NOTES

1. This valve is controlled to maintain a leaving water temperature of 120 degrees F on the domestic hot water side of the heat exchanger when the heat recovery system is in operation (pump 11-HP-D in operation).

2. Pump speed for heat recovery pump 11-HP-D is controlled to maintain an 18 psig pressure differential between the heat recovery secondary circuit mains (between the suction side of the pump and the inlet to control valve 11-CV-B). As 11-CV-B and/or 11-CV-C open, this differential pressure will drop and the pump speed will increase. As the valves close, the differential pressure will rise and the pump speed will decrease.

3. This valve is controlled in sequence with the steam heat exchanger control valves to maintain the desired central plant leaving water temperature. The sequencing will be accomplished in the DDC control system software. If the outdoor air temperature is above 60 degrees F, the steam valves on the back-up/trimming heat exchangers will be forced closed unless the system is placed in the back up mode via operator command. (The system would be placed in back up mode if the heat recovery circuit was not in operation for any reason such as an equipment failure or a shut down for service.) As the plant leaving water temperature drops below set point, the valve is modulated open allowing return water to be moved through the heat recovery circuit by pump 11-HP-D and heated via condenser water through plate and frame heat exchanger 11-PFHX-A (if the chilled water system is in operation) and/or via the heat rejection from the heat pump. A further drop in plant leaving water temperature below set point causes the heat exchanger steam valves to be modulated from fully closed to fully open. (See note 6 for additional details regarding the control of the heat exchanger steam valves.) As the plant leaving water temperature rises above set point, the sequence is reversed. If the central chilled water plant is in operation and the condenser water system is being used as a source of recovered heat, valve 11-CV-B is force closed any time the return water temperature to the central plant is above 90 degrees F. If the central chilled water plant is not in operation, valve 11-CV-B is forced closed any time the return water temperature to the central plant is less than the current leaving condenser water temperature set point for the heat pump.

4. The system is designed so that only two of the three system pumps installed will be required for operation under design conditions with the third pump acting as a 100% standby pump. The speed of the lead pump and the staging of the lag pump will be controlled as required to maintain the desired differential pressure set point across the mains where they leave the boiler room to go to West Wing, North Wing, and East Wing. The set point of this control loop will be reset as required to maintain differential pressures at remote points in the system via the DDC system. As the differential pressure drops, the speed of the lead pump will be increased from minimum to maximum. A further drop in differential pressure will cause the lag pump to be cycled on. A rise in differential pressure above set point will reverse the sequence. If the DDC system detects a failure of either the lead pump or the lag pump, it will sound an alarm an automatically start the back up pump and operate it as the new lead pump.

5. In the renovated system, the heat pump can operate in two different modes. If electric rates are favorable during the winter, it will be operated in the heat recovery mode. In this mode, it will load and unload as required to maintain a leaving condenser water temperature of 140 degrees F. This water will then be used to heat domestic hot water via heat exchanger 11-PFHX-B and/or as a source of heat for the central heating hot water system. Its primary function in this mode is the production of hot water and chilled water is a by-product. The unit will also be capable of operating in a chilled water mode. In this mode, its primary function is the production of chilled water. When operated in this mode, heat is rejected to preheat domestic hot water to 85degrees F and is also rejected to the central heating hot water system. If neither of these systems need heat, then heat is stored in the flywheel tanks and finally rejected to the condenser water system via heat exchanger 11-PFHX-A. The DDC control system will place the heat pump in this mode of operation to use it as an emergency back-up chiller and/or as a peaking chiller if necessary in the summer months. Otherwise the heat pump will not normally operate during the summer. When operating in this mode, the condensing temperature is lowered from 140 degrees F to improve the machine efficiency thereby making it capable of producing more tons of refrigeration than it could with 140 degree F condenser water temperatures.

6. These heat exchangers can see very large load fluctuations (i.e. they have large turn down ratios). The load on them will be at a minimum when they are trimming up the plant leaving water temperature from what is available leaving the heat recovery system to what is required leaving the central plant. The load on them will be at a maximum when the heat recovery system is not in operation due to maintenance requirements and/or equipment failures. For this reason, the heat exchangers are equipped with two steam valves and a special control sequence as follows to allow them to achieve stable operation under all load conditions. One valve is sized for 30% of the heat exchanger capacity and the second valve is sized for 70% of the heat exchanger capacity. At low load conditions, the smaller valve is modulated as a function of the load condition and the large valve is forced closed. If the small valve is fully open for a given period of time and still can not maintain the desired leaving water temperature, then the control system switches to a different sequence in which the large valve is modulated first in sequence with the small valve. If the large valve can maintain the desired set point for a given period of time with the output to the valve at 20% of maximum or less, then the large valve is closed and the small valve is modulated alone as required to maintain the desired central plant leaving water temperature.

7. Close the bypass balance valve and then crack it open on all loads equipped with 3 way valves to convert them to two way operation.

8. Heat exchanger 11-PFHX-A performs two functions. If the central chilled water plant is in operation, it allows heat to be recovered from the condenser water system for use in the central heating water system when water is pumped through it by heat recovery pump 11-HP-D. In this mode, flow would be from the side of the heat exchanger connected to the discharge of 11-HP-D to the side of the heat exchanger connected to control valves 11-CV-B and 11-CV-C. If the heat pump is placed in operation in the chilled water mode, and the heat it is rejecting is not required by the central heating hot water system, flow will reverse through 11-PFHX-A and it will reject heat to the condenser water system. During the winter months when the central chilled water plant is not in operation, the heat exchanger performs no heat transfer because the pump on the condenser water side will be shut down.