By Adam Freill

HIGH PERFORMANCE

Achieving pump, and system, BEP

Richard Medairos

PRACTICING WHAT HE PREACHES

Richard Medairos recently led a team of experts in designing Taco's monument to building efficiency, the company's own Innovation & Development Center in Cranston, R.I. The LEED Gold structure is a living laboratory built to demonstrate hydronic versatility, performance and efficiency.

The best efficiency point, or simply BEP, of a pump can be an elusive target. Sure, there's a dot on the pump curve, but keeping a pump operating close to that point is a complex puzzle.

We recently spoke with Richard Medairos, a professional engineer and the senior systems engineer and trainer for Taco to chat about BEP, and how to hone in on that target.

To optimize hydronic pumping and system configurations, he explained that it is necessary to consider the operating characteristics of the building.

What's the purpose of the building? Are there laboratories, a cafeteria and/or warehouse space? Is it dormant during the evening hours, or is it alive 24-hours-a-day, perhaps the way a hospital or other similar structure might be? If it's a dynamic building, with an active and mobile population, the system needs will vary greatly.

"To ask about pumps and system components without these insights is to let the tail wag the dog," he insists.

Q&A

AF: Rich, how can you determine what a building's characteristics really are?

RM: Ask yourself, "What's the building's intended use?" Mechanically, is the design of environmental systems driven by cooling or heating needs? Does it have a migrating population? Is it owner-occupied, or a leased facility?

AF: Let's say that we're designing a hydronic system for a 100,000 sq. ft. owner-occupied office facility in Ottawa. Influencing our choice of system design and pumping strategy is the owner's interest in reducing operating costs with less emphasis on initial cost. What are your thoughts?

RM: You've just told me a lot. As a system designer, I may now have the flexibility to specify hydronic heating and cooling systems, and to apply a higher efficiency pumping solution as part of the design – with a focus on comfort and control.

AF: So let's say you're granted the opportunity to design that hydronic heating and cooling system. How do you set out to achieve optimal system performance, or BEP?

RM: I'd likely choose a primary/secondary/tertiary pumping solution for starters. I'd also choose a differential temperature or Delta T (ΔT) mode of operation for the pumps as opposed to differential pressure. The Delta T mode will allow the system to closely match the dynamic characteristics of the building. **RM:**

continued on page 52

RM: Response for the building that I have in mind – referring here to change in flow as the building calls for it – is faster and better matched to building load with a Delta T design. System flow is designed to optimally meet the two key needs: dynamic change, and load change.

AF: Are multiple pumps more efficient within a commercial system than, say, one or two pumps sized to meet the load?

RM: Multiple pumps are much more adept at responding to a need for change in flow than a few larger pumps. They're also much more capable of maintaining optimal system performance.

Let's say the building owner is looking at a choice between using two pumps, or using three pumps. The choice of three pumps may be a more expensive one on the front end, but the dividend paid by the "up-charge" would be quickly apparent in terms of comfort, control, system efficiency, the cost of operation, and perhaps also in the lifespan of system components, including the pumps.

When a pump slows down, it loses efficiency. With multiple pumps, we can choose pumps matched precisely for the load, allowing each pump to operate frequently within its maximum efficiency sweet spot. This is an advantage that translates to high

continued on page 54

energy efficiency, and best pump and system performance.

AF: Rich, let's talk about further levels of system efficiency. What can you tell us about VFDs or ECM-driven, variable speed pumps?

RM: Still new to many building owners is the emergence of "smart"or self-sensing pumps. So far, the super-high efficiency ECM pumps are limited by size, typically in the 2.5 to five horsepower range. If larger pumps are needed, pumps are matched with variable frequency drives (VFDs) to achieve ultra-high efficiency.

Let's say that, to meet the needs of that 100,000 sq. ft. office building in Ottawa we were looking at earlier, we need hot water circulation of 300 gallons per minute. Let's also assume we've determined that we can meet demand with two 7.5 hp pumps matched with VFDs; the pumps are sized to exactly meet maximum load. It's important to note that pumps operate most efficiently at maximum load – they're selected that way.

Yet, professionals in the industry know from experience that design conditions are a rarity. In this case, the two 7.5 hp pumps may be sized to meet load needs, each pumping 50 per cent of the load. Combined, they efficiently move the needed 300 gpm when ambient temperatures are -23°C, yet those conditions may be seen only three or four days a year.

As outside temperatures increase, the load decreases, and now the two pumps are operating at, say, 70 per cent of their original speed. As they do, they lose operational efficiency.

A better plan would be to meet system needs with three five-horsepower pumps, operating in ΔT mode, and attached to correspondingly smaller VFDs. Pumped system designers have all learned that there's a bit of "hydronic magic" with the use of three pumps (or more) for larger volume applications.

SHARING **THE LOAD**

Using more pumps when trying to match pump performance to the load profile of a system allows for a more efficient use of each of those pumps.

"Picture it," says Richard Medairos, senior systems engineer and trainer for Taco. "In stepped fashion, a system rather predictably moves from one-third capacity, to two-thirds, to full capacity. At one-third capacity, one pump operating in its BEP sweet spot can meet the need. Two pumps can kick in, also in their most efficient mode, as the load goes over the one-third capacity mark. And all three pumps are there for those rare design condition days."

Adding pumps adds flexibility and efficiency, so that regardless of the load being called for, the pumps can pump away while always being much closer to their most efficient operational range.

"Three pumps, each matched closely to their BEP. That's smart use of pumping horsepower and the energy needed to drive them," says Medairos.