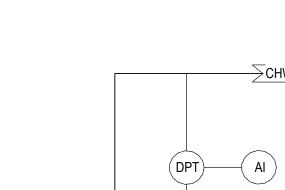


CHILLED WATER SYSTEM CONTROL DIAGRAM - TOWER A&B SCALE: NTS

SEQUENCE OF OPERATIONS

- A. SYSTEM OFF: 1. CHILLED WATER PRIMARY AND SECONDARY WATER PUMPS OFF. 2. CHILLER OFF. 3. DIFFERENTIAL PRESSURE BYPASS CONTROL VALVE OPEN.
- 4. CONTROL LOOPS INACTIVE. B. SYSTEM START:
- 1. OPERATOR ENTERED COMMAND AT THE BMS. 2. AUTOMATICALLY BY THE BMS BASED ON PREPROGRAMMED SCHEDULES (OCCUPIED MODE OR COOL-DOWN MODE), AND THERE IS A COOLING LOAD DEMAND. C. SYSTEM OPERATION
- 1. PRIMARY CHILLED WATER SYSTEM: a. BOTH PRIMARY CHILLED WATER PUMP SHALL START AND EVAPORATOR ISOLATION CONTROL VALVES SHALL OPEN. AFTER FLOW IS PROVEN THROUGH THE EVAPORATOR START THE CHILLER THROUGH ITS UNIT MOUNTED STARTER AND CONTROLLER. b. CHILLER SHALL BE CONTROLLED THROUGH UNIT MOUNTED CONTROLLER TO MAINTAIN THE SECONDARY CHILLED WATER SUPPLY TEMPERATURE.
- 2. SECONDARY CHILLED WATER SYSTEM: a. SECONDARY PUMP SPEED SHALL BE MODULATED TO MAINTAIN A PRE-DETERMINED DIFFERENTIAL PRESSURE SETPOINT. ADDITIONAL SECONDARY PUMPS SHALL START IF PRESSURE DIFFERENTIAL SETPOINT CANNOT BE MAINTAINED FOR A DEFINED TIME PERIOD OR IF THE OPERATING PUMPS ARE AT 100 PERCENT SPEED. OPERATING PUMPS SHALL BE REDUCED BY ONE PUMP IF OPERATING SPEED FALLS BELOW 40 PERCENT. FIRST PUMP STARTED SHALL BE FIRST PUMP STOPPED.
- 3. PUMPS: a. IF MULTIPLE PUMP ARE OPERATING IN PARALLEL THE LEAD PUMP SHALL BE OPERATING AT 95 PERCENT OF FULL FLOWRATE WHEN THE SECOND STAGE PUMP IS STARTED. BOTH PUMPS SHALL THEN SHARE THE LOAD EQUALLY. b. LEAD PUMP SHALL BE STARTED WHENEVER THE CHILLED WATER SYSTEM IS IN OPERATION. ALTERNATE LEAD PUMPS. c. IF THE LEAD PUMP FAILS TO START, THE LAG PUMP SHALL START.
- D. SYSTEM STOP: 1. OPERATOR COMMAND AT THE BMS OR AUTOMATICALLY BY THE BMS BASED ON PREPROGRAMMED SCHEDULES. 2. WHEN THE SYSTEM IS CALLED TO STOP, THE SYSTEM SHALL REVERT TO THAT "OFF" STATE AS DESCRIBED ABOVE. E. SAFETIES: 1. PUMP OR CHILLER FAILS TO START.
- 2. LOW OR NO FLOW IN OPERATING CHILLER. 3. MINIMUM FLOW METER IS INACTIVE OR OUT OF RANGE.
- 4. CHILLER ALARM. 5. PUMP VARIABLE FREQUENCY DRIVE ALARM.



- TO DDC SYSTEM VIA

BACNET INTERFACE

 \prec CHWR<

PUMP

DO

(SS)

 \bigcirc

PUMP

____ ~___

SEQUENCE OF OPERATIONS

- A. SYSTEM OFF: 1. CHILLED WATER PRIMARY AND SECONDARY WATER PUMPS OFF. 2. CHILLERS OFF. 3. CHILLER EVAPORATOR AUTOMATIC ISOLATION VALVES CLOSED. 4. DIFFERENTIAL PRESSURE BYPASS CONTROL VALVE OPEN.
- 5. CONTROL LOOPS INACTIVE. B. SYSTEM START:
- 1. OPERATOR ENTERED COMMAND AT THE BMS. 2. AUTOMATICALLY BY THE BMS BASED ON PREPROGRAMMED SCHEDULES (OCCUPIED MODE OR COOL-DOWN MODE), AND THERE IS A COOLING LOAD DEMAND. C. SYSTEM OPERATION
- 1. PRIMARY CHILLED WATER SYSTEM: a. BOTH PRIMARY CHILLED WATER PUMP SHALL START AND EVAPORATOR ISOLATION CONTROL VALVES SHALL OPEN. AFTER FLOW IS PROVEN THROUGH THE EVAPORATOR START THE CHILLER THROUGH ITS UNIT MOUNTED STARTER AND CONTROLLER.
- SUPPLY TEMPERATURE. c. THE LEAD CHILLER IS MORE THAN 95 PERCENT LOAD AND CHILLED WATER SUPPLY TEMPERATURE SETPOINT CANNOT BE MAINTAINED, THE NEXT CHILLER IN THE GROUP SHALL START AND THE CHILLERS SHALL SHARE LOAD EQUALLY. CONTINUE TO ADD CHILLER CAPACITY AS REQUIRED TO SATISFY REQUIREMENTS ABOVE.
- CHILLED WATER PUMP AND THE OPERATING CHILLERS ARE LOADED LESS THAN THE CAPACITY REQUIREMENTS OF ALL OPERATING CHILLERS AND THE CHILLED WATER SUPPLY TEMPERATURE IS BELOW SETPOINT, THE SMALLEST CHILLER SHALL STOP. CONTINUE TO DELETE CHILLER CAPACITY AS REQUIRED. 2. SECONDARY CHILLED WATER SYSTEM:
- a. SECONDARY PUMP SPEED SHALL BE MODULATED TO MAINTAIN A PRE-DETERMINED DIFFERENTIAL PRESSURE SETPOINT. ADDITIONAL SECONDARY PUMPS SHALL START IF PRESSURE DIFFERENTIAL SETPOINT CANNOT BE MAINTAINED FOR A DEFINED TIME PERIOD OR IF THE OPERATING PUMPS ARE AT 100 PERCENT SPEED. OPERATING PUMPS SHALL BE REDUCED BY ONE PUMP IF OPERATING SPEED FALLS BELOW 40 PERCENT. FIRST PUMP STARTED SHALL BE FIRST PUMP STOPPED. b. BYPASS VALVE SHALL BE MODULATED OPEN TO MAINTAIN THE MINIMUM FLOWRATE MEASURED BY THE FLOW METER. 3. PUMPS:
- a. IF MULTIPLE PUMP ARE OPERATING IN PARALLEL THE LEAD PUMP SHALL BE OPERATING AT 95 PERCENT OF FULL FLOWRATE WHEN THE SECOND STAGE PUMP IS STARTED. BOTH PUMPS SHALL THEN SHARE THE LOAD EQUALLY. b. LEAD PUMP SHALL BE STARTED WHENEVER THE CHILLED WATER SYSTEM IS IN OPERATION. ALTERNATE LEAD PUMPS. c. IF THE LEAD PUMP FAILS TO START, THE LAG PUMP SHALL START. D. SYSTEM STOP:
- 1. OPERATOR COMMAND AT THE BMS OR AUTOMATICALLY BY THE BMS BASED ON PREPROGRAMMED SCHEDULES. 2. WHEN THE SYSTEM IS CALLED TO STOP, THE SYSTEM SHALL REVERT TO THAT "OFF" STATE AS DESCRIBED ABOVE. E. SAFETIES: 1. PUMP OR CHILLER FAILS TO START.
- 2. LOW OR NO FLOW IN OPERATING CHILLER. 3. MINIMUM FLOW METER IS INACTIVE OR OUT OF RANGE.
- 4. CHILLER ALARM. 5. PUMP VARIABLE FREQUENCY DRIVE ALARM.

b. BYPASS VALVE SHALL BE MODULATED OPEN TO MAINTAIN THE MINIMUM FLOWRATE MEASURED BY THE FLOW METER.

b. CHILLER SHALL BE CONTROLLED THROUGH UNIT MOUNTED CONTROLLER TO MAINTAIN THE SECONDARY CHILLED WATER d. ON A REDUCTION IN LOAD AND THE BYPASS FLOW RATE IS GREATER THAN THE FLOW OF THE SMALLEST OPERATING

