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Hospital Engineering Trends

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Creating an Energy Efficient Building

by Paul McCown, CEM LEED®AP

More hospitals are realizing that saving energy has a huge impact on their bottom line, but assessing the impact can be difficult.

Efforts to identify energy-guzzling systems in facilities often falter due to a focus on a single system. In fact, maintenance and engineering departments can help their organizations minimize energy costs by being more proactive in monitoring a range of energy-using systems and developing a comprehensive approach to identifying energy waste.

The Numbers

The Department of Energy generates millions of statistics annually concerning energy use and buildings. These statistics can be used to understand how the energy consuming aspect of any type of building compares to national averages. This is known as building benchmarking – comparing one building to an average of many. Two great resources include the Commercial Building Energy Consumptions Surveys, generated every four years, and the 2003 Buildings Energy Databook, both available on the Department of Energy Web site.

According to the 2003 Buildings Energy Databook, residential and commercial buildings account for 39 percent of total energy consumption in the United States. Until recently, there was little emphasis on energy regulations for buildings. This sector also faces challenges from developers that focus on keeping costs low to get a building built and operational, and owners that don't have capital readily available for system upgrades and maintenance. Also, the construction process focuses on system installation, not system integration, and the building maintenance staff is left to ensure systems operate as designed.

Challenges

Facility operators are challenged each day to stay on top of the many systems in their buildings. Operations and maintenance manuals detail everything from the type of wrench to use for replacing sprinkler heads to how often water cooled

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chiller tubes need cleaning. Inherit problems exist that couldn't be fixed or weren't clearly documented from previous operators. Sick building syndrome isn't just about air quality. Many commercial facilities are sick from something else – lack of proper system effectiveness and integration. System effectiveness ensures systems operate as designed. System integration is how well systems operate and communicate with each other. If both occur, routine maintenance is just that, with no problem solving required. But many systems don't operate as designed, which leads to difficulty for the building operations team.

The constant need for problem solving by building operators often dissuades proper system and equipment maintenance. This creates a "snowball" effect in which systems and equipment degrade and begin to cause more problems. A strict maintenance schedule that includes equipment cleaning is one of the best ways to maintain overall hospital efficiency.

Identifying Energy Waste

Building systems *are* integrated, whether this is recognized or not. For instance, lights produce heat, which in turn produces additional cooling load. Operating lights efficiently makes the HVAC system work less. There are many things building operators can do to identify energy waste and improve energy efficiency for a variety of systems.

A Chilled Water Example

"Low delta T syndrome" is a common problem among buildings with chilled water cooling. Chillers are designed to operate with a certain temperature difference (commonly 10 to 12 degrees) between water entering and leaving the chiller. When this delta is not maintained, problems arise.

The issue is system integration among the air handling units (AHU) or fan coil units and chilled water pumps. In a variable flow chilled water distribution system, the pressure in the line drops when AHUs "call" for more cooling and open chilled water valves. This causes the pumps to increase chilled water flow to maintain a differential pressure in the system. If the system is properly balanced between water flow and each AHU, there is no problem.

The obscurity lies in the original balance of the system versus current building demands. It's not cost effective to place a flow meter at each chilled water coil. Once a change that opens a balancing valve is made in the system, it is difficult for the system to respond appropriately. If a balancing valve at one chilled water coil is opened or closed, it affects the balance of the entire system. When the water flow to the chilled water coils is too high for the installed coil, the "delta T" cannot be maintained. This forces the chiller to operate at a lower "delta T" than designed, reducing its efficiency and effectiveness, and may result in multiple chillers operating to satisfy the chilled water load when only one is required based on actual tonnage.

This can be avoided by allowing agencies trained in testing, adjusting and balancing to make changes when necessary. The scenario can also be addressed by the controls system in re-programming the interactions of system components.

Building Pressurization

Many hospitals have ever-evolving user demands. Floor plans are modified in shape and function, and building systems are forced to adapt. One common oversight in this process is the flow of air throughout the spaces. Systems must be checked to ensure that pressure relationships among various spaces meet code requirements. If a build out causes problems with space temperature or pressure, it may be

due to a restricted air path. Airflow always follows the path of least resistance. If pressure problems exist, always begin by checking the air path before changing fan speeds. Once a fan speed is changed, measurements must be made to determine the new airflow to re-balance the system.

Variable Frequency Drives

Variable frequency drives (VFDs), also known as variable speed drives or adjustable speed drives, are becoming more common and less costly to implement. VFDs can help save energy and are a good tool for producing an efficient system. However, use caution when installing VFDs on existing constant speed systems. VFDs may make for a more efficient pump or fan, but could cause problems with system integration. Investigate other parameters that may need to be modified if a VFD is installed before making the change.

Data Trending and Benchmarking

Data is very important. Data trends kept for systems are useful in determining how the system is operating versus how it is designed to operate. Many controls systems are capable of producing trending data. Implementing data trending techniques could be a low cost step towards system effectiveness and integration.

Examples of data trends include:

- Entering and leaving chilled water temperature versus time of day
- Equipment schedule (on/off) versus time of day
- Zone temperature versus time of day

Data trends can be extremely helpful in troubleshooting problems, especially if they were in place before the problem arose.

Trended data from a utility company is helpful in determining a building's benchmark. Keeping good records of utility data on a monthly basis allows you to see how your building performs on a monthly and annual basis and aids in problem solving if the need arises. A record of your utility bills can be obtained from your utility company, but it often takes the company time to access and send the data, and records are only available from the last few years.

Building Commissioning

The most effective way to identify waste and create an energy efficient building is through commissioning. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) defines commissioning as the process of ensuring that systems are designed, installed, functionally tested, and capable of being operated and maintained to perform in conformity with the design intent. The key word is that commissioning is a *process*. This process has even created a new industry of consulting services, where individuals highly skilled in systems integration and effectiveness implement the commissioning process.

The Association of Energy Engineers recently published two excellent articles pertaining to energy efficiency and operations expenses, entitled "Is Commissioning Once Enough?" and "Implementing the Continuous Commissioning Process in Retrofit Projects." These articles outline a process called Continuous Commissioning® and provide detailed examples.

The commissioning process not only looks at the effectiveness of each system, but the integration of connected systems. There are various degrees of commissioning, ranging from simple maintenance techniques to highly involved data collection and analysis. Commissioning helps building operators put systems in place to operate a high quality and properly functioning building.

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Five Steps Toward Efficiency

Educate yourself
Peruse the O&M manuals behind your desk. Learn which system parameters can be adjusted without much disturbance and which ones can't. The Internet is also a great place to find more information.

Determine priorities for operating and maintaining your building
Formulate a plan to obtain optimal building performance (with the aid of a consultant, if necessary), and then do your best to execute the plan. Always keep in mind that efficiency is directly related to dollars.

Be patient
Most problems concerning system integration don't appear overnight and aren't quickly resolved. Rash decisions often bring about new problems.

Find someone you trust
Form relationships with consultants who familiarize themselves with your building. This will keep future costs down, because they will have prior knowledge about your systems when investigating new issues that arise.

Get a second opinion
This isn't just good medical advice. Some consultants understand system integration, some don't. Take time to "test" several consultants with small assignments, and give the more difficult assignments to the one that performs best based on your criteria.

About the Author

Paul McCown, CEM LEED®AP *is a commissioning authority for SSRCx (www.ssrcx.com), a total facility commissioning provider and subsidiary of Nashville, Tenn.-based engineering and facility consulting firm, Smith Seckman Reid. McCown holds LEED®AP registration and has expertise in the commissioning of HVAC systems and energy conservation analysis concerning energy management and system efficiency.*

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