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Northeast University Achieving Huge Energy Savings

Energy manager wants to share technology with other schools

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Tim is the campus energy manager for a major northeast public university, and he has a story to tell about his major strides to reduce campus energy usage.

Tim is responsible for energy maintenance for more than 120 buildings located on nearly 1,000 acres of campus.

"The state gave us a dictate to improve the energy usage on the campus. We were mandated to improve energy efficiency by 20 percent by the year 2020," he said. "My team coordinates energy efficiency projects and has completed approximately thirty projects in our first two years. Most of

these have been routine — low energy light, energy saving doors and windows, etc. But some have been real eye openers.

“And it is here that I can’t make this suggestion strong enough,” he continued. “Make your rep firms an integral part of your team. They have to be on top of new technology developments to remain competitive and are a great source of cutting-edge information.

Building dashboards — “I learned that a lot of building managers are still relying solely on their building automation system (BAS) to monitor their HVAC energy use,” said Tim. “But if you’re going to truly improve the efficiency of this massive user of energy, you’ll need to manage usage in real time, and that’s where a building dashboard comes in. If you’re still relying on only your BAS to monitor your HVAC, talk to your appropriate rep firm.”

Computer power savings — “Another overlooked energy savings comes from computer power management. At the advice of one of my reps, I looked into specialized ‘deep sleep’ software which enabled us to upgrade more than 1,600 computers' power software and achieve significant energy savings when computers were idle,” Tim said.

Metering: The most important solution — “Anyone involved with energy efficiency knows that the biggest user of energy in any complex is the HVAC system, and the key to saving energy in those systems is the flow metering capability,” said Tim. “Nearly all flow meters are designed for gradual failure because they come in direct contact with the fluids they are monitoring, and that means the sensors they use will accumulate particulates from the fluid.

“There are some ultrasonic meters that clamp onto the outside of pipes, but I never had any success with them,” he continued. “When I came to our campus, we had a couple of ultrasonic meters that required a lot of maintenance because they used a contact gel to connect their transducers to the exteriors of the pipes. In a hot water environment, the gel would migrate, causing a drift in the measurement.

“When I first arrived on campus, I made it known that I was looking for more reliable flow measurement than the differential flow meters that made up the majority of our metering,” he said.

“Our construction planning design group invited me to a presentation by the president of an ultrasonic flow meter manufacturer, FLEXIM Americas. Given my experience, I was skeptical, but the members of the group persuaded me to sit in. The presentation addressed all of my problems with previous ultrasonic meters, noting that they no longer used gels, having replaced them with permanent pads. It also made the point that their meter development had added the ability to accurately measure very low flows, which would contribute to better energy efficiency.”

How ultrasound measures flow — “The technique most ultrasonic flow meters use is called transit-time difference,” said Izzy Rivera, product manager for FLEXIM Americas. “It exploits the fact that the transmission speed of an ultrasonic signal depends on the flow velocity of the carrier medium — kind of like a swimmer swimming against the current. The signal moves slower against the flow than with it.

“When taking a measurement, the meter sends ultrasonic pulses through the medium, — one in the flow direction and one against it,” Rivera added. “The transducers alternate as emitters and receivers. The transit time of the signal going with the flow is shorter than the one going against. The meter measures transit-time difference and determines the average flow velocity of the medium. Since ultrasonic signals propagate in solids, the meter can be mounted directly on the pipe and measure flow non-invasively, eliminating any need to cut the pipe. Or, with the new technology, it can be isolated from an excessively hot environment and still deliver accurate data.”

A successful trial — “We decided to put one meter on our chemistry building, which had been a problem for us,” said Tim. “We agreed to a trial period on both chilled and hot water that reached up to 350°F,” he said. “The measurements were within one percent with no drift. It finally gave us accurate data on that building that we had been lacking. Given that success, we began replacing our differential flow meters with the ultrasonics.”

Temperature control — “While we had started out to measure flow, temperature was also important because some buildings are farther away from the plant, and there is cold and heat loss during transportation. Before, we could only estimate what that was,” said Tim.” The ultrasonics could also measure temperature at the building and communicate it to our dashboard.”

“What Tim said is true now,” said Rivera. “But it wasn’t true with the two ultrasonic meters he inherited when he came on board with the university. As he explained, those meters relied on a gel to make acoustic contact between the meters’ transducers and the exterior of the pipes they monitored. The heat from a hot water pipe would cause the gel to migrate from the contact area and give faulty temperature and flow measurements. The gels have a limited temperature tolerance. Also, high temperatures accelerate the aging of the transducer’s piezzo elements and reduce their operating life.

“That’s why we developed permanent contact pads for most high temperature applications up to 400°,” continued Rivera. “For higher temperatures, we developed and patented our WaveInjector transducer mounting fixture. It permits the transducers to be mounted at a safe distance from the pipe while still maintaining accurate readings. It enables a set of standard transducers to operate accurately at temperature ranges from minus 160° to 1,100°.”

“We now have a total of about 100 ultrasonic meters monitoring our HVAC flow and temperature and reporting to our dashboard/BAS system,” said Tim. “We recently added 70 new meters for domestic water, and we continue to expand building by building. Our future plans include adding more analytics on the data for more efficiency.”

Hands-on HVAC manager — “We wanted to create an HVAC metering capability that would enable us to meet or exceed our state mandates,” said Jim, university HVAC manager.

“Many people think that a building automation system gives you all the monitoring capability you need, but that just isn’t so. True, BAS have internal functions capable of generating large reports. But, they are limited in their ability to plot and trend multiple data points over a user-designed timeline. We wanted to track all of the functions of our HVAC systems in real time, especially water flow.

“That’s the great thing about the building dashboard that Tim identified,” Jim continued. “I can see everything happening throughout the HVAC system from my computer. I can monitor all of my controllers. I can click on to any building, go to any air handler and raise the supply temperature, shut the machine down, check on humidity, carbon dioxide, supply air temperature, and so on.

Flow control -- the critical measurement — Of all the parameters monitored by the new system, Jim is most concerned with water flow.

“I’d never been happy with our system balancing because it can’t be accurate without accurately measuring the flow of the water,” he said. “In the past, they’ve measured the flow by differential pressure. I’ve always said that’s not an accurate reading. I want to know how many gallons per minute are going through the system. The manufacturers’ manuals give me the designed flows and tell me at what flow I receive optimum performance from the system. And I know that because we were using differential pressure, our water flow accuracy wasn’t where we wanted it to be. I needed to know if the system was working too hard and using too much power”

Precision flow metering — “Since our favorable introduction, we now always specify the ultrasonic flow meters because their accuracy is within one percent of rate backed up with ‘wet flow’ calibration certification,” said Tim. “More important, they maintain that accuracy even at low-flow rates. While HVAC applications do not require very low flow rate capability, we find on the submetering applications that the meters capture low velocities better than any other meter we have encountered, and if the flow rates aren‘t detected, you’re giving away free energy.”

Pump control — “It’s like I finally have control over our HVAC systems,” said Jim. “Not only are the dashboard and BAS constantly monitoring the operation, I can also use the flow meter data to fine tune the system. Now I can accurately put our settings exactly where the factory recommends for optimum performance.

“But there’s more to it than that,” he continued. “Since our pumps have frequency drives, we can stop running them at full speed. Before the ultrasonic meters, we used butterfly valves and gate valves to back down flow. Now I’m able to turn every valve wide open and program the frequency drive to run at the optimum speed to control the water flow. For instance, if I have a 1,000-ton chiller that calls for 2,000 gallons in the evaporator barrel, relying on the flow meter to give me the data, I use the frequency drive to ramp up the pump until the flow meter tells me I am getting the 2,000 gallons I need, and I lock the drive on that setting. So, say out of 60 hertz available, I may need only 50 hertz to get me the flow I need, and we save power. And there’s another advantage — I don’t need to run my pump at full speed. The frequency drive brings the pump up gradually instead of starting all at once. Not only does that cut down the amperage, it also saves considerable wear and tear on the pump and motor.”

“With the real-time control the ultrasonic meters and the dashboard gives us over our HVAC systems, we have already exceeded the 20 percent efficiency increase the state mandated, and we have plenty of time to improve on that,” said Tim. “I hope that my colleagues can use what we have discovered to achieve similar success.”