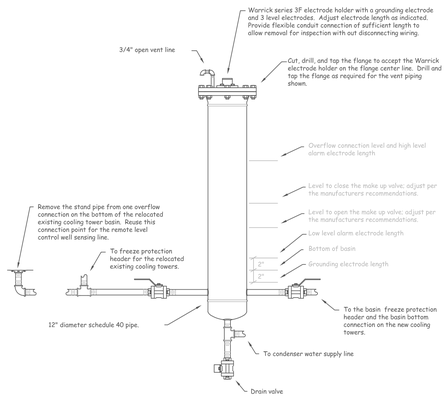
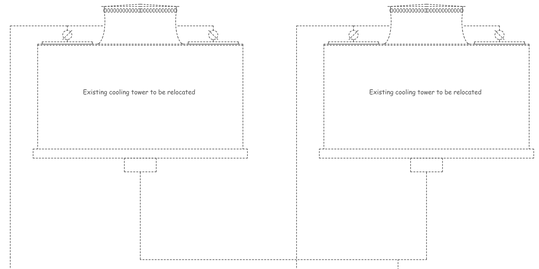


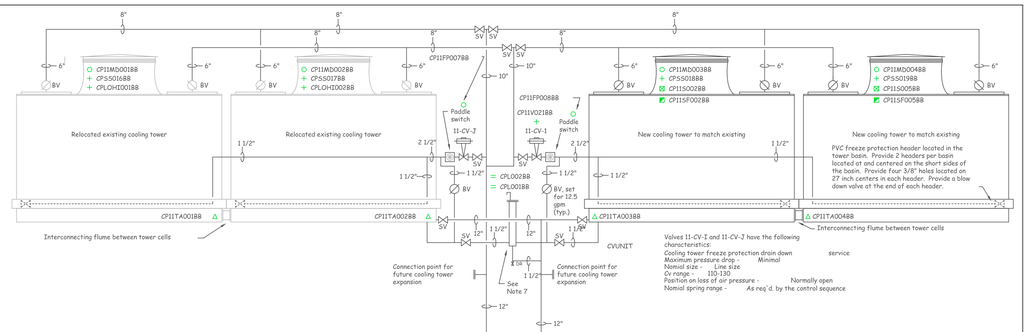
COOLING TOWER LEVEL CONTROL WELL DETAIL

NO SCALE



Design data for each cooling tower cell is as follows:

Cell flow rate (gpm) -	1770
Cell entering water temperature (deg. F) -	96.5
Cell leaving water temperature (deg. F) -	86.5
Design wet bulb temperature (deg. F) -	78.0
Cell fan diameter (ft.) -	7.0
Cell fan flow rate (cfm) -	83,170
Cell fan speed (rpm) -	426
Cell fan blades -	6
Cell motor horse power -	15
Cell motor speed (rpm) -	1750
Cell motor volts/phase -	460/3



NOTES:

1. The balance valves are to be adjusted to that with the largest condenser water pump in operation, the pump head is just enough to begin to lift water over the tower with the bypass valve fully open; i.e. all of the flow is through the bypass. Proceed as follows:

   a. Place the largest condenser water pump on the system in operation.

   b. Open the bypass valve fully.

   c. Gradually close the two balance valves until water just begins to flow over the tower.

   Note that there are two balance valves simply because they were already there from the previous system configuration. It may be possible to totally close one valve and make all adjustments with the remaining valve. If not, then both valves should be adjusted an equal amount.

2. Cut new steel tees with service valves into the existing piping as indicated during the first available cold weather. This will allow the existing system to be refilled and returned to service as required while the new system and new tower cells are installed on the Nursing Wing roof. When the new system is ready for operation, valve out the existing tower cells and valve in the new tower cells. Operate the existing chiller plant off of the new towers while the existing towers are moved. Cap the valves in the boiler room where the existing piping connected to the existing towers for use as the connection point for the future chiller that will be added if the medical office building is built to the East of the hospital. This valving arrangement also allows the fiberglass piping system to be isolated from the steel piping system so that in the event of some sort of failure in the fiberglass system a portion of the condenser water system is still available for operation while any repairs are made.

3. Tower fans and the bypass valve are sequenced based on the entering water temperature to the chillers in the boiler room header down stream of the bypass valve connection. Due to the location of the bypass connection point in the header, the sensor(s) used for this function are selected based on which of the chillers are in operation. The set point of this loop is reset based on the average basin water temperature (at the cooling towers) to help compensate for transportation delays associated with the time it takes the tower water to flow through the basins and down to the boiler room. This time delay will be in excess of 10 minutes with just the absorption chiller in operation and will be at least 2 minutes with all chillers in the plant in operation (including the future 250 ton unit associated with the potential medical building expansion). With the two centrifugal units associated with this project in operation the delay will be something like 3 to 4 minutes. Note that if two of the basins are taken out of service and drained for cleaning, it will be necessary to somehow compensate for the sensors located in the drained basins to maintain the desired cooling tower set point. Toward this end, the software will be arranged to eliminate either the sensors in the North basins or the South basins from the calculation based on the status of a manually controlled variable. The operators should set this variable appropriately when they are draining the tower basins for service.

   As the supply temperature to the chillers in the boiler room header begins to deviate from set point, the output of the control loop begins to increase. An increasing control loop output causes the following events to occur in sequence.

   The bypass valve modulates from fully open to fully closed.

   The lead variable speed tower fan comes on and modulates from minimum speed to 50% speed.

   The lag variable speed tower fan comes on and modulates with the lead fan from minimum speed to 50% speed.

   The lead two speed tower fan cycles from off to low speed.

   The lag two speed tower fan cycles from off to low speed.

   The lead and lag variable speed tower fans modulate together from 50% speed to 100% speed.

   The lead two speed tower fan cycles from low speed to high speed.

   The lag two speed tower fan cycles from low speed to high speed.

   As the deviation from set point decreases, the sequence is reversed.

   The tower fans, bypass valve, and water treatment system are all interlocked with the operation of the chiller condenser water pumps. If none of the condenser water pumps are in operation, then the tower fans are shut down, the water treatment system is shut down, and the bypass valve is fully opened. Lead and lag tower fans are rotated based on accumulated hours of operation.

4. The freeze protection system is provided so that it is not necessary to drain the cooling towers during cold weather, thereby making the system more readily available for immediate operation when the weather turns warm and saving on water treatment costs. The system is designed to hold the basin water temperatures at 40 degrees F on with an outdoor temperature of -30 degrees F and a 15 mile per hour wind. The system is arranged to operate any time the condenser water pumps are off and the outdoor air temperature is below 40 degrees F. Under these conditions, the hot basin header drain down valves at the tower open and the circulator pump is started. The heat exchanger steam valve is controlled to maintain the tower basin temperature at 40 degrees F. Water circulates from the circulating pump, through the heat exchanger and up to the tower via the normal piping mains. The open drain down valves prevent water from circulating over the top of the tower. Instead, the water circulates through the open valves into the distribution header in the tower basin, flows through the basin, and then flows back to the inlet of the circulating pump via the normal return piping system. Blow down valves are provided at the end of the headers. By opening these valves during normal maintenance, any debris in the header can be blown out into the basin for removal.

   It is important to note that this freeze protection system is intended to keep the towers in a standby state during subfreezing weather. It is not designed or intended to provide for cooling tower operation under these conditions. Any attempt to operate the current system under these conditions will more than likely result in poor performance and severe damage to the cooling towers.

5. The system is arranged to allow two of the tower cells to be valved out while the other two cells are in operation for maintenance and service work. Blow down switches are provided at the tower hot basin header drain down valves to allow the valves to be opened while the basin is drained to flush out the freeze protection header.

6. The physical arrangement of the piping incorporates the following design features.

   Headers are sized at for minimal pressure drop at full flow.

   Distribution and collection piping to each tower is symetrically arranged so that the pressure drop from the header to each hot basin and from the sumps to the header is nearly identical.

   These features are intended to maintain uniform flow over all cells regardless of the number of pumps in operation once the system has been balanced out.

7. An level sensing well is provided to allow the tower level control system to be independent of the basins. This in turn allows either tower basin to be valved out for servicing while the other tower cells are in operation with out disrupting the operation of the level ocntrol system. See the detail for information regarding the construction of this well. During service operations, the side of the level control piping loop that is connected to the tower to be drained should be valved out.