INPUT/OUTPUT SUMMARY

POINT NO.	SYSTEM APPARATUS OR AREA POINT DESCRIPTION	INPUTS																								OUTPUTS											SYSTEM FEATURES																	GEN.		
		ANALOG														BINARY										BINARY					ANALOG						ALARMS								PROGRAMS											
		MEASURED								CALC.																																														
		TEMPERATURE	VELOCITY PRESSURE	STATIC PRESSURE	DIFFERENTIAL PRESSURE	RELATIVE HUMIDITY	CARBON DIOXIDE			BTU/HR	RUN TIME	CFM	ENTHALPY			STATUS (DIFF. PRESS.)	SMOKE	FREEZE STAT	HIGH HUM. LIMIT	STATUS (AMPS)	END SWITCH	VFD FAULT	HIGH STATIC LIMIT			START - STOP	DAMPER POSITION	VALVE POSITION			DAMPER POSITION	COOLING COIL	FAN SPEED	WHEEL SPEED	GAS HEAT		LOW TEMP LIMIT	HIGH DIFF. PRESSURE	FAULT (VFD)	PROOF	FAILURE	SMOKE ALARM	HIGH STATIC		TIME SCHEDULING	ALTERNATE	TIME DELAY START	OCCUPIED/UNOCCUPIED	TEMPERATURE RESET	MORNING WARM-UP	LEAD/LAG			COLOR GRAPHICS		
	AHU-1																																												X			X	X	X				X		
1,2,3	SUPPLY AIR	X		X																			X																				X											X		
4,5	COOLING COIL CC-1	X																										X																										X		
6	GAS HEATING COIL																																		X																			X		
7	SUPPLY FAN SF-1										X									X						X							X								X													X		
8	DAMPER D-1-1																														X																							X		
9,10	OUTSIDE AIR		X									X																			X																							X		
11	DAMPER D-1-2																														X																							X		
12-13	HOT GAS REHEAT COIL RHC-1	X																																	X																			X		
14-15	RETURN AIR	X				X																																																X		
16-18	REMOTE SENSORS	X				X	X																																															X		

DRAWING NOTES:

1. STATIC PRESSURE SENSOR SHALL BE LOCATED IN THE SUPPLY DUCTWORK AT THE POINT(S) OF MINIMUM STATIC PRESSURE (TYPICALLY 2/3 DOWNSTREAM) AND THE INITIAL BALANCED SET POINT DETERMINED THROUGH TEST AND BALANCE.
2. SMOKE DETECTOR SHALL BE FURNISHED AND WIRED UNDER DIVISION 26 AND INSTALLED BY DIVISION 23.

SEQUENCE OF CONTROLS

PART 1 - TEMPERATURE CONTROL SEQUENCES

A. SEE SCHEMATICS FOR LOCATIONS OF ALL TEMPERATURE TRANSMITTERS, PANELS, DAMPERS, VALVES, AND EQUIPMENT; WHERE SUCH DEVICES ARE NOT INDICATED, HOWEVER REQUIRED BY THE SEQUENCES, THEY SHALL BE PROVIDED BY THE BUILDING AUTOMATION SYSTEM (BAS) PROVIDER AND LOCATED IN THE FIELD BY THE ENGINEER.

B. A FULL COMMUNICATIONS INTERFACE AND COMPLETE INTEROPERABILITY WITH THE BAS SHALL BE PROVIDED TO PERFORM THE FUNCTIONS HEREIN DESCRIBED OR INDICATED IN THE CONTRACT DOCUMENTS.

C. THE BAS PROVIDER AND THE EQUIPMENT MANUFACTURER SHALL PROVIDE A COMPLETE LIST OF ALL BACNET POINTS AVAILABLE TO BE ACCESSED FROM WITHIN THE MANUFACTURER'S FACTORY CONTROLLERS AND, SPECIFICALLY, IDENTIFY WHAT POINTS CAN BE READ FROM THE BAS, WHICH POINTS CAN BE WRITTEN TOO AND WHICH POINTS CANNOT BE ACCESSED AT ALL.

D. THE BAS SUBMITTAL, SEQUENCES AND POINTS LISTS SHALL INDICATE ALL ROUTINES THAT ARE CONTROLLED COMPLETELY BY THE MANUFACTURER'S CONTROLLERS, WHICH ROUTINES ARE CONTROLLED PARTIALLY BY THE MANUFACTURER'S CONTROLLERS AND BAS AND WHICH ROUTINES ARE CONTROLLED COMPLETELY BY THE BAS.

E. THE BAS PROVIDER AND EQUIPMENT MANUFACTURER, IN COLLABORATION, SHALL PROVIDE COORDINATED SUBMITTALS THAT INDICATE ANYTHING THAT HAS TO BE SET, RESET OR ACCESSED IN A MANUFACTURER'S CONTROLLER AT THE PIECE OF EQUIPMENT AS OPPOSED TO BEING ACCESSED AT OR FROM THE BAS USER INTERFACE/CONTROL CONSOLE. THIS COORDINATION AND COLLABORATION SHALL ALL OCCUR AT THE SUBMITTAL PHASE AND WELL BEFORE EQUIPMENT AND CONTROLS ARE DELIVERED TO THE SITE.

F. ALL SET POINTS SHALL BE FULLY ADJUSTABLE FROM THE BAS.

PART 2 - MASTER HEATING AND COOLING CONTROL

A. THE BAS SHALL COMMAND THE AIR HANDLING UNIT ON BASED ON THE OCCUPIED/UNOCCUPIED SCHEDULE (INITIAL SCHEDULE SHALL BE PROVIDED BY THE OWNER) AND ENABLE THE AHU'S AUTOMATIC CONTROLS TO OPERATE AS INDICATED BELOW

B. BAS SHALL NORMALLY CONTROL THE SYSTEM HEATING AND COOLING MODES AS SELECTED IN ACCORDANCE WITH OUTDOOR AIR TEMPERATURE THROUGH THE BUILDING GLOBAL OUTDOOR AIR SENSOR. ON A RISE IN OUTDOOR AIR TEMPERATURE TO 50°F AND ABOVE, SYSTEMS SHALL OPERATE IN THE COOLING MODE. ON A FALL IN OUTDOOR AIR TEMPERATURE BELOW 50°F SYSTEMS SHALL OPERATE IN THE HEATING MODE.

C. CONTROL POINT ADJUSTMENT FOR "HEATING" AND "COOLING" CHANGEOVER TEMPERATURE SHALL BE BY THE BAS.

D. WHERE USED TO CONTROL BOTH COMFORT HEATING AND COOLING, ZONE THERMOSTATIC CONTROLS SHALL BE CAPABLE OF PROVIDING A TEMPERATURE RANGE OR DEAD BAND OF AT LEAST 5°F WITHIN WHICH THE SUPPLY OF HEATING AND COOLING ENERGY TO THE ZONE IS SHUT OFF OR REDUCED TO A MINIMUM.

PART 3 - AIR HANDLING UNIT CONTROL

A. SYSTEM CONTROL

a. SUPPLY FAN SHALL BE MANUALLY INDEXED TO THE AUTOMATIC MODE AT THE BYPASS.

b. THE AIR HANDLING UNIT SHALL BE ENERGIZED VIA REMOTE SIGNAL FROM THE BAS. THE BAS SHALL DETERMINE AND OPERATE THE UNIT ON AN OPTIMAL OCCUPIED AND UNOCCUPIED SCHEDULE WITH A 365 DAY/24 HOUR GRAPHIC INTERFACE SCHEDULE PROGRAM.

c. WHEN THE UNIT IS DEENERGIZED THROUGH THE BAS, ALL CONTROLS SHALL RETURN TO THEIR NORMAL POSITION READY FOR RESTARTING. THE SUPPLY FAN SHALL DEENERGIZE AND, AFTER AN ADJUSTABLE INTERVAL, OUTSIDE AIR DAMPER D-1-2 SHALL CLOSE. END SWITCH ON DAMPER SHALL PROVIDE PROOF OF CLOSURE. THE REFRIGERATION CIRCUIT SHALL DEENERGIZE.

d. WHEN THE AIR HANDLING UNIT IS ENERGIZED THROUGH THE BAS, THE RELIEF D-1-1 AND OUTDOOR AIR D-1-2 DAMPERS SHALL OPEN TO THEIR MINIMUM BALANCED POSITIONS. THE SUPPLY FAN SHALL BE SOFT STARTED TO MINIMUM SPEED.

e. THE SUPPLY FAN SF-1 SHALL BE SOFT STARTED THROUGH THE BAS, UPON FAILURE OF DAMPER D-1-2 TO OPEN, THE AIR HANDLING UNIT SHALL BE DEENERGIZED AND AN ALARM SHALL BE ANNUNCIATED AT THE BAS.

f. THE SUPPLY FAN SF-1 SPEED SHALL BE CONSTANT SPEED.

g. A FAILURE OF THE SUPPLY FAN AS SENSED BY THE CURRENT TRANSDUCER SHALL BE ALARMED TO THE BAS. UPON SENSING FAILURE, THE BAS SHALL INDICATE ALARM, DISABLE THE FAN AND RETURN ALL CONTROLS TO THEIR NORMAL POSITION.

h. WHEN THE UNIT IS DEENERGIZED THROUGH THE BAS, ALL CONTROLS SHALL RETURN TO THEIR NORMAL POSITION READY FOR RESTARTING. OUTSIDE AIR AND RELIEF AIR DAMPERS SHALL CLOSE; COOLING COIL SHALL BE DEENERGIZE AND GAS HEAT SHALL BE DEENERGIZED. RETURN AIR DAMPER SHALL BE OPEN.

B. HEATING MODE CONTROL

a. OCCUPIED MODE: SUPPLY FAN SHALL BE RUNNING; OUTDOOR DAMPER D-1-2 SHALL BE SET TO THE MINIMUM POSITION. THE DIRECT EXPANSION REFRIGERANT COIL SHALL BE DEENERGIZED. THE GAS HEATING COIL SHALL BE ENERGIZED ON A DROP IN SPACE TEMPERATURE BELOW THE SPACE AIR TEMPERATURE SETPOINT OF SEVENTY (70) DEGREES FAHRENHEIT. THE BAS SHALL DEENERGIZE THE GAS HEATING COIL WHEN THE TEMPERATURE REACHES A MINIMUM OF SEVENTY (70) DEGREES FAHRENHEIT.

b. UNOCCUPIED MODE: THE BAS SHALL DETERMINE THE UNOCCUPIED MODE BASED ON A 365 DAY/24 HR GRAPHIC INTERFACE SCHEDULER PROGRAM. THE AIR HANDLING UNIT SHALL BE DEENERGIZED WHEN THE UNOCCUPIED MODE IS INITIATED. THE SUPPLY FAN SHALL BE ENERGIZED WHEN OUTDOOR AIR TEMPERATURE SENSOR, FALLS BELOW 40 DEGREES FAHRENHEIT AND THE ROOM TEMPERATURE IS BELOW THE UNOCCUPIED TEMPERATURE SET POINT OF SIXTY-FIVE (65) DEGREES FAHRENHEIT (ADJ). THE ROOF TOP UNIT SHALL BE DEENERGIZED WHEN THE TEMPERATURE IN ALL ZONES REACHES A MINIMUM OF SEVENTY (70) DEGREES FAHRENHEIT (ADJ).

c. THE AHU INTERNAL CONTROL SYSTEM SHALL ENERGIZE AND CONTROL THE GAS HEATING COIL TO MAINTAIN THE OCCUPIED HEATING SPACE AIR TEMPERATURE SETPOINT.

C. COOLING MODE CONTROL

a. OCCUPIED MODE: SUPPLY FAN SF-1 SHALL BE RUNNING; OUTDOOR DAMPER D-1-2 SHALL BE OPEN TO ITS' MINIMUM POSITION.

b. THE BAS SHALL MODULATE THE REFRIGERANT CIRCUIT TO MAINTAIN THE SPACE AIR TEMPERATURE SET POINT OF SEVENTY-FIVE (75) DEGREES FAHRENHEIT. ON A FALL IN TEMPERATURE BELOW ITS SPACE AIR SET POINT OF SEVENTY-FIVE (75) DEGREES FAHRENHEIT, THE BAS SHALL DEENERGIZE THE REFRIGERANT CIRCUIT.

c. UNOCCUPIED MODE: BAS SHALL DETERMINE THE UNOCCUPIED MODE BASED ON A 365 DAY/24 HR GRAPHIC INTERFACE SCHEDULER PROGRAM. THE AHU SHALL BE DEENERGIZED WHEN THE UNOCCUPIED MODE IS INITIATED. THE SUPPLY FAN SHALL BE ENERGIZED WHEN OUTDOOR AIR TEMPERATURE, AS SEEN BY GLOBAL OUTDOOR AIR TEMPERATURE SENSOR, RISES ABOVE 90°F AND THE ROOM TEMPERATURE RISES ABOVE THE UNOCCUPIED TEMPERATURE SET POINT OF SEVENTY-EIGHT (78) DEGREES FAHRENHEIT (ADJ). THE AHU SHALL BE DEENERGIZED WHEN THE TEMPERATURE REACHES A MINIMUM OF SEVENTY-FIVE (75) DEGREES FAHRENHEIT (ADJ).

D. OUTDOOR AIR DAMPER AND CO2 LEVEL CONTROL

a. THE OUTDOOR AIR DAMPER SHALL BE CLOSED DURING WARM-UP AND UNOCCUPIED MODES.

b. DURING OCCUPIED MODE, OUTDOOR AIR DAMPER SHALL INITIALLY OPEN TO ITS MINIMUM POSITION TO MAINTAIN THE MINIMUM OUTDOOR AIR QUANTITY AS SEEN BY OUTDOOR AIR FLOW MONITORING STATION AFMS-1-1. MINIMUM OUTDOOR AIR POSITION/QUANTITY SHALL BE SET TO THE SCHEDULED VALUE.

c. THE OUTDOOR AIR DAMPER SHALL MODULATE OPEN TO MAINTAIN THE MAXIMUM OUTDOOR AIR QUANTITY UPON A RISE IN CO2 ABOVE 900 PPM (ADJ). MAXIMUM OUTDOOR AIR POSITION/QUANTITY SHALL BE SET TO THE SCHEDULED VALUE. ON A DROP IN CO2 DIFFERENTIAL BELOW THE SETPOINT, THE DAMPER SHALL MODULATE TO ITS MINIMUM POSITION.

E. ECONOMIZER CONTROL

a. WHEN THE OUTDOOR AIR DRY BULB TEMPERATURE IS LESS THAN 70°F AND THE ENTHALPY IS LESS THAN 28 BTU/LB OF DRY AIR, THE BAS SHALL MODULATE THE OUTDOOR AIR, RELIEF AIR, AND RETURN AIR DAMPERS IN SEQUENCE TO MAINTAIN THE AHU LEAVING AIR TEMPERATURE SETPOINT OF 55°F.

b. ECONOMIZER CONTROL SHALL BE DISABLED IF OUTDOOR AIR DRY BULB TEMPERATURE RISES ABOVE 72°F OR ENTHALPY RISES ABOVE 30 BTU/LB OF DRY AIR.

DEHUMIDIFICATION CONTROL

a. WHEN THE RETURN AIR RELATIVE HUMIDITY RISES ABOVE SIXTY (60) PERCENT, THE INTERNAL CONTROL SYSTEM SHALL OPERATE THE REFRIGERANT CIRCUIT TO SUBCOOL THE SUPPLY AIR VIA THE EVAPORATOR COIL AND REHEAT THE AIR VIA THE HOT GAS REHEAT COIL. WHEN THE RETURN AIR RELATIVE HUMIDITY, SEEN BY HS-1-1 DROPS BELOW FIFTY-FIVE (55) PERCENT, CONTROL OF REFRIGERANT CIRCUIT SHALL BE RETURNED TO THE SPACE AIR TEMPERATURE SENSOR.

b. ON A RISE IN RETURN AIR HUMIDITY ABOVE 60% RH ALL TEMPERATURE CONTROL, ECONOMIZER AND CO2 SEQUENCES SHALL BE OVERRIDDEN. OUTSIDE AIR, RETURN AIR AND RELIEF AIR DAMPERS SHALL RETURN TO THEIR MINIMUM BALANCED POSITIONS.

c. WHEN THE RETURN AIR RELATIVE HUMIDITY DROPS BELOW 55% FOR 15 MINUTES, THE DEHUMIDIFICATION MODE SHALL BE CANCELED. THE DISCHARGE AIR SETPOINT SHALL BE RETURNED TO NORMAL (55°F) AND THE COOLING COIL SHALL BE CONTROLLED TO MAINTAIN THE DISCHARGE AIR SETPOINT.

G. SMOKE CONTROL

a. THE AHU AND ASSOCIATED AIR DISTRIBUTION SYSTEM SHALL BE EQUIPPED WITH SMOKE DETECTORS AND CONNECTED TO THE BUILDING FIRE ALARM SYSTEM IN ACCORDANCE WITH THE INTERNATIONAL FIRE AND MECHANICAL CODES.

b. ANY AHU OR ASSOCIATED AIR DISTRIBUTION (HVAC) SMOKE DETECTOR SHALL, UPON ACTIVATION, SHUT DOWN ALL OPERATIONAL CAPABILITIES OF THE AIR DISTRIBUTION SYSTEM. THE AIR HANDLING UNIT AND ALL ASSOCIATED SYSTEM SUPPLY FAN SHALL DEENERGIZE AND AN ALARM SHALL BE ANNUNCIATED AT THE BAS.

c. ALL HVAC SMOKE DETECTORS SHALL BE CONNECTED TO THE FIRE ALARM SYSTEM AND ACTIVATE THE BUILDING'S ALARM NOTIFICATION AND AUDIO/VISUAL ALARM-INDICATING DEVICES IN ACCORDANCE WITH THE REQUIREMENTS OF THE INTERNATIONAL FIRE AND MECHANICAL CODES.

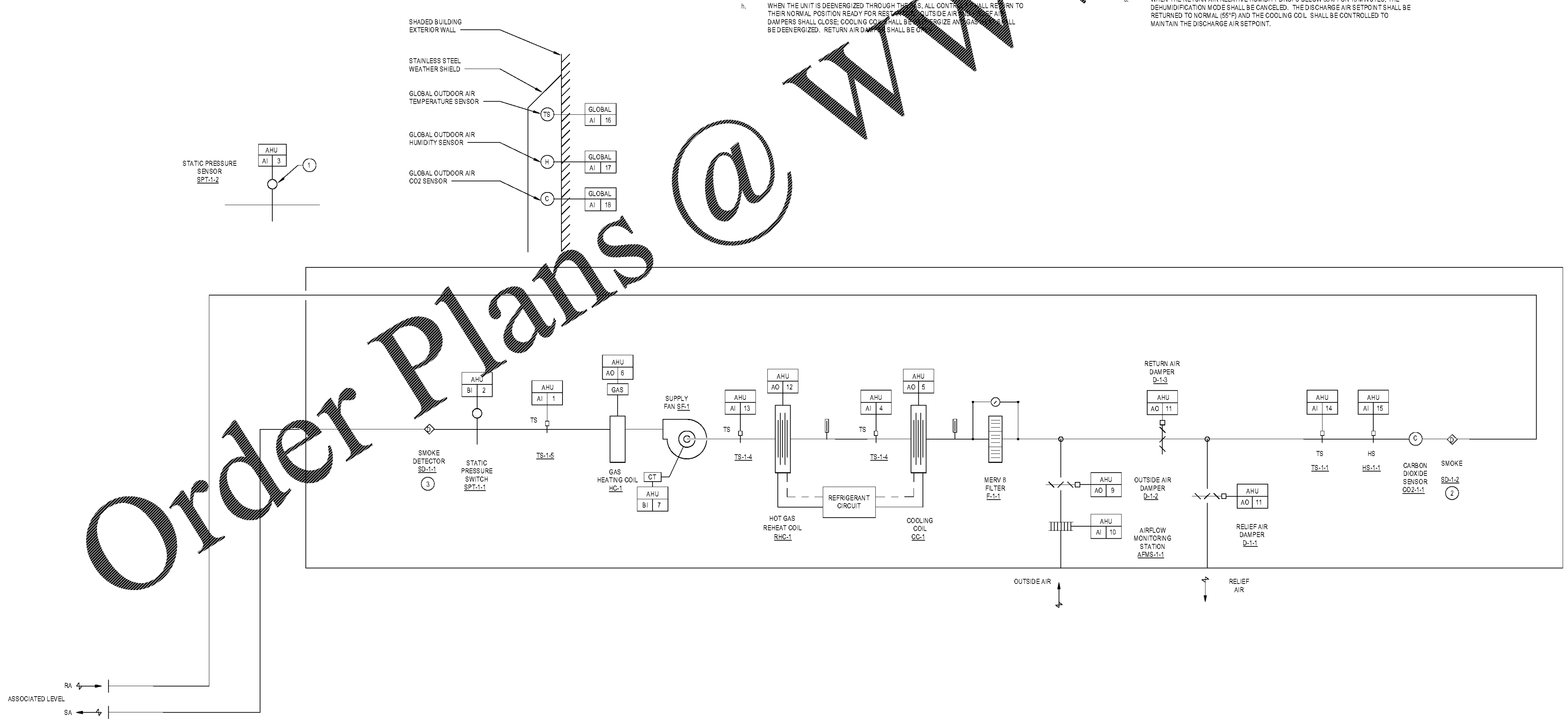
H. ALARMS

a. FAN FAILURE: A FAILURE OF THE SUPPLY FAN, AS SENSED BY THE CURRENT TRANSDUCER, SHALL BE ALARMED TO THE BAS. UPON SENSING FAILURE, THE BAS SHALL INDICATE ALARM, DISABLE THE FAN, AND RETURN ALL CONTROLS TO THEIR NORMAL POSITION.

b. DAMPER FAILURE: A FAILURE OF ANY OF THE DAMPERS THAT ARE REQUIRED TO BE PROVEN OPEN FOR NORMAL OPERATION SHALL BE ALARMED TO THE BAS. UPON SENSING FAILURE, THE BAS SHALL INDICATE ALARM, DISABLE THE AHU AND RETURN ALL CONTROLS TO THEIR NORMAL POSITION.

I. FAILURE MODES

a. OUTSIDE AIR AND RELIEF AIR DAMPERS SHALL FAIL CLOSED. RETURN AIR DAMPERS SHALL FAIL OPEN.



AHU CONTROLS DIAGRAM
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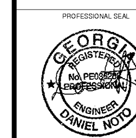

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