108050000-TD0017-R00

Spallation Neutron Source

Ring Service Building Air Handler Controls
Functional System Design (FSD)

January, 2003

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SNS Project Engineer

Ring Service Building Air Handlers Controls Description
TD80017 Rev 0; January 13, 2003

Operating Philosophy

Purpose:

The purpose of this air handler is to:

a) control the high bay space and two zone air temperatures
b) save energy by using outside air to cool the building when possible
c) de-energize supply and return fans upon detection of smoke
d) provide the operator with modes of operation that insure adequate control and aid in trouble shooting and startup testing
e) provide freeze protection

Assumptions:

1) Outside air will not be needed to heat the building.
2) Space temperature setpoints will not be automatically changed (such as between winter and summer). Manually changing the setpoints will be possible.
3) Fans are interlocked by the PLC logic so that the return air fan is energized only when the supply air fan is energized. (Note: No differential pressure switch exists to detect that the supply fan is not running.)
4) A smoke damper in the air handler outlet must be closed when the air handler is fan is de-energized and open when the fan is energized. This action is provided by hardwiring in the MCC, not PLC logic. Closing the damper in response to a smoke detection signal from the fire alarm system is accomplished by de-energizing the fan.
5) A mechanical stop will be provided to prevent the outside air damper from completely closing. This will provide a minimum of outside air at all times and enable the pressure control loop to function at all times.
6) MCCs for smoke exhaust fans are equipped with a Hand, OFF, Auto (HOA) switch that will prevent the logic from energizing the fan if the switch is in the OFF position. This has been examined and found to be in compliance with an appropriate exception in NFPA 92A. Thus no special wiring or logic will be implemented to energize fans when the HOA switch is not in the AUTO position. However, a graphical alarm that obviously stands out from others will be presented to the operator whenever any smoke exhaust fan is not in the AUTO position.
7) The Fire Alarm Control Panel (FACP) provides a hardwired signal to shutdown the air handler fan in response to detection of smoke. The FACP must reset this shutdown signal when the smoke exhaust switch is actuated to permit the CF controls PLC to energize the fan and open the damper.
8) Freeze protection will be provided as follows:
a) when air handler internal temperatures fall below 45 degF, the logic will issue a command to close the outside air damper and generate an operator alarm

b) if the temperature continues to fall below 40 degF, the logic will:
    De-energize air handler fans
    Open the valves to heating coils closest to the outside air to 50% to add heat
    Generate an operator alarm
(Signals from the fire alarm system, would override these commands.)

Operator Controls and Operating Modes

1) Space temperature setpoint – the temperatures to which the building is controlled by the outside air damper, chilled water valve, or heating water valve.
2) OFF: Air handler is not in use. Fans are de-energized. All dampers are closed, heating valve is closed and chilled water valve is closed. Setpoints remain at last setting.
3) Auto: Logic determines how the space setpoint temperature is to be maintained (via heating control valve, chilled water control valve, or outside air and exhaust dampers) and automatically transitions from one configuration to the other as appropriate. Fans are energized.
4) Heat: Air handler is forced to control space temperature with heat. Fans are energized. Outside air damper is closed, economizer damper is closed, *and* chilled water valve is closed. Heating water valve is modulated.
5) Cooling with Outside Air: Air handler is forced to control space temperature with outside air. Fans are energized. Economizer damper is closed. Outside air and exhaust dampers are modulated. Chilled water valve is closed. Heating water valve is closed.
6) Cooling with Chilled Water: Air handler is forced to control space temperature with chilled water. Fans are energized. Economizer damper is open. Outside air and exhaust dampers are closed. Chilled water valve is modulated. Heating water valve is closed.

OPERATOR INTERFACE DEFINITIONS

Local Hardware/Manual Operator Controls

1) Air handler filter differential pressures *(PDI2200A, PDI2200B, PDI2300A, PDI2300B, PDI2400A, PDI2400B)*
2) HOA switch for return fan *(HS2200B, HS2300B, HS2400B)*
3) HOA switch for supply fan *(HS2200A, HS2300A, HS2400A)*
4) Cooling chilled water supply temperature *(TI2200G, TI2300G, TI2400G)*
5) Cooling chilled water return temperature *(TI2200F, TI2300F, TI2400F)*
6) Heating water supply temperature *(TI2200J, TI2300J, TI2400J)*
7) Heating water return temperature *(TI2200H, TI2300H, TI2400H)*

Software HMI/EPICS Digital Operator Controls

1) Temperature Control Mode
    0) OFF (default)
    1) SEMI-AUTO – Heat only
    2) SEMI-AUTO – Cooling only W/OA

3) SEMI-AUTO – Cooling only W/CW
4) AUTO

Software HMI/EPICS Digital Displays

1) Temperature Control Mode switch status
    a. OFF (default)
    b. SEMI-AUTO – Heat only
    c. SEMI-AUTO – Cooling only W/OA
    d. SEMI-AUTO – Cooling only W/CW
    e. AUTO
2) HOA return air fan switch status *(HS2200B, HS2300B, HS2400B)*
3) HOA supply air fan switch status *(HS2200A, HS2300A, HS2400A)*
4) Air handler supply fan on/off *(F2200A, F2300A, F2400A)*
5) Air handler return fan on/off *(F2200B, F2300B, F2400B)*
6) Supply fan damper open/close *(SOV2200, SOV2300, SOV2400)*
7) Outside air enthalpy status
8) Smoke detector *(NE2200, NE2300, NE2400)*

Software HMI/EPICS Analog Operator Controls

1) Temperature Cooling Setpoint
2) Temperature Heating Setpoint3)

Software HMI/EPICS Analog Displays

1) Outside air temperature *(TT2200D, TT2300D, TT2400D)*
2) Outside air humidity *(MT2200D, MT2300D, MT2400D)*
3) Return air temperature *(TT2200C, TT2300C, TT2400C)*
4) Return air humidity *(MT2200C, MT2300C, MT2400C)*
5) Mixed air temperature *(TT2200B, TT2300B, TT2400B)*
6) Supply air temperature *(TT2200E, TT2300E, TT2400E)*
7) Supply air flow *(FT2200, FT2300, FT2400)*
8) Space air temperature *(TT2200A, TT2300A, TT2400A)*
9) Cooling water valve command *(IP2200B, IP2300B, IP2400B)*
10) Heating water valve command *(IP2200A, IP2300A, IP2400A)*

Alarms

1) Return (space) air temperature low and high
2) Return (space) air humidity low and high
3) Mixed air temperature low (45 degF)
4) Mixed air temperature low (40 degF)
5) Smoke detected

Control Logic Description

Control Logic Description

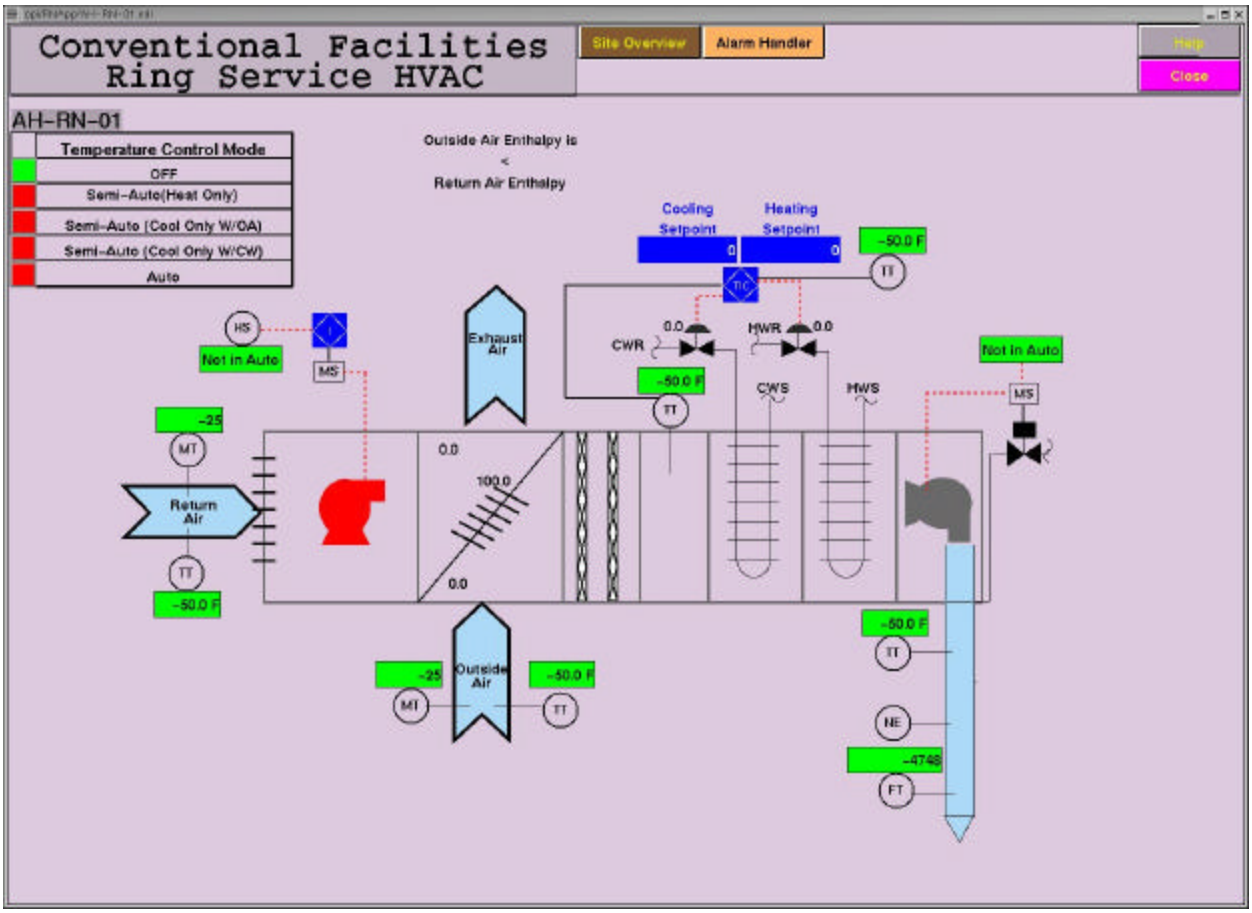
In the OFF mode, the air handler is not in use. The dampers and all control valves are closed.

Unless signals are received from the fire alarm, PPS, or ODH systems, the freeze protection actions described above will be activated.

Automatic temperature controls used in the AUTO mode work as follows:

> If the return air temperature is less than the setpoint (72 degF) then heating will be supplied by closing the outside, exhaust, and economizer dampers and modulating the heating coil valve to maintain the return air temperature at setpoint.
>
> If the return air temperature is greater than the 75 degF, the heating valve will be closed and cooling will be provided as follows:
>
> > If the enthalpy calculation shows that outside air can be used and the return air temperature is less than 85 degF, the outside air damper control loop will be used to modulate the outside and exhaust dampers simultaneously. If not, the chilled water control loop will be used to modulate the chilled water control valve. In both cases, control will be to the space temperature setpoint.

In the manual modes the air handler is forced to cool with outside air by modulating the outside air damper, cool with chilled water by modulating the chilled water valve, or heat by modulating the heating water valve respectively.


Conventional Facilities
Ring Service HVAC
Site Overview
Alarm Handler
Help
Close
AH-RN-01
Temperature Control Mode
OFF
Semi-Auto(Heat Only)
Semi-Auto (Cool Only W/OA)
Semi-Auto (Cool Only W/CW)
Auto
Outside Air Enthalpy is
<
Return Air Enthalpy
Cooling Setpoint
Heating Setpoint
-50.0 F
TT
TIC
HS
Not in Auto
MS
Exhaust Air
CWR
HWR
0.0
CWS
HWS
-25
MT
Return Air
100.0
Outside Air
NE
-4748
FT