PART II - PRIMARY SYSTEMS INFORMATION

2 DIRECT DIGITAL CONTROL SYSTEM

1. Operation

e. System Flow Diagrams - Control diagrams and related information are provided as indicated below:

1) Control Sequences Page 2-2-1f3
2) Control Diagram – AHU-1 & 2 on Page 2-2-1f2.
3) Control Diagram - VAV Terminal Unit Controls on Page 2-2-1f2.
4) Control Diagram - Hot Water Heating, on Page 2-2-1f4.
5) Control Diagram - Chilled Water Control System, on Page 2-2-1f4.
6) Miscellaneous Control Diagrams, Page 2-2-1f2 through Page 2-2-1f4.

1-a. Control Sequence: The DDC system shall operate the HVAC system in the following manner:

General:

(A) When placed in operation the control system shall be energized through the DDC system subject to Hand-off-auto switches located on unit starters. Dampers shall open to their respective positions and after a variable time delay the air handling unit fan and interlocked fans shall start. The system may also be energized from the terminal unit thermostats. (See terminal unit controls hereinafter.)

(B) Whenever air handling units are stopped the control system shall be de-energized, dampers shall close, and interlocked fans shall stop.

(C) The minimum outside, return, and relief air and outside air economizer dampers shall operate as follows:

(1) During occupied periods when the outside air temperature is above 11.4 degrees C (54 degrees F). the relief air and outside air dampers shall be closed, minimum outside air and return air dampers shall be open. An air flow measuring station located in the outside air damper duct section shall measure the minimum outside air flow. The return air damper shall modulate open and the minimum outside air damper shall modulate closed to decrease the minimum outside air flow, the minimum outside air damper

shall modulate open to increase the minimum outside air flow to the minimum outside air flow requirements.

(2) During occupied periods when the outside air temperature is at or above 11.4 degrees C (54 degrees F). the system shall operate in economizer mode as follows: A mixed air sensor shall control the modulation of relief air damper, outside air economizer damper, minimum outside air damper, and return air damper to maintain 11.4 degrees C. mixed air temperature as follows: The system shall operate similarly to (1) above except economizer outdoor air damper shall modulate open, relief air damper shall modulate open and the return air damper shall modulate closed. As the outside air temperature drops below 11.4 degrees C. the reverse sequence shall occur. During economizer operation, if the preheat coil valve opens, the economizer operation shall stop and all dampers shall return to normal "occupied" positions.

(3) During night, set back the heating system shall be started by terminal unit sensors sensing the need for heat. During night, set back heating mode of operation the AHU supply fan and return fan shall run, the return air damper shall open, the minimum outside air damper, the economizer outside air damper and relief air damper shall remain closed and all other interlocked fans shall remain off. When heating requirement is satisfied, the fans shall stop and return air damper shall close.

(D) Any duct smoke detector sensing smoke shall signal the Fire Alarm Control Panel, and be hardwired to stop the respective AHU supply and return air fans. When signal is received by the AHU, the unit shall stop and any interlocked fans shall stop unless otherwise indicated. The system may only be restarted by the Fire Department or other qualified personnel from the Fire Alarm Control Panel. When an "all clear" signal is received, all detectors, etc. shall be automatically reset. After a variable time delay, AHU fan(s) and interlocked fans shall start.

(E) Interlocked Exhaust Fans:

The DDC system shall monitor the operation of all exhaust fans. The exhaust fans shall be electrically interlocked to operate only when the Air Handling System it serves is operating except exhaust fans shall be "Off" during "set back" mode. Any interlocked dampers shall be open when the fan starts and close when the fan stops.

(F) System Start Sequence Procedure: The system start sequence shall be initiated through the DDC system.

Air Handling Unit 1 & 2

When the system is in operation as here-in-before indicated the following sequence shall occur. The minimum outside airflow shall be measured through a duct mounted airflow measuring station located in the outside air duct. When the outside air temperature is at or above 21° C. the min. outside air damper (D-1) shall open, the return air and relief air dampers (D-4 & D-5) shall be closed and cooling coil control valve (V-1) shall modulate to maintain a discharge air temperature of 11.4° C. temperature and the minimum outside airflow shall be maintained. When the outside air temperature drops below 11.4 C. cooling coil control valve (V-1) shall be closed to the cooling coil and economizer, relief and return air dampers (D-3, D-4 & D-5) shall modulate in sequence to maintain the discharge air temperature of 11.4° C.. Two duct mounted static pressure sensor/controllers shall modulate the variable frequency drives mounted near the AHU, through a discriminator selector, to maintain a minimum static pressure of 250 Pa set point. The return air fan shall track the operation of the supply fan by maintaining a constant differential airflow equal to that of the minimum outside air. Supply and return airflows shall be measured by airflow measuring stations mounted in the fan inlet/s. A high static pressure sensor shall shut down both supply and return air fan drives when duct pressure rises above 1250 Pa. This controller shall be directly connected to the VFD drives and shall alarm the DDC system on high static pressure shut down.

Hot Water Pump, HWP-1, HWP-2 and Boiler

The heating control sequence shall be initiated from the DDC system as follows: when the control system is energized HWP-1 and HWP-2 pumps shall start, through hand-off-auto switches (when in auto position), and shall provide flow to the system. When hot water flow is proven through flow switches at the boiler then the boiler controls shall be energized and the boiler shall operate through its own safety and operating controls to maintain 82° C boiler water temperature. Temperature sensors located in the HWS and the HWR at the boiler shall indicate heating water temperatures at the DDC system. The boiler water temperature shall be reset as indicated on the boiler water reset schedule.

Chilled Water System:

The cooling control sequence shall be initiated from the DDC system as follows: when the outside air temperature is above 13° C. and when the control system is energized CWP-1 and CWP-2 pumps shall start, through hand-off-auto switches (when in auto position), and shall provide flow to the system. When chilled water flow is proven through flow switches at the chiller then the chiller controls shall be energized and the chiller shall operate through its own safety and operating controls to maintain 7° C. discharge water temperature. Temperature sensors located in the CWS and CWR at the

chiller shall indicate the chilled water temperatures at the DDC system. When the outside air temperature drops below 13° C. the chiller system shall be de-energized.

Air Compressor:

See General description hereinbefore for General HVAC operation. The DDC system shall monitor the pressure of the compressed air systems for the dental air compressor.

Vacuum Pumps:

See General description hereinbefore for General HVAC operation. The DDC system shall monitor the pressure of the medical vacuum system and the oral evacuation system.

Set point Schedule:

Mark	**LEAVING TEMPERATURE**
AHU-1	
Cooling coil	10.8°C lvg. air(51.44° F)
AHU-2	
Cooling coil	11.33°C lvg. air(52.4° F)

Mark	**Flow GPM**
Hot Water Pump HWP-1 & 2	10.5 m^3/hr (46.23 GPM) Each

Air Flow:

MARK	**AIR FLOW MAXIMUM**	**AIR FLOW MINIMUM**	**OUTSIDE AIR FLOW MINIMUM**
AHU-1	12385 L/s	8850 L/s	3255 L/s
AHU-2	10675 L/s	6130 L/s	2385 L/s

Filters	**Flow l/s**	**Filter Change P.D..**	**Filter Effic.**
PF-1	12385 L/s	90 Pa	30%
AF-1	12385 L/s	300 Pa	90%
PF-2	10675 L/s	90 Pa	30%
AF-2	10675 L/s	300 Pa	90%