A. TERMINAL UNITS (UH, CUH)
1.CABINET UNIT HEATER, HYDRONIC:
a.THREE-WAY CONTROL VALVE SHALL MODULATE TO MAINTAIN ROOM TEMPERATURE.
b.STRAP-ON AQUASTAT ON RETURN WATER PIPE SHALL PREVENT THE OPERATION OF THE FAN UNLESS HOT WATER OF ADEQUATE TEMPERATURE (140 DEG F) IS AVAILABLE.
2.UNIT HEATER, HYDRONIC:
a.THREE-WAY CONTROL VALVE SHALL MODULATE TO MAINTAIN ROOM TEMPERATURE.
b.STRAP-ON AQUASTAT ON RETURN WATER PIPE SHALL PREVENT THE OPERATION OF THE FAN UNLESS HOT WATER OF ADEQUATE TEMPERATURE (140 DEG F) IS AVAILABLE.

B. GENERAL EXHAUST FANS
1.TOILET ROOMS, JANITOR ROOMS, LOCKER ROOMS AND SIMILAR SPACES: EXHAUST FANS SHALL BE STARTED AND STOPPED VIA THE SAME OCCUPANCY SCHEDULE AS THE ASSOCIATED AIR HANDLING SYSTEM. EXCEPTION: EF-4,5,6 SHALL RUN CONTINUOUSLY.

C. ELECTRICAL ROOM VENTILATION (EF-2)
1. SPACES INCLUDING:
A.MAIN ELECTRICAL A138, A138A
2. WHEN SPACE TEMPERATURE EXCEEDS 80 DEGREES F, OPEN INTAKE MOTORIZED DAMPERS. WHEN ROOM TEMPERATURE EXCEEDS 85 DEGREES F, START ROOM EXHAUST FAN. WHEN ROOM TEMPERATURE DROPS BELOW 70 DEGREES, STOP EXHAUST FAN AND CLOSE INTAKE DAMPERS.
3. IF SPACE TEMPERATURE EXCEEDS 100 DEGREES, SIGNAL ALARM.

D. ELEVATOR MACHINE ROOM EXHAUST (EF-7)
1. SPACES INCLUDING:
A.MAIN ELECTRICAL 107, 207, 307.
2. WHEN ROOM TEMPERATURE EXCEEDS 85 DEGREES F, START ROOM EXHAUST FAN. WHEN ROOM TEMPERATURE DROPS BELOW 70 DEGREES, STOP EXHAUST FAN.
3. IF SPACE TEMPERATURE EXCEEDS 100 DEGREES, SIGNAL ALARM.

J1 GENERAL SEQUENCES OF OPERATION

NOT TO SCALE

COMPUTER ROOM UNIT SEQUENCE OF OPERATION

A. GENERAL:
1. UNIT SHALL BE PROVIDED WITH FACTORY MOUNTED CONTROLS WITH INTERFACE TO COMMUNICATE WITH BAS SYSTEM.
2. WITH THE H-O-A SWITCH IN THE "AUTO" POSITION, UNIT SHALL START THROUGH THE BAS SYSTEM PROVIDED THE SAFETIES HAVE BEEN SATISFIED.
3. BAS PROGRAMMING SHALL DEFINE OCCUPIED AND UNOCCUPIED SCHEDULING.
4. PROVIDE REMOTE START/STOP.

B. SUPPLY FAN CONTROL: THE UNIT SUPPLY FAN SPEED SHALL RUN AT A CONSTANT SPEED.

C. DISCHARGE AIR TEMPERATURE CONTROL:
1. WHEN SUPPLY AIR TEMPERATURE RISES ABOVE THE 55 DEG F SET POINT (ADJ.), THE CHILLER SHALL ENABLE TO MAINTAIN TEMPERATURE AT ITS SET POINT.

D. DEHUMIDIFICATION: THE CHILLED WATER COOL VALVE SHALL MODULATE TO MAINTAIN A RETURN DUCT RELATIVE HUMIDITY SET POINT OF 60% RH (ADJ.). IN THE DEHUMIDIFICATION MODE THE HOT GAS REHEAT COIL SHALL ENABLE TO MAINTAIN THE SPACE TEMPERATURE AT ITS SETPOINT.

E. HUMIDIFICATION: UNIT HUMIDIFIER SHALL MODULATE TO MAINTAIN A RETURN DUCT RELATIVE HUMIDITY SET POINT OF 35% RH (ADJ.).
1. THE HUMIDIFIER SHALL BE ENABLED BY THE DUCT MOUNTED AIRFLOW PROVING SWITCH.
2. THE HUMIDIFIER SHALL BE DISABLED ABOVE A HIGH HUMIDITY ALARM SET POINT OF 70 % RH (ADJ.).

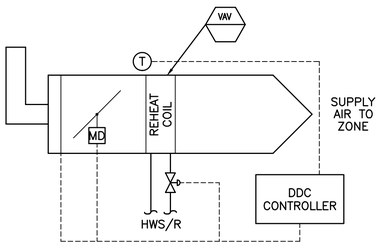
F. SAFETY DEVICES:
1. FREEZE STAT SERPENTINED ACROSS THE HEATING COIL FACE SHALL STOP UNIT FANS, CLOSES DAMPERS AND SETS ALARM AT A TEMPERATURE BELOW 38 DEG F (ADJ.).
2. FAN FAILURE ALARM.
3. ROOM HIGH TEMPERATURE ALARM.
4. HIGH AND LOW HUMIDITY ALARM.
5. CONDENSATE PAN OVERFLOW FLOAT SWITCH.

J8 COMPUTER ROOM COOLING

NOT TO SCALE

NOTE:

1. SEE SHEET M-001 FOR LEGEND AND ABBREVIATIONS.

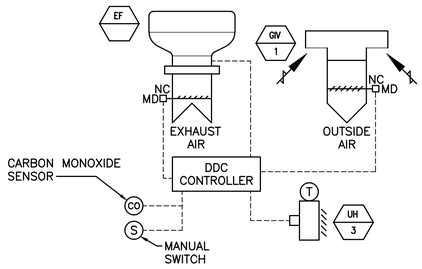


VARIABLE AIR VOLUME BOX SEQUENCE OF OPERATION

1. OFFICE SPACE VAV CONTROL: DUAL TEMPERATURE THERMOSTAT SET AT 75'F (ADJUSTABLE) MAINTAINS CONSTANT SPACE TEMPERATURE BY MODULATING THE VARIABLE AIR VOLUME DAMPER OPERATOR. ON A RISE OF TEMPERATURE ABOVE THE COOLING SET POINT (75'F ADJUSTABLE), THE VAV TERMINAL UNIT SHALL MODULATE TO ITS MAXIMUM CFM. AS THE TEMPERATURE DROPS BELOW THE COOLING SET POINT, THE TERMINAL UNIT SHALL MODULATE TO ITS MINIMUM CFM. AS THE SPACE TEMPERATURE CONTINUES TO FALL TO THE HEATING SET POINT (70'F ADJUSTABLE), THE PROPORTIONAL HOT WATER VALVE SHALL MODULATE OPEN.
2. PROVIDE NIGHT SETBACK AND MORNING WARM-UP AS REQUIRED BY THE ASSOCIATED SYSTEM.
3. CONFERENCE ROOM VAV CONTROL: SEQUENCE FOR HEATING, COOLING AND SETBACK SHALL BE AS DESCRIBED ABOVE FOR OFFICE SPACES. HOWEVER, UPON AN INCREASE IN CO2 THE VARIABLE AIR VOLUME DAMPER SHALL MODULATE OPEN TO ITS MAXIMUM CFM TO MAINTAIN CO2 BELOW 1000 PPM. IF THE CO2 CONTINUES TO INCREASE ABOVE THE 1000 PPM THEN THE OUTSIDE AIR DAMPER AT THE AIR HANDLER SHALL MODULATE OPEN TO PROVIDE MORE OUTSIDE AIR.

F1 VAV BOX SEQUENCE OF OPERATION

NOT TO SCALE



VEHICLE TRAP SEQUENCE OF OPERATION:

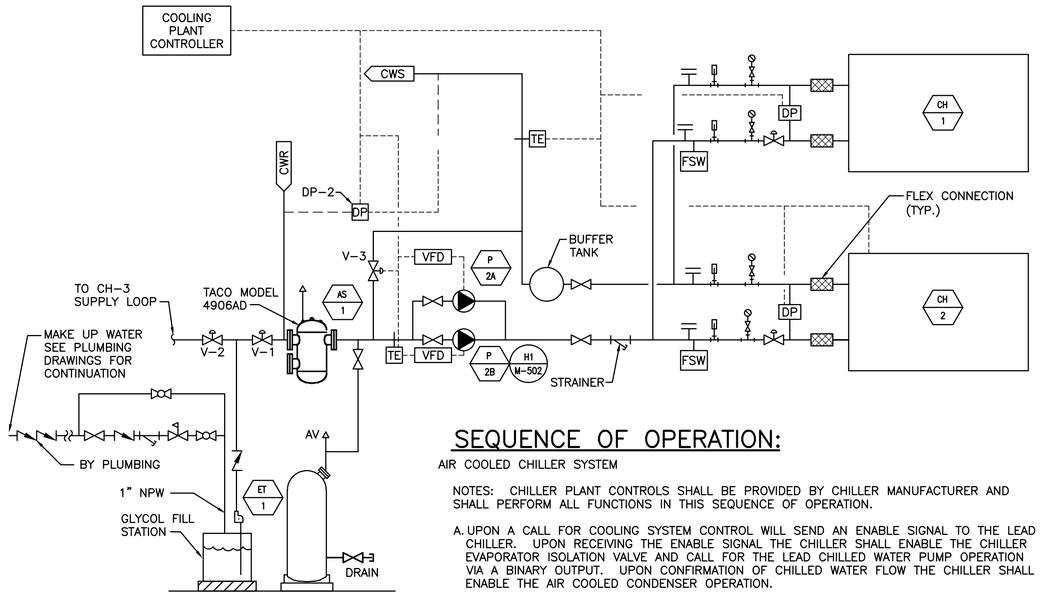
A. THE UNIT HEATER SHALL CYCLE TO MAINTAIN THE HEATING SET POINT OF 60 DEGREES F (ADJUSTABLE) UTILIZING THE CABINET UNIT HEATER/UNIT HEATER SEQUENCE OF OPERATION.

B. THE SPACE CARBON MONOXIDE (CO) LEVELS SHALL BE MONITORED AT ALL TIMES. AT SPACE CO LEVELS AT OR ABOVE 100 PPM (ADJUSTABLE), THE VENTILATION SYSTEM SHALL BE ACTIVATED AND AN ALARM SHALL FLASH ON THE GRAPHICAL INTERFACE. ALARM SHALL AUTOMATICALLY RESET WHEN CO LEVELS DROP BELOW 100 PPM. ACTIVATION OF THE VENTILATION SYSTEM SHALL OPEN THE MOTOR OPERATED DAMPER AT GRAVITY VENTILATOR GIV-B1 AND A DAMPER END SWITCH SHALL ENERGIZE EXHAUST FAN EF-B6. AT CO LEVELS BELOW 100 PPM, THE GRAVITY VENTILATOR DAMPER SHALL BE CLOSED AND THE EXHAUST FAN SHALL BE DE-ENERGIZED.

C. THE SPACE VENTILATION SYSTEM SHALL BE CAPABLE OF BEING MANUALLY ACTIVATED BY PRESSING A SECURE WALL MOUNTED SWITCH. PRESSING THE BUTTON SHALL START THE VENTILATION SEQUENCE DESCRIBED ABOVE AND SHALL REMAIN ACTIVE FOR A PERIOD OF 15 MINUTES (ADJUSTABLE).

F8 H & V SYSTEM AT THE VEHICLE TRAP CONTROL SCHEMATIC & SEQUENCE OF OPERATION

NOT TO SCALE



SEQUENCE OF OPERATION:

AIR COOLED CHILLER SYSTEM

NOTES: CHILLER PLANT CONTROLS SHALL BE PROVIDED BY CHILLER MANUFACTURER AND SHALL PERFORM ALL FUNCTIONS IN THIS SEQUENCE OF OPERATION.

A. UPON A CALL FOR COOLING SYSTEM CONTROL WILL SEND AN ENABLE SIGNAL TO THE LEAD CHILLER. UPON RECEIVING THE ENABLE SIGNAL THE CHILLER SHALL ENABLE THE CHILLER EVAPORATOR ISOLATION VALVE AND CALL FOR THE LEAD CHILLED WATER PUMP OPERATION VIA A BINARY OUTPUT. UPON CONFIRMATION OF CHILLED WATER FLOW THE CHILLER SHALL ENABLE THE AIR COOLED CONDENSER OPERATION.

B. THE SYSTEM SETPOINT SHALL BE 42 DEGREES F ADJ. BY THE OPERATOR. THE CHILLER SEQUENCING SOFTWARE SHALL CONTROL INDIVIDUAL CHILLER SETPOINTS TO MAINTAIN THE SYSTEM SUPPLY WATER TEMPERATURE AT SETPOINT.

C. WHEN THE CHILLED WATER TEMPERATURE EXCEEDS 1.5 F (OPERATOR ADJUSTABLE) ABOVE THE SETPOINT CONTINUOUSLY FOR 5 MINUTES (ADJ.) THE LAG CHILLER SHALL BE ENABLED. PRIOR TO THE START OF THE LAG CHILLER THE LEAD CHILLER SHALL UNLOAD TO 0%. FOLLOWING CONFIRMATION OF LAG CHILLER OPERATION BOTH CHILLERS SHALL BE ALLOWED TO RELOAD. LAG CHILLER SHALL START IN A SIMILAR MANNER TO THE LEAD CHILLER START SEQUENCE.

D. THE LAG CHILLER SHALL BE DISABLED WHENEVER THE LOAD ON OPERATING CHILLERS DROPS TO A LEVEL LOW ENOUGH SO THAT THE CHILLER CAN BE TURNED OFF AND THE REMAINING CHILLER CAN CARRY THE LOAD. THE LOAD ON THE OPERATING CHILLER(S) SHALL BE DETERMINED BASED ON THE MONITORED ACTUAL CURRENT DRAW (% AMPS). WHEN THE TOTAL LOAD ON OPERATING CHILLERS ARE LESS THAN 85% CONTINUOUSLY FOR 15 MINUTES THE SYSTEM SHALL DISABLE THE NEXT CHILLER IN THE SEQUENCE.

E. THE CHILLER SEQUENCING SOFTWARE SHALL NOT SHUTDOWN A CHILLER PUMP UNTIL ALL CHILLERS ARE PROVEN OFF INDICATED BY THE FLOW SWITCH.

F. UPON SENSING A LEAD CHILLER FAILURE THE CHILLER SEQUENCING SOFTWARE SHALL LOCKOUT THAT CHILLER AND IMMEDIATELY INITIATE THE START OF THE LAG CHILLER.

G. CHILLER LEAD/LAG SEQUENCING: ROTATION SHALL BE INITIATED BASED ON AN OPERATOR ENTERED DAY INTERVAL. THE METHOD OF SEQUENCE SHALL BE OPERATOR SELECTABLE. CHILLERS MAY BE FORCED INTO A NEW ROTATION SEQUENCE BY CYCLING CHILLERS AT THE TIME OF INITIATION. ALTERNATIVELY CHILLER CYCLING CAUSED BY NORMAL SYSTEM LOAD FLUCUATIONS SHALL CAUSE THE CHILLERS TO CHANGE ROTATION SEQUENCE THEREFORE ELIMINATING UNNECESSARY CHILLER CYCLING.

H. THE CHILLED WATER PUMPS, P-2A/2B SHALL OPERATE SUBJECT TO DIFFERENTIAL PRESSURE SENSOR DP-2. AS THE BYPASS VALVE OR INDIVIDUAL COIL CONTROL VALVE OPENS THE PUMP SHALL BE RAMPED UP TO MAINTAIN DIFFERENTIAL PRESSURE IN THE "SECONDARY" LOOP. PROVIDE LEAD/LAG PUMP AUTOMATIC SWITCHOVER EVERY 7 --DAYS AND ALARM FOR PUMP FAILURE. PUMP SPEED SHALL NOT DROP BELOW THAT REQUIRED TO MAINTAIN MINIMUM FLOW THROUGH CHILLER(S). UPON FAILURE OF LEAD PUMP, LAG PUMP SHALL START AND ALARM SHALL NOTIFY OF PUMP FAILURE.

I. CHILLER SOFT START – THE CHILLER SEQUENCING SOFTWARE WILL PROVIDE A USER ADJUSTABLE LOADING TIME AT SYSTEM START-UP. THIS PREVENTS THE UNNECESSARY OPERATION OF CHILLERS AND LIMITS SYSTEM ELECTRICAL DEMAND DURING CHILLED WATER LOOP PULLDOWN.

J. CHILLER MINIMUM FLOW BY-PASS VALVE CONTROL

1. THE CHILLER MINIMUM FLOW BY-PASS LINE AND VALVE SHALL BE SIZED TO ALLOW FOR THE MANUFACTURER'S RECOMMENDED MINIMUM FLOW, WITH ALL LOAD CONTROL VALVES CLOSED, FOR THE LARGEST CHILLER IN THE SYSTEM.

2. THE "CHILLER MINIMUM FLOW BY-PASS VALVE" SHALL BE A NORMALLY OPEN VALVE.

3. THE "CHILLER MINIMUM FLOW BY-PASS VALVE" SHALL BE MODULATED TO THE FULLY OPEN POSITION WHEN THE SYSTEM IS SHUTDOWN. THIS SHALL BE DONE TO PREVENT WATER HAMMER WHEN A PUMP IS STARTED [AND TO ALLOW FOR MINIMUM FLOW IN THE EVENT THE CHILLER CALLS FOR PUMP OPERATION].

4. FOLLOWING THE CONFIRMED START OF THE LEAD CHILLER AND WHENEVER SYSTEM IS ENABLED CHILLER SEQUENCING SYSTEM SHALL MODULATE THE "CHILLER MINIMUM FLOW BY-PASS VALVE" SUCH THAT THE CHILLED WATER FLOW THROUGH ANY OPERATING CHILLER(S) SHALL NOT DROP BELOW THE MANUFACTURERS RECOMMENDED MINIMUM FLOW.

5. THE CHILLER MINIMUM FLOW SHALL BE DETERMINED BASED ON THE PRESSURE DROP ACROSS THE CHILLER EVAPORATOR BARREL USING A HIGH ACCURACY PRESSURE DIFFERENTIAL SENSOR (1% OF THE PRESSURE RANGE). THE DIFFERENTIAL PRESSURE SETPOINT SHALL BE DETERMINED BASED ON THE MANUFACTURERS CHILLER PRESSURE DROP RATING CURVES.

K. MONITORING POINTS AND ALARMS

1. SYSTEM WATER SUPPLY AND RETURN TEMPERATURE
2. AMBIENT REFRIGERANT TEMPERATURE
3. SYSTEM CHILLED WATER FLOW
4. SYSTEM CHILLER ENABLE/DISABLE
5. SYSTEM PUMP ON/OFF
6. CHILLED WATER SETPOINT
7. SYSTEM DEMAND SETPOINT
8. CHILLER FAILURE
9. PUMP FAILURE
10. HIGH TEMPERATURE WATER
11. LOW TEMPERATURE WATER
12. FLOW NOT PROVED
13. HIGH PRESSURE ALARM
14. LOW PRESSURE ALARM
15. LOW GLYCOL FILL LEVEL ALARM
16. GLYCOL PUMP FAILURE.

L. GLYCOL FILL SEQUENCE

1. UPON LOSS OF SYSTEM PRESSURE FOR BUILDING CHILLED WATER LOOP CONTROL VALVE V-1 SHALL OPEN UNTIL SYSTEM IS RECHARGED TO OPERATING PRESSURE.
2. UPON LOSS OF SYSTEM PRESSURE FOR SERVER ROOM CHILLED WATER LOOP CONTROL VALVE V-2 SHALL OPEN UNTIL SYSTEM IS RECHARGED TO OPERATING PRESSURE.
3. WHEN BOTH SYSTEM PRESSURES ARE AT OPERATING PRESSURE CONTROL VALVES V-1 AND V-2 SHALL BE CLOSED.

A1 COOLING SYSTEM SCHEMATIC

NOT TO SCALE

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PROJECT TITLE:
MAINE TURNPIKE AUTHORITY
ADMINISTRATION BUILDING
PORTLAND, MAINE

CURRENT ISSUE STATUS:
ISSUED FOR BIDDING/CONSTRUCTION
7-9-07

REV	DESCRIPTION	DATE
0	BIDDING/CONSTRUCTION	7-9-07

GRAPHIC SCALE: 0" 1"

SCALE:	AS NOTED
PROJECT MANAGER:	SLB
JC/DRAWN BY:	TCM/BGG
A/E OF RECORD:	RMW
CAD FILE:	M-652-06016
PROJECT NO:	06016
DATE:	7-9-07

SHEET TITLE:
SCHEMATICS

SHEET No.
M-652