Top ten worst practices — cooling towers

A contractor's response

Eddie Park

In the April issue of HVAC&R Nation we published a feature written in conjunction with Australia's leading light on the management of *Legionella*, Clive Broadbent AM. In the article, Broadbent lists the top ten worst practices he comes across in the field when designing and installing cooling towers. The article goes on to point out the best practice guidelines which should be employed in each case.

In the interests of giving a voice to the contractors we approached Eddie Park of contracting firm James L Williams. We posed him Broadbent's top ten worst practices and found out that employing best practice with the best will and intent is not always as straight forward as one might believe.

Just for good measure, Park has a bugbear of his own pertaining to the correct setting up and commissioning of the ball float valve – something not covered in the textbooks. Look for the side box containing Park's 14 minimum steps to the correct process.

1. Return line to the tower run overhead such that long lengths are above basin level.

Often the pump starts and stops depending on load and at each shutdown the water in the elevated line drains to the tower leading to overflowing at the basin if it is unable to contain the additional water.

The contractor says:

"This is a common problem. It causes a situation that makes it impossible to set the cooling tower ball float valve correctly. Drain down must be minimised by elevating the pipe work prior to entering the cooling tower. It is always easier and cheaper to correct this on the installation drawings than later on site. This is a situation that should be eliminated and only eventuates if design, engineering, drafting, installation and commissioning have been lax in their responsibilities."

2. Two or more towers connected to a single system without a balance line connecting their basins.

Although system balance valves may be fitted to tower returns, these rarely are so precise that water returns are evenly balanced under all operating conditions. If there is a dedicated pump for each tower, the bad practice condition exists every time one pump shuts down on part load.

The contractor says:

"I have come to believe over the years that a dedicated balance line is not a choice, it is essential. It should not be used in conjunction with side stream filtration or any other pump disturbing features on the system. Again, proper design, engineering, drafting, installation and commissioning will completely eliminate this issue."

3. Over-use of motorised valves

Over-use of motorised valves for head pressure control, warm ups or simply to be able to shut down an item in a multi-tower arrangement while half the system continues, can be over-design.

The contractor says:

"It has become common place with screw chillers that low condenser water temperature can create operational issues. It has therefore become necessary for control motorised bypass valving to be introduced into a system. As long as this device is kept at low level to prevent drain down from the return line and it bypasses the tower fill by returning the water back to the tower basin, problems should not be encountered. It is also important to ensure that check valve preventing flow back is correctly located, as this is relevant to a lot of installation errors. At the end of the day, each system has to be treated on its merits and carefully evaluated."

4. Installation of a tower pump at the same height as the tower

This results in insufficient pump suction head and/or cavitation.

The contractor says:

"All centrifugal pump manufacturers advise that the suction of the condenser water pumps should be flooded by having sufficient head. The suction line pressure drop should be kept to a minimum such that the pump inlet is maintained above atmospheric pressure at design flow conditions.

The terminology of cavitation is to be avoided; aeration or vortexing at the pump inlet is my preferred description. Cavitation is the boiling of water due to reduced pressure which is beyond the capability of most centrifugal pumps at the temperatures we are discussing.

Clive nonetheless provides sound advice here."

Ball float valve setting and commissioning

The procedure for correctly setting up and commissioning the ball float valve is something that is not covered in most text books. The ball valve is adjusted to the level that represents the operating basin volume, less the amount of water due to drain back and the amount of water held in suspension during operation.

To correctly set a cooling tower ball valve, the following minimum steps are required:

1. Ensure that in the design flow through the cooling tower, both water and air is present.
2. Shut off the system.
3. Isolate the balance line by closing manual service valves.
4. Fast fill the cooling tower (if fitted), otherwise hold down the ball valve until the basin is 20 mm beneath the overflow point and then shut off ball valve.
5. Turn the system back on, including tower fan, at full capacity and mark the drop in basin water level.
6. Shut off the system.
7. Drain the basin to the level marked.
8. Open the manual shut-off valve to the ball valve and adjust the ball float valve to start making up any drop in level from this mark. (A short ball float valve arm is generally preferred for rapid makeup when the level falls beneath this mark)
9. Fast fill the cooling tower (if fitted) otherwise hold down the ball valve until the basin is 20 mm beneath the overflow point.
10. Open the balance line manual service valves.
11. Use the same procedure for each tower in turn. The same procedure can be used for individual cooling towers with the omission of balance line steps.
12. Operate all cooling towers simultaneously and check for overflow.
13. Shut system down and check for any overflow.
14. If overflow occurs, there is a system condition that requires rectifying.

5. Lengths of piping installed for future connection result in deadlegs.

The contractor says:

"It is sometimes unavoidable not to provide piping requirements for future access and also avoid an unacceptable cost blow out down the track. It therefore becomes more an issue of how to best manage this situation rather than how to eliminate it. One alternative is to provide a permanent small fixed bypass connection and ensure minimal circulation to provide chemical treatment to this part of the system."

6. Pipe headers provided with branch valves mid-length while valves at header ends are for future connection.

Again the result is deadlegs being created at the header/s.

The contractor says:

"Deadlegs are not permitted so you have to change what would have been normal practice, and comply with the installation codes."

7. A header constructed from stainless steel tubing while the general reticulation is of copper, resulting in corrosion.

The contractor says:

"Dissimilar metals always have to be carefully managed in building services installations and this is not restricted to condenser water systems."

8. Water sampling point, corrosion coupon rack and system water bleed-off (blowdown) connected at the tower basin, rather than return line.

The contractor says:

"A corrosion coupon rack or sampling point should always be located adjacent to the most expensive part of the system or system equipment that is of most value. In this way it gives a representative measurement of the water condition where it is most beneficial. Bleed-off should be facilitated where the most non-condensable concentrations are likely to be present,. E.g. At the bottom of the circulation loop."

9. Balance line at towers mounted below the level of basins.

The balance line will then act as a deadleg and may not be drainable.

The contractor says:

"This is quite true, however; there can be hydraulic issues and air locks if the balance lines are not mounted beneath the cooling towers. It can also introduce other operational issues such as drain back, which cannot be restricted in a balance line.

An automatic solenoid or drain valve will keep a balance line from being a deadleg if it is periodically opened to provide circulation for short periods of time. Isolation valves and inspection end caps are generally a maintenance requirement."

10. Chemical dosing system pipes connected underneath main pipe runs.

The contractor says:

"The location of the connection into the main pipe is done with the intent to keep the dosing system as clean as practical."

Eddie says:

"All these pointers are achievable from a contractor's point of view. It may just take some experience and an awareness of the issues that need to be overcome. Training is the key issue! Maintenance personnel, chemical treatment subcontractors and facility managers to mention a few, should all be conversant with these relevant points."

Eddie Park is the Victorian engineering manager with James L. Williams Contractors.