Belimo Energy Valve™ Proves Air Coils are Batting a Thousand

When sports fans crave game highlights or need to check the latest stats and ranking for their favorite teams, they turn to this large sports entertainment complex. This cable channel has been providing sports news and programming for more than 30 years. What started as one cable channel three decades ago is now a multimedia giant, with several sports channels televised in more than 200 countries.

In July 2013, Belimo turned to this large sports entertainment complex when it needed to check some important stats, but these numbers had nothing to do with RBI's or yards passing. The manufacturer brought its Belimo Energy Valves to see how they would perform on a 700 acre campus.

The sprawling campus is home to several buildings with sophisticated HVAC mechanical systems. The buildings, which house the offices, radio stations, and broadcast studios, served as the perfect location to install the Belimo Energy Valve. The Energy Valve is a complete package including characterized control valve, BTU meter, and intelligent actuator with patented Delta T Manager™, on-board data storage and network integration capabilities. The Energy Valve package is easily installed and the sensor data used for the Energy Valve process logic can be also used for data acquisition purposes. The data can be used live, or stored in the actuator for later use. The data can be used to provide important and meaningful insights into the operation of a hydronic system. The Energy Valves rich data array and storage capability complements and unburdens the typical DDC system. What Belimo was able to find was a home run for their flagship valve product.

Keeping Score

According to this sports entertainment complex, its 18 building main campus is the company's "mother ship," employing close to 4,000 people. It's the job of these employees to keep this 24/7 sports channel running. The buildings on campus are also an important factor. They need the most efficient and reliable mechanical systems in order for the show to go on. That is why Belimo chose this facility to install its Energy Valves.

"We thought this facility would be a great site to show the strength of the Energy Valve in multiple ways," said Ayotunde Williams, Manager of Product Management (water products) for Belimo.

The goal of the project was to employ the Energy Valves at a building on campus and record the valve's numerous data points. Those readings would later be compared to a similar building with no relation to the campus suspected of having a less than efficient mechanical system.

"Belimo wants to show the strength of the communication you can get with the Energy Valve," said Williams. "The information transfer via BACnet and the points of data can be used to understand how well the system is performing. Overall, we can end up using the data to even predict how much money a system like this would use in operation."

So what is the Belimo Energy Valve and what is it capable of recording? The valve is a two-way pressure independent control valve capable of monitoring a variety of data points, including Delta T. Low Delta T can be a major culprit when it comes to system inefficiencies. It puts a strain on HVAC systems and could cause cooling costs to skyrocket. If air-handling are oversized, demand too much water, or foul and degrade with age, low Delta T can occur. When cooling coils are not working up to their potential, the DDC requests more chilled water but the

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extra water has limited or no cooling effect. This negatively impacts the chiller. In some cases, buildings must install additional chillers to keep up with the water demand. The Belimo Energy Valve can monitor Delta T and maintain a predefined Delta T setpoint which ensures only the necessary amount of chilled water through the system.

The Energy Valve includes temperature sensors to monitor supply and return water for energy management. The valve can also document coil performance and prove that it is working to design specifications. A static IP address can be assigned to the valve, giving building operators the ability to log onto the internet with TCP/IP communication and see exactly how the valve and system is performing. The IP address can also be assigned to a DDC network with BACnet MS/TP or BACnet IP communication. A technician can check system parameters and make changes to flow rates by simply connecting to the valve with a PC. Tablet devices can also be used to check valve readings while in the field.

“One of the strengths of this valve is that it enables transparency of the heat exchange process – we can see how the cooling load is behaving,” said Williams. “It not only gives you the numbers, but allows you to analyze this data and to understand what these values mean and what has affected these values.”

The Game Plan

Automated Building Systems Inc. (ABS), a Belimo Platinum Distributor for many years, was responsible for the installation. The building automation company operates three locations in Glastonbury, CT; Southborough, MA; and Braintree, RI. It has been providing service to southern New England for the past 25 years, and has a roster of high-profile customers, including the headquarters of this large sports complex. ABS was tapped by Belimo to install the Energy Valves, which would be used to record numerous points of data, including water temperature, water flow, and thermal power.

Bill Dauphinee, Project Manager at ABS, coordinated and contracted the individuals responsible for the installation at building no. 4. The building chosen for the project houses broadcasting studios and office spaces. It also shares the heating and cooling capabilities of a chiller plant with two other nearby structures. This chiller plant operates three chillers and has several mechanical redundancies. At the top of this main building are two penthouses storing air handlers and controls equipment. Two Energy Valves were installed in each of the penthouses so that four cooling air handling units were equipped with Energy Valves. This was done in order to impact enough of the capacity and to show the difference in the overall system. It would also help to understand the different effects of the chiller water temperature and cooling.

A total of four Energy Valves replaced older valves, which are now recording flow, temperature, power, energy, and position of the valve. Flow meters were added to measure the overall flow going into the buildings. The installation team also added meters to measure the actual current usage of the three chillers and added CFM meters to measure the velocity of air flowing across the specific air handlers. All of this was done to get the complete overview of what the Energy Valve was doing. Data from the controller was then used to validate that the Energy Valve was providing good comfort and useful data.

According to Dauphinee, the installation itself was rather simple. Based on the product and how it is designed, it can be plugged in like a regular valve. It is a single plug-and-play product with additional features that are not found on other valves. “The installation was very easy,” said Dauphinee. “The connectivity was relatively painless. And they respond and perform just as they need to.”

Not an Ordinary Player

With the system now online with the new Energy Valves, Belimo had the ability to record data over the next several months and to prove the coil efficiencies. These efficiencies were later compared to a similar building to see how this complex stacked up. The data Belimo was able to capture is not cost effectively collected today by typical products or systems.

“A typical DDC controller just sees that a room is uncomfortable and it forces the valve to open,” said Williams. “The Energy Valves can see the coil and can see the efficiency of the coil from the coil power curve it generates. A building operator can visually see the coil thermal power characteristic and use this information to set the Energy Valve logic to achieve the most efficient Delta T. The DDC doesn’t do that, it doesn’t take into account the Delta T and the characteristics of the coil – it is blind to this phenomenon.”

Williams also stated: “While the BMS typically logs data in roughly hour-long increments, the Energy Valve can record data at 30 second increments

without burdening the BMS."

"What we are doing is looking for the subsections the DDC does not normally take into account and we are finding those inefficiencies and optimizing them," he said. "So when we talk about Delta T and improving coil efficiency, a DDC controller does not see that. And that is one of the reasons why the Energy Valve works so well."

Dauphinee agrees with Williams, saying that the Belimo Energy Valve has a number of benefits, including the ability to monitor the flow through the valve. Also, it is the valve's ability to collect data that is a true asset. "I think a great advantage to using the Energy Valves will be the easily relatable analysis of the focused coil data to enhance a BMS system," he said.

Winning Numbers

For the next seven months, Dauphinee and his team at ABS collected the data from the Belimo Energy Valves that were stored in the actuator. The team then went online to access a data file that is setup through a Building Management System (BMS).

"We have connectivity to the valve actuators," said Dauphinee, "and we siphon off that information that is stored and then attach it to an e-mail that is sent off to Belimo. We can go online and get the information through the communication backbone we built at the campus." This information pulled from the Energy Valves can be compiled in the form of graphs and spreadsheets. Each week, Dauphinee collected that data and packaged it in an e-mail to Belimo. With all of the data collected, Williams and his team at Belimo were then able to prove that sports complex system was operating as it was designed to. "We have been able to show that the coil is operating in a linear direction and has not reached the saturation point," said Williams. He explained that when levels show a system has gone past the saturation point, flow will be increased without the benefit of power output. This was not happening on the campus.

More specifically, Belimo was able to find that as water flow through the coil increased, power continued to increase as well. This means that the system was running in a very efficient manner. These numbers were compared to another site in Florida suspected of not working quite as efficiently as the sports complex site.

Belimo found that the building in Florida was reacting in the opposite fashion of the sports complex building. As more and more water was introduced into the system, BTU rates were not rising. In fact, when water flow was reaching anywhere from 40 gallons per minute to 120 gallons per minute, an increase in heat transfer is not being achieved. The coil was reaching saturation at flow rates around 30% of the maximum flow rate.

"All this time the valve showed that the system was constantly wasting about 70 gallons per minute," said Williams. "Because you didn't get any increase in power you just got more flow." This type of overflow, according to Williams, has a negative event on the system.

The pump is pumping additional flow without any additional benefits. The chiller has to process this additional flow which is outside the optimum water temperature range hence a waste in power of the pump and inefficient running of the chiller. The chiller needs a certain amount of load to work efficiently."

The building is not having any of these problems and the mechanical systems are working as they should, as shown in Figure 1. Collected data from the valve shows that there is continuous increasing power as the flow increases. In Figure 2 illustrates a different building with an early saturation point as the flow increases from 50 GPM to 120 GPM the power output does not increase hence low Delta T. For Figure 1, this is good news because it means that the coil allowed heat to get transferred from the air blowing across the coil resulting in heat transfer to the water in the coil. If there is little to no temperature difference, as was found at the building in Florida, heat transfer was not taking place resulting in a building not achieving optimal comfort levels and wasting water and energy.

Staying Strong

The next step is to return to the sports complex site and monitor readings across the valve during the hotter summer months when the building will be calling for more cooling. By periodically checking on the valve, Belimo will be able to see if the building will need larger coils to deal with ongoing cooling demand. At this point in time, this is not something the sports complex site requires.

With the ability to monitor the information the valve supplies, Williams said hydronic components can be serviced as needed instead of generic periodic time intervals.

Typically today systems "leave you blind" when trying to diagnose any potential coil inefficiency and maintenance intervals.

"What the Energy Valve gives you is transparency of the heat exchange process and you see exactly how your coil is performing to know when to service your coil. You can also see trend data, and that allows you to see flow, and temperature over time, thermal power over time, and the condition of the inputs from the DDC. It can see all of these things in real time and over time you can compare and analyze the system," he said.

Besides proving that air handlers and coils are working to their design intent, and providing a timestamp on exactly when efficiencies or inefficiencies are occurring, Williams said the Belimo Energy Valve has more long-term benefits. By documenting and understanding how an existing building is operating; future building strategies can be planned.

For instance, if a campus such as the sports complex wanted to construct another similar building, it could look at the Energy Valve data to duplicate the mechanical

system, knowing that it will work to its intended design. Williams said this information can be taken even one step further. Companies like the sports complex could gather this data and create mechanical systems even better than what they currently do. “This is a good way to understand your system,” he said. “The overall analysis of your system can even allow you to potentially design another system better.”

Conclusion

For Belimo, the findings at the campus are a validation that its Energy Valve is one of the most valuable players when it comes to detecting, tracking, and optimizing mechanical system efficiencies. The valve allows engineers, contractors, and maintenance personnel to use a building management system in an effort to dig deeper when it comes to understanding their HVAC system and proving its reliability.

Facility engineers can collect data from the valve and show for a fact that Delta T readings are where they should be, that coils are sized correctly, working properly, and working efficiently. They can show that water temperatures and water flow are adequate for maintaining or achieving needed room temperatures. As flow rates rise as too should thermal power readings. There is no waste of water or energy, which results in lower utility costs. This level of understanding is what sets the Belimo Energy Valve apart from other valve products.

“Our goal was not just to show that the Energy Valve can have an in-depth understanding of your system from the information that is collected,” said Williams. “By seeing the coil characteristics, and an increase and decrease in the flow across the valve, you have a combination of data that makes the heat transfer process of the system transparent. Knowledge is power, and understanding what the system is doing is the first step to optimizing any system.”

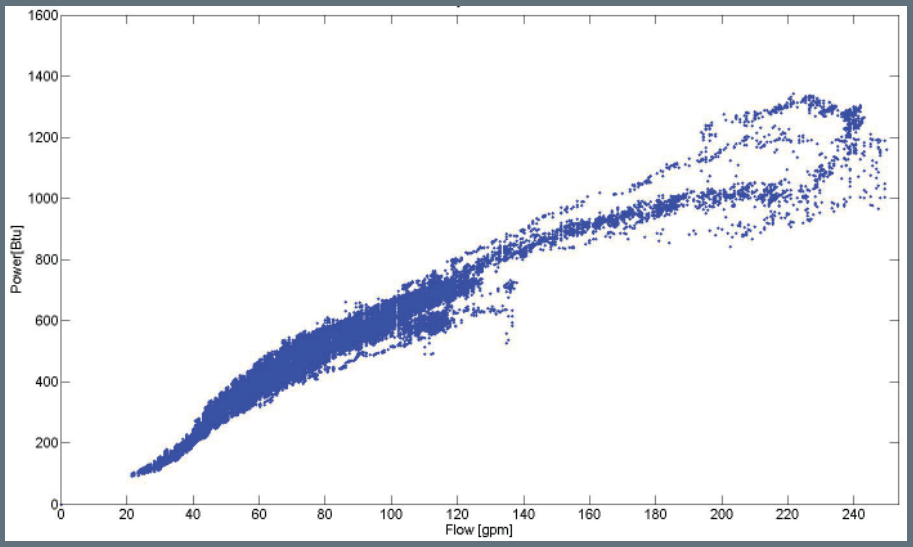

Figure 1 - Sports/Entertainment Complex - Non Saturation/No Waste

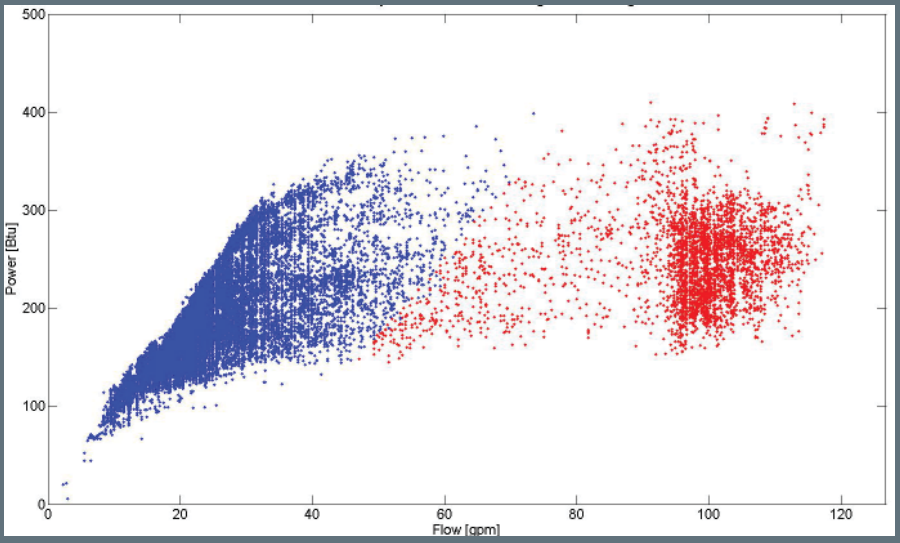

Figure 2 - Florida Site - Low Delta-T

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