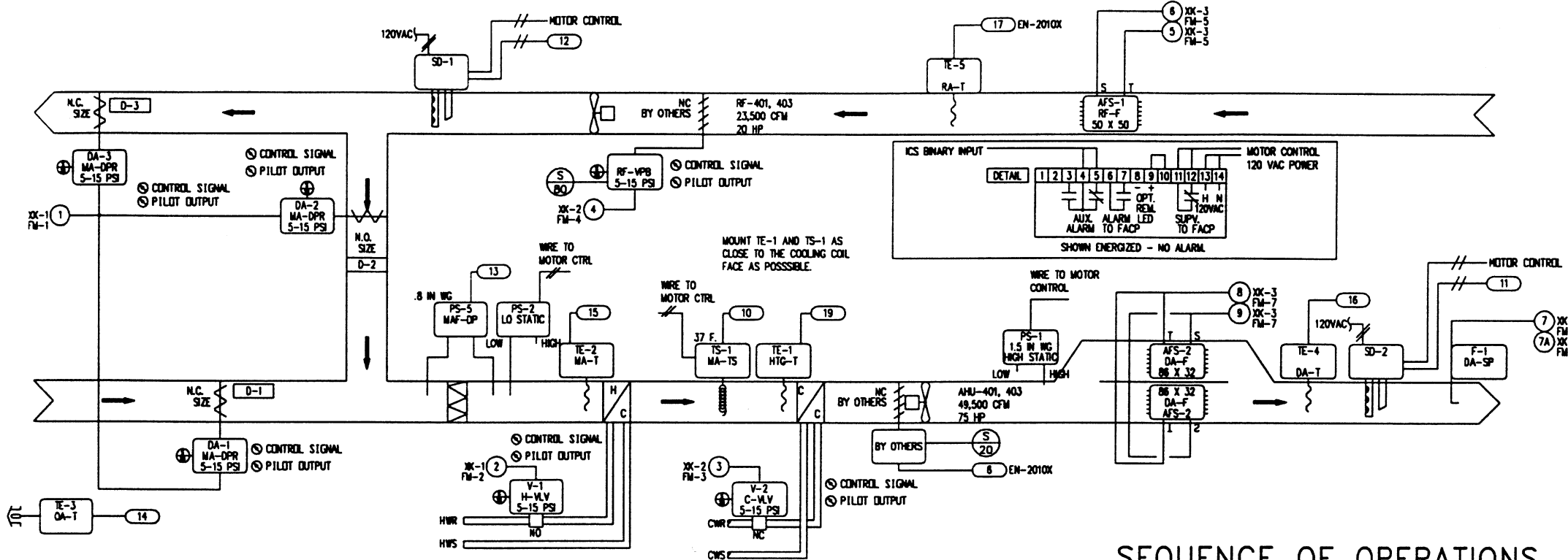
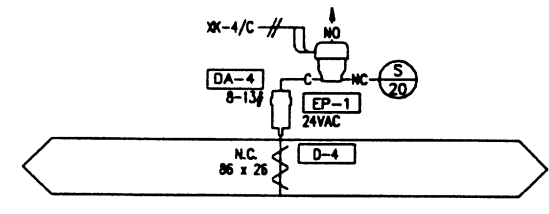


FLOW DIAGRAM AND EQUIPMENT LOCATIONS FOR AIR HANDLING UNITS, AHU-401 AND AHU-403

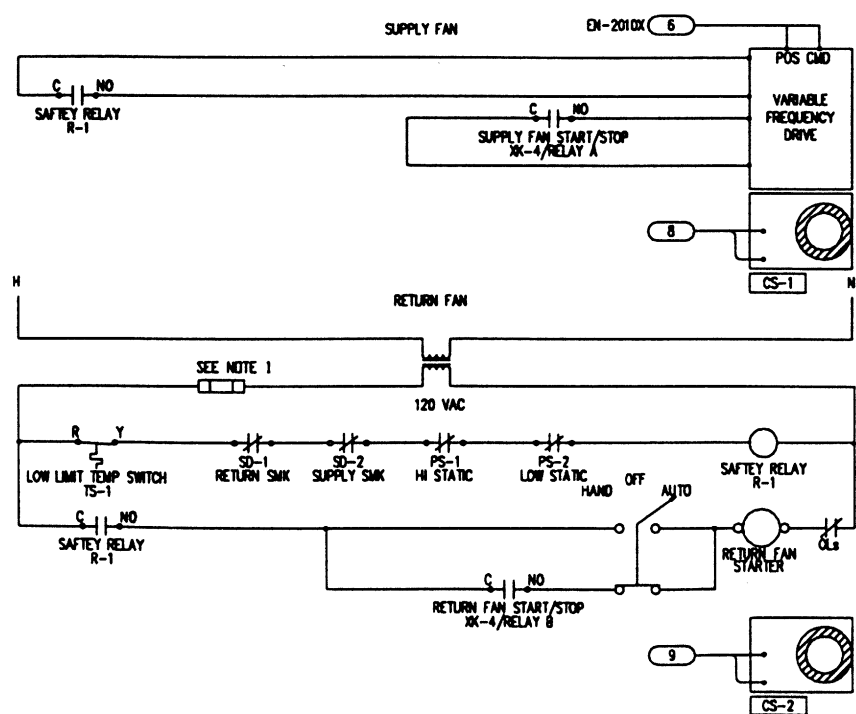


FIELD MATERIAL			
DEVICE TAG	QTY	CODE NUMBER	DESCRIPTION
Y-1-V-2	4	----	SEE SCHEDULE
D-1-D-4	7	----	SEE SCHEDULE
DA-1-DA-3	6	----	SEE DAMPER SCHEDULE
DA-4	1	----	SEE DAMPER SCHEDULE
PS-1-PS-2	4	1900-5-NR	DUCT PRESS MONITOR-DWYER
PS-5	2	P32AF-2C	SEN DIFF PRESSURE SWITCH
SD-1-SD-2	4	DH1831AC-2C	DUCT DETECTOR, 1DN, SAMPLING TUBE FOR
	4	ST-10	
TE-1,2,4,5	8	TE-6100-1	17 FT. 1000 OHM, NI TE
TE-3	2	TE-6000-100	SENSOR, 1000 OHM +/- .1Z
	2	TE-6001-2	HOUSING F/O O.A.TEMP.
TS-1	2	A70HA-1C	TEMP CONTROL 4 WIRE, 2-C
ACC	12	G-2010-5	AIR GAGE 1-1/2"
EP-1	2	Y-2410-1	VALVE, SOL. AIR, 3-WAY
R-1	2	PD-109-20	RELAY; PLUG IN, 3PDT
	2	PD-109-35	SOCKET, 1/16 IN BLADE
CS-1-CS-2	4	D150-1ND	CURRENT SWITCHING
AFS-1-AFS-2	6	DAND	AIR FLOW MEASURING STATION
F-1	2	FTG1BA-600R	STATIC TIP

ANY MATERIAL WITH A (P) PRECEDING THE DEVICE TAG IS CONSIDERED PROPRIETARY EQUIPMENT AND IS BEING SUPPLIED BY JOHNSON CONTROLS, INC. ALL OTHER MATERIAL IS NON-PROPRIETARY EQUIPMENT.



MOTOR CONTROL



SEQUENCE OF OPERATIONS

SYSTEM: Mixed Air Single Path, Variable Volume Air Handling Unit AHU-401, AHU-403

CONFIGURATION: Supply Air Reset from Return Air Temperature
Variable Air Volume with Supply and Return Fans

Occupied Mode
The supply and return fans will operate continuously in this mode.

Discharge Air Temperature Setpoint
The building operating engineer will set the discharge air temperature by adjusting the discharge air setpoint, DA-SP form any ISC terminal. The digital controller will modulated controlled devices as described below to maintain a fan discharge temperature of 47 F.

Discharge Temperature Loop
The discharge cooling deadband is added to the discharge air setpoint. This value establishes the point at which mechanical cooling begins when the controller uses proportional only control. The digital controller will continually adjust the damper and mechanical cooling command in sequence according to the controller's result of the proportional-integral cooling loop calculation. The digital controller modulates the controlled devices until the discharge air temperature equals the calculated discharge setpoint. The digital controller will continually adjust the heating command according to the controller's result of the proportional-integral heating loop calculation. The digital controller will modulate the heating control valve, V-1, mixed air dampers, DA-1-DA-3 and cooling control valve, V-2 until the discharge air temperature equals the setpoint. The controller will provide an output between 0 and 100 percent as the discharge air temperature travels through the proportional bands.

The state of 'Heating Mode' and 'Cooling mode' will lockout the operation of the controlled device, V-1 and V-2 if the respective mode is set 'OFF'. The PID control algorithm will sequence the heating and cooling devices so that both do not operate in the same proportional band.

The digital controller will control the mixed air dampers between minimum and 100 percent in the occupied mode and from 0 percent in the unoccupied mode.

Mixed air low limit
The mixed air low limit setpoint and the mixed air low limit proportional band will establish a back off effect to the mixed air damper output command. This happens when the mixed air temperature, TE-2 decreases into the range of the mixed air low limit plus the mixed air low limit proportional band. This back-off feature multiplies the damper command by the proportional percentage of the mixed air temperature inside the mixed air low limit proportional band. The mixed air low limit proportional band is reset inversely by 20 degrees between outdoor air temperatures of 40 and -30 degrees F.

Dry Bulb Economizer Switchover
When the outdoor air temperature, TE-3 is greater than the Econo Switchover setpoint, 68 F. (Adj.) the digital controller commands the mixed air dampers to minimum position (Adj.). When the outdoor air temperature decreases below the Econo Switch Setpoint minus the Econo Switch Differential, the controller modulates the mixed air dampers to provide free cooling. When ECON is on, free cooling is available.

Control systems, AHU-401 and AHU-403 will use a common outside air temperature value while the digital controller is online with its controlling NCM. In the event that communication is lost the controller will operate using the temperature element that is hardwired to that system, TE-3.

Heating Mode
The digital controller will enter the heating mode at outdoor air temperatures below 45 F. The digital controller will position the cooling control valve at zero percent and the freeze protection pump will be turned on.

Cooling Mode
The digital controller will enter the cooling mode at outdoor air temperatures above 50 F. The digital controller will position the heating control valve at zero percent and the freeze protection pump will be turned off.

Single Supply and Return Fan - Volume Matching
The digital controller will provide an output command to the supply fan variable pitch blades based on the controller's PI loop calculation. The controller will add the static pressure offset value to the PI control calculation. The static pressure deadband value establishes a range above and below the static pressure setpoint where the error is considered zero, causing corrective action to stop. This value is input above and below the static pressure setpoint. The controller will establish a return fan volume setpoint by subtracting the CFM Differential, 26,000 CFM from the actual supply fan CFM. The return volume proportional band integration value will cause the controller to continually provide corrective action until the actual return volume equals the return volume setpoint. If the calculation becomes unreliable, the output to the return fan will be zero percent.

Supply Static High/Low limit
The supply/return fans system will stop in the event that the supply static exceeds 5.00 inch WG or the mixed air static exceeds a negative 1.50 inches WG. at pressure sensing switches, PS-1 and PS-2. All controlled devices will be commanded to the position indicated in 'Loss of Air Flow' until the appropriate pressure sensing switch is reset.

Electric Low Limit
The supply/return fans system will stop and the mixed air dampers will be positioned at zero percent in the event that the heating coil discharge drops below 37 F. (adjustable) at temperature switch, TS-1.

Isolation damper
The building operating engineer has the ability to open isolation damper, D-4 and make the supply air plenums for AHU-401 AHU-403 common by setting binary output object 'ISD_40X' to 'open'. The systems will operate individually with the damper closed.

Filter Alarm
The mixed air filter condition will be monitored by differential pressure switch, PS-5. The switch will close in the event that the pressure drop exceeds .8 inches WG (adjustable) and an alarm will be sent to the ICS network, 'Dirty Mixed air Filter'.

The smoke detectors' condition will be monitored by the digital controller. The alarm contact will close in the event that smoke is detected in the supply or return ductwork and an alarm will be sent to the ICS network, 'Supply (or return) smoke detected'. The supply and return fans will stop through a hardware interlock in the event that either smoke detector is activated.

Loss of Air Flow
Upon loss of air flow as determined by current sensing switches, CS-1 and CS-2 the following controlled devices will be commanded to the following states:

- Heating valve, V-1 will remain in control.
- Heating water circulating pump will be turned off.
- Cooling valve, V-2 will be positioned at zero percent.
- Mixed air dampers, DA-1-3 will be positioned at zero percent.
- Return and supply fan positions will be commanded to zero percent.

Unoccupied Mode
The supply and return fans will remain off and the controlled devices will be commanded to the positions indicated above under 'Loss of Air Flow'.

Shutdown
Upon a command from the higher level digital controller, MC-8, the AHU digital controller will command all analog outputs to zero percent and will turn off all binary outputs.

Power Fail Restart
The power fail restart will delay the startup of the digital controller for 1-2 min (adj.) after a power failure for controller reset condition. This logic will hold the controller in the shutdown mode until the restart timer has expired.

The following point objects will be adjustable from any ICS terminal:

- Power fail restart timer (Adj at DWS)
- Discharge air setpoint
- Heating and Cooling lockout setpoints
- Cooldown temperature setpoint (return air)
- Supply air static pressure setpoint.

The following point objects will be monitored/alarmed at any ICS terminal:

- Electric low limit temperature switch, TS-1 status
- Mixed air filter differential pressure alarm, PS-3
- Supply and Return fan status, PS-1 and PS-2
- Smoke detectors, SD-1 and SD-2 status

DRAWING TITLE				FILE: AHU-401H			
Flow Diagram and Equipment Locations for AHU-401-AHU-403				DCODE: 19930820.2237			
Single Path, Mixed Air - VAV W/ Enclosures EN-20102,20103							
PROJECT				SALES ENGR PROJECT MGR/ APPL ENGR			
The Argonne National Labs				DRAWN			
Advanced Photon Source Campus				BY SF DATE 11/11/91			
9700 Cass Avenue South				APPROVED			
Argonne, IL 60439				DATE			
CONTRACT NUMBER				CONTRACT NUMBER			
91390-0009				91390-0009			
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91-9-C-03A				91-9-C-03A			