Institute of Energy Professionals

Volume 11, Issue 2
Fourth Quarter 2021

Energy Issues

IEP Newsletter

WE WANT YOUR OPINION!

IEP has a big goal to update their offerings to better serve its current and future PEMs. One of those offerings under evaluation is the quarterly newsletter. If you have any comments on the newsletter, including a "video" newsletter (vs traditional), desired topics, format/frequency, or others, we would love to hear them! Please drop us a note at contactus@theiep.org.

INSIDE THIS ISSUE:

Professional Energy Manager

***IEP Contact Information*:**
4204 Whistler Ct.
Raleigh, NC 27606
USA

Phone: 1-919-545-6800

E-mail: *Contactus@theiep.org*

Website:
http://www.theiep.org

Professional Energy Manager Emeritus

By: Walter Bright, PE, PEM

IEP is pleased to announce the introduction of the Professional Energy Manager Emeritus designation. The PEM Emeritus designation has been created to serve those PEMs who have retired, but still wish to maintain a connection to IEP, the PEM certification, and energy in general. The PEM Emeritus requires no points for renewal and is a lifetime benefit – in other words it is the final renewal required. The individual may also still use the PEM descriptor in communications, such as email signatures. At a cost of only $25, which covers the cost of a new certificate custom to the PEM Emeritus designation, it is intended to be a way to thank Professional Energy Managers for their longstanding service to the energy efficiency and energy management industry.

To be eligible for a PEM Emeritus designation, the individual must have retired during their current three-year renewal period and no longer be working full-time. There is no age requirement for the designation. Upon time to renew, the individual can indicate on the renewal form that they wish to apply for a PEM Emeritus designation in lieu of a standard renewal. Payment and other procedures remain as normal.

Please note that if you:

- Are retired from one job, but are in full time employment elsewhere, or
- Are retired, but wish to enter the workforce again full-time

then you should have a current and active PEM certification. You may contact IEP to re-instate your certification as active. Volunteer activities, sporadic consulting, or other non-full-time activities (less than 30 hours per week) are permissible with a PEM Emeritus designation.

FAQ regarding the PEM Emeritus designation

Q: If I have retired from one job, but I am currently employed full-time, do I qualify for the PEM Emeritus? A: No, the goal of the PEM Emeritus is for those individuals who are no longer using their PEM to actively express their qualifications with regards to energy management. As you are actively employed in energy, a standard PEM certification is required.

Q: I am working part-time in energy, but do not consider myself retired, do I qualify for the PEM Emeritus? A: No, the PEM Emeritus is intended for retired individuals only. If you are not retired, whether employed part-time or full-time, a standard PEM certification is required.

Q: I am retired, a PEM Emeritus, and I want to continue to work within energy. Is that permissible? A: Yes, a PEM Emeritus may continue to work within energy on a part-time basis (less than 30 hours per week), but only if they have retired prior to returning to part-time employment. If you have not retired, then you should have an active PEM certification.

Any other questions regarding eligibility or use of the PEM Emeritus designation should be sent to IEP personnel. We would be happy to assist in what renewal is most appropriate for your needs.

Updated PEM Renewal Procedures

By: IEP Staff Writer

Due to COVID and other issues which have been uncovered with renewal procedures in 2020 and 2021, IEP is revising the renewal procedures, effective January 1, 2022. Late fees for 2020 and 2021 were relaxed to help with financial issues due to COVID. Enforcement of late fees will be resumed, with the following modifications.

A late fee was originally enforced immediately after the expiration of the certification, based on the date on the certificate. IEP acknowledges that there are times when processing an individual's renewal late can be an honest mistake. As such, the date for late fee enforcement is moving to three months after the expiration of the certification.

Also, there are times you move jobs or addresses and notifying us with updated contact information slips through the cracks. To address this, IEP is introducing some new internal procedures to try and track down individuals who we lose contact with. While this happens during our usual communications, such as newsletters or other emails, a special effort will be made during renewal periods.

These additional efforts come at a cost, and as such the late fee is being increased from $50 to $100. So long as the certification is renewed in a timely manner and given that a very few individuals renew after the three-month window, this will be of minimal impact to the majority of PEMs.

If you have any questions regarding these new procedures, feel free to reach out and we would be happy to assist you.

Hydronic Systems, an Energy Perspective, Part 4

By: Walter Bright, PE, PEM

In our previous newsletters, we presented a case study on the Belimo Energy Valve (Q2 2020). To fully explain what is going on, we took a step back to the basics for how hydronic systems are created, designed, and balanced (Q3 2020, Part 1). Next, we introduced the concept of automatic balancing valves (Q4 2020, Part 2), followed by the concept of non-balanced hydronic systems (Q1 2021). In Part 4, we continue to look at hydronic systems with the ultimate goal of fully explaining low delta T and how to correct it. While this article is intended to be stand alone, we'll be building on our simple CHW system created in Part 1 and expanded upon in Part 2 and 3.

Figure 1 – Belimo Energy Valve, courtesy of Belimo

To setup our discussion for Part 4, let us consider a situation we all encounter on a (semi) regular basis. It is an early morning, and we sleepily climb into our shower/tub, only to begin fiddling with the knob to find that PERFECT water temperature. There are a variety of different shower valves but let us consider the most basic one for now: a simple mixing valve with a single handle. By pulling the handle out, the water is allowed to flow to the shower head. We can then control the temperature of the water by twisting the knob towards the left to make it hotter, or to the right to make it colder. This of course works by taking some hot water and mixing it with some cold water. The more hot/less cold, the warmer the water coming out of the shower head. The reverse is also true.

With the perfect water temperature dialed in, we step in and enjoy the warm shower. However, after some period of time, our significant other/roommate will inevitably flush the toilet. When we hear it many of us, without hesitation, will immediately jump out of the way of the falling water. Why? Well, probably because the perfect water temperature all the sudden gets a little hotter than we would probably prefer. Then, once we hear the toilet finish refilling, we know the water temperature will go back to where we wanted it to be. Only for the same individual to begin washing their hands with hot water, causing our perfect water temperature to crash the other way, freezing us to death.

What is happening above is fairly intuitive. Consider the case of the flushing toilet. When the toilet flushes, the flush valve begins to fill the toilet again with cold water. This increases the cold water consumption and the increasing flow results in higher pressure drop. This decreases the pressure of the incoming cold water to our shower valve. The shower valve is a fixed orifice, just like our circuit setter in Part 1 of the series.

As such, less pressure means less flow. In fact, we could predict the drop in flow if we knew the beginning and ending pressures. Less cold water mixing with the same amount of hot water means a hotter mixture going to the shower head. A very similar thought experiment could be had for the situation of using hot water to wash their hands. In either case, we can see our shower is pressure dependent; the events elsewhere in the system impact the operation of the subsystem (aka shower).

Surely, we can develop a better solution to this and make our showers more immune to the actions of others' morning routines. A simple solution (in theory only) is upstream of the shower valve, we could install flow meters and valves in each water line and have a smart monkey watch and control them. In the morning, when we turned on the shower and found our perfect water temperature, the monkey would write down the flowrate of the hot and cold water. When our housemate begins their morning routine, and the flow drops/increases, the smart monkey can open/close the valve in each line to keep the flow to our shower valve the same. By doing this, we have isolated our shower valve from the system pressure fluctuations, making it pressure independent.

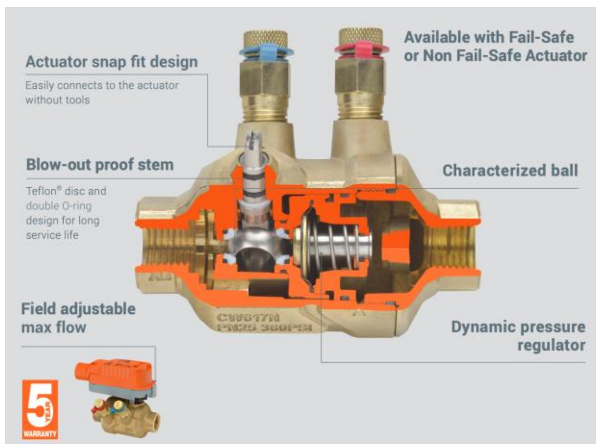

Figure 2 – Belimo Pressure Independent Control Valve, courtesy of Belimo

Of course, this is impractical. However, some very clever people have developed a solution to this in a mechanical fashion. We replace the smart monkey with a mechanical device that opens/closes to keep the flow of hot/cold water the same. There are even shower valves which can compensate if the temperature of the hot water changes. In other words, as the temperature of the hot water drops, the shower valve will begin to send more hot water and less cold to keep the mixed temperature the same. If the discussion(s) above are a foreign concept, or you have never experienced this phenomenon, it could be because you already have one of these "intelligent" valves installed.

Believe it or not, this is a perfect analogy to what happens in our hydronic systems daily. In the United States, the vast majority of existing systems are pressure dependent. As pressure fluctuates, the flow though our coils fluctuates as well. With changing flowrates, we get more/less heat transfer, and our air handler discharge temperatures will fluctuate. Just like us in the shower trying to find the perfect temperature, fiddling with the knob back and forth, our BAS will do the same with the control valves, trying to dampen the fluctuations, and keep our air handler discharge temperature constant.

Just like with the smart people who have found ways to mitigate this in our shower, there are smart people who have found how to mitigate this in our hydronic systems, by introducing pressure-independent control valves (PICVs). For now, we will let the analogy stand on its own as a reason to consider PICVs over their pressure-dependent counterparts and focus on the physics around how they operate for the remainder of the article. A deeper discussion into the benefits of PICVs will be the main focus in Part 5.

Before introducing how a pressure-independent valve works, let's look at how a standard (aka pressure-dependent) control valve works first.

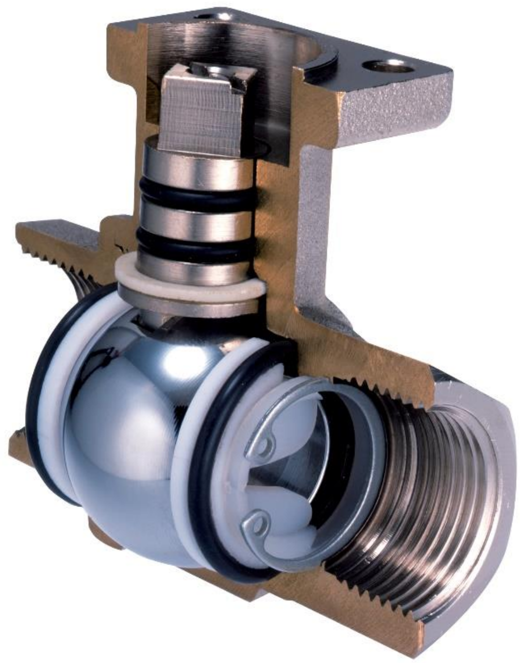

Figure 3 – Pressure-Dependent Control Valve Cutaway, courteously of Belimo

This particular control valve is a ball valve; however, all control valves generally work under the same principle. The actuator is attached to the valve stem and rotates the ball below. The ball has a hole through the center, so when parallel with the flow it allows the water to travel through unimpeded. When the valve rotates 90 degrees, the hole is perpendicular to the stream and no water can pass. Anywhere in between allows a portion of the water to pass: the more open, the more water. Consider a situation when the valve is 50% open, which allows some amount of water to pass. If we were to increase the pressure on the upstream side, this would "force" more water through the valve. Similarly, if we were to decrease pressure on the downstream side, this would "allow" more water through the valve. As such, you can see how the valve is pressure-dependent: any fluctuation in pressure will impact the amount of water passing through the valve.

There is an interesting loophole in the pressure-dependent situation. If we keep the pressure difference (not to be confused with pressure ratio) across the valve the same, the flow will remain the same. As an example, if we increase the pressure upstream of the valve by 10 psi, but also increase the pressure downstream of the valve by 10 psi, the flow does not change even though the pressure has increased. This is an important concept for pressure-independent control valves. Note that the fact the valve is 50% open is arbitrary; this is true for any valve position. However, if the valve moves, it is no longer a "fixed orifice," and the math gets much more complicated.

There are two types of pressure-independent control valves, mechanical and electro-mechanical. Both types still have an actuator which the BAS can move, opening and closing the valve. That actuator, in most cases, is electronic. As such, the classification refers to what makes the valve pressure independent. At this point, nearly all manufacturers of control valves have both pressure-dependent and pressure-independent as an option for purchase. However only a few manufacturers offer both mechanical and electro-mechanical PICV solutions; many have standardized on one or the other.

In a mechanical PICV, a standard control valve is coupled with "regulator" to keep the pressure drop across the control valve constant. This is somewhat a simplification, as most PICVs are a totally unique design which integrates many components together in one package; however, conceptually this is how they operate. The regulator, depending on the manufacturer, can be either upstream or downstream of the control valve. Below is a conceptual diagram for a situation where the regulator is in front of the control valve.

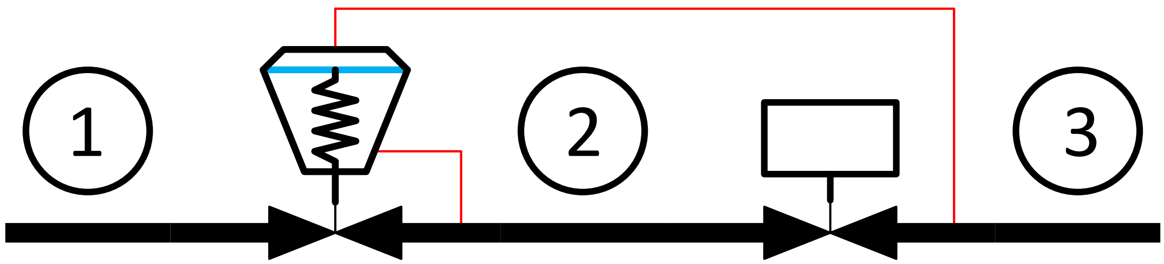

Figure 4 - PICV Conceptual Diagram

In Figure 4, water enters the regulator (Point 1) at some pressure and leaves at a lower pressure (Point 2), depending on how much the regulator is open or closed. The regulator works by a diaphragm (in blue) which has a pressure reference to Points 2 and 3 (represented by the red lines). If the pressure increases at Point 3, the diaphragm is compressed downward, which opens the regulator. Likewise, if the pressure increases at Point 2, the diaphragm is compressed upward, which closes the regulator.

After the regulator, the water enters the control valve (Point 2) and leaves (Point 3) at an even lower pressure, again, depending on how much the valve is open or closed. Just like in a pressure-dependent valve, the control valve can open and close to allow more or less water to pass through the valve, based on the command from the BAS. Also, just like in a pressure-dependent valve, if the pressure differential across the control valve (Point 2 to 3) is held constant, the valve will flow the same amount of water so long as it does not move. The advantage here is the regulator. Consider a situation where the pressure increases at Point 1. The regulator can now close, increasing the pressure drop across it, and holding the pressure at Point 2 constant. As such, the control valve flows the same amount of water, despite the increased pressure at Point 1. Consider a second situation where the pressure at Point 3 decreases. The regulator must respond by closing to reduce the pressure at Point 2 by an equal amount to keep the pressure differential across the valve constant.

The second type of PICV is the electromechanical version. In this situation, there is no mechanical regulator to keep the pressure differential across the control valve constant. Instead, a flow meter is installed to measure the flow through the valve. Now, the BAS commands the valve to a specific flowrate in lieu of position. For example, consider a PICV sized for 100 gpm. At 50%, the valve would modulate to provide 50 gpm. Depending on the pressure differential across the valve, that may or may not be positioned to 50% open. It could just as easily be 40% open when the pressure differential is high, or 60% open when the pressure differential is low. In either case, the pressure differential is not very important and in fact is not even measured. The flow meter simply tells the valve to open/close to maintain 50 gpm. As such, the BAS no longer controls the valve actuator, like it is in a mechanical PICV. A very close analogy is the way a pressure-independent variable air volume (VAV) terminal unit operates.

Both mechanical and electromechanical PICV have advantages and disadvantages, which could be discussed ad nauseum here. However, the simplest conversation to have on why there are two types is cost. On a very small valve, say ½” or ¾”, a pressure regulator is fairly cheap compared to a flow meter. As such, the mechanical PICVs will generally be cheaper than their flow meter counterparts. On the other side, for a large valve, say 4” and up, the flow meter cost is relatively independent of valve size. The regulator, however, gets exponentially more expensive due to increased material needs. As such, somewhere in the middle, there is a breakeven for which style is cheaper. Cheaper is not always better, so depending on the application mechanical or electromechanical may be better than the other and the added cost justifiable.

There is a misunderstanding in the engineering community which deserves attention. Many are of the opinion that a PICV is simply an automatic balancing valve (ABV) coupled with a standard control valve. As such, the added cost of a PICV is not justified and simply a different way of packaging two components. This is simply false. An ABV does have a similar mechanical regulator as a PICV but is only actuated at design flow conditions (100%). A PICV works across the entire flow range of the coil, from 0% to 100%. This is a very important advantage of PICVs as compared to their distant ABV cousins, and there is no way to have all the benefits of a PICV using a pressure-dependent control valve coupled with an ABV.

As you recall from Part 1, there are still several things remaining to discuss before we finally get to the ultimate goal of fully explaining low delta T and how to correct it. Remaining discussions include benefits of PICVs and why to use them, DP setpoint reset based on valve position, sensor-less pumping… The list goes on; we will get to those in future newsletters. For now, the takeaways are: 1) PICVs are advantageous because they are pressure-independent, and can help us deal with pressure fluctuations, which if not solved can result in temperature fluctuations. 2) If you have a new facility, ask your design team about their preferences between pressure-dependent and independent control valves. 3) If you are an avid pressure-dependent or pressure-independent control valve fan, reach out to us and share your opinions. A spirited debate is always a good way to learn about pitfalls of different technologies.