

## HP-1 AND HP-2 HEAT PUMP DEHUMIDIFYING AIR HANDLING SYSTEM

### SEQUENCE OF OPERATION

#### GENERAL:

THE SYSTEM SHALL CONSIST OF A CONSTANT VOLUME DEHUMIDIFYING AIR HANDLING UNIT WITH SUPPLY AND EXHAUST/RETURN FANS AND HOT WATER HEATING COILS. THE SYSTEM SHALL HAVE ELECTRICALLY OPERATED VALVES AND DAMPERS AND ITS OWN REMOTE CONTROL STATION WITH DDC INTERFACE FOR TROUBLE ALARMS AND ON/OFF/DEHUMIDIFYING STATUS TO THE BACS. ALL SETPOINTS SHALL BE ADJUSTABLE.

#### DEAD BANDS AND SETPOINTS:

SPACE COOLING DEADBAND	78-82 DEG F
SPACE COOLING SETPOINT	80 ±1 DEG F
SPACE HEATING DEADBAND	68-72 DEG F
SPACE HEATING SETPOINT	70 DEG F
SPACE RH SETPOINT	50% RH ±5
SPACE RH MAXIMUM AND ALARM	60% RH
FREEZE PROTECTION ALARM	40 DEG F
FREEZE PROTECTION LIMIT	35 DEG F
SUPPLY FAN INLET STATIC PRESSURE LIMIT	-3 IN WG
SUPPLY FAN DISCHARGE STATIC PRESSURE LIMIT	4 IN WG
RETURN FAN INLET STATIC PRESSURE LIMIT	-2 IN WG
RETURN FAN DISCHARGE STATIC PRESSURE LIMIT	2 IN WG
TRAINER BUILDING PRESSURIZATION MONITORING ONLY	-0.2 ±0.05 IN WG
SUPPLY VS RETURN AIR CFM DIFFERENTIAL	1300 CFM

#### FREEZE CONTROL:

THE LOW LIMIT MIXED AIR FREEZE PROTECTION SHALL BE LOCATED ON THE ENTERING SIDE OF DEHUMIDIFYING COIL. WHEN THE TEMPERATURE ENTERING THE DEHUMIDIFYING COIL IS AT OR BELOW THE FREEZE PROTECTION LIMIT SET POINT, THE FOLLOWING EVENTS SHALL OCCUR:

1. THE SUPPLY FAN SHALL STOP.
2. THE EXHAUST / RETURN AIR FAN SHALL STOP.
3. THE RETURN AIR DAMPER SHALL OPEN.
4. THE OUTSIDE AIR AND EXHAUST AIR DAMPERS SHALL CLOSE.
5. A VISUAL AND AUDIBLE ALARM SHALL BE TRANSMITTED TO THE BACS CENTRAL CONTROL STATION.
6. A MANUAL RESET OF FREEZE PROTECTION DEVICES SHALL BE REQUIRED.

#### SYSTEM START/STOP CONTROL:

THE UNITS SHALL BE STARTED AND STOPPED VIA THE BUILDING AUTOMATION CONTROL SYSTEM (BACS) OR THE REMOTE CONTROL STATION. HP-1 SHALL OPERATE DURING TRAINING AND AFTERWARDS TO DRY OUT SPACE BEFORE SHUTTING DOWN. UNIT SHALL THEN CYCLE IN AUTO MODE TO MAINTAIN HUMIDITY SETPOINT. EXHAUST FAN EF-156 SHALL BE ON WHENEVER HP-1 IS ON. HP-2 AND EF-B16 TO RUN CONTINUOUSLY.

#### WHEN A FAN SYSTEM IS STARTED, THE FOLLOWING EVENTS SHALL OCCUR:

1. ITS RESPECTIVE CONTROL SYSTEM SHALL BE ENABLED, AND ITS SUPPLY AND RETURN FAN ISOLATION DAMPERS SHALL OPEN.
2. WITH RETURN DAMPER OPEN, OUTSIDE AIR DAMPER CLOSED, AND EXHAUST DAMPER CLOSED, THE EXHAUST / RETURN FAN SHALL START.
3. THE SUPPLY AIR FAN SHALL START.
4. CONFIRMATION OF AIR FLOW SHALL BE BY A DIFFERENTIAL PRESSURE SWITCH ACROSS THE FANS.
5. THE MIXED AIR TEMPERATURE CONTROL SHALL BE TEMPORARILY OVERRIDDEN AND THE RETURN, EXHAUST, AND OUTSIDE AIR DAMPERS SHALL BE MODULATED TO SETPOINT.
6. THE USE OF OPTIMUM START/STOP PROGRAMS SHALL BE IMPLEMENTED IN THE CONTROL SOFTWARE.
7. THE SUPPLY AND RETURN CROSS-CONNECT DAMPERS SHALL REMAIN CLOSED, SUBJECT TO A MANUAL SWITCH TO OPEN THEM IF HP-1 OR HP-2 IS NOT OPERABLE.
8. DAMPER SWITCHES IN CONTROL ROOM 242 SHALL OPEN AND CLOSE SUPPLY AIR TO THE INDIVIDUAL DECKS OF THE TRAINER DEVICE TO ALLOW SMOKE BUILDUP.

#### WHEN THE FAN SYSTEM IS SHUT-DOWN, THE FOLLOWING EVENTS SHALL OCCUR:

1. THE SUPPLY FAN AND THE EXHAUST / RETURN FANS SHALL STOP,
2. THE RETURN AIR DAMPER SHALL OPEN,
3. THE OUTSIDE AIR DAMPER SHALL CLOSE,
4. THE EXHAUST AIR DAMPER SHALL CLOSE,
5. ITS SUPPLY AND RETURN FAN ISOLATION DAMPERS SHALL CLOSE.
6. ITS RESPECTIVE CONTROL SYSTEM SHALL BE DISABLED.
7. HP-1 SHALL OPERATE DURING NORMAL HOURS, AND SHALL CYCLE AFTER HOURS TO DRY THE TRAINER AREA AND MAINTAIN A MAXIMUM 60% RH. THE SUPPLY AND RETURN CROSS-CONNECT DAMPERS SHALL REMAIN CLOSED. HP-2 FOR THE BASEMENT TANK ROOM SHALL OPERATE CONTINUOUSLY.

#### CYCLE CONTROL:

DURING THE COOLING SEASON, IF THE SELECTED SPACE AIR ENTHALPY IS GREATER THAN THE OUTSIDE AIR ENTHALPY, THE CONTROL SYSTEM SHALL OPEN THE OUTSIDE AIR DAMPER AND EXHAUST AIR DAMPER THE RETURN AIR DAMPER AND PURGE WITH 100% OUTSIDE AIR.

IF THE RETURN AIR ENTHALPY IS GREATER THAN THE OUTSIDE AIR ENTHALPY, THEN MECHANICAL DEHUMIDIFICATION IS REQUIRED. THE UNIT SHALL GO TO THE DEHUMIDIFYING MODE WITH MINIMUM OUTSIDE AIR AND THE DEHUMIDIFYING COIL SHALL BE MODULATED TO MAINTAIN THE RETURN AIR TEMPERATURE AND RELATIVE HUMIDITY SETPOINT.

#### ECONOMIZER CYCLE CONTROL (STAGE 1):

WHENEVER DEHUMIDIFICATION IS ENABLED, THE FOLLOWING EVENTS SHALL OCCUR:

1. THE ECONOMIZER SHALL BE ENABLED.
2. THE MIXED AIR TEMPERATURE CONTROLLER SHALL MODULATE THE OUTSIDE AIR DAMPERS AND THE RETURN AIR DAMPERS IN SEQUENCE TO MAINTAIN THE ROOM RELATIVE HUMIDITY SETPOINT.
3. WHEN THE RETURN AIR ENTHALPY IS LESS THAN THE OUTSIDE AIR ENTHALPY, THE OUTSIDE AIR DAMPER SHALL GO TO THE MINIMUM POSITION AND ENABLE MECHANICAL DEHUMIDIFYING MODE.
4. CONDENSER/REHEAT COIL SHALL MAINTAIN ROOM DRY BULB TEMPERATURE SETPOINT.

OPERATOR SELECTABLE OUTSIDE AIR TEMPERATURE AND RELATIVE HUMIDITY LIMITS SHALL BE INCORPORATED IN THE ECONOMIZER CONTROLS TO PREVENT THE USE OF ENTHALPY CONTROLS ABOVE AND BELOW CERTAIN OUTSIDE CONDITIONS.

#### REFRIGERANT COOLING CYCLE CONTROL (STAGE 2):

ON A CALL FOR DEHUMIDIFICATION AND THE OUTSIDE AIR ENTHALPY IS STILL BELOW THE RETURN AIR ENTHALPY, THE FOLLOWING EVENTS SHALL OCCUR:

1. THE ECONOMIZER MODE SHALL REMAIN ENABLED.
2. THE COIL SHALL COOL AND DEHUMIDIFY TO SATISFY THE REQUIRED DISCHARGE AIR TEMPERATURE.
3. THE CONDENSER/REHEAT COIL SHALL MAINTAIN ROOM DRY BULB TEMPERATURE SETPOINT.
4. THE AUXILIARY WATER COOLED CONDENSER AND GLYCOL PUMP SHALL OPERATE TO REJECT EXCESS HEAT TO THE OUTDOOR DRYCOOLER. WHEN THE OUTSIDE AIR ENTHALPY BECOMES GREATER THAN THE RETURN AIR ENTHALPY.
5. THE OUTDOOR AIR AND EXHAUST AIR DAMPERS SHALL GO TO MINIMUM POSITION, WHEN THE OUTSIDE AIR ENTHALPY BECOMES GREATER THAN THE RETURN AIR ENTHALPY.

#### DUCT STATIC PRESSURE SAFETY LIMIT:

THE DUCT STATIC PRESSURE LIMIT SHALL BE AS FOLLOWS:

1. AN ALARM SHALL ANNUNCIATE AT THE BACS CENTRAL CONTROL STATION WHEN THE STATIC PRESSURE IS WITHIN 0.5 IN WG OF THE STATIC PRESSURE LIMIT.
2. THE SYSTEM SHALL STOP WHEN THE DUCT STATIC PRESSURE IS GREATER THAN OR EQUAL TO THE STATIC PRESSURE LIMIT. THE UNIT SHALL FOLLOW THE SYSTEM START/STOP CONTROL SEQUENCE OF OPERATION.

#### DUCT SMOKE DETECTOR CONTROL:

WHENEVER THE SUPPLY AIR OR RETURN AIR SMOKE DETECTOR IS ACTIVATED, AND A SIGNAL IS RECEIVED FROM THE FIRE ALARM PANEL, THE FOLLOWING EVENTS SHALL OCCUR:

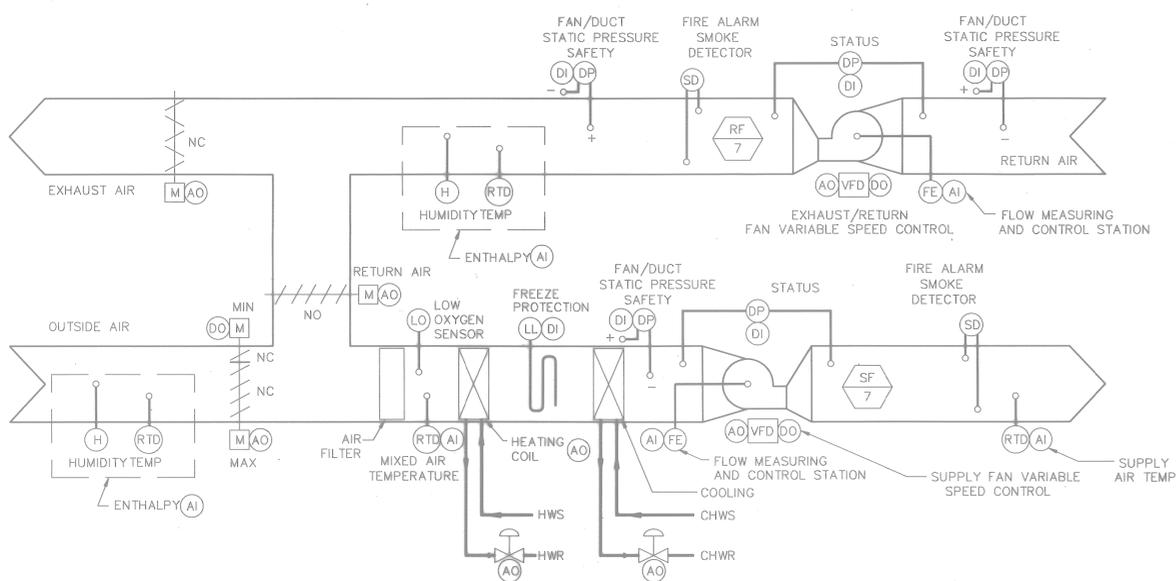
1. AN ALARM SHALL BE ANNUNCIATED AT THE FIRE ALARM PANEL.
2. THE SUPPLY FAN SHALL STOP AND EXHAUST / RETURN FAN SHALL STOP.
3. THE OUTSIDE AIR, RETURN AIR, AND EXHAUST AIR DAMPERS SHALL CLOSE.
4. RESPECTIVE EXHAUST FANS SHALL STOP AND THEIR DAMPERS SHALL CLOSE.

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SF-6 AND RF-6 HEATING AND COOLING SYSTEM FOR P250 LAB

SEQUENCE OF OPERATION

GENERAL:  
THE SYSTEM SHALL CONSIST OF A VAV AIR HANDLING UNIT WITH VAV TERMINAL UNITS AND HOT WATER HEATING COILS. THE SYSTEM SHALL HAVE ELECTRICALLY OPERATED VALVES AND DAMPERS AND ITS OWN DDC STAND ALONE LOCAL CONTROL STATION (LCS). ALL SETPOINTS SHALL BE ADJUSTABLE.

DEAD BANDS AND SETPOINTS:

SPACE COOLING DEADBAND	73-77 DEG F
SPACE COOLING SETPOINT	75 ±1 DEG F
SPACE HEATING DEADBAND	68-72 DEG F
SPACE HEATING SETPOINT	70 DEG F
OUTSIDE AIR ECONOMIZER ENTHALPHY RH MAXIMUM	80 % RH
OUTSIDE AIR ECONOMIZER ENTHALPHY DRY BULB	70 DEG F
MIXED AIR-LOW TEMPERATURE LIMIT	50 DEG F
MIXED AIR SETPOINT	53 DEG F
SUPPLY AIR SETPOINT	55 DEG F
HEATING ENABLED MIXED AIR LESS THAN	53 DEG F
COOLING ENABLED MIXED AIR GREATER THAN	53 DEG F
FREEZE PROTECTION ALARM	40 DEG F
FREEZE PROTECTION LIMIT	35 DEG F
SUPPLY FAN INLET STATIC PRESSURE LIMIT	-3 IN WG
SUPPLY FAN DISCHARGE STATIC PRESSURE LIMIT	4 IN WG
RETURN FAN INLET STATIC PRESSURE LIMIT	-2 IN WG
RETURN FAN DISCHARGE STATIC PRESSURE LIMIT	2 IN WG
SUPPLY VS RETURN AIR CFM DIFFERENTIAL	440 MIN/2200 MAX

FREEZE CONTROL:

THE LOW LIMIT FREEZE PROTECTION SHALL BE LOCATED ON THE LEAVING SIDE OF HEATING COIL WHEN THE TEMPERATURE LEAVING THE HEATING COIL IS AT OR BELOW THE FREEZE PROTECTION LIMIT SET POINT, THE FOLLOWING EVENTS SHALL OCCUR:

1. THE SUPPLY FAN SHALL STOP.
2. THE EXHAUST / RETURN AIR FAN SHALL STOP.
3. THE RETURN AIR DAMPER SHALL OPEN.
4. THE OUTSIDE AIR AND EXHAUST AIR DAMPERS SHALL CLOSE.
5. THE COOLING COIL CONTROL VALVE SHALL RETURN TO ITS NORMAL POSITION (CLOSED).
6. THE HEATING COIL CONTROL VALVE SHALL BE FULL OPEN.
7. A VISUAL AND AUDIBLE ALARM SHALL BE TRANSMITTED TO THE BACS CENTRAL CONTROL STATION.
8. A MANUAL RESET OF FREEZE PROTECTION DEVICES SHALL BE REQUIRED.

SYSTEM START/STOP CONTROL:

THE UNITS SHALL BE STARTED AND STOPPED VIA THE BUILDING AUTOMATION CONTROL SYSTEM (BACS) OR THE LOCAL CONTROL STATION (LCS).  
WHEN A FAN SYSTEM IS STARTED, THE FOLLOWING EVENTS SHALL OCCUR:  
1. ITS RESPECTIVE CONTROL SYSTEM SHALL BE ENABLED.  
2. WITH RETURN DAMPER OPEN, OUTSIDE AIR DAMPER CLOSED, AND EXHAUST DAMPER CLOSED, THE EXHAUST / RETURN FAN SHALL START.  
3. THE SUPPLY AIR FAN SHALL START  
4. CONFIRMATION OF AIR FLOW SHALL BE BY A DIFFERENTIAL PRESSURE SWITCH ACROSS THE FANS.  
5. THE MIXED AIR TEMPERATURE CONTROL SHALL BE TEMPORARILY OVERRIDDEN AND THE RETURN, EXHAUST, AND OUTSIDE AIR DAMPERS SHALL BE MODULATED TO SETPOINT.  
6. THE USE OF OPTIMUM START/STOP PROGRAMS SHALL BE IMPLEMENTED IN THE CONTROL SOFTWARE.

WHEN THE FAN SYSTEM IS SHUT-DOWN, THE FOLLOWING EVENTS SHALL OCCUR:  
1. THE SUPPLY FAN AND THE EXHAUST / RETURN FANS SHALL STOP.  
2. THE RETURN AIR DAMPER SHALL OPEN,  
3. THE OUTSIDE AIR DAMPER SHALL CLOSE,  
4. THE EXHAUST AIR DAMPER SHALL CLOSE,  
5. THE COOLING COIL CONTROL VALVE SHALL RETURN TO ITS NORMAL POSITION (CLOSED),  
6. THE HEATING COIL CONTROL VALVE SHALL RETURN TO ITS NORMAL POSITION (CLOSED),  
7. ITS RESPECTIVE CONTROL SYSTEM SHALL BE DISABLED.

A HAND (OFF) AUTO SWITCH AT THE LOCAL CONTROL STATION (LCS) SHALL OVERRIDE THE SYSTEM FOR USE.

MIXED AIR HEATING CYCLE CONTROL:

WHENEVER THE MIXED AIR TEMPERATURE SENSOR CALLS FOR HEATING, THE FOLLOWING EVENTS SHALL OCCUR:  
1. THE COOLING COIL VALVE SHALL MODULATE CLOSED.  
2. THE ECONOMIZER AS WELL AS THE COOLING MODE SHALL BE DISABLED.  
3. THE OUTSIDE AIR DAMPER SHALL GO TO A MINIMUM POSITION.  
4. THE HEATING COIL VALVES SHALL BE MODULATED TO MAINTAIN THE DESIRED SUPPLY AIR TEMPERATURE SETPOINT.

COOL DOWN CYCLE CONTROL:

DURING THE COOLING SEASON AND AT SOME PREDETERMINED TIME PRIOR TO INITIATING THE OCCUPIED CYCLE, THE UNIT SHALL START THE COOL DOWN CYCLE. IF THE SELECTED SPACE AIR TEMPERATURE IS GREATER THAN OR EQUAL TO THE OUTSIDE AIR TEMPERATURE, THE CONTROL SYSTEM SHALL OPEN THE OUTSIDE AIR DAMPER AND EXHAUST AIR DAMPER OPEN THE VAV TERMINAL UNITS SUPPLY DAMPERS CLOSE THE RETURN AIR DAMPER AND PURGE WITH 100% OUTSIDE AIR.

THE UNIT SHALL CONTINUE NORMAL COOL DOWN CYCLE OR PROCEED TO THE OCCUPIED COOLING CYCLE. IF THE RETURN AIR ENTHALPHY IS GREATER THAN OR EQUAL TO THE OUTSIDE AIR ENTHALPHY, THEN MECHANICAL COOLING IS REQUIRED. THE UNIT SHALL GO TO THE COOLING MODE AND THE COOLING COIL CONTROL VALVE SHALL BE MODULATED TO MAINTAIN THE SUPPLY AIR TEMPERATURE.

ECONOMIZER CYCLE CONTROL (COOLING STAGE 1):

- WHENEVER COOLING IS ENABLED, THE FOLLOWING EVENTS SHALL OCCUR:
1. THE ECONOMIZER SHALL BE ENABLED.
  2. THE MIXED AIR TEMPERATURE CONTROLLER SHALL MODULATE THE OUTSIDE DAMPERS AND THE RETURN AIR DAMPERS IN SEQUENCE TO MAINTAIN THE DISCHARGE AIR TEMPERATURE SETPOINT.
  3. WHEN THE RETURN AIR ENTHALPHY IS GREATER THAN THE OUTSIDE AIR ENTHALPHY, THE OUTSIDE AIR DAMPER SHALL GO TO THE MINIMUM POSITION AND ENABLE MECHANICAL COOLING MODE.

OPERATOR SELECTABLE OUTSIDE AIR TEMPERATURE AND RELATIVE HUMIDITY LIMITS SHALL BE INCORPORATED IN THE ECONOMIZER CONTROLS TO PREVENT THE USE OF ENTHALPHY CONTROLS ABOVE AND BELOW CERTAIN OUTSIDE CONDITIONS.

CHILLED WATER COOLING CYCLE CONTROL (COOLING STAGE 2):

ON A CALL FOR COOLING FROM THE DISCHARGE AIR CONTROLLER AND THE OUTSIDE AIR ENTHALPHY IS STILL BELOW THE RETURN AIR ENTHALPHY, THE FOLLOWING EVENTS SHALL OCCUR:

1. THE ECONOMIZER MODE SHALL REMAIN ENABLED.
2. THE CHILLED WATER COOLING MODE SHALL BE ENABLED, AND THE CHILLED WATER COIL SHALL MODULATE TO SATISFY THE REQUIRED DISCHARGE AIR TEMPERATURE.
3. THE OUTDOOR AIR AND EXHAUST AIR DAMPERS SHALL POSITION AT MINIMUM POSITION, WHEN THE OUTSIDE AIR ENTHALPHY BECOMES GREATER THAN THE RETURN AIR ENTHALPHY.

VARIABLE VOLUME CONTROL:

- THE VARIABLE FLOW LIMIT SHALL BE AS FOLLOWS:
1. THE SUPPLY VARIABLE FREQUENCY DRIVE SHALL MODULATE THE SUPPLY FAN MOTOR TO MAINTAIN THE SUPPLY AIR STATIC PRESSURE.
  2. VOLUMETRIC AIR FLOW STATIONS SHALL BE LOCATED IN THE SUPPLY AND RETURN AIR DUCTS AND INPUT A VELOCITY PRESSURE READING INTO THE LCS.
  3. THE LCS SHALL PERFORM THE NECESSARY CALCULATIONS TO DETERMINE CFM FLOW RATES.
  4. THE LCS SHALL OUTPUT A CONTROL SIGNAL TO THE RESPECTIVE EXHAUST/RETURN FAN VARIABLE FREQUENCY DRIVE SO AS TO MAINTAIN A PREDETERMINED CFM DIFFERENTIAL (PRESSURIZING THE BUILDING)
  5. THE EXHAUST/RETURN FAN SHALL "TRACK" THE SUPPLY AIR FLOW CHANGE AND SHALL MAINTAIN A CFM DIFFERENTIAL, RESET BY THE BUILDING DIFFERENTIAL PRESSURE CONTROL SETPOINT.

DUCT STATIC PRESSURE SAFETY LIMIT:

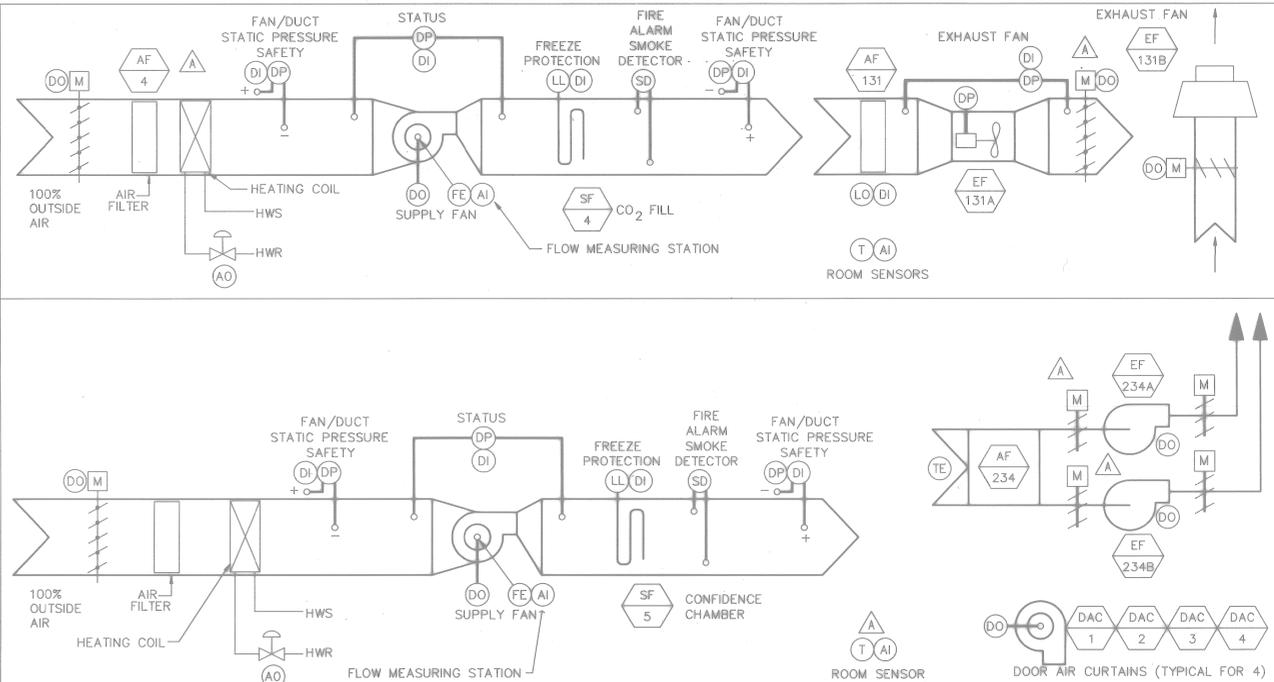
THE DUCT STATIC PRESSURE LIMIT SHALL BE AS FOLLOWS:

1. AN ALARM SHALL ANNUNCIATE AT THE BACS CENTRAL CONTROL STATION WHEN THE STATIC PRESSURE IS WITHIN 0.5 IN WG OF THE STATIC PRESSURE LIMIT.
2. THE SYSTEM SHALL STOP WHEN THE DUCT STATIC PRESSURE IS GREATER THAN OR EQUAL TO THE STATIC PRESSURE LIMIT. THE UNIT SHALL FOLLOW THE SYSTEM START/STOP CONTROL SEQUENCE OF OPERATION.

DUCT SMOKE DETECTOR CONTROL:

WHENEVER THE SUPPLY AIR OR RETURN AIR SMOKE DETECTOR IS ACTIVATED, AND A SIGNAL IS RECEIVED FROM THE FIRE ALARM PANEL, THE FOLLOWING EVENTS SHALL OCCUR:

1. AN ALARM SHALL BE ANNUNCIATED AT THE FIRE ALARM PANEL.
2. THE SUPPLY FAN SHALL STOP AND EXHAUST / RETURN FAN SHALL STOP.
3. THE OUTSIDE AIR, RETURN AIR, AND EXHAUST AIR DAMPERS SHALL CLOSE.
4. THE COOLING COIL VALVE SHALL RETURN TO ITS NORMAL POSITION (CLOSED).
5. THE HEATING COIL VALVE SHALL CLOSE.
6. AN ALARM SHALL OCCUR AT THE BACS PANEL IN THE SECURITY OFFICE.



SF-4(TANK FILL) AND SF-5(CONFIDENCE CHAMBER) HEATING AND VENT UNITS

SEQUENCE OF OPERATION

GENERAL:

THE SYSTEM CONSISTS OF A SINGLE ZONE, CONSTANT VOLUME, VENTILATION AIR HANDLING UNIT AND LOCAL CONTROLLERS WITH ELECTRONIC SENSING VALVES AND DAMPERS. ALL SETPOINTS SHALL BE ADJUSTABLE.

DEAD BANDS AND SET POINTS:

1. HEATING SETPOINT	68 DEG F
2. HEATING ENABLED AT LESS THAN	68 DEG F
3. FREEZE PROTECTION SETPOINT	40 DEG F
4. FREEZE PROTECTION LIMIT	35 DEG F
5. SUPPLY FAN INLET STATIC PRESSURE LIMIT	-3.0 IN WG
6. SUPPLY FAN DISCHARGE STATIC PRESSURE LIMIT	1.5 IN WG

FREEZE CONTROL:

THE LOW LIMIT FREEZE PROTECTION IS LOCATED ON THE LEAVING SIDE OF HEATING COIL. WHEN THE TEMPERATURE LEAVING THE HEATING COIL IS AT OR BELOW THE FREEZE PROTECTION SET POINT, THE FOLLOWING EVENTS SHALL OCCUR:

1. THE SUPPLY FAN SHALL STOP.
2. THE EXHAUST FANS SHALL STOP.
3. THE OUTSIDE AIR AND EXHAUST DAMPERS SHALL CLOSE.
4. THE HEATING COIL VALVE SHALL RETURN TO ITS NORMAL POSITION.
5. A VISUAL AND AUDIBLE ALARM SHALL BE ANNUNCIATED AT THE BACS CENTRAL CONTROL STATION.
6. A HARD COPY SHALL BE PROVIDED THROUGH THE ALARM PRINTER. A MANUAL RESET OF FREEZE PROTECTION DEVICES SHALL BE REQUIRED.

SYSTEM START/STOP CONTROL:

EACH UNIT SHALL BE STARTED AND STOPPED REMOTELY VIA THE BUILDING AUTOMATION CONTROL SYSTEM (BACS) OR LOCALLY AT THE MOTOR CONTROL CENTER. WHEN THE FAN SYSTEM IS STARTED, THE FOLLOWING EVENTS SHALL OCCUR:

1. ITS RESPECTIVE CONTROL SYSTEM SHALL BE ENABLED,
  2. THE OUTSIDE AIR DAMPER SHALL BE OPENED,
  3. THE SUPPLY FAN SHALL START,
  4. THE EXHAUST FANS SHALL START AND THE DOOR AIR CURTAINS SHALL START.
  5. PROOF OF AIR FLOW SHALL BE BY DIFFERENTIAL PRESSURE SWITCHES ACROSS THE FANS.
- PROVIDE A SCHEDULE START / STOP FOR THE UNIT CONTROL. THE EXHAUST FANS SHALL BE SOFTWARE INTERLOCKED TO THE SUPPLY FAN.

WHEN THE FAN SYSTEM IS STOPPED, THE FOLLOWING EVENTS SHALL OCCUR:

1. THE SUPPLY FAN SHALL STOP.
2. THE EXHAUST FANS SHALL STOP.
3. THE OUTSIDE AIR DAMPER SHALL CLOSE.
4. THE EXHAUST FAN EF-234A/B/D DAMPERS SHALL CLOSE.
5. DOOR AIR CURTAINS AND CORRIDOR EXHAUST EF-237 SHALL STOP.

HEATING CYCLE CONTROL:

WHENEVER THE OUTSIDE AIR TEMPERATURE IS BELOW THE HEATING SET POINT, THE HEATING COIL VALVE SHALL MODULATE TO MAINTAIN THE SPACE TEMPERATURE SETPOINT.

FILTER CONTROL:

PROVIDE A DIFFERENTIAL PRESSURE GAGE ACROSS THE FILTER SECTION FOR VISUAL PRESSURE DROP INDICATION.

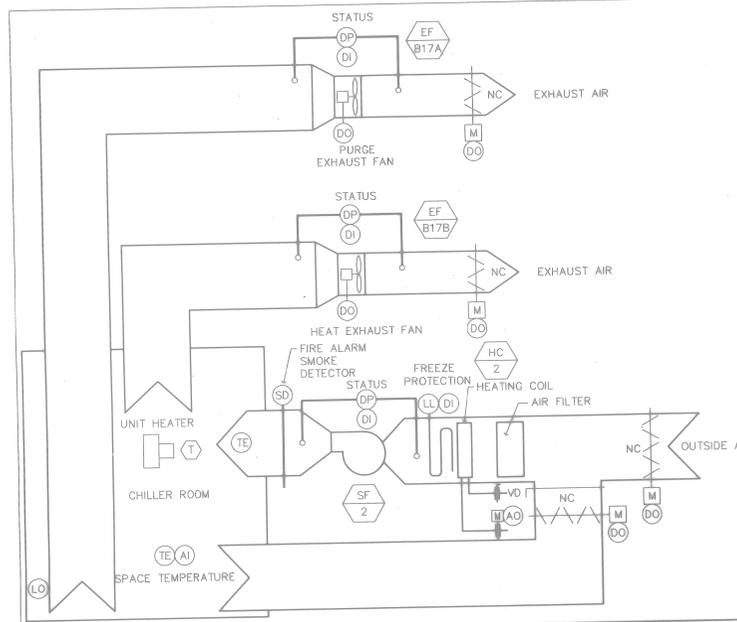
DUCT SMOKE DETECTOR CONTROL:

WHEN A SMOKE DETECTOR IN THE SUPPLY AIR IS ACTIVATED, THE FOLLOWING EVENTS SHALL OCCUR:

1. AN ALARM SHALL BE ANNUNCIATED AT THE BACS CENTRAL CONTROL STATION.
2. THE SUPPLY FAN AND EXHAUST FANS SHALL STOP.
3. THE OUTSIDE AIR DAMPER AND EXHAUST FAN DAMPERS SHALL CLOSE.
4. THE HEATING VALVES SHALL CLOSE.

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DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND SOUTHERN DIVISION CHARLESTON, S.C.	
NAVAL TRAINING CENTER GREAT LAKES, ILLINOIS	
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**SF-2 CHILLER ROOM VENTILATION SYSTEM**

**SEQUENCE OF OPERATION**

GENERAL:  
THE SYSTEM CONSISTS OF VENTILATING EXHAUST FANS, MAKE-UP AIR AND RECIRCULATION SUPPLY FAN AND LOCAL CONTROLLERS WITH ELECTRONIC SENSING VALVES AND DAMPERS. ALL SETPOINTS SHALL BE ADJUSTABLE.

SET POINTS:

1. VENTILATION SETPOINT (LEAD FAN) EF-B17B	85 DEG F
2. VENTILATION SETPOINT (LAG FAN) EF-B17A	95 DEG F
3. FREEZE PROTECTION ALARM	40 DEG F
4. FREEZE PROTECTION LIMIT	35 DEG F
5. HIGH TEMPERATURE ALARM	105 DEG F
6. UNIT HEATER SETPOINT	50 DEG F
7. LOW OXYGEN SETPOINT	19.5 VOLUME %

SYSTEM START/STOP CONTROL:  
THE VENTILATION SYSTEM SHALL BE STARTED AND STOPPED REMOTELY BY THE BACS. WHENEVER THE SPACE TEMPERATURE EXCEEDS THE VENTILATION SETPOINT, THE VENTILATION SYSTEM SHALL START AND THE FOLLOWING EVENTS SHALL OCCUR:

1. THE OUTSIDE AIR AND EXHAUST AIR DAMPERS SHALL OPEN AND RETURN DAMPER SHALL CLOSE IN SEQUENCE.
2. THE EXHAUST FANS SHALL START IN SEQUENCE.
3. PROOF OF AIR FLOW SHALL BE BY A DIFFERENTIAL PRESSURE SWITCH ACROSS THE FAN.
4. SF-2 SHALL OPERATE CONTINUOUSLY DURING NORMAL OCCUPANCY HOURS. IT SHALL BE ON FULL RECIRCULATION UNLESS THE THERMOSTAT CALLS FOR COOLING WITH OUTSIDE AIR.
5. A TWO-STAGE THERMOSTAT SHALL SEQUENCE EXHAUST FAN OPERATION.
6. WITH ONLY ONE EXHAUST FAN ON, BOTH THE OUTSIDE AIR AND RETURN AIR DAMPERS SHALL BE OPEN, BALANCED FOR 50% OF THE CFM FROM EACH.
7. WITH BOTH EXHAUST FANS ON, THE OUTSIDE AIR DAMPERS SHALL OPEN AND THE RETURN AIR DAMPERS SHALL CLOSE FOR 100% OUTSIDE AIR SUPPLY.
8. HEATING COIL VALVE SHALL SEQUENCE TO MAINTAIN MINIMUM 55° SUPPLY AIR

WHENEVER THE VENTILATION SYSTEM IS SHUT DOWN, THE FOLLOWING EVENTS SHALL OCCUR:

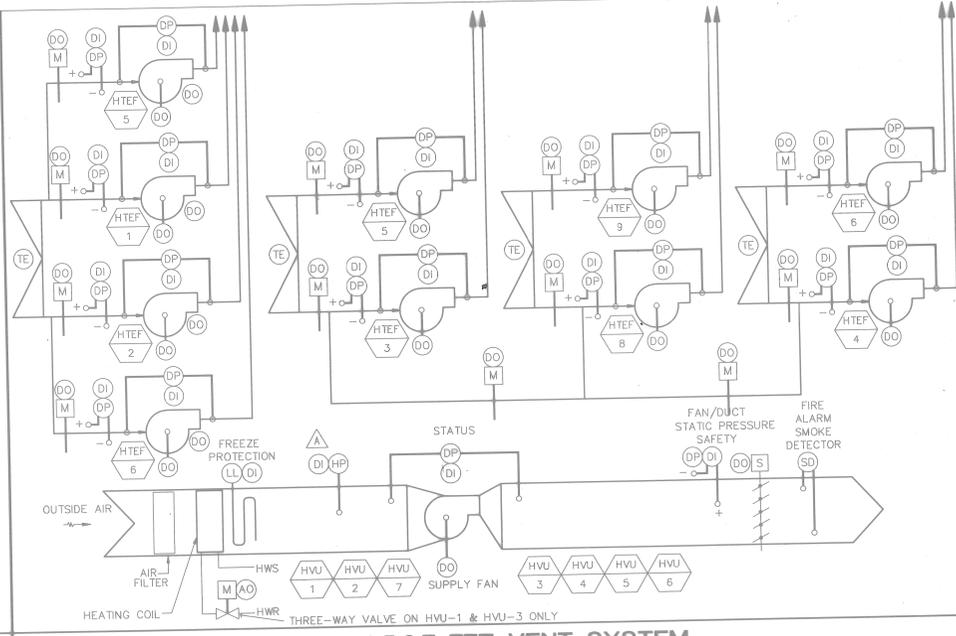
1. THE EXHAUST FANS SHALL STOP.
2. THE OUTSIDE AIR AND EXHAUST AIR DAMPERS SHALL CLOSE.

VENTILATING CYCLE CONTROL:

AN OXYGEN SENSOR IN THE CHILLER ROOM SHALL ALARM AT 19.5 VOLUME % OXYGEN CONCENTRATION, OPEN THE OUTSIDE AIR AND EXHAUST AIR DAMPERS AND START THE REFRIGERANT PURGE EXHAUST FAN. FOR ALL FANS, FAN ON/AUTO SWITCHES ARE PROVIDED AT THE ENTRANCE DOOR.

HEATING CYCLE CONTROL:

THE UNIT HEATER SHALL ACTIVATE UPON REACHING THE MINIMUM SPACE SETPOINT AND OPERATE UNTIL THE MINIMUM TEMPERATURE IS REACHED, WHEREBY THE UNIT SHALL SHUT DOWN.



**HVU - 1,2,3,4,5,6,7 FT VENT SYSTEM**

**SEQUENCE OF OPERATION**

GENERAL:  
THE SYSTEM CONSISTS OF A SINGLE ZONE, CONSTANT VOLUME, VENTILATION AIR HANDLING UNIT AND LOCAL CONTROLLERS WITH ELECTRONIC SENSING VALVES AND DAMPERS. ALL SETPOINTS SHALL BE ADJUSTABLE.

DEAD BANDS AND SET POINTS:

1. HEATING CRAWL SPACE SETPOINT	55 DEG F
2. HEATING ENABLED AT OUTSIDE AIR LESS THAN	55 DEG F
3. FREEZE PROTECTION SETPOINT	40 DEG F
4. FREEZE PROTECTION LIMIT	35 DEG F
5. SUPPLY FAN DISCHARGE STATIC PRESSURE LIMIT	1.5 IN WG

FREEZE CONTROL:  
THE LOW LIMIT FREEZE PROTECTION LOCATED ON THE LEAVING SIDE OF HEATING COIL WHEN THE TEMPERATURE LEAVING THE HEATING COIL IS AT OR BELOW THE FREEZE PROTECTION SET POINT, THE FOLLOWING EVENTS SHALL OCCUR:

1. THE SUPPLY FAN SHALL STOP.
2. THE OUTSIDE AIR AND EXHAUST DAMPERS SHALL CLOSE.
3. THE HEATING COIL VALVE SHALL RETURN TO ITS NORMAL POSITION.
4. A VISUAL ALARM SHALL BE ANNUNCIATED AT THE DTC. THE ALARM IS A RED PILOT NEXT TO THE "FAIL" PILOT, SAYING: "HTE FAN ON".
5. A MANUAL RESET OF FREEZE PROTECTION DEVICES SHALL BE REQUIRED.

SYSTEM START/STOP CONTROL:

EACH UNIT SHALL BE STARTED AND STOPPED REMOTELY VIA THE DTC. WHEN THE FAN SYSTEM IS STARTED, THE FOLLOWING EVENTS SHALL OCCUR:  
1. ITS RESPECTIVE CONTROL SYSTEM SHALL BE ENABLED.  
2. THE OUTSIDE AIR (SMOKE) DAMPER AND LOUVER INTAKE DAMPERS SHALL OPEN.  
3. THE EXHAUST FANS SHALL START.  
4. THE SUPPLY FAN SHALL START.  
5. PROOF OF AIR FLOW SHALL BE BY DIFFERENTIAL PRESSURE SWITCHES ACROSS THE FANS.

THE EXHAUST FANS SHALL BE INTERLOCKED TO THE SUPPLY FAN ONLY SUCH THAT AN ALARM WILL OCCUR AT THE DTC IF A SUPPLY FAN IS STARTED WITHOUT ITS CORRESPONDING EXHAUST FAN ON.

WHEN THE FAN SYSTEM IS STOPPED, THE FOLLOWING EVENTS SHALL OCCUR:

1. THE SUPPLY FAN SHALL STOP.
2. THE EXHAUST FANS SHALL STOP.
3. THE OUTSIDE AIR DAMPER AND LOUVER INTAKE DAMPERS SHALL CLOSE.
4. THE EXHAUST FAN DAMPER SHALL CLOSE.
5. HTEF-5,6,7,9 ARE CONTINUOUS PURGE (FLUSHING FANS) WHICH REMAINS ON UNLESS THE SEQUENCE FOR THE RESPECTIVE HTEF-1,2,3,4,8 IS "ON".

HTEF-5,6,7,9 OPERATE TO PREVENT PROPANE BUILD-UP "AFTER HOURS". THE RESPECTIVE HTEF-5,6,7,9 MUST BE OFF (WITH ITS INLET DAMPERS CLOSED) BEFORE HTEF-1,2,3,4,8 STARTS (TO PREVENT MOTOR BURN-OUT) OR AN ALARM IS ACTIVATED ON THE DTC. MAKE-UP AIR IS BY DAMPER LEAKAGE.

HEATING CYCLE CONTROL:

WHENEVER THE OUTSIDE AIR TEMPERATURE IS BELOW THE HEATING SETPOINT, THE HEATING COIL VALVE SHALL MODULATE TO MAINTAIN THE SPACE TEMPERATURE SETPOINT.

FILTER CONTROL:

PROVIDE A DIFFERENTIAL PRESSURE GAGE ACROSS THE FILTER SECTION FOR VISUAL PRESSURE DROP INDICATION.

DUCT SMOKE DETECTOR CONTROL:

SMOKE IN THE SUPPLY AIR (OCCUPIED MODE) WHEN A SMOKE DETECTOR IN THE SUPPLY AIR IS ACTIVATED, THE FOLLOWING EVENTS SHALL OCCUR:

1. AN ALARM SHALL BE ANNUNCIATED AT THE BACS CENTRAL CONTROL STATION AND FIRE ALARM PANEL.
2. THE SUPPLY FANS SHALL STOP.
3. THE OUTSIDE AIR (SMOKE) DAMPERS SHALL CLOSE.
4. THE HEATING VALVES SHALL CLOSE.
5. THE COOLING VALVES SHALL CLOSE.

1ST FLOOR STAGING (HVU-6):

1. NORMAL SPEED SETTING SHOULD BE ON LOW. HIGH MAY BE MANUALLY SELECTED IF THE OPERATOR IS CERTAIN THAT THERE IS SUFFICIENT

- EXHAUST FROM ONE OR BOTH HTE FANS (HTEF-1&2) TO AVOID OVERPRESSURIZING THE FIRST FLOOR STAGING AREA/PIT FIRE AREA INTO THE CRAWL SPACE AND BURNER ROOM.
2. NORMAL SUPPLY SETTING SHOULD BE AUTO. HVU-6 DAMPER TO OPEN AND UNIT TO RUN WHENEVER HTEF-1 AND/OR HTEF-2 RUNS. SUPPLY OFF MAY BE SELECTED IN SUMMER IF THE STAGING AREA 101 ROLL-UP DOORS ARE OPEN. HAND MAY BE SELECTED IF THE AUTO SETTING FAILS, OR IF THE OPERATOR WANTS TO VENTILATE THE STAGING AREA 101 WITH ROLL-UP DOORS OPEN OR HTE FANS ON A MANUAL OPERATION.
  3. RUN INDICATOR LIGHT (W) TO CONFIRM FAN START (WHETHER BY HAND OR AUTO) VIA A PRESSURE DIFFERENTIAL INDICATOR ACROSS THE SUPPLY FAN FAIL INDICATOR LIGHT (R) TO SIGNAL A FAILURE TO ESTABLISH A SUPPLY FAN DIFFERENTIAL PRESSURE (WHETHER BY A HAND OR AUTO START). FAIL LIGHT WOULD CLEAR FROM A MANUAL OFF SWITCH POSITION OR FROM AN "OFF" SIGNAL WITH THE AUTO SWITCH POSITION.
  4. NORMAL HVU-6 DAMPER SETTING TO BE AUTOMATIC. THE SHUT-OFF DAMPERS (MINIMUM 2 ACTUATORS ON SEPARATE DAMPER SECTIONS) SHALL OPEN BEFORE THE FAN STARTS. TO AVOID NOISE TRIP, PILOT LIGHT (W) TO INDICATE (VIA END SWITCHES WIRED IN PARALLEL) WHEN THE DAMPERS ARE IN FULL CLOSE POSITION, AND PILOT LIGHT (G) TO INDICATE WHEN THE DAMPERS ARE IN THE FULL OPEN POSITION. THE OPERATOR MAY MANUALLY SELECT THE DAMPER OPEN SETTING, WITH OR WITHOUT HVU-6 ON.

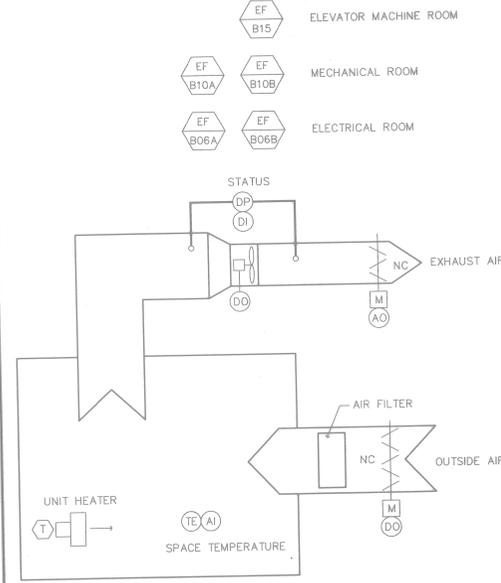
- ▲ HTEF TEMPERATURE INDICATORS:
1. PANEL MOUNT LED TYPE DIGITAL DISPLAY UNIT WITH NOMINAL 0.6 INCH HIGH RED NUMERALS TO READ 000 TO 999. UNIT TO OPERATE ON 120 VOLTS. DISPLAY AN INPUT TO BE COMPATIBLE WITH TEMPERATURE SENSORS AT INLET OF EACH RESPECTIVE HTEF.
  2. A HIGH LIMIT SENSING, EITHER A SEPARATE SENSOR OR IN CONJUNCTION WITH SAME SENSOR AS FOR THE TEMPERATURE INDICATOR, TO LIGHT THE RESPECTIVE (R) HIGH TEMP PILOT AT 1000 DEGREE F AND ABOVE.

- ▲ CROSS-CONNECT PLENUM (HTEF-1&8 AND HTEF-2&6):
1. NORMAL POSITION IS FULL CLOSE FOR EACH DAMPER WITH (W) PILOT LIGHT ON. ONE OR BOTH DAMPERS MAY BE OPENED AS REQUIRED BY THE OPERATOR.
  2. THIS IS A MANUAL OPERATION ONLY, TO OPEN OR CLOSE THE TWO-POSITION CROSS CONNECT DAMPERS ON THE ROOF BETWEEN THE RESPECTIVE PLENUMS. IF ONE HTE FAN(1,2 OR 8) FAILS AND TRAINING MUST STILL CONTINUE, AN ADJACENT FAN MAY BE USED TEMPORARILY FOR EXHAUST. END SWITCHES ON THE RESPECTIVE DAMPERS TO INDICATE VIA PILOT LIGHTS WHEN THE DAMPER HAS REACHED THE FULL OPEN (R) POSITION.

- ▲ HVU-1,2,3,4,5,7 FAN FAIL INDICATORS:
1. NORMAL INDICATION OF (R) PILOT LIGHT IS OFF.
  2. FAIL INDICATOR LIGHT (R) TO SIGNAL A FAILURE TO ESTABLISH A SUPPLY FAN DIFFERENTIAL PRESSURE (WHETHER BY A HAND OR AUTO START).
  3. FAIL LIGHT WOULD CLEAR FROM A MANUAL OFF SWITCH POSITION OR AN "OFF" SIGNAL WITH THE "AUTO" SWITCH POSITION.

- ▲ CO2 ALARM:
1. CO2 (LOW OXYGEN) SENSING IN THE TANK FILLING ROOM 131 TO START EF-131B (NORMALLY OFF). STOP EF-131A (NORMALLY ON) AND START MAKEUP AIR UNIT SET-4 (IF NOT ALREADY ON). UPON INDICATION OF A CO2 CONDITION ABOVE THE SENSOR SETPOINT.
  2. SEE SPECIFICATION SECTION 16783 (GAS MONITORING SYSTEM) AND THE USER INTERFACE RELAYS IN THE CONTROL PANEL IN SECURITY OFFICE 131.

- ▲ PROPANE ALARMS:
1. ALSO SEE DRAWING E2-1.
  2. PROPANE YARD ALARM FOR (R) PILOT LIGHT, PROPANE YARD ALARM FOR (R) PILOT LIGHT, SEE DRAWING U1-1, (NOTE 2 REQUIRES A REMOTE ALARM FROM THE VAPORIZERS TO THE DTC). THE ON PILOT LIGHT TO INDICATE THE STATUS OF THE RESPECTIVE ALARM CIRCUIT.
  3. PROPANE SENSORS WIRED IN PARALLEL FOR HVU-1,2,7 AND HVU-3,4,5,6 TO ALARM UPON PROPANE SENSING WITHIN THE UNIT, WHETHER ON OR OFF. THE RESPECTIVE ON PILOT LIGHTS TO INDICATE THE STATUS OF THE RESPECTIVE ALARM CIRCUITS.



**MECH AND ELEC ROOM VENT**

**SEQUENCE OF OPERATION**

GENERAL:  
THE SYSTEM CONSISTS OF A VENTILATING EXHAUST FAN, AIR SUPPLY LOUVERS, ELECTRIC SENSING AND DAMPERS. ALL SETPOINTS SHALL BE ADJUSTABLE.

SET POINTS:

1. VENTILATION SETPOINT (LEAD FAN) EF-B06A,B10A,B15	85 DEG F
2. VENTILATION SETPOINT (LAG FAN) EF-B06B,B10B	95 DEG F
3. FREEZE PROTECTION ALARM	40 DEG F
4. FREEZE PROTECTION LIMIT	35 DEG F
5. HIGH TEMPERATURE ALARM	105 DEG F
6. UNIT HEATER SETPOINT	55 DEG F

VENTILATION SYSTEM START/STOP CONTROL:

THE VENTILATION SYSTEM SHALL BE STARTED AND STOPPED REMOTELY BY THE BACS. WHENEVER THE SPACE TEMPERATURE EXCEEDS THE VENTILATION SETPOINT, THE VENTILATION SYSTEM SHALL START, AND THE FOLLOWING EVENTS SHALL OCCUR:

1. EXHAUST AND OUTSIDE AIR DAMPERS SHALL OPEN.
2. EXHAUST FAN SHALL START.
3. PROOF OF AIR FLOW SHALL BE BY A DIFFERENTIAL PRESSURE SWITCH ACROSS THE FAN.

THE VENTILATION SYSTEM SHALL SHUT DOWN UPON THE SPACE TEMPERATURE BEING SATISFIED. THE FOLLOWING EVENTS SHALL OCCUR:

1. THE EXHAUST FAN SHALL STOP.
2. THE EXHAUST AND OUTSIDE AIR DAMPERS SHALL CLOSE.

HEATING CYCLE CONTROL:

THE UNIT HEATER SHALL ACTIVATE UPON REACHING THE MINIMUM SPACE SETPOINT AND OPERATE UNTIL THE MINIMUM TEMPERATURE IS REACHED, WHEREBY THE UNIT SHALL SHUT DOWN.

4. VAPORIZERS 1 AND 2 TO HAVE INDIVIDUAL PILOT LIGHT STATUS INDICATIONS FOR WHETHER THE UNITS ARE ON (W) OR OFF (R), AND ALARM PER DRAWING U3-1.
5. PROPANE DEVICE ALARM TO HAVE 24-VOLT SPARK-SUPPRESSING CONTACTS AND PILOT LIGHT TO INDICATE STATUS AND ALARM FOR A 24-VOLT SIGNAL FROM THE GOVERNMENT DEVICE CONTRACTOR'S PROPANE SENSING SYSTEM. (W) INDICATES CIRCUIT IS ACTIVE.

▲ PROPANE EMERGENCY OFF:

1. PILOT LIGHT (W) TO INDICATE THAT THE EMERGENCY CIRCUIT IS ENERGIZED.
2. PILOT LIGHT (R) TO INDICATE THAT THE EMERGENCY CIRCUIT IS DE-ENERGIZED.
3. PROPANE "OFF" BUTTON IS MANUAL ACTUATION IN CONJUNCTION WITH THE SAFETY CIRCUIT SHOWN IN THE EMERGENCY SHUTOFF VALVE SYSTEM WIRING DIAGRAM SHOWN ON DRAWING U6-1.

SEE DTC DRAWINGS M4-1 THRU M4-7 FOR ADDITIONAL REQUIREMENTS.

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DEPARTMENT OF THE NAVY  
 NAVAL FACILITIES ENGINEERING COMMAND  
 CHARLESTON, S.C.

**SOUTHERN DIVISION**

NAVAL TRAINING CENTER  
 GREAT LABELS, FLORIDA

**DAMAGE CONTROL SCHOOL  
 HVAC VENTILATION DIAGRAMS  
 AND SEQUENCE OF OPERATIONS**

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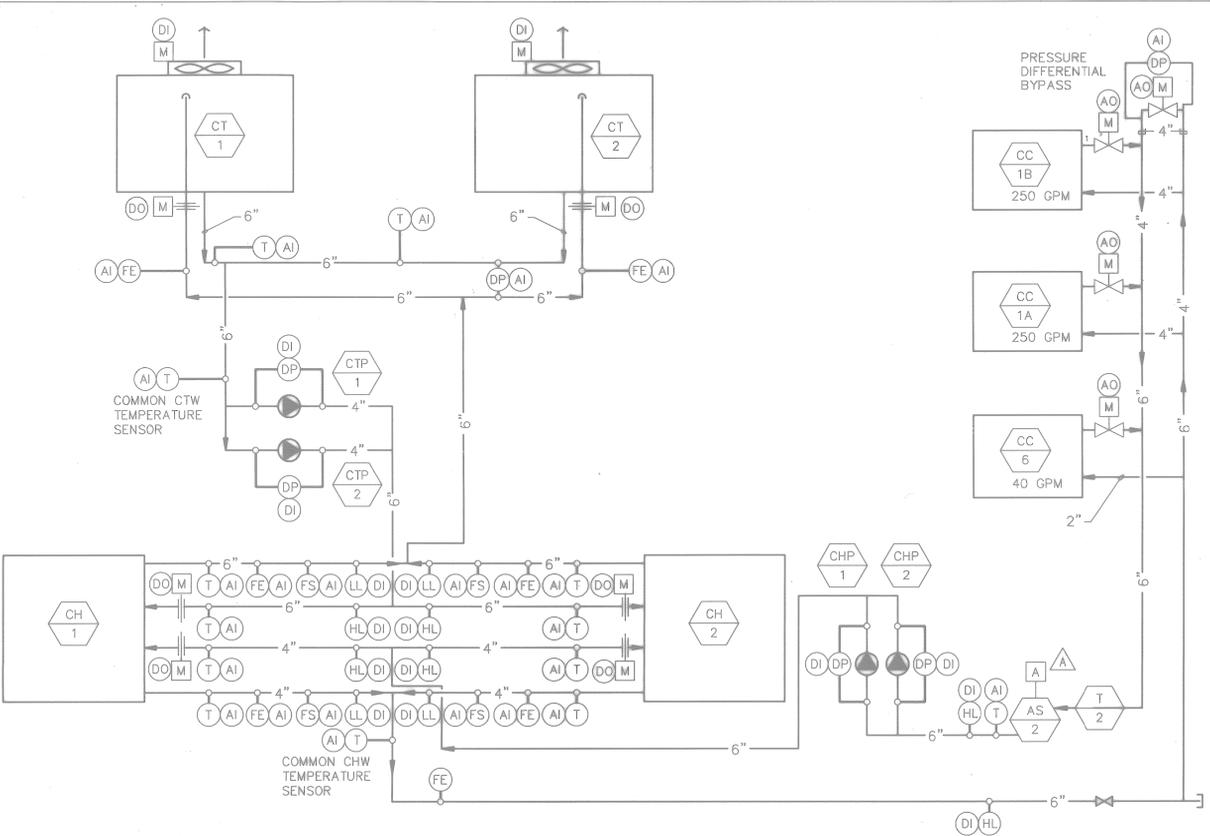
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### CHILLER AND COOLING TOWER

#### SEQUENCE OF OPERATION

**GENERAL:**  
 THE CHILLER PLANT SHALL CONSIST OF TWO 50% CAPACITY TOWER WATER-COOLED LIQUID CHILLERS AND TWO 50% CAPACITY END-SUCTION CONSTANT VOLUME PUMPS. THE SYSTEM COMPONENTS SHALL HAVE ELECTRICALLY OPERATED VALVES AND THEIR OWN DDC STAND ALONE LOCAL CONTROL STATION (LCS). THE BACS CENTRAL CONTROL STATION SHALL PROMPT THE CHILLER PLANT OPERATOR BY RECOMMENDING "COOLING MODE" OR "NON-COOLING MODE". THE OPERATOR SHALL SELECT THE LEAD CHILLER AND CHW PUMP.

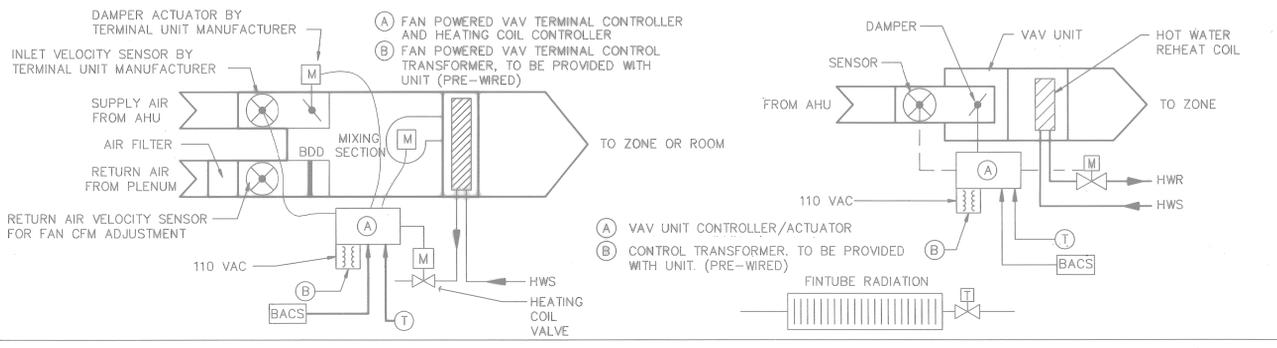
THE OPERATING CONTROLS AND SAFETIES FOR THE CHILLERS SHALL BE PRE-SET BY THE CHILLER MANUFACTURER AT THE FACTORY. FLOW SWITCHES, TEMPERATURE SENSORS, DIFFERENTIAL SENSING DEVICES AND CONTROL ITEMS AS INDICATED ON THE DRAWINGS AND IN THE SPECIFICATIONS SHALL BE PROVIDED.

**SETPOINTS:**

LOW LIMIT TEMPERATURE SETPOINT	40 DEG F
MAXIMUM TEMPERATURE SETPOINT	48 DEG F
CHILLED WATER SUPPLY TEMPERATURE SETPOINT	45 DEG F
CHILLED WATER RETURN TEMPERATURE SETPOINT	55 DEG F
CHILLED WATER HIGH LOAD LIMIT SETPOINT	59 DEG F
CHILLED WATER RETURN HIGH LIMIT ALARM	60 DEG F
CHILLED WATER RETURN HIGH LIMIT SHUTDOWN	61 DEG F
CHILLED WATER PIPING PRESSURE DIFFERENTIAL	10 PSIG

**SYSTEM START/STOP CONTROL:**  
 BOTH THE LEAD AND LAG CHILLERS AND CHILLED AND TOWER PUMPS SHALL START AND STOP VIA A PROGRAMMED TIME SCHEDULE RESIDENT AT THE BUILDING AUTOMATION CONTROL SYSTEM (BACS). THE TIME SCHEDULE SHALL ALTERNATE CHILLER AND PUMP OPERATION FOR EQUAL USAGE. THE FOLLOWING EVENTS SHALL OCCUR WHEN THE CHILLER PLANT IS IN OPERATION:

- THE LEAD CHILLER AND PUMP SHALL HAVE THEIR RESPECTIVE LOCAL CONTROL STATIONS ENABLED.
- THE LEAD CHILLER SHUTOFF VALVE SHALL OPEN.
- THE LEAD CHW PUMP SHALL START AND UPON PROOF OF FLOW, THE LEAD CHILLER SHALL START AND OPERATE UNDER NORMAL CONDITIONS ACCORDING TO THE TIME SCHEDULE.
- WHEN THE LEAD CHILLER IS "ON" AND THE BUILDING COOLING LOAD REACHES 90% OF THE LEAD CHILLER CAPACITY AS CALCULATED BY THE BACS, OR THE CHILLED WATER SUPPLY TEMPERATURE EQUALS OR EXCEEDS THE MAXIMUM TEMPERATURE SETPOINT, THE LAG CHILLER AND PUMPS SHALL HAVE THEIR LOCAL CONTROL STATION ENABLED, THE LAG CHILLER SHUTOFF VALVE SHALL OPEN, THE LAG PUMPS SHALL START AND UPON PROOF OF FLOW, THE LAG CHILLER SHALL START.
- IF THE LEAD CHILLER AND ITS LCS IS INDEXED TO OPERATE AND "ON" STATUS IS NOT RECEIVED BY THE BACS, THE LAG CHILLER LCS SHALL BE ENABLED, THE LAG CHILLER SHUTOFF VALVE SHALL OPEN AND UPON PROOF OF CHW FLOW, THE LAG CHILLER SHALL START AND AN ALARM SHALL ANNUNCIATE AT THE BACS.
- IF THE LEAD PUMPS AND THEIR LCS IS INDEXED TO OPERATE AND "ON" STATUS IS NOT RECEIVED AT THE BACS, THE LAG PUMP LCS SHALL BE ENABLED, THE LAG CHW PUMP SHALL START AND AN ALARM SHALL ANNUNCIATE AT THE BACS.
- IF THE LAG CHILLER OR PUMPS AND THEIR RESPECTIVE LOCAL CONTROL STATION ARE INDEXED TO OPERATE AND "ON" STATUS IS NOT RECEIVED AT THE BACS AN ALARM SHALL BE ANNUNCIATED AT THE BACS.
- WHEN BOTH CHILLERS ARE IN OPERATION AND THE BUILDING COOLING LOAD FALLS BELOW 40% OF THE COMBINED CHILLER CAPACITY AS CALCULATED BY THE BACS, THEN THE LAG CHILLER SHALL STOP, THE LAG PUMPS SHALL STOP, THE LAG CHILLER SHUTOFF VALVE SHALL CLOSE AND ITS RESPECTIVE LOCAL CONTROL STATION SHALL BE DISABLED.
- THE CHILLER PLANT OPERATOR SHALL HAVE THE ABILITY TO OVERRIDE THE TIME SCHEDULE FROM THE BUILDING AUTOMATION CONTROL SYSTEM (BACS) OR LOCAL CONTROL STATION (LCS).
- THE USE OF OPTIMUM START/STOP PROGRAMS SHALL BE IMPLEMENTED IN THE BUILDING AUTOMATION CONTROL SYSTEM SOFTWARE.
- TWO PUMPS SHALL NOT OPERATE WITH ONLY ONE CHILLER SHUTOFF VALVE OPEN.
- COOLING TOWER OPERATION:  
 (1) SYSTEM START-UP AND OPERATION SHALL BE AS FOLLOWS:  
 (A) WHEN CONDENSER WATER FLOW HAS BEEN ESTABLISHED, ENABLE THE COOLING TOWER FAN START CIRCUITS.  
 (B) COOLING TOWER FANS SHALL BE CYCLED IN SEQUENCE TO MAINTAIN REQUIRED CONDENSER WATER SUPPLY TEMPERATURE. INITIAL CWS TEMPERATURE SHALL BE 85°F.  
 (C) CHILLER CONTROL SYSTEM SOFTWARE PROGRAM SHALL OPTIMALLY RESET CWS TEMPERATURE ACCORDING TO A WET BULB TEMPERATURE CWR TEMPERATURE AND CHILLER PERFORMANCE CURVE INPUTS TO THE TEMPERATURE CONTROL SYSTEM.  
 (D) FAN SEQUENCE SHALL BE SUCH THAT ALL OPERATING TOWER FANS SHALL BE RUN ON LOW SPEED BEFORE ANY OPERATING TOWER FAN IS ALLOWED TO BE SEQUENCED TO HIGH SPEED.  
 (2) COOLING TOWER BASIN FREEZE PROTECTION SYSTEM WILL OPERATE AS FOLLOWS: ON A BASIN WATER TEMPERATURE FALL BELOW 38 DEGREE F, OPERATING THERMOSTAT WILL ENERGIZE CONTROL OF BASIN HEATING SYSTEM.
- COOLING CYCLE CONTROL:  
 THE BACS SHALL RECOMMEND CHILLER OPERATION WHEN THE OUTSIDE AIR TEMPERATURE IS EQUAL TO OR GREATER THAN 53 DEG F AND THE DISCHARGE AIR TEMPERATURE SETPOINTS ON ANY AIR HANDLER CANNOT BE MAINTAINED. THE CHILLER PLANT OPERATOR SHALL INITIATE THIS OPTION BY CHOOSING A "COOLING MODE" ICON DRIVEN MENU PROMPT AT THE BACS.
- HEATING CYCLE OR NON-COOLING CONTROL:  
 BOTH CHILLERS AND PUMPS SHALL BE IN THE "OFF" MODE BY DEFAULT. THE BACS SHALL RECOMMEND CHILLER SHUTDOWN WHEN THE OUTSIDE AIR TEMPERATURE IS LESS THAN 53 DEG F AND THE AIR HANDLERS ARE ABLE TO MAINTAIN THE DISCHARGE SETPOINTS. THE CHILLER PLANT OPERATOR SHALL INITIATE THIS OPTION BY CHOOSING A "NON-COOLING MODE" ICON DRIVEN MENU PROMPT AT THE BACS.
- MANUAL TIME SCHEDULE OPERATOR OVERRIDE:  
 IN THE CASE THAT THE CHILLER PLANT OPERATOR OVERRIDES THE DEFAULT CONTROL MODE, THE BACS SHALL DISPLAY A GRAPHICS SCREEN THAT REMINDS THE OPERATOR THAT THE CHILLER OPERATION IS IN OVERRIDE OPERATION. THE BACS SHALL ALSO RECOMMEND ON THE SAME GRAPHICS SCREEN CHILLER OPERATION BASED ON COOLING OR NON-COOLING CYCLE CONTROL.



### VAV TERMINAL UNIT WITH HW HTG COIL AND FIN-TUBE RADIATION

#### FPVAV SEQUENCE OF OPERATION

**GENERAL:**  
 THE SERIES FLOW CONSTANT VOLUME FPVAV TERMINAL UNITS SHALL BE CONTROLLED THROUGH A SPACE THERMOSTAT OR RETURN AIR RTD (SEE PLANS). THE UNIT CONTROLLER SHALL DETERMINE COOLING OR HEATING CONDITIONS BY AN ELECTRONIC DUCT SENSOR. PROVIDE AN INLINE AIR FILTER ON THE "HIGH" SIDE OF THE VELOCITY PRESSURE SENSOR TUBING AS LOCATED BY UNIT MANUFACTURER.

**SAFETIES:**  
 THE TERMINAL UNIT SHALL BE PROTECTED BY THE FOLLOWING:

- THE FPVAV TERMINAL UNIT FANS SHALL BE STARTED 30 SECONDS PRIOR TO THE SYSTEM UNIT OPERATION START MODE.

**EMERGENCY MODE (SMOKE CONDITION):**  
 THE CONTROL SYSTEM SHALL ENTER AND EXIT THE EMERGENCY #2 MODE THROUGH A COMMAND FROM THE BACS. ALL OTHER MODES OF OPERATION SHALL BE SUPERSEDED. WHILE IN THE EMERGENCY #2 MODE, THE CONTROL SYSTEM SHALL DRIVE THE UNIT DAMPER FULLY CLOSED AND TURN "OFF" ANY OTHER OUTPUTS INCLUDING THE FAN AND THE HEATING COIL.

**OCCUPIED MODE:**  
 THE CONTROL SYSTEM SHALL ENTER THE OCCUPIED MODE IN ONE OF THREE WAYS:

- A COMMAND FROM THE BACS.
- A SCHEDULED TIME OF DAY FROM THE BACS.
- A LOCAL OVERRIDE AT THE LCS.

**WHILE IN THE OCCUPIED MODE, THE CONTROL SYSTEM SHALL TURN THE FAN ON AND MAINTAIN THE ZONE TEMPERATURE AT THE HEATING OR COOLING TEMPERATURE SETPOINTS AS FOLLOWS:**

**COOLING MODE:** WHEN THE ZONE TEMPERATURE IS WITHIN THE COOLING PROPORTIONAL BAND, THE UNIT CONTROLLER SHALL MODULATE THE PRIMARY AIR FLOW BETWEEN MINIMUM AND MAXIMUM AIR FLOW SETPOINTS USING A PROPORTIONAL-INTEGRAL-DERIVATIVE (PID) ALGORITHM TO MAINTAIN THE COOLING SETPOINT.

**DEAD BAND:** WHEN THE ZONE TEMPERATURE IS BELOW THE COOLING PROPORTIONAL BAND, THE PRE-DETERMINED MINIMUM DAMPER SETPOINT SHALL BE MAINTAINED. THE DEAD BAND SHALL BE BETWEEN THE COOLING PROPORTIONAL BAND AND THE FIRST STAGE OF HEAT.

**HEATING MODE:** THE HEAT SHALL BE DUTY CYCLED USING A PID ALGORITHM TO MAINTAIN THE HEATING SETPOINT. EACH STAGE HEAT CYCLE TIME SHALL BE PROGRAMMABLE. STAGE 2 SHALL NOT BEGIN THE CYCLE UNTIL STAGE 1 IS ON FOR 100% OF THE DUTY CYCLE TIME. EACH HEATING STAGE SHALL BE "ON" FOR A MINIMUM OF TEN SECONDS. WHEN THE ZONE TEMPERATURE DROPS TO ONE AND ONE HALF DEGREES FAHRENHEIT BELOW THE HEATING SETPOINT, THE CONTROL SYSTEM SHALL ENERGIZE THE FIRST STAGE OF ELECTRIC HEAT. THE HEATING COIL SHALL REMAIN ENERGIZED UNTIL THE SPACE TEMPERATURE SATISFIES THE HEATING SETPOINT. IF THE ZONE TEMPERATURE DROPS TO TWO AND ONE HALF DEGREES FAHRENHEIT BELOW THE HEATING SETPOINT, THE CONTROL SYSTEM SHALL ENERGIZE THE SECOND STAGE OF HEAT (IF APPLICABLE). DURING THE HEATING OPERATION THE PRE-DETERMINED MINIMUM PRIMARY AIR DAMPER SETPOINT FOR HEATING OPERATION SHALL BE MAINTAINED. CONTRACTOR SHALL FOLLOW THE MANUFACTURER'S RECOMMENDATION FOR MINIMUM AIR FLOW PER KILOWATT OF HEAT.

**DEAD BAND:** WHEN THE ZONE TEMPERATURE IS BELOW THE COOLING PROPORTIONAL BAND, THE PRE-DETERMINED MINIMUM DAMPER SETPOINT SHALL BE MAINTAINED. THE DEAD BAND SHALL BE BETWEEN THE COOLING PROPORTIONAL BAND AND THE FIRST STAGE OF HEAT.

**UNOCCUPIED MODE:**  
 THE CONTROL SYSTEM SHALL ENTER THE UNOCCUPIED MODE IN ONE OF THREE WAYS:

- A COMMAND FROM THE BACS.
- A SCHEDULED TIME OF DAY FROM THE BACS.
- A LOCAL OVERRIDE AT THE LCS.

**WHILE IN THE UNOCCUPIED MODE, THE CONTROL SYSTEM SHALL MAINTAIN THE ZONE AT THE HEATING SET BACK OR COOLING SET UP TEMPERATURE SETPOINT. THE TERMINAL UNIT FAN SHALL BE OFF.**

**NIGHT SET BACK MODE:**  
 THE CONTROL SYSTEM SHALL ENTER AND EXIT THE NIGHT SETBACK MODE IN ONE OF THREE WAYS:

- A COMMAND FROM THE BACS.
- A SCHEDULED TIME OF DAY FROM THE BACS.
- A RETURN FROM A LOCAL OVERRIDE OF THE NIGHT SETBACK MODE AT THE ROOM SENSOR.

**WHILE IN THE NIGHT SET BACK MODE, THE CONTROL SYSTEM SHALL MAINTAIN THE ZONE AT THE HEATING SET BACK TEMPERATURE SETPOINT. THE FIN-TUBE RADIATION CONTROL VALVE SHALL MODULATE TO MAINTAIN THE SPACE SETPOINT. THE TERMINAL UNIT SHALL REMAIN OFF.**

**WARM UP MODE:**  
 DURING THE WARM UP MODE, THE ZONE DAMPER SHALL OPEN TO MINIMUM POSITION. THE ZONE THERMOSTAT SHALL MODULATE THE HOT WATER COIL AND FIN-TUBE RADIATION VALVE TO MAINTAIN THE WARM UP SETPOINT.

#### VAV SEQUENCE OF OPERATION

**GENERAL:**  
 THE VAV UNITS SHALL BE CONTROLLED THROUGH A SPACE THERMOSTAT OR RTD. THE UNIT CONTROLLER SHALL DETERMINE COOLING OR HEATING CONDITIONS BY AN ELECTRONIC ROOM SENSOR. PROVIDE AN INLINE AIR FILTER ON THE "HI" SIDE OF THE VELOCITY PRESSURE SENSOR TUBING AS REQUIRED BY UNIT MANUFACTURER. ALL SETPOINTS SHALL BE ADJUSTABLE. THE FIN-TUBE RADIATION SHALL BE ACTIVATED IN A HEATING MODE IN TANDEM.

**OCCUPIED MODE:**  
 THE CONTROL SYSTEM SHALL ENTER THE OCCUPIED MODE IN ONE OF THREE WAYS:

- A COMMAND FROM THE BACS.
- A SCHEDULED TIME OF DAY FROM THE INTERNAL CONTROLLER MEMORY, OR
- A LOCAL OVERRIDE OF THE NIGHT SET BACK OR UNOCCUPIED MODES.

**WHILE IN THE OCCUPIED MODE, THE CONTROL SYSTEM SHALL MAINTAIN THE ROOM TEMPERATURE AT THE HEATING OR COOLING TEMPERATURE SETPOINTS AS FOLLOWS:**

**COOLING MODE:** WHEN THE ROOM TEMPERATURE IS WITHIN THE COOLING PROPORTIONAL BAND, THE UNIT CONTROLLER SHALL MODULATE THE PRIMARY AIR FLOW BETWEEN MINIMUM AND MAXIMUM AIR FLOW SETPOINTS USING A PROPORTIONAL-INTEGRAL-DERIVATIVE (PID) ALGORITHM TO MAINTAIN THE COOLING SETPOINT.

**DEAD BAND:** WHEN THE ZONE TEMPERATURE IS BELOW THE COOLING PROPORTIONAL BAND, THE PRE-DETERMINED MINIMUM DAMPER SETPOINT SHALL BE MAINTAINED. THE DEAD BAND SHALL BE BETWEEN THE COOLING PROPORTIONAL BAND AND THE START OF HEATING CONTROL.

**HEAT MODE:** WHEN THE ZONE TEMPERATURE DROPS TO ONE AND ONE HALF DEGREES FAHRENHEIT BELOW THE HEATING SET POINT, THE CONTROL SYSTEM SHALL MODULATE THE HOT WATER VALVE USING A PID ALGORITHM TO MAINTAIN THE ROOM TEMPERATURE AT THE HEATING SET POINT. THE PRE-DETERMINED MINIMUM DAMPER SET POINT SHALL BE MAINTAINED. THE FIN-TUBE RADIATION CONTROL VALVE SHALL MODULATE TO MAINTAIN THE SPACE SETPOINT. IF THE ZONE TEMPERATURE IS NOT SATISFIED WITH THE REHEAT VALVE OPEN, ALARM AT THE BACS, THEN CONTINUE TO REDUCE CFM BELOW THE MINIMUM SETPOINT.

#### UNOCCUPIED MODE:

THE CONTROL SYSTEM SHALL ENTER THE UNOCCUPIED MODE IN ONE OF THREE WAYS:

- A COMMAND FROM THE BACS.
- A SCHEDULED TIME OF DAY FROM THE INTERNAL CONTROLLER MEMORY.
- A RETURN FROM A LOCAL OVERRIDE OF THE UNOCCUPIED MODE AT THE ROOM SENSOR.

**WHILE IN THE UNOCCUPIED MODE, THE CONTROL SYSTEM SHALL MAINTAIN THE ROOM TEMPERATURE AT THE UNOCCUPIED HEATING TEMPERATURE SETPOINT. THE FIN-TUBE RADIATION CONTROL VALVE SHALL MODULATE TO MAINTAIN THE SPACE SETPOINT. THE TERMINAL UNIT SHALL REMAIN OFF.**

**NIGHT SET BACK MODE:**  
 THE CONTROL SYSTEM SHALL ENTER AND EXIT THE NIGHT SETBACK MODE IN ONE OF THREE WAYS:

- A COMMAND FROM THE BACS.
- A SCHEDULED TIME OF DAY FROM THE INTERNAL CONTROLLER MEMORY, OR
- A RETURN FROM A LOCAL OVERRIDE OF THE NIGHT SETBACK MODE AT THE ROOM SENSOR.

**WHILE IN THE NIGHT SET BACK MODE, THE CONTROL SYSTEM SHALL MAINTAIN THE ZONE AT THE HEATING SET BACK TEMPERATURE SETPOINT. THE FIN-TUBE RADIATION CONTROL VALVE SHALL MODULATE TO MAINTAIN THE SPACE SETPOINT. THE TERMINAL UNIT SHALL REMAIN OFF.**

**WARM UP MODE:**  
 DURING THE WARM UP MODE, THE ZONE DAMPER SHALL OPEN TO MINIMUM POSITION. THE ZONE THERMOSTAT SHALL MODULATE THE HOT WATER COIL AND FIN-TUBE RADIATION VALVE TO MAINTAIN THE WARM UP SETPOINT.

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**RECORD DRAWING**  
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SUBMITTED BY: RAUCH

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NAVY FACILITIES ENGINEERING COMMAND

SOUTHERN DIVISION

CHARLESTON, S.C.

NAVAL TRAINING CENTER

GREAT LAKES, ILLINOIS

**DAMAGE CONTROL SCHOOL**

**HVAC COOLING SYSTEM DIAGRAMS**

**AND SEQUENCE OF OPERATION**

SIZE: F

CODE IDENT NO: 80091

NAVJCE DRAWING NO: 5276582

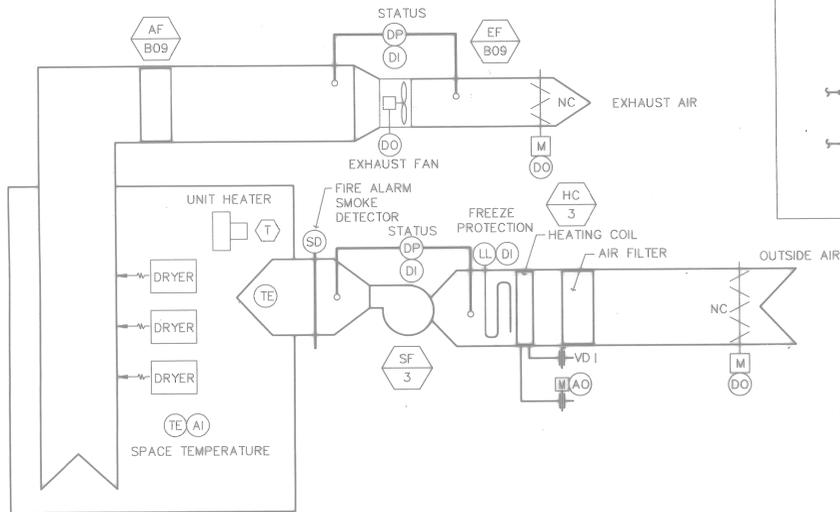
CONSTR CONTR NO: N62467-93-C-1143

ENGINEER NO: M5-5

SPEC: 06-93-1143

SHEET: 68 OF

ARCH. & ENGR. SEAL



### SF-3 LAUNDRY ROOM VENTILATION SYSTEM

#### SEQUENCE OF OPERATION

**GENERAL:**  
THE SYSTEM CONSISTS OF VENTILATING EXHAUST FANS, MAKE-UP AIR AND RECIRCULATION SUPPLY FAN AND ELECTRONIC SENSING AND ELECTRICALLY OPERATED DAMPERS. ALL SETPOINTS SHALL BE ADJUSTABLE.

**SET POINTS:**

1. MINIMUM SPACE TEMPERATURE SETPOINT	55 DEG F
2. MINIMUM SUPPLY AIR SETPOINT	50 DEG F
3. FREEZE PROTECTION ALARM	40 DEG F
4. FREEZE PROTECTION LIMIT	35 DEG F
5. HIGH TEMPERATURE ALARM	105 DEG F
6. UNIT HEATER SETPOINT (CORRIDORS)	50 DEG F

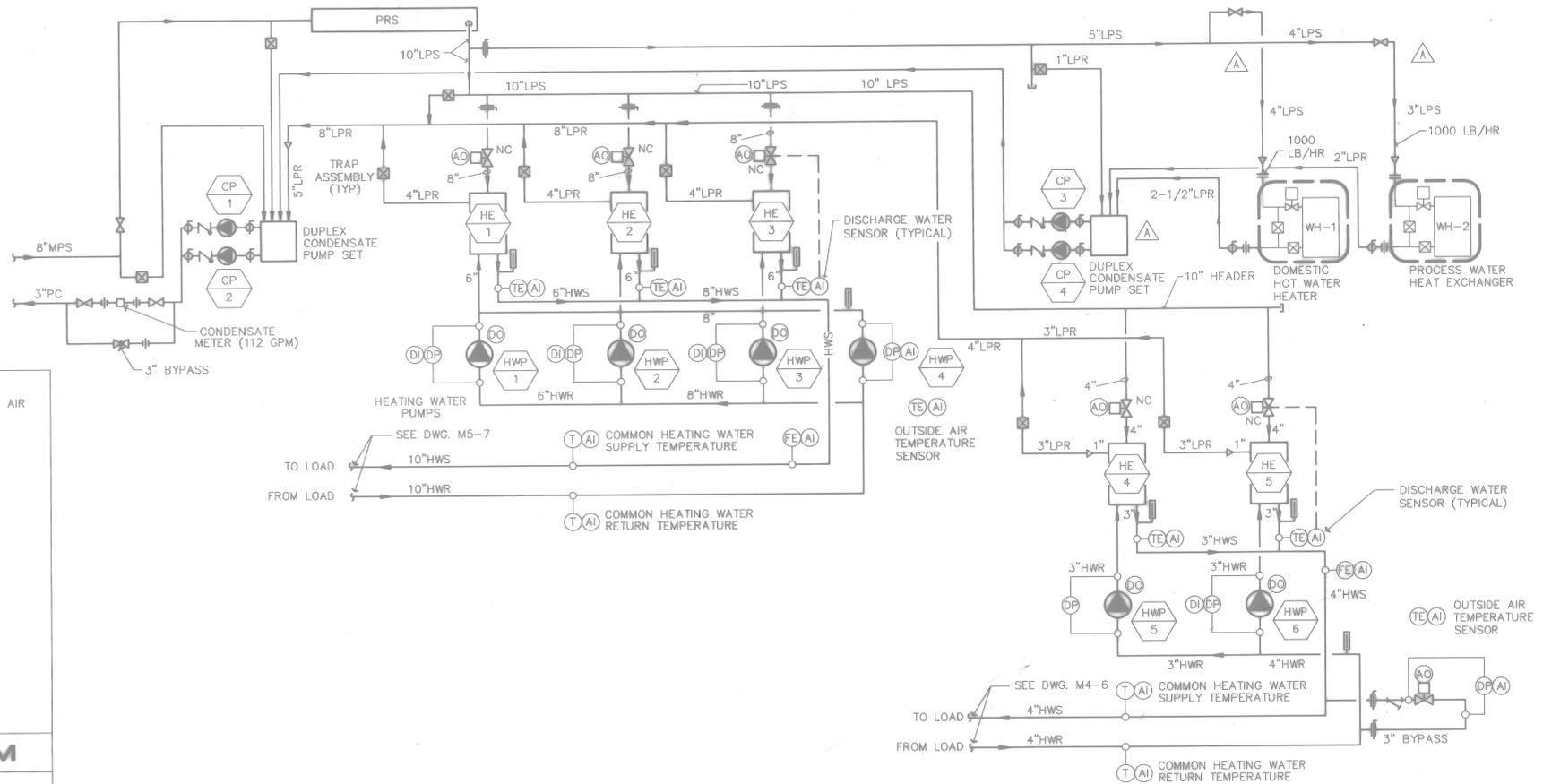
**SYSTEM START/STOP CONTROL:**  
THE VENTILATION SYSTEM SHALL BE STARTED AND STOPPED LACALLY BY A DRYER INTERLOCK (4 WIRED IN PARALLEL). WHENEVER THE LAUNDRY DRYERS ARE ON, THE VENTILATION SYSTEM SHALL START AND THE FOLLOWING EVENTS SHALL OCCUR:

1. THE OUTSIDE AIR AND EXHAUST AIR DAMPERS SHALL OPEN
2. THE EXHAUST FAN SHALL START IN SEQUENCE.
3. PROOF OF AIR FLOW SHALL BE BY A DIFFERENTIAL PRESSURE SWITCH ACROSS THE FAN.
4. SF-3 SUPPLY FAN SHALL START
5. HEATING COIL VALVE SHALL SEQUENCE TO MAINTAIN MINIMUM 55° SUPPLY AIR

WHENEVER THE VENTILATION SYSTEM IS SHUT DOWN, THE FOLLOWING EVENTS SHALL OCCUR:

1. THE EXHAUST FANS SHALL STOP.
2. THE OUTSIDE AIR AND EXHAUST AIR DAMPERS SHALL CLOSE.

**HEATING CYCLE CONTROL:**  
THE UNIT HEATER SHALL ACTIVATE UPON REACHING THE MINIMUM SPACE SETPOINT AND OPERATE UNTIL THE MINIMUM TEMPERATURE IS REACHED, WHEREBY THE UNIT SHALL SHUT DOWN.



### HEATING SYSTEM SEQUENCE OF OPERATION

**GENERAL:**  
THE HEATING SYSTEM CONSISTS OF MULTIPLE STEAM-TO-WATER HEAT EXCHANGERS AND THREE 33% CAPACITY CONSTANT VOLUME PUMPS. THE SYSTEM COMPONENTS SHALL HAVE ELECTRICALLY OPERATED VALVES AND THEIR OWN DDC STAND ALONE LOCAL CONTROL STATION (LCS). THE BACS CENTRAL CONTROL STATION SHALL INITIATE "HEAT MODE" OR "NON-HEAT MODE." HEAT IS REQUIRED YEARROUND FOR AIR HANDLING UNIT SYSTEM OPERATION ZONING CONTROL. THE OPERATOR SHALL SELECT THE LEAD PUMP. ALL SETPOINTS SHALL BE ADJUSTABLE.

**OPERATING CONTROLS, SAFETIES,**  
FLOW SWITCHES, TEMPERATURE SENSORS, DIFFERENTIAL SENSING DEVICES AND CONTROL ITEMS AS INDICATED ON THE DRAWINGS AND IN THE SPECIFICATIONS WERE PROVIDED BY THE TEMPERATURE CONTROL CONTRACTOR.

**SETPOINTS:**

HEATING WATER DESIGN SUPPLY TEMPERATURE SETPOINT	200 DEG F
HEATING WATER DESIGN RETURN TEMPERATURE SETPOINT	140 DEG F
SUPPLY WATER TEMPERATURE SHALL BE RESET BY RAMPING BY OUTSIDE AIR TEMPERATURE TO 120 DEG F AT 60 DEG F	

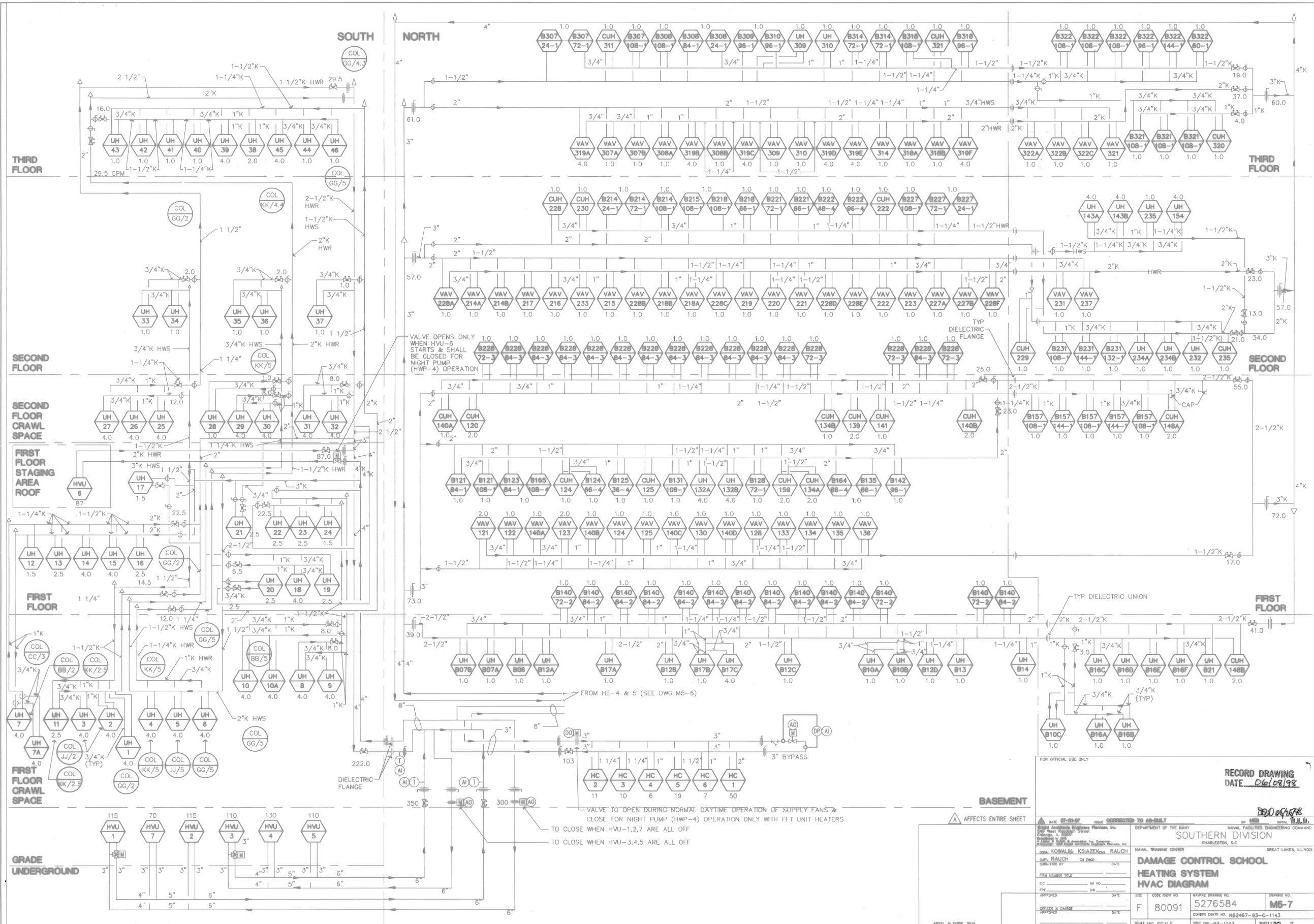
**SYSTEM START/STOP CONTROL:**  
THE LEAD HEAT EXCHANGER AND PUMP SET SHALL START AND STOP VIA A PROGRAMMED TEMPERATURE SCHEDULE RESIDENT AT THE BUILDING AUTOMATION CONTROL SYSTEM (BACS). THE HEAT EXCHANGERS WITH THEIR CONTROL VALVES AND THEIR RESPECTIVE PUMPS SHALL BE INITIATED IN A LEAD-LAG SEQUENCES TO MEET INCREASING DEMAND. THERE WILL BE A TOTAL OF THREE STAGES WITH NO STANDBY. THE SCHEDULE SHALL ALTERNATE PUMP OPERATION FOR EQUAL USAGE. THE FOLLOWING EVENTS SHALL OCCUR WHEN THE SYSTEM IS IN OPERATION:

1. THE LEAD PUMP SHALL START AND UPON PROOF OF FLOW, SHALL OPERATE UNDER NORMAL CONDITIONS ACCORDING TO THE SCHEDULE.
2. IF A SECOND OR THIRD PUMP/HEAT EXCHANGER SET IS INDEXED TO OPERATE AND CONFIRMATION "ON" STATUS IS NOT RECEIVED AT THE BACS, THE NEXT LAG PUMP SHALL START AND AN ALARM SHALL ANNUNCIATE AT THE BACS.
3. PROVIDE A PRESSURE DIFFERENTIAL PUMP BYPASS TO MODULATE THE BYPASS CONTROL VALVE OPEN ON AN INCREASE IN DIFFERENTIAL PRESSURE.
4. FOR NIGHT HEATING OF FFT. VALVES TO ALL HVU'S AND HC'S SHALL CLOSE, AND HWP-4 START TO CIRCULATE HOT WATER TO THE FFT. UNIT HEATERS.
5. ON MORNING WARMUP AND OCCUPIED MODE, HWP-4 SHALL BE OFF. HWP-1, HWP-2, AND HWP-3 SHALL START. THE HEATING BYPASS VALVES AND THE THREE-WAY VALVES IN HVU-1 AND HVU-3 SHALL STAY ON BYPASS UNTIL THE MAIN RETURN WARMS UP TO 140°F.

**CABINET HEATERS AND UNIT HEATERS:**  
TWO-WAY CONTROL VALVES TO MODULATE TO MAINTAIN ROOM SETPOINT AND CYCLE FAN OFF AND CLOSE VALVE WHEN SETPOINT IS REACHED.

FOR OFFICIAL USE ONLY		<b>RECORD DRAWING</b> DATE <u>06/08/98</u>	
DATE <u>07-01-97</u> <small>REVISED TO 4D-BILT</small>		BY <u>RAUCH</u> <small>DATE</small>	
DESIGNED BY <u>RAUCH</u>		DRAWING NO. <u>MS-6</u>	
CHECKED BY <u>RAUCH</u>		CONSTR CONTR NO. <u>MS2487-93-C-1143</u>	
APPROVED BY <u>RAUCH</u>		SCALE NO SCALE	
DATE <u>07-01-97</u>		SHEET <u>109</u> OF <u>109</u>	

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