INTERPRETATION IC GDL 36-2021-1 OF
ASHRAE GUIDELINE 36-2021
HIGH-PERFORMANCE SEQUENCES OF OPERATION FOR HVAC SYSTEMS

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Reference: This request for interpretation refers to the requirements presented in ASHRAE Guideline 36-2021, Section 5.20.7.3, regarding Secondary Chilled Water Pumps.

Background: SI Edition, (highlighted excerpt attached):

1) 1st statement:
"Staging at slightly less than design flowrate for operating pumps yields good results for most applications".

With respect to the following clause:

If desired, the stage down flow point can be offset slightly below the stage up point to prevent cycling.

2) *2nd statement:*
Shut off the last lag pump whenever the following is true for 10 minutes:

SCHWFR > (Number of Operating Pumps -1)/Design Number N − .03

Regarding the 1st statement I'm looking forward to having the following:

Interpretation No.1: Good results means lowest energy use, most efficient. "Slightly less" is because the pumps have dedicated branches with valves, strainers, etc. The flow through this branch will cause a higher pressure drop than flow through the common system piping. In other words, if the pressure drop in the pump branch were zero, then the 0.03 value would be zero.

Question No.1: Is this interpretation correct?

Answer No.1: Yes.

Comments No.1: "Good results" in this context means that the staging point will be reasonably close to the best efficiency point for most pump selections and the pumps should not have an issue achieving the desired flowrate. The modeling that determined this equation was based on pumps selected close to its best efficiency point. See a summary in "Optimizing Design and Control of Chilled Water Plants, Part 4 Chiller and Cooling Tower Selection" ASHRAE Journal March 2012. It is also true that circuit pressure drop is reduced by introducing more flow paths through pumps, which explains the 0.03 value; if the pressure drop through the pump branch were zero, the 0.03 value would be zero.

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Interpretation No.2: Guideline 36 does not use dead bands to prevent short cycling. Instead it uses time delays for a more direct way of addressing the same issue. This informative comment suggests you could add a dead band too - it is OK to stage up when the flow is, say, 1000 gpm, then stage down when it is 900 gpm.

Question No.2: Is this interpretation correct?

Answer No.2: Yes.

Comments No.2: Some sequences use time delays, some use deadbands and some use both to minimize cycling. The G36 pump staging sequences uses only time delays by default. The informative comment suggests that the 0.03 offset can be increased to lower the stage-down point and create a staging deadband to accompany the existing time delay, thereby further reducing cycling. Deadbands vs. time delays vs. deadband and time lays combinations are the different ways to achieve similar results.

As a guideline, it provides suggested best practices to HVAC system designers. Every project is different and requires attention from the engineer of record to how they design the sequence, review the control submittals, and provide support for project testing and commissioning. Adjustments to settings and tuning will be needed for projects and the initial values recommended in the guideline may not be the final values for a specific project.

Interpretation No.3: No lag pumps can be operating when there are more than two pumps. There is a lead pump and may be multiple lag pumps. Say you have 4 pumps. At one point, the staging order may be 2, 4, 1, 3. In that case, pump 2 is the lead and the others are lag pumps.

Question No.3: Is this interpretation correct?

Answer No.3: No.

Comments No.3: There is one lead pump and the others are lag pumps, but the interpretation is incorrect to suggest that only the lead pump can be operating; all of the pumps (the lead plus any number of lag pumps) may be operating based on stage-up and stage-down logic, up to the number of pump limit entered by the designer e.g. (N-PCHWP and N-SCHWP).

Interpretation No.4: If there are two pumps (N) and we are operating 2 pumps. Then shut off one if flow is less than (2-1)/2 - 0.03 = 0.47. Same as stage up logic with one pump on:

SCHWFR > (Number of Operating Pumps / N) - 0.03

Stage up when flow is greater than 1/2 - 0.03 = 0.47.

Question No.4: Is this interpretation correct?

Answer No.4: Yes.

Comments No.4: With two pumps, the staging flow ratios SCHWFR are the same for both stage-up and stage-down, with time delays provided to prevent short-cycling. But this is only

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true for 2 pumps. If there are 3 pumps (N=3) and number of operating pumps is 2, the stage-up point is 0.64 (2/3 – 0.03 = 0.64) and the stage-down point is 0.30 (2-1)/3 – 0.03 = 0.30). The stage down threshold subtracts 1 from the number of operating pumps because it evaluates to the upper SCHWFR limit for the next lower stage.

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