



- NOTES:**
1. COOLING TOWER CT-4 IS PART OF A DEDUCTIVE ALTERNATE. IF ACCEPTED DELETE CT-4 CONTROLS INCLUDING MODULATING CONTROL VALVE, VFD, AND VIBRATION SWITCH WIRING.
 2. THE CONTROL AND MECHANICAL SUBCONTRACTORS SHALL ADJUST THE EXISTING SUMP LEVEL/MAKE UP WATER CONTROLS TO ENSURE PROPER WATER LEVEL OPERATION AT ALL MODES OF OPERATION.
 3. VFD START/STOP, ALARMS, STATUS, AND SPEED SHALL BE HARD WIRED.

SEQUENCE OF OPERATION

GENERAL
 THE LEAD COOLING TOWER AND CONDENSER WATER PUMP SHALL BE ENABLED WHENEVER THE EXISTING CHILLERS ARE ENABLED. PROVIDE A 2 MINUTE DELAY (ADJUSTABLE) AFTER COOLING TOWER AND CONDENSER WATER PUMP START PRIOR TO STARTING CHILLER(S). THE CURRENT CHILLED WATER SYSTEM ENABLE STATUS SHALL BE PROGRAMMED WITH THE CAPABILITY TO BE MANUALLY OVERRIDDEN ON OR OFF VIA THE ASSOCIATED GRAPHIC DISPLAY.

THE CHILLERS AND COOLING TOWERS OPERATE ON A LEAD/LAG, ROTATING WEEKLY, BASIS. SHOULD THE LEAD CHILLER OR COOLING TOWER FAIL, THE LAG CHILLER OR COOLING TOWER SHALL BE ENABLED AND AN ALARM SIGNAL SHALL BE INITIATED. THERE ARE 3 CHILLERS AND 4 COOLING TOWERS WITH THE THIRD CHILLER AND TWO EXISTING COOLING TOWERS INTENDED TO SERVE AS STAND-BY OR REDUNDANT EQUIPMENT WITH THE REDUNDANT CHILLER AND NEW COOLING TOWERS INCLUDED IN THE WEEKLY LEAD/LAG ROTATION. (EXISTING COOLING TOWERS SHALL REMAIN ON LAG STATUS). THE LEAD COOLING TOWER FAN VARIABLE FREQUENCY DRIVE SHALL BE MODULATED FROM 20% TO 100% OF MAXIMUM SPEED (FROM 12 TO 60 HZ) AS REQUIRED TO MAINTAIN THE CONDENSER WATER TEMPERATURE SETPOINT (APPROXIMATELY 85 DEGREES, ADJUSTABLE). WHEN THE SPEED OF THE LEAD FAN EXCEEDS 70% (ADJUSTABLE) THE SECOND COOLING TOWER FAN SHALL BE ENABLED AND BOTH FAN VFD'S SHALL BE CONTROLLED IN UNISON. WHEN THE SPEED OF TWO FANS OPERATING TOGETHER FALLS BELOW 30% (ADJUSTABLE) THE SECOND FAN SHALL BE DISABLED. WHENEVER A COOLING TOWER FAN IS ENERGIZED ITS ASSOCIATED INLET ISOLATION CONTROL VALVE SHALL OPEN AND SHALL CLOSE WHENEVER THE COOLING TOWER IS DE-ENERGIZED.

THE CONDENSER WATER PUMPS OPERATE ON A LEAD/LAG, ROTATING WEEKLY, BASIS (THIRD PUMP IS INTENDED TO OPERATE AS A STAND-BY PUMP). IN THE EVENT THAT THE LEAD PUMP FAILS, THE LAG PUMP SHALL BE ENABLED AND AN ALARM SIGNAL SHALL BE INITIATED. WHEN THE LEAD PUMP RE-STARTS, THE LAG PUMP SHALL BE DISABLED. THE LEAD PUMP VARIABLE FREQUENCY DRIVE SHALL BE MODULATED FROM 20% TO 100% OF MAXIMUM SPEED (FROM 12 TO 60 HZ) AS REQUIRED TO MAINTAIN THE CONDENSER WATER DIFFERENTIAL PRESSURE SETPOINT (APPROXIMATELY 10 PSI, ADJUSTABLE - AS DETERMINED BY THE TEST AND BALANCE CONTRACTOR). WHEN THE SPEED OF THE LEAD PUMP EXCEEDS 80% (ADJUSTABLE) THE SECOND PUMP SHALL BE ENABLED AND BOTH PUMP VFD'S SHALL BE CONTROLLED IN UNISON. WHEN THE SPEED OF TWO PUMPS OPERATING TOGETHER FALLS BELOW 40% (ADJUSTABLE) THE SECOND PUMP SHALL BE DISABLED.

WHENEVER A COOLING TOWER IS ENERGIZED ITS ASSOCIATED MOTORIZED ISOLATION VALVE SHALL MODULATE TO A PREDETERMINED POSITION TO MAINTAIN PROPER COOLING TOWER WATER FLOW BASED UPON ANY COMBINATION OF TOWERS/PUMPS/CHILLERS IN OPERATION. POSITION TO BE DETERMINED BY THE BALANCING CONTRACTOR.

CHILLER MODE
 THE COOLING TOWER FAN VFD SHALL BE MODULATED (WHEN THE ASSOCIATED CONDENSER WATER PUMP IS ENABLED) FROM 20% TO 100% OF MAXIMUM SPEED (FROM 12 TO 60 HZ) AS REQUIRED TO MAINTAIN THE CONDENSER WATER SUPPLY TEMPERATURE SETPOINT (85°F, ADJUSTABLE - WITH A 12" RANGE; FAN ON AT 89°F; FAN OFF AT 77°F). WHEN BOTH COOLING TOWERS ARE ENABLED (SEE LAG COOLING TOWER ENABLE CONTROL SEQUENCE) THE COOLING TOWER FAN VFD'S ARE CONTROLLED IN UNISON.

AN ALARM CONDITION SHALL BE INDICATED UPON FAILURE OF ANY COOLING TOWER.

COOLING TOWER SAFETIES AND FREEZE PROTECTION
 THE COOLING TOWER FAN SHALL BE DISABLED AND AN ALARM CONDITION SHALL BE INDICATED WHENEVER THE ASSOCIATED VIBRATION SWITCH SENSES EXCESS VIBRATION.

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