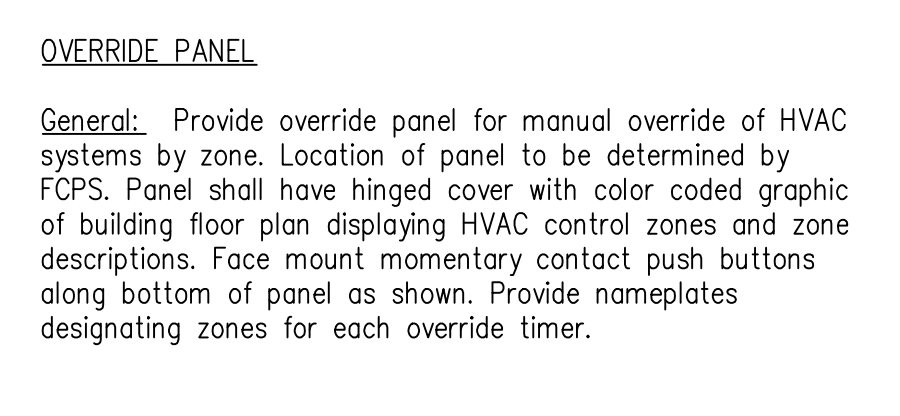
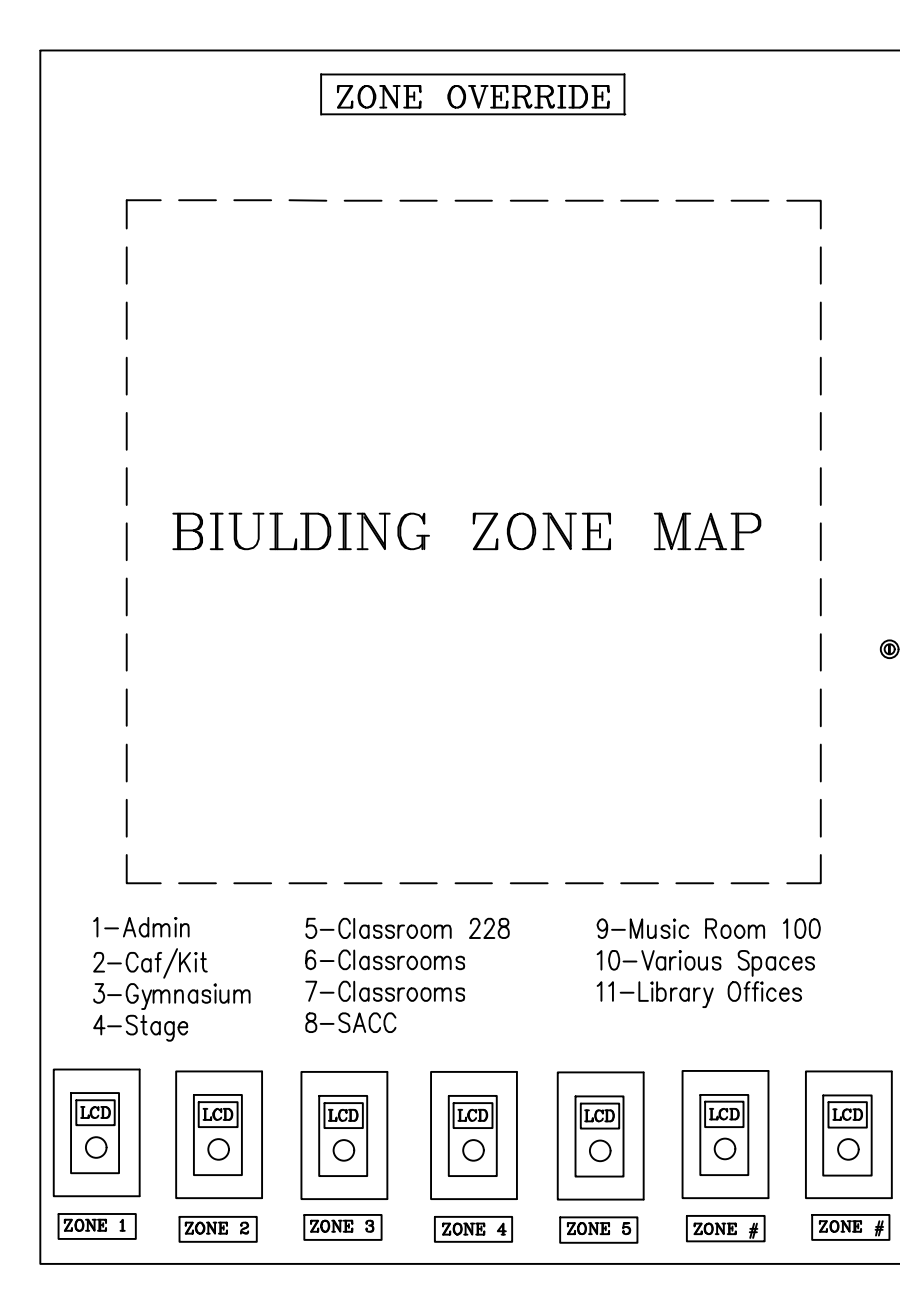
interrupts 24 volt power to valve and damper actuators

Note: Wire HW valve to spring Open & OA Damper to spring Closed when Freezestat is tripped. Wire OA damper to close when fan is OFF. Do NOT tie HW valve to Fan status.

WIRING DIAGRAMS



UVS & FCU W/ HOT/CHILLED WATER & OUTSIDE AIR



TYPICAL OVERRIDE PANEL

ZONES - AREA SERVED

- ADMIN OFFICES
- CAFETERIA/KITCHEN
- GYMNASIUM
- STAGE
- CLASSROOM 228
- CLASSROOMS
- CLASSROOMS
- SACC
- MUSIC ROOM 100
- VARIOUS SPACES
- LIBRARY OFFICES

Provide individual virtual shown on mechanical control zone diagram

Override Push Buttons shall be digital time switch with LCD display (Wattstopper TS-400-24), and shall be programmed to provide two hours overtime use when pushed. Zones shall be defined by the Control Zone Diagrams as shown on these control drawings. Upon activation of the zone timer, BAS shall place all HVAC equipment located in the applicable zone into the occupied mode. Whenever the override button is pushed while in the active mode, the timer shall be reset to zero and the zone override run request removed.

Reports: The BAS shall log all override data and be made available in a report via operator command.

Global Override Disable Point: Provide an override disable point embedded in the program code which will disable all zone overrides at the same time.

TYPICAL OVERRIDE PANEL

PROJECT TITLE

AUTOMATIC TEMPERATURE CONTROL SYSTEM REPLACEMENT

OAK VIEW ELEMENTARY SCHOOL

5400 Sideburn Rd,
Fairfax, VA 22032

DRAWN SM

CHECKED

DATE 4/3/2024

PROJECT # MMB-074-24

REVISIONS

NO. DATE DESCRIPTION

DRAWING TITLE

STANDARD CONTROL & LOGIC SYMBOLS

DRAWING NUMBER

DDC FUNCTION BLOCK LOGIC SYMBOLS

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	OUTPUT POINT - TRANSMITS A VALUE FROM THE FB TO A PHYSICAL OUTPUT CHANNEL ON THE CONTROLLER. DESCRIPTOR - CONTROLLER ADDRESS, POINTNAME AND POINT TYPE AI - ANALOG OUTPUT DI - DIGITAL OUTPUT		PID CONTROLLER - PROPORTIONAL, INTEGRAL, DERIVATIVE LOOPS USE STANDARD ALGORITHMS TO CALCULATE AN OUTPUT BASED ON A VARIABLE INPUT. PROPORTIONAL IS BASED ON THE DIFFERENCE BETWEEN THE INPUT AND THE SETPOINT. INTEGRAL IS BASED ON THE TIME THE INPUT DEVIATES FROM THE SETPOINT. DERIVATIVE IS BASED ON THE RATE THE INPUT IS APPROACHING THE SETPOINT. THE PID CAN BE EITHER DIRECT ACTING (DA) OR REVERSE ACTING (RA). IN A DA PID WHEN THE INPUT INCREASES THE OUTPUT INCREASES. IN A RA PID WHEN THE INPUT INCREASES THE OUTPUT DECREASES.
	INPUT POINT - READS A VALUE FROM A PHYSICAL INPUT ON THE CONTROLLER AND CONVERTS FOR USE INSIDE THE FB. DESCRIPTOR - CONTROLLER ADDRESS, POINTNAME AND POINT TYPE AI - ANALOG INPUT DI - DIGITAL INPUT		FLOATING CONTROLLER - OUTPUT WILL INCREASE OR DECREASE INCREMENTALLY AS INPUT DEVIATES FROM SETPOINT. IN A DA CONTROLLER WHEN THE INPUT INCREASES THE OUTPUT INCREASES. IN A RA CONTROLLER WHEN THE INPUT INCREASES THE OUTPUT DECREASES.
	VIRTUAL POINT - ANALOG OR DIGITAL VALUE USED WITHIN A FB OR BROADCAST ACROSS THE LAN.		RESET CONTROLLER - USER DEFINED OUTPUT VALUE WILL RESET IN A LINEAR RELATIONSHIP BASED ON USER DEFINED INPUT VALUE.
	DIGITAL WIRE - DIGITAL LOGIC CONNECTION BETWEEN FB'S		SWITCHING RELAY - SWITCHES OUTPUT BETWEEN TWO INPUTS WHEN DIGITAL PILOT INPUT IS ON. SWITCH SHOWN IN NORMAL POSITION
	ANALOG WIRE - ANALOG LOGIC CONNECTION BETWEEN FB'S		DEADBAND SWITCHING RELAY - DIGITAL OUTPUT CHANGES WHEN INPUT VALUE RISES/FALLS ABOVE/BELOW SETPOINT 1 (SP1). DIGITAL OUTPUT RESTORES TO NORMAL WHEN INPUT RISES/FALLS ABOVE/BELOW SETPOINT 2 (SP2). SWITCH SHOWN IN NORMAL POSITION
	CONSTANT - CONSTANT VALUE INPUTS		LOGICAL IF EXPRESSION - THE OUTPUT IS ON IF THE INPUT MEETS THE CONDITION OF THE SETPOINT.
	GRAPHIC INTERFACE - VALUE APPEARS ON GRAPHIC SCREEN		RAMP CONTROLLER - LIMITS THE RATE OF CHANGE OF AN OUTPUT ON AN INCREASE IN VALUE OR A DECREASE IN VALUE. CHNG% - % OF TOTAL MAXIMUM OUTPUT VALUE ALLOWED FOR OUTPUT CHANGE I = TIME IN SECONDS MAX = MAXIMUM OUTPUT VALUE MIN = MINIMUM OUTPUT VALUE
	ALARM & PRIORITY - TRANSMITS AN ALARM AND ALARM PRIORITY TO APPROPRIATE DEVICES.		TIMER - OUTPUT IS ON FOR A USER SPECIFIED TIME AFTER INPUT CHANGES FROM OFF TO ON
	MESSAGE AND NUMBER - TRANSMITS A MESSAGE AND MESSAGE NUMBER TO APPROPRIATE DEVICES.		AUTOMATIC TIME SCHEDULER - INCLUDES SCHEDULES ENTERED INTO CONTROLLER FOR 7 DAY SCHEDULING WITH HOLIDAYS AND OVERRIDE SCHEDULES. INCLUDES OVERRIDE INPUT FOR UNSCHEDULED OVERRIDE. OUTPUTS REFERENCE FLAGS CAN INCLUDE HEATING SETBACK, COOLING SETBACK, AND UNOCCUPIED
	TREND - ESTABLISHES TREND IN CONTROLLER.		OPTIMUM START/STOP TIME SCHEDULER - INCLUDES SCHEDULES ENTERED INTO CONTROLLER FOR 7 DAY SCHEDULING WITH HOLIDAYS AND OVERRIDE SCHEDULES. INCLUDES OPTIMUM START STOP ROUTINE. OUTPUTS REFERENCE FLAGS CAN INCLUDE WARM-UP, COOL-DOWN, HEATING SETBACK, COOLING SETBACK, AND UNOCCUPIED. INCLUDES OVERRIDE INPUT (OVR) FOR UNSCHEDULED OVERRIDE
	RUN TIME MONITOR - ACCUMULATES RUNTIME FOR DIGITAL OUTPUT AND CONVERTS TIME TO HOURS.		CALCULATION BLOCK - OUTPUT IS EQUAL TO CALCULATION USING INPUT(S). EQUATION CAN BE MATHEMATICAL OR A PREDEFINED INDUSTRY STANDARD ALGORITHM (ie. CFM, VELOCITY PRESSURE, ENTHALPY, DEW POINT ETC.)
	REFERENCE FLAG - USED AS CONNECTION TO FB'S BY REFERENCE INSTEAD OF WIRES.		HIGH SELECTOR - SELECTS HIGHER OF INPUT VALUES
	DIGITAL AND GATE - OUTPUT IS ON IF ALL INPUTS ARE TRUE		LOW SELECTOR - SELECTS LOWER OF INPUT VALUES
	DIGITAL OR GATE - OUTPUT IS ON IF ANY INPUT IS TRUE.		AVERAGING BLOCK - MATHEMATICALLY AVERAGES INPUT VALUES.
	DIGITAL EXCLUSIVE OR GATE - OUTPUT IS ON IF ONLY ONE INPUT IS TRUE.		PROOFING MODULE - GENERATES VALUES BASED ON A COMPARISON OF COMMAND AND MONITORING INPUTS. DLY - PROOFING DELAY PERIOD MTR - MONITOR (INPUT FOR PROOF) COM - COMMAND (INPUT FOR PROOF) RST - RESET (IF LATCHING IS USED) ALM - ON WHEN MONITOR INPUT IS NOT EQUAL TO COMMAND INPUT NML - OUTPUT IS ON WHEN MONITOR AND COMMAND INPUTS ARE ON AND NORMAL CONDITIONS ARE MET
	INVERSE (NOT) - IF INPUT = ON, OUTPUT = OFF; CONVERSELY IF INPUT =OFF, OUTPUT =ON		TIME AVERAGE BLOCK - OUTPUT IS EQUAL TO SUM OF INPUTS FROM USER SPECIFIED PREVIOUS TIME PERIOD (OR NUMBER OF SCANS) TO CURRENT TIME (OR SCANS) DIVIDED BY NUMBER OF DISCRETE POINTS IN THE SUMMATION PERIOD. OUTPUT IS A ROLLING TIME BASED AVERAGE OF THE INPUT VALUE.
	LATCH OFF - OUTPUT IS OFF WHENEVER INPUT IS ON. OUTPUT REMAINS OFF UNTIL RESET CHANGES FROM OFF TO ON.		STAGER BLOCK - OUTPUT IS EQUAL TO SUM OF REQUESTS FROM USER SPECIFIED INPUTS. ROTATION SHALL BE DETERMINED BY USER DEFINED PARAMETERS. EACH INDIVIDUAL OUTPUT CAN BE LOCKED OUT BY USER DEFINED INDIVIDUAL INPUTS. LOCKED OUT OUTPUTS SHALL BE SKIPPED IN ROTATION. (SEE SEQUENCE OF OPERATION FOR DETAILS)
	LATCH ON - OUTPUT IS ON WHENEVER INPUT IS ON. OUTPUT REMAINS ON UNTIL RESET CHANGES FROM OFF TO ON.		SAMPLE & BUMP - CHANGE IN OUTPUT (WITH DEFINED MINIMUM & MAXIMUM VALUES) BY A DEFINED AMOUNT WHEN INPUT DEVIATES FROM SETPOINT (SP) BY A DEFINED AMOUNT AT A DEFINED INTERVAL. I - INPUT D - OUTPUT MX - MAXIMUM OUTPUT MN - MINIMUM OUTPUT INTVL - INTERVAL > +IE, +DA - WHEN INPUT RISES ABOVE SETPOINT BY AMOUNT '+IE', OUTPUT IS INCREASED BY AMOUNT '+DA' < -IE, -DA - WHEN INPUT FALLS BELOW SETPOINT BY AMOUNT '-IE', OUTPUT IS REDUCED BY AMOUNT '-DA'
	ON/OFF DELAY TIMER - AFTER INPUT IS ON, OUTPUT IS ON/OFF AFTER A PREDETERMINED TIME (H) HAS ELAPSED.		
	CYCLE DELAY TIMER - WHEN SET TIME HAS ELAPSED, THE FIRST TIME INPUT IS ON, OUTPUT IS ON AND TIMER RESETS. BEFORE SET TIME HAS ELAPSED, OUTPUT IS OFF WHEN INPUT IS OFF. IF INPUT GOES FROM OFF TO ON BEFORE SET TIME HAS ELAPSED, OUTPUT WILL REMAIN OFF.		
	POWER FLAG - ON WHEN CONTROLLER IS INITIALLY POWERED ON AND NO PHASE LOSS IS DETECTED		
	FLIP FLOP - CHANGE STATE OF OUTPUT WHEN INPUT CHANGES FROM OFF TO ON; OUTPUT SET TO OFF WHEN RESET (R) GOES CHANGES FROM OFF TO ON		
	SETPPOINT OPTIMIZATION - RESET OF OUTPUT FROM A MAXIMUM VALUE TO A MINIMUM VALUE BASED ON VALUES OR REQUESTS DB - DEAD BAND INC - INCREMENT/DECREMENT VALUE HI - MAXIMUM RESET VALUE LD - MINIMUM RESET VALUE		

CONTROL SYMBOLS

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	DDC POINT DESCRIPTOR WITH NAME AI - ANALOG INPUT DI - DIGITAL INPUT AO - ANALOG OUTPUT DO - DIGITAL OUTPUT		DISCONNECT SWITCH
	TEMPERATURE SENSOR WITH AVERAGING ELEMENT		CONTROL TRANSFORMER
	TEMPERATURE SENSOR WITH SINGLE POINT ELEMENT		RELAY COILS
	TEMPERATURE SENSOR WITH PIPE WELL		FUSE
	HUMIDITY SENSOR		THERMAL OVERLOAD
	LOW TEMPERATURE SWITCH (FREEZESTAT)		NORMALLY OPEN AND NORMALLY CLOSED CONTACTS
	HIGH TEMPERATURE SWITCH (FIRESTAT)		HAND-OFF-AUTO SELECTOR SWITCH
	SMOKE DETECTOR		WIRING DESIGNATION (NO. OF HATCHES INDICATES NO. OF CONDUCTORS)
	DIFFERENTIAL PRESSURE SWITCH		WIRING CONNECTION
	WATER FLOW SWITCH		ON-OFF SELECTOR SWITCH
	DUCT AIR QUALITY SENSOR		STRAP-ON TEMPERATURE SENSOR
	CURRENT TO PNEUMATIC TRANSDUCER		ROOM TEMPERATURE SENSOR AS SHOWN ON FLOOR PLANS
	TWO WAY CONTROL VALVE		ROOM HUMIDITY SENSOR AS SHOWN ON FLOOR PLANS
	THREE WAY CONTROL VALVE		DIGITAL CONTROL STATION
	DAMPER ACTUATOR		WAN INTERFACE
	WATER DETECTOR		PILOT LIGHT (WITH LENS COLOR)
	CURRENT SENSOR		FIRE ALARM RELAY BY DIV. 16
	LIMIT SWITCH		TIME DELAY RELAY DELAY ON MAKE OR BREAK
	DPST FREEZESTAT		AIR FLOW MONITORING STATION
	RELAY - NORMALLY OPEN		

LEGEND	
	NEW WIRING
	WIRING BY OTHERS