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Professional Energy Manager

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WE WANT YOUR OPINION!

IEP has a big goal for 2021 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.

To IAQ or not to IAQ?

By: Walter Bright, PE, PEM

In the age of COVID, facility managers, engineers and operators have been inundated with opportunities to install new equipment to keep buildings safe. To evaluate this equipment and new technology, we need to take a step back to make sure we understand indoor air quality, ventilation, its energy impacts, and what we can do to change (or not change) it.

The purpose of ventilation is to keep our buildings healthy by bringing in fresh air for occupants. Except for some unique locales, primarily large cities, we can generally assume the air outside is "cleaner" than the air inside. Therefore, if we can replace air in the building, we will generally be healthier. This helps maintain good indoor air quality (IAQ). The counterpoint is that too much outside air is expensive to heat and cool in the peak of summer/dead of winter, so there is a good balance point between the occupant health and energy. That balance point is established in ASHRAE Standard 62.1. This standard is used by engineers, code officials, and others world-wide to established standards for that balance point. Local codes can always differ from 62.1, but in general they mirror very closely.

ASHRAE 62.1 essentially gives us a table to look up the required outside air for a given population and square footage. It is easiest to explain via example: if I have a 1,000 square foot room with 10 people in an open office/cubical setting, the outside air requirement is 5 cfm/person and 0.06 cfm/sq ft (see Table 6-1 in Standard 62.1). There are additional things that need to be considered per 62.1, but for now let's focus on what the table tells us. Now it is just easy math:

(10 people) x (5 cfm/person) + (1,000 sq ft) x (0.06 cfm/sq ft) = 110 cfm
Cubic feet per minute (cfm) of outside air required for office space per ASHRAE 62.1.

As you can imagine, more outside air is required for more strenuous activities, like a gym or cafeteria.

Here is where it gets complicated. ASHRAE 62.1 acknowledges there are technologies which reduce the need for outside air because they “clean it” and put it back into the building, verses replacing it with fresh outside air. This has the potential to have massive energy impacts while keeping occupants healthy. There are many technologies and ways in which this can be done, some of which are legitimate science and some of which are snake oil.

To use these technologies, the calculations go from these basic sorts of equations, which is typically referred to as the “prescriptive” method, to complicated, iterative calculations, known as the IAQ procedure. The calculations are so complex, the author would conservatively estimate that 90% or more licensed professional engineers that do building design do not understand them, including the author himself. The vendors that sell this equipment and technologies are much more versed in them and have spreadsheets/software that do the calculations more or less automatically. Any legitimate vendor would not try and fake ASHRAE 62.1 calculations. So, if the science is valid and ASHRAE 62.1 can be satisfied, why are they not being used?

The rub is the engineer who designs the building is required to stamp the construction documents as a “licensed professional engineer.” Part of those construction documents require that the outside air requirement(s) be clearly indicated on the drawings. If somebody gets sick, there are building problems, and lawyers get involved, what is risker? Simple calculations or complex? The vendor says their calculations are correct, but the engineer is at the most risk as the “professional” who is sealing the drawings. As such, what does the engineer do – the simple version of the calculations. The industry is extremely risk averse, which to some extent, kills some potentially great technologies. Since they do not get exposure, they do not get the opportunity to be “accepted.” As such, it is hard for people to be comfortable taking the risk installing them.

Often when they do actually get installed, they are installed to improve IAQ beyond the requirements of 62.1. So, we use the same 62.1 simple calculations that make the engineer happy, and you get even better IAQ because of the additional “cleaning” the technologies provide. This comes at the cost of energy (they take additional electricity to run, and we are not reducing outside air), upfront expense and maintenance. As such, they are rarely installed. Sometimes they are provided for LEED buildings to get extra points – a different conversation. Sometimes they are installed for productivity purposes – the 3/30/300 rule1.

In the author’s opinion, the solution is for owners to advocate for systems like this if they want them. Owners hold the power to make equipment get installed and do not accept the risk – a powerful place to be. The author also believes the future is a building where the consulting engineer is not on the hook for every design problem that occurs, and the vendors and contractors have some “skin in the game” with respect to the design as well as the construction. This can be accomplished via a design-build process or other new innovative construction contract methods beginning to take hold.

Keep in mind there are technologies that help clean the air and provide benefits other than just IAQ. UV technology is a good example. UV cleans the air (lots of documentation on this) as well as keeping cooling coils clean and reducing maintenance.

When it comes to deciding whether to “IAQ or not to IAQ,” in our current environment the obvious answer is yes. The implementation of the technology choice is a key decision to make that choice a successful one.

1. https://www.us.jll.com/en/trends-and-insights/workplace/a-surprising-way-to-cut-real-estate-costs

Why Energy Management Programs Fall Short

By: Thomas D. "Dan" Mull, PE, PEM

As a consulting engineer having worked with global corporations in the facilitation of energy evaluations, I've seen program successes and failures. When failure to achieve the anticipated benefits occur the first question from management is why? While there may be extenuating circumstance in some cases, there is a common thread that runs through the failure of most energy management programs.

Organizational Focus:

While companies have always focused on their primary business, in the mid-1990s they began to realize *energy is a controllable expenditure* and should be addressed with the same vigor as their core values. When energy prices are stable it is generally considered one of the costs of doing business. However, energy becomes a major consideration when prices escalate rapidly, as we have seen in the past. In fact, the genesis of most energy management programs has historically been the result of a dramatic increase in utility costs and/or economic recession. Stable energy prices breed complacency, but a major price shock rekindles the corporate desire to re-examine energy practices and policies. Technology also plays a part. As new technologies hit the market, they garner attention. But, until they have proven reliability and their price verses savings dictates an acceptable return, technology alone is insufficient.

When organizations embark on an energy management program, one the main interests are controlling costs, i.e., energy related expenditures. This is typically achieved through increased efficiency, process modifications, and applying enhanced technologies.

Identifying Opportunities:

One of the first steps to a successful energy management program is to assess energy utilization needs, existing operational practices impacting energy consumption, and current costs. This necessitates an understanding of the energy consuming systems/processes, their requirements, the utility suppliers, and the tariffs under which a facility is billed. The expertise needed cuts across multiple disciplines and requires experienced professionals to perform the energy assessment, also commonly referred to as an analysis, evaluation, or audit.

Figure 1 – Conducting an Assessment

There is generally strong management support to assess energy utilization patterns and identify opportunities for savings. Once a site assessment is completed, a report is prepared by the consultants for a presentation to company management. The report should be based upon corporate guidance including their economic criterion, specifically the required ROI or acceptable payback timeframe for measures. Identifying opportunities and quantifying the savings and costs for the recommendations is just the beginning. Management is interested in "cashing the check", i.e., achieving the projected savings.

Management Commitment:

The level of success of any energy management program is contingent upon the commitment an organization has to turning the report findings into actionable items to achieve the projected benefits. All too often management accepts the assessment report with the expectation that the approved initiatives will be implemented in a timely manner. Unfortunately, that is not always the case.

Once the report has been accepted the real work for operations personnel begins. For each measure, initiative, or recommendation there must be accountability. Each item *must be assigned to an individual* with the authority and resources to see it through to completion. It should become part of their performance evaluation, just like other job accountabilities. In fact, accountability should be required upstream as well, such as to the site/regional manager. With senior management acceptance of the report, they have endorsed the recommendations and should be held accountable for that endorsement.

If accountability is not specified, experience has shown the actual benefits from the report recommendations will range from:

1. Measure fully implemented with projected savings achieved,
2. Measure partially implemented with limited savings achieved,
3. Measure not implemented at all.

Without personal accountability the reasons for the lack of implementation will be endless: insufficient resources, scheduling issues, lack of support from other departments, we were waiting on contractors, there were production issues that took priority, etc.

Importance of Accountability – Case Study:

Over a period of slightly more than three years an international corporation conducted approximately fifty (50) energy assessments, a sampling of their facilities across several continents. The economic guidelines mandated all report recommendations had to have a simple payback of two years or less. After completion of the last major assessment, the consultants, along with corporate personnel, were asked to follow up and report on the savings achieved from their surveys. It should be noted the consultants had no accountability or authority for implementation, only the development of recommendations and their projected costs and benefits.

With significant economic savings projected one would think implementation would have been a priority, especially for a company spending billions of dollars (US) annually in energy worldwide. However, senior management was less than pleased when it was reported only about fifty percent of the anticipated savings (two years and older) had been achieved. The obvious question was why? The nearly universal reason was lack of specific accountability. For this company, the loss of “savings” due to the lack of focus on accountability was projected to be in excess of ten million dollars (US) annually.

Admittedly, the nuts and bolts of implementing recommended measures is an additional responsibility for personnel who may already be short on time. However, this should be viewed as an opportunity to explain to operations personnel the benefits of the measures, or changes in policies, and why they are important to the organization. Optimizing performance by minimizing utility expenditures goes directly to an organization’s bottom line. The savings produced are essentially retained earnings, which improves the financial health of the organization.

The annual savings generated by report items, however, are not assured each year without appropriate attention to each recommendation. Without an understanding of the benefits of report initiatives, it is only human nature for personnel to revert to practices that “worked” and with which they were comfortable. Therefore, any deviation from the new practices should be continually reinforced.

An Implementation Aid:

There are any number of project management related tools that can assist in the implementation of report recommendations. One of the more effective tools in facilitating the process of implementing measures, especially where one may be contingent upon another, is the Gantt chart. These charts can provide a visual “roadmap” for scheduling and show the inter-relationship of items. They can also detail the specifics of accountability to make sure that everyone knows what needs to be done, when an item is to be completed, and who is responsible. Free templates are available on-line to assist in their development, including in an Excel format.

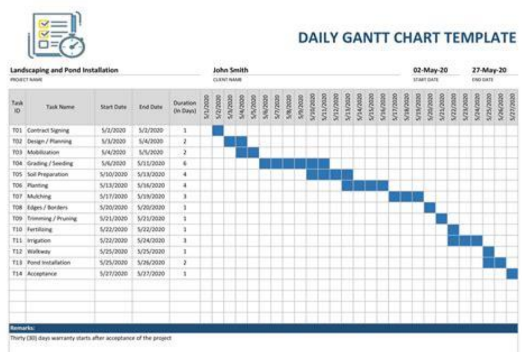

Figure 2 – Sample Gantt Chart

Financial Incentive:

For companies that have the option, an account which can accrue energy savings dollars is an ideal way to help implement future projects. The account is an incentive for energy managers and plant personnel to continually fund energy projects as they are identified, vs having to justify each of them to upper management, even though they already fall within the required ROI. This account helps prove to operators, technicians, and others that their best practices are translating to dollars that help them daily, vs just the company’s bottom line.

Summary:

There have been an untold number of energy programs since the 1970s, when the terms “energy conservation” and “energy management” first came to the forefront. The success or failure of these programs has not been on their ability to identify and quantify savings opportunities, but on the emphasis applied to their implementation. Too many assessment reports, providing meaningful and cost-effective recommendations, have been put on a shelf with the expectation of being addressed at another time. The result has been untold economic and environmental savings never achieved. To prevent this, it is key to provide top management support, assign accountability, and have a continuous eye on our energy management programs for short and long-term success.

Hydronic Systems, an Energy Perspective, Part 3

By: Walter Bright, PE, PEM

In our previous newsletters, we presented a case study on the Belimo Energy Valve (Q2 2020), took a step back to the basics for how hydronic systems are created, designed, and balanced (Q3 2020, Part 1) and introduced the concept of automatic balancing valves (Q4 2020, Part 2). In Part 3 of our series, 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.

Figure 1 – Belimo Energy Valve, courtesy of Belimo

If you ask a traditional design engineer if he prefers automatic or manual balancing valves, the answer will be highly dependent upon their experiences (good and bad) and risk tolerance. If you get an engineer that tells you neither, he belongs to a small group of individuals that believes balancing will take care of itself, and the additional complexity of balance valves, whether manual or automatic, is an unnecessary expense with minimal upside. These engineers are not wrong; there are several reasons why balancing is not required. Looking back at our examples in Part 1 and 2, we have shown how the control valve will close to satisfy the load of the coil at part-load conditions. The argument is if the control valve is closing to satisfy the load, then why do we need the balance valve as well. If we can eliminate the balance valve, then the pressure drop across it will go away as well. That results in energy savings from reduced pumping head. The benefits don't stop there, but they are generally related to ease of construction, cost, or other benefits which are not related to energy consumption.

To show this, see Figure 2. Using similar principles established in Part 1 and 2, we can see how the balance valve removed reduces the pump head requirements. The comparable Figures from Part 1 (Figure 2, circuit setters, in purple) and Part 2 (Figure 2, ABVs, in green) are shown for comparison's sake. Note: similar figures could be created for Figures 3 through 7 in Part 1, similarly to how we did for ABVs in Part 2, but no major conclusions beyond what can be discovered via Figure 2 would be drawn.

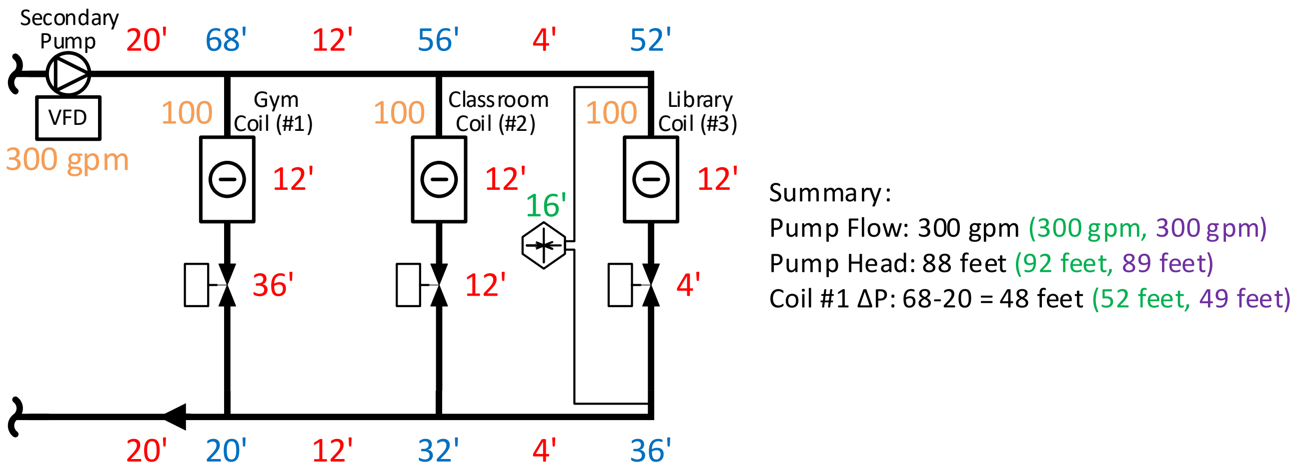

Figure 2 – Balanced CHW System without Balancing Valves (at Full Load)

The downside is you are relying upon the control valve to keep the coil from overflowing. As discussed previously (see Part 2), this has the potential of resulting in coil overflow, and you will have greater flow than desired. Some would argue this is not a major downside, as the coil can only overflow when we are close to design conditions, aka 100% load. Since we are almost always at part load, the argument is the coil does not overflow that often, and the benefits of balancing are reduced or even eliminated.

If you are now convinced that balancing is no longer needed (and wondering why the author fabricated such a verbose discussion on balancing in Part 1 and 2), the biggest downside is you must have it…depending on who you ask. ASHRAE 90.1, an extremely common standard that has been adopted in some form for nearly every energy code, requires that hydronic systems be “proportionately balanced in a manner to first minimize throttling losses.” One might could argue that the control valve accomplishes, however most design engineers are much more conservative and will require you to put in either a manual or automatic balancing valve. The compromise, in the authors opinion, is to utilize a PIC valve (PICV) in lieu of a control valve and balance valve. In addition, there are other upsides to PICVs that make them the only choice for CHW control valves…which we will try to prove in Part 4.

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 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) whether you have circuit setters or ABVs, the takeaways from Part 1 still apply. 2) If you have a new facility, ask your design team about their preferences between circuit setters, ABVs, and no balance valve systems. 3) If you are an avid circuit setter, ABV, or no balance 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.