Cooling Tower Preliminary Findings List

	Finding or Opportunity	Obvious Indicator	Associated Scenes	Savings		Non-resource Benefit					Potential low cost/no cost	Next Step	Precautions/Considerations (Generally speaking due to their open nature, condenser water systems have a number of design details that need to be considered and addressed relative to what needs to be addressed for a closed system like the chilled water system)
				Energy Savings	Other Resource Savings	Cleaner	Safer	Comfort	Productivity	Performance			
1.	A cooling tower fan is running with a dry basin on one cell while a basin on the second cell with the fan that is off has water flowing through it.	The visual of the basin's once you open up the basin covers. It is good to get in the habit of opening basin convers and access panels that allow you to assess how flow well flow is being distributed (or not)	11,12	X	X					X	X	Perform a point to point check and verify the program logic. Bottom line, something has to be causing the wrong valve to open when only one tower fan is required.	Low flow/poor flow distribution over a cooling tower can reduce tower efficiency and ruin the fill. Air short circuits through the dry fill, reducing the cooling provided where the fill is wet and could cause the fill to flutter and crack. Partail wetting of the fill can also cause scale and
2.	The tower hot basin levels are not the same, meaning the tower flow rates to the different basins are not the same, which can create problems with the tower's performance and aso degrade the fill.	Since flow out of the hot basin is a fuction of the orifice size and water depth, all things being equal and assuming the orifices are not plugged, the water level in all basins will be the same if the flow is the	12, 27, 28	X	X					X	X	Balance flows until the basin levels are equal under all operating conditions. Note that unless the tower piping is symetric or is configured with headers that have very little pressure drop at any concievable flow condition, this may not be possible.	At some point, no matter if a tower uses orifices in hot basins to distribute flow or flow nozzels, you will reach a flow rate where the distribution technology is no longer effective. At that point, you will start to have dry fill, which can cause fan power to not match expectation
3.	The cooling tower float valve is leaking and the tower basins are overflowing. Due to the nature of a tower laod profile, most float valves will operate at a very low flow much of the time, wire drawing the seat and ruining them.	Observation of the sunken float with water coming out of the make-up valve along with observation of water flowing out of the overflow and into the floor sink below the towers.	14 - 17		X					X	X	Replace the float valve at a minimum and monitor frequently for leakage. Consider upgrading to a system that uses a snap acting float or a level sensor controlling a two position valve, like a Warrick sensor controlling a Belimo ball valve.	Despite being prone to failure, float valves are used because they are cheap relative to some of the more robust options that would be more immune to failure. Taking a life-cycle cost based persective that includes th cost of undetected leakage can justify the better but more constly
4.	There is no meter in the blowdown line from the cooling tower. Adding a meter allows you to measure the water evaporated by the tower when combined with the make up meter data and may can be used for a sewer charge credit and as a ton-	Observation of the meter in the make-up line with no meter in the blowdown line.	13, 18		X						X	Contact the water utility to see if they will provide a credit on the sewer bill for water that is evaporated from the tower (the difference between the make-up meter reading and blow-down rate).	Many water treatment systems monitor both make-up and blow-down as a part of their water quality management strategy. Thus if the utility will provide a sewer credit for the evaporated water, capturing the credit may be fairly low cost/no cost.
5.	Tower fans do not have VFDs. Since towers seldom operate at full load and see huge capacity variations and since their capacity is nearly linear with air flow rate, VFDs offer an attractive energy saving strategy that will also provide more stable	Observing that the tower has starters, not variable speed drives. Trend data would likely show unsteady leaving water temprature control due to the all or nothing effect of cyling the fan vs. modulating	16, 19, 20	X						X		By nature towers have huge turn-down requirements and are ideal VFD candidates. Consider upgrading single speed starters to VFDs, which will also improve the stability of the leaving water temperature control from the tower. See also	Two speed tower fans can approach the savings potential provided by a VFD. Years ago, two speed starters and motors were much less expensive than a VFD so older towers may have two speed starters and this needs to be recognized in the context of any savings projections you
6.	The basin heaters are on with the towers active; while not a common finding, it does happen and it is a huge energy savings potential easily achieved.	Observing basin heaters and deploying data loggers because of the potential problem that they represent.	17, 24 - 26	X	X					X	X	Basin heaters and probably any heat trace on the CW piping should not be operating if the tower cell is active; if they are then it is basically unecessary simultaneous heating and cooling.	Draining a totally standby tower in the winter is probably the most cost effective freeze protection strategy. If an immediate run capability is needed, then basin heaters and heat trace operation may be needed, but should be carefully coordinated with the winter load profile.
7.	A heating hot water based basin freeze protection system may be a much moroe economical way to heat the basins	A knowledge of source vs. site energy issues and the relative cost of making a btu of heat with electricity vs. thermal energy created by burning a fuel on site.	17, 24 - 26	X						X		Run out a source energy and cost assessment for providing basin heat and heat trace on the CW piping using electricity vs. using steam or hot water from a heating system that is active during cold weather. Relocate make-up and blow-down piping	If basin heat is requried, from a source energy and cost standpoint, using hot water or steam frequently will be more cost effective. Even the first cost may not be that much more than an electric system if the panel board, wire and conduit requiremetnts for electric heat are
8.	It may be possible to open up both cells at part load and run two tower fans instead of one. This will leverage the cubic relationship between fan power and air flow in a given system and can save significant fan energy.	Flow over one tower with one fan running (Finding 1 aside). The constraint here is that at reduced flow, you still need to get good distribution over the fill, otherwise you "shoot yourself in the foot"	11, 12	X						X	X	Investigate the tower's minimum flow characteristic to determine if one chiller's flow can be split over two cells. It may be possible to modify the basin to accommodate lower flow rates using wiers or cups.	If the flow to the basin is too low, then not all of the fill will be wet. Air will short circuit through the dry fill, decreasing performance. And, for the fill were water evaporates before reaching the cold basin, scale will begin to accumulate, requiring additional cleaning and
9.	One of the tower fans has been retrofitted with a two speed starter and motor that was salvaged from a kitchen hood when it was upgraded to variable flow. This has the potential to reduce (but not elminate) the benefit of finding 5.	Close observation of the existing conditions.	16, 19 - 22	X						X	X	Include the impact of the two speed fan in your energy savings calculation for Finding 5. You may only need 1 VFD. But replacing the 2 speed starter with a VFD will improve control stability even though the 2 speed starter captures most of the	It is important to verify everything associated with the primary savings mechanism for a recommendation you are making. If you had assumed both fans had single speed starters, you would have over-stated the savings potential, espeically if the plant has a lot of high load hours.
10.	The operating team reports they need to keep the condenser water pump for the lead chiller in hand to ensure the system can start unattended. If they don't, the tower basins over-flow on shut down and the system needs a lot of manual venting	Conversation with the operating team and the position of the Hand-Off-Auto switch (HOA) on the condenser pump starter.	None	x	x					x		The lesson here is that sometimes, there is a reason something is being operated in hand and to get the system back to "Auto", you need to address the root cause of the problem, in this case, probably Findings 11 and 12.	Always ask the operating team if there is a reason that they are running something in "Hand" or, for that matter, if there is a specific reason they have "aborted" some feature of the system. Sometimes, it is just lack of understanding or forgetting to put it back in "Auto", but not always.
11.	The relative elevation of the mains in the chiller plant, the pumps in the tunnel below the towers connecting the tower location with the plant, and the cold and hot basins in the cooling tower creates inverted trops in the system. See also Finding	The inverted trops will make it challenging to fill the system because air will be trapped with the only way out being to push it through the condensers. This can a;so contribute to operating issues; see finding	30 - 34		X					X		The inverted traps are created by where the piping rises up in the central plant and then drops into the chiller and by where the piping rises at the cooling tower and the drops into the hot basins. (Continued with Finding 12).	Condenser water systems like the one in the model are "open" systems, meaning there is an air gap in them someplace. In the system in the model, the air gap is between the water level in the cold basin and the bottom of the hot basins in each tower cell. (Continued in in Finding 12).
12.	The elevation of the top of the piping in the chiller plant is above the elevation of the water level in the cold basins of the cooling tower cells. As a result, when combined with the inverted traps, the system will be challenging to fill and operate.	If the pump check valves or bypass valve leak, and/or if the operation of the bypass valve is not sequenced with a pump shut down, then basins may over-flow, which also sets up the Finding 10 and 11 problem	30 - 34		X					X		Adding automatic air vents and auxilliary fill connections to the inverted trops and ensuring the bypass valve is closed when the pumps shut down along with making sure the bypass and pump check valves do not leak will help alleviate this issue.	When the pumps shut down, the water in the pipes above the elevation of the cold basins will tend drain to them, but the check valves and closed bypass valves will minimize the problem. But if they leak, the basins will probably overflow, wasting water and creating a start-up issue.
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