

Understanding BAS Functions

Picture a 2.3 million square foot facility with a total HVAC system capacity of 10,500 tons to support occupancy of up to 40,000 people. Now imagine letting the HVAC system run at full load all the time, regardless of how many people are actually in the building.

No building would operate that way. At the building just referred to — the Washington Convention Center in the nation's capital — a building automation system (BAS) manages the HVAC system, lighting and other equipment. The BAS observes the building's schedule and any load changes, allowing it to subsequently modify levels as needed, maintaining a comfortable atmosphere for occupants at all times. What's more, from the BAS screen, operators can read the up-to-the-minute temperature of the convention center's halls and stats on its HVAC equipment as well as electrical equipment, power loads and fire alarm system.

It's hardly news that a BAS can control and sustain a facility's equipment around the clock. But when a BAS is in place, it's crucial that the facility executive ensure that the power of the system is being tapped. That means making sure that system settings are taking advantage of a group of fundamental BAS functions.

Boiler/Chiller Optimization

Maximizing the efficiency of individual systems is the most significant way a BAS reduces energy expenditure. Boiler/chiller optimization is one example. When operators maintain a standalone system manually, it is almost impossible for them to maximize equipment life or improve its energy efficiency. For example, chiller No. 1 starts automatically at 6 a.m. and is working at maximum capacity by noon. Soon, chillers No. 2 and No. 3 come to the rescue, each weighing in at 50 percent capacity.

In this scenario, the lead chiller is always working to 100 percent of its ability, and will therefore age quickly, while the lag chillers, occasionally weighing in to meet the load requirements, will last longer. Additionally, when the building's load is light, at 4 a.m., only one boiler may be needed at 10 percent capacity, instead of three boilers running at 60 percent capacity carrying the same load.

Enter the BAS. Now the duty cycling needed in the first example is performed automatically. The BAS alternates and sequences the boilers/chillers evenly, resulting in a gradual aging of all equipment. As for the second scenario, the BAS instantly calculates load changes and adjusts equipment accordingly, conserving more energy.

Duty cycling also applies to tower control. Cooling towers need to be rotated often and sometimes are not used at all. With a BAS, once building temperature drops to 68 degrees or less, it will automatically bypass the unneeded towers.

Pump Optimization

A BAS can also control the amount of air and water pumped through HVAC equipment, further contributing to a facility's energy efficiency. Traditionally, one-pump, or primary pump, systems have been utilized to carry single loops from the chilled, heating and condensed water systems throughout the building. But, because these pumps often support a number of different areas under one roof or even multiple buildings which may not demand the same load, stand-alone, one-pump systems typically feed water where it isn't needed.

For example, one building operates from 8 a.m. to 5 p.m. daily, while a neighboring building's employees don't arrive until 3 p.m., working until 8 p.m. Using only a one-pump system for both facilities means that water will be heating or cooling both facilities from 8 a.m. to 8 p.m. daily, wasting a significant amount of energy and raising operational costs unnecessarily.

But when a secondary pumping system, which carries the water out of its primary loop further into each area or building it serves, is added to the configuration and specified in combination with a BAS, facilities can conserve energy by transporting the right amount of heat or cooling to each space as needed.

The pumping system's energy efficiency can also be enhanced by including variable frequency drives (VFD) on the air handling units. Utilizing a VFD allows a facility to circulate a variable water flow (again, controlled by the BAS), instead of simply maintaining a constant water flow volume, regardless of demand. (For more on VFDs, [see "VFDs Can Optimize Efficiency"](#))

Imagine one building with two diverse water flow needs. One section of the facility needs water flow 24/7 to maintain its cooling needs, while the other demands variable water flow, depending on the time of day. Specifying a dedicated pumping system and VFD for each building area, both controlled by the facility's BAS, can promote energy efficiency, as the system delivers water to each system only as needed.

Like boilers and chillers, pumps and valves also need to be rotated to slow aging and maximize daily building operations. The BAS executes duty cycling automatically. By grouping building areas or facilities into different tiered systems and rotating them as needed, the BAS trims energy use.

Other Functions Can Reduce Costs

The BAS economizer settings and its set point reset function enable operators to set a desired temperature for the facility, with the ability to alter it at any time. A building no longer has to maintain the same temperature year-round; instead operators can set it according to interior factors, including occupants and lighting, as well as external factors like outside air and precipitation. By resetting the temperature regularly, the BAS once again helps to conserve energy.

Obviously, when outside air is 20 degrees in the winter or 95 degrees in the summer, it needs to be conditioned before the building can use it to heat or cool its spaces. But when the outside temperature is pleasant, between 60 and 70 degrees, there's no reason to waste energy conditioning the air introduced into

the facility. To systematize this process, the BAS utilizes 100 percent outside air economizers that are programmed to condition outside air only as needed.

At noon on a hot summer day, electricity not only reaches its peak demand, but also bears its highest price tag. Once a facility exceeds its daily profile load, energy costs skyrocket. A BAS responds with its load shedding function. Take an ice storage system, for example. Controlled by the facility's BAS, it makes ice or cold water during nighttime hours when electricity is least expensive, and utilizes it to cool the building during the day's peak load (noon), instead of drawing from the utility. The BAS can also be programmed to take other load-shedding steps, like dimming lights slightly.

Missed Opportunities

Although a BAS can help maintain an energy-efficient facility, it won't be successful on its own. Instead, it relies heavily on its operator-partner to set the stage. The more knowledge an operator has about the BAS, the more efficient it will be.

Maintenance staff will often override BAS settings in an effort to resolve a perceived problem. The result is almost always higher energy use and a breakdown in systems communication.

Another key to efficiency is integration. If a BAS is used only on a portion of building systems, it will fall short of achieving its full potential benefit.

Implementing Solutions

The most obvious solution to a BAS breakdown is operator training. When the BAS or an individual component being controlled by the system is initially installed, a six- to eight-week training course provided by the building automation contractor or design engineers is recommended.

What's even more significant is the training of each subsequent operator. Very often, when a new piece of equipment is installed, the current engineer is well-versed on the ins and outs of the software. But, when that person leaves, the replacement operator may receive no formal training before assuming the post.

Training those who operate BAS and other equipment is a crucial element in the implementation of those technologies, as it will enhance system efficiency and reliability.

Commissioning plays an important role as well. Not only does this final project step ensure that each system is operating per construction documents and specifications, but it may also include engineer training.

It is important for facility executives to understand the facility's infrastructure. The BAS can improve reliability, trim operating costs, enhance operator safety and environmental awareness, and reduce maintenance costs. The BAS can control each piece of equipment separately, but integrating the separate pieces of the puzzle provides a more energy-efficient building.

RELIABILITY, TOO

Integration Brings Efficiency

The more that building systems are integrated, the more efficient the building will be. In a truly integrated system, a building's cooling, ventilation, lighting and other systems are communicating with one another throughout the day, weighing in to compare their current loads. When little occupancy is sensed in the facility, and the chiller and air flow begin declining, they'll interface through the BAS, sending a message to the lighting system to cut back its energy expenditure automatically.

INSTANT INTERACTION BETWEEN THE BAS AND EACH PIECE OF EQUIPMENT means adherence to schedules with programmed and optimal start/stop settings and ease of maintenance for its operators. The return on the BAS investment comes in the form of increased reliability, reduced energy and maintenance costs, and enhanced operator safety and environmental awareness.

The alternative? Traditional separate systems control, monitored by a stand-alone controller. This option not only leaves tremendous room for human error, but also doesn't account for the multiple lateral decisions that need to be made simultaneously, around the clock.

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