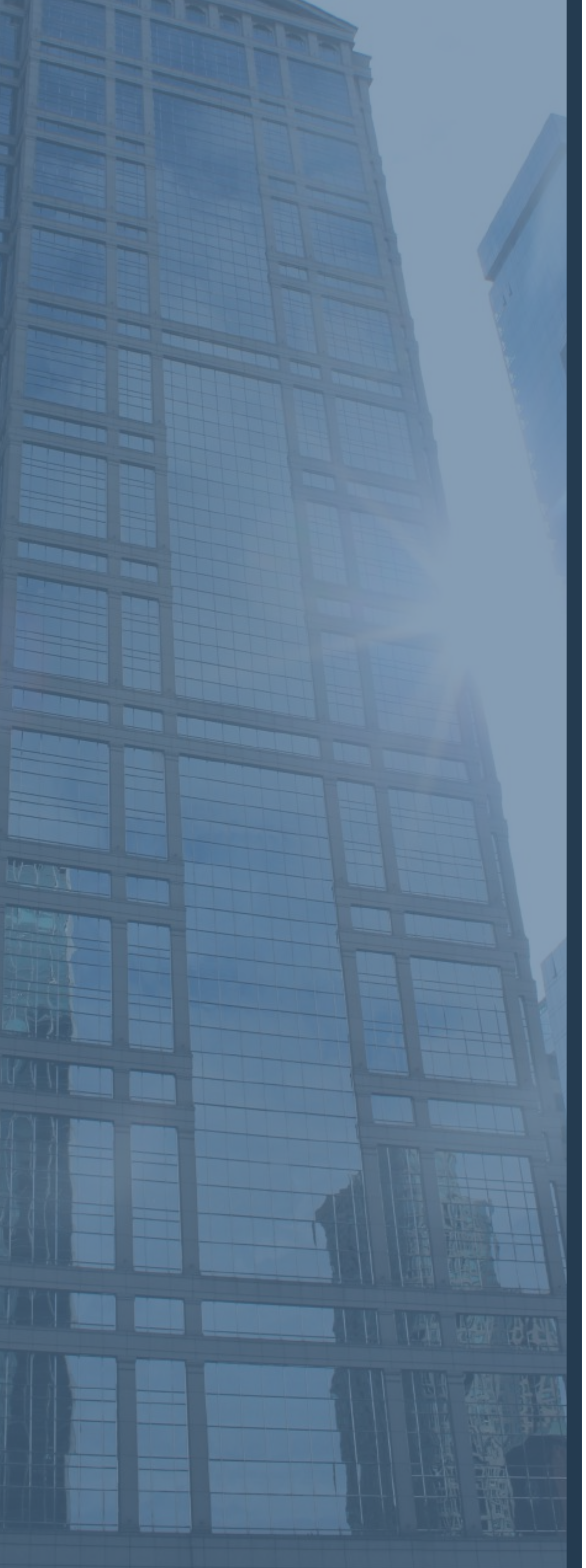
SMART BUILDINGS

FALL EDITION

CONSULTING - SPECIFYING engineer eBOOK | SIEMENS



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Chiller energy optimization systems versus building automation systems

Learn the nuances of a chiller energy optimization system operates contrasted with a building automation system

Chilled water systems are a significant portion of a building's energy use, sometimes accounting for up to 40% of peak electric demand and 15% to 25% of annual electrical energy usage for a large building. As such, efforts to reduce the amount of energy used by a chilled water system are worthwhile.

Control sequences in the building automation system are written to identify and respond to variables that impact chilled water system energy. Engineers write and BAS vendors implement control sequences that are intended to meet the system demand, operate within safe parameters, protect the equipment and perform those tasks as efficiently as possible within the capability of the BAS.

Another software tool for controlling system operation is a chiller energy optimization system. Consulting engineers hear from the chiller vendors that the chiller not only meets system demand and protects the equipment, but does so more efficiently. They also hear from many BAS vendors, "We can do that."

What's the difference? And is a separate chiller energy optimization system worth the investment?

Typical BAS control

In a simple overview, a BAS comprises several levels:

- Management level: Makes systemwide adjustments from external input, provides user interface.
- Control level: Receives input, sends instruction to output devices based on the control loops.
- Application level: The sensors, transmitters and devices that measure input and apply output.

The sequences are written to measure an input, make a decision, then instruct the output to be implemented. Each sequence for a control loop is focused on one or a few variables and one output. For example: If the building chilled water demand exceeds 90% of operating chillers capacity or the chilled water supply temperature exceeds setpoint for five minutes, next lag chiller shall be started.

In this example, the BAS monitors two variables, chilled water system demand and supply temperature. The BAS compares the current values to the maximum operating capacity and chilled water temperature setpoints then, if either condition is true, the BAS initiates one output (start next chiller).

There are many other control loops operating simultaneously that are monitoring and controlling the chilled water pumps, the condenser water pumps, cooling tower fans, valve positions, water temperature setpoints and pressure differentials across piping mains. Each control loop is focused on a single piece of equipment; having multiple control loops trying to control the same piece of equipment often results in sending conflicting output instructions to the equipment. The sequences consider a limited number of factors, compare to a setpoint or decision value, then adjust to meet that setpoint or value.

Information flows up from the application level to the control level, where programmed responses are then sent back to the application level for implementation. The management level provides interfaces for both users and other systems (fire alarm, security, etc.).

While the sequences can be complex, they are still mainly "static" — that is, the sequences themselves don't change. For example, they don't consider changes in equipment operating efficiency that happen over time and don't recognize changes to the operation of the system due to lack of maintenance, all factors affecting the overall operating performance of the system. In other words, BAS control comprises multiple control

Figure 1: Any chiller that serves a hospital, which is a 24/7 critical load with a heavy energy demand, is a viable candidate for a chiller energy optimization system because chiller energy is a significant part of its operating costs. Courtesy: Smith Seckman Reid

loops acting simultaneously but independently, each focused on a particular part of the chilled water system. However, the parts of a chilled water system don't act independently; they affect each other.

By contrast, a chiller energy optimization system takes a global view of the chilled water system. It not only monitors all of the various control loops for each particular device or piece of equipment as the BAS does, but it also has the capability to understand how the various loops affect each other and can make adjustments to the control loops based on that understanding. This capability to make changes automatically to control loops — to make a control sequence "dynamic" — is what differentiates a chiller energy optimization system from a BAS. In fact, it can be argued that a chiller energy optimization system is a low-level form of "internet of things" in which one system controls and makes dynamic changes to another system without direct human evaluation or intervention.

Factors that impact system operation

In a chilled water system, there are four major equipment types that consume electrical energy: the chillers, chilled water pumps, condenser water pumps and cooling tower fans. As noted above, there are control loops and sequences that control the operation of each piece of equipment. In doing so, the control sequences directly affect the resultant power consumed by operation of that equipment.

With the installation of electrical energy usage meters for real time data collection, the chiller energy optimization system can monitor the individual power consumption for every separate piece of equipment and can attempt to tune or trim the power used for a specific piece of equipment. The total amount of electrical energy used by all of the

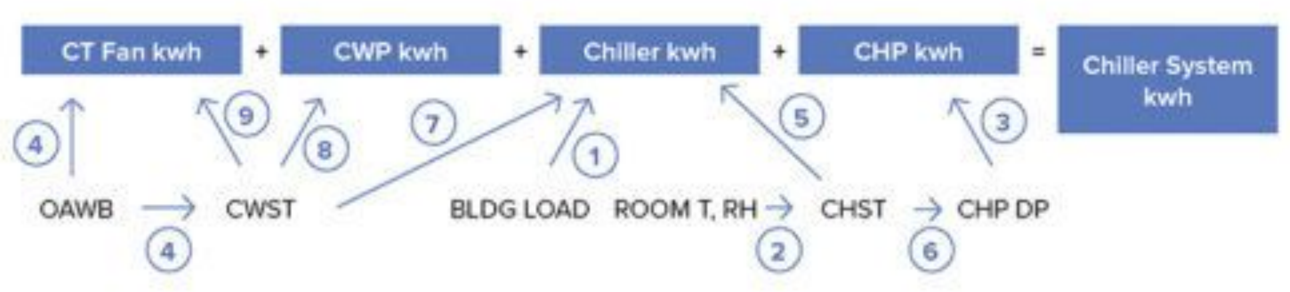

Figure 2: A schematic diagram shows how different input variables affect not only equipment but other inputs. Courtesy: Smith Seckman Reid

equipment, the overall chiller plant kilowatt/ton, is the sum of the simultaneous demands of all of the equipment. This is the purpose of a chiller — to minimize overall chiller plant kilowatt/ton in real time.

Figure 2 illustrates how various inputs and variables affect not only the intended piece of equipment, but how the resultant action affects other pieces of equipment.

Direct inputs from external sources:

1. Building load affects number of chillers and individual chiller loading to maintain enough capacity online to meet cooling demand.

2. Space temperature and relative humidity affect chilled water supply temperature setpoint to obtain chilled water sufficiently cold enough to provide required sensible cooling and dehumidification.

3. Chilled water delta P across the mains affects chilled water pump speed to maintain sufficient flow to all chilled water-cooling coils.

4. Outside air wet-bulb temperature affects condenser water temperature setpoint that can be produced by the cooling towers. It also affects cooling tower fan speed needed to meet the CWST setpoint.

Control sequences are written to take the input above and stage chillers on and off to match cooling demand, change CHST setpoints if space temperature or relative humidity is too high, increase or decrease chilled water pump speed to maintain sufficient flow as chilled water control valves modulate open or closed to maintain required supply air temperature and change CWST setpoint to obtain lower CWST when possible.

These individual actions, however, affect each other and become indirect inputs to other equipment:

1. CHST affects chiller efficiency. Chillers are more efficient at higher CHST but require more energy per ton of cooling at lower CHST (lower CHST require more compressor work for a larger "lift" from evaporator temperature and pressure to condenser temperature and pressure).

2. CHST also affects chilled water pump operation. Lower CHST can result in less chilled water needed, which reduces pumping energy; in contrast, higher CHST may require more chilled water flow and, therefore, more chilled water pump energy.

3. CWST affects chiller efficiency. Higher CWST increases compressor lift (between evaporator and condenser), which increases chiller work and energy required.

4. CWST also affects CWP operation. Higher CWST can result in more condenser water needed, which increases CWP energy.

5. CWST also affects CTF operation. Lower CWST requires more evaporative cooling, which requires more airflow through the cooling tower and, therefore, more CTF energy.

Figure 3: A chiller energy optimization system can use the actual part-load efficiency curves of installed equipment to select the most energy-efficient combination for that particular demand at that particular time. This information, based on the equipment specifications when new, is part of the "predictive" analysis of the chiller. In addition, the chiller will monitor, record and store the resultant energy usage. As equipment wears over time, which may affect efficiency, the chiller will recognize and update this information. This update to the information, based on operating history, is part of the "adaptive" analysis of the chiller. Courtesy: tekWorx

Common control loops for equipment operation in a chilled water system include:

- Chiller staging based on load; sometimes monitoring CHST is also included in chiller staging.

- Chilled water pump speed to maintain delta P across the coil and control valve at an AHU.

- Cooling tower fan speed to maintain CWST setpoint.

- Sometimes a control loop to vary condenser water flow and CWP speed is used as the first stage of CWST setpoint; at part load, condenser water from one chiller might flow through two cooling towers to take advantage of available heat transfer area. In addition, condenser water flow might vary from 50% to 100% before starting fans.

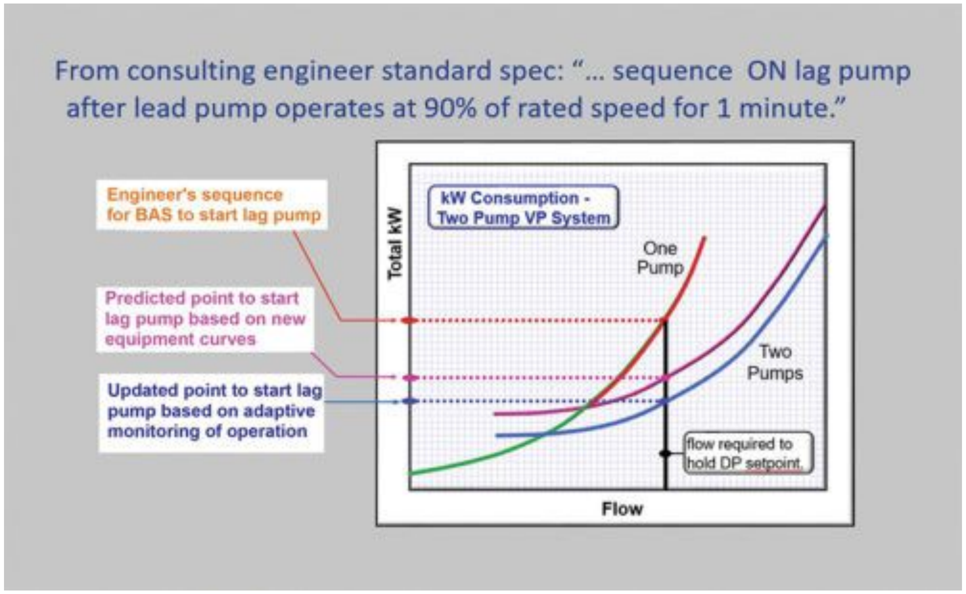

Figure 4: The chiller energy optimization system uses efficiency curves of the newly installed equipment to predict the most efficient time to start the lag pump. After building a database of operating equipment and the resultant energy use, the optimization system adapts to the actual operating characteristics to fine-tune to the most optimal point. Courtesy: tekWorx

There are also control loops that seek to optimize setpoints to minimize energy:

- CHST setpoints can be increased slowly until space relative humidity exceeds set-point.

- CHST setpoints can also be lowered to try and increase the chilled water system delta T, which reduces chilled water flow and pump energy.

- Chilled water pump delta P setpoint can be decreased until some chilled water air handling unit control valves are open past 95%.

- CWST setpoint can be decreased slowly based on the projected available CWST from the cooling towers as outside air wet bulb temperature drops.

Each of these reset control loops, which are intended to save energy, can also have unintended consequences:

- Increasing CHST setpoint increases chiller efficiency. However, it may also result in more chilled water needed at the cooling coils to obtain required cooling, which would increase pumping energy, so there's a trade between increased chiller efficiency (decreased chiller energy) and increased chilled water pump energy. The increase in required flow at the coils will also result in more chilled water control valves opening, which will cause the chilled water pump delta P setpoint to be reset to a higher value.

- Lowering the CHST setpoint may reduce chilled water pump flow and energy but increases chiller energy per ton because the chiller works against a higher compressor lift.

- Lowering the CWST increases chiller efficiency. It also may require more CTF energy, which is a trade-off against the lower chiller energy. The sequence could also affect CWP energy if varying the condenser water flow is part of controlling the CWST setpoint.

The big question is, how do you control the chilled water plant equipment to operate as efficiently as possible and ultimately consume the least amount of energy, while meeting the building needs?

What an optimization system chiller offers

A chiller energy optimization system continuously looks at all of the operating equipment and seeks to minimize the overall chiller plant electric demand. It may adjust the CHST and CWST setpoints up or down. It may reduce CWP speed while increasing CTF speed or do the opposite. It constantly monitors and adjusts setpoints and equipment speeds to respond to changes in the chilled water system demand. It is this readjusting of established control loops that a chiller acts as a low-level smart device — one system working in conjunction with the BAS to optimize the operation of the chiller plant without human intervention. The system can be installed and operate on local servers for security, if desired.

How does it do that? Different chiller vendors use their own software and proprietary algorithms to reach the goal of minimizing real-time kilowatt/ton, but one common aspect is that they all build a "library" or type of database that reflects project-specific equipment performance data. The operating characteristics for all equipment in the chiller system and the resultant electric demand are cataloged for comparison. This collection of empirical data becomes the basis for the chiller to know the best combination of equipment and settings for a particular load.

As an example, a common BAS control sequence might be: "When lead chilled water pump reaches 90% rated speed for five minutes, start lag chilled water pump." A chiller energy optimization system will look at the operating curves of the pumps and sequence two pumps online where traditionally there may only be one. This would happen because two pumps operating at a lower frequency may use less energy than one pump operating at 60 hertz.

Another example would be where the chiller knows the part-load operational characteristics of each chiller in a system and uses that information to determine the best combination of chillers for the real-time demand.

One factor that is inherent in this method is that the part-load efficiencies of the specific equipment installed becomes a factor in the analysis. Power is the cube of flow for both water and air, so the energy used by pumps and tower fans during part load conditions becomes a major input to the overall plant energy usage. Chiller efficiencies, as well, are not linear but are functions of the installed equipment and change over time due to wear.

In effect, the chiller energy optimization system "learns" about the installed system then uses that data to select the most energy-efficient combination of equipment and settings. The chiller uses predictive methods at first to determine equipment operation, observes the resulting energy usage then adapts to tune the settings. (This process is similar to when a patient goes for an eye exam for corrective lenses. As the patient looks through the lens device, the eye doctor will select then reselect the proper lens, asking, "Is this better or worse?" until the patient sees no difference, at which point the doctor has found the right prescription.)

Because the chiller energy optimization system incorporates specific equipment efficiency data, building the database takes time. It will use various combinations of equipment and it may take several months to optimize the most effective plant operating scenarios. As it continues to run, the database continues to grow, with more accumulated history of operating combinations and associated energy usage.

Relationship of optimization system and BAS

It is important to recognize that a chiller energy optimization system does not replace a BAS. Rather, it complements and enhances overall chiller plant operation. The chiller energy optimization system is an optimization of chilled water system control. It takes the available inputs and outputs of the BAS and optimizes their use.

The chiller energy optimization system does not directly command a pump on or off, nor does it directly change a temperature setpoint. It tells the BAS to start or stop a pump or to change a temperature setpoint. The BAS retains direct control of sensors, transmitters and actuated devices and equipment at the application level.

Because they communicate so closely, the BAS and the optimization system must "speak the same language." They must use the same protocol (BACnet, Modbus, etc.). The BAS and chiller energy optimization system are communicating constantly; they need to have compatible network speeds. There need to be sufficient interfaces in the management level of the BAS with which the chiller can communicate.

Just because there is an optimization system, the engineer should not abdicate design and intended operation of the chilled water system. There is always the chance that communication will be lost between the chiller and the BAS; if that happens, how is the chiller system supposed to work? There need to be sufficient control sequences for the system to operate properly without an optimization system.

As mentioned earlier, some BAS vendors may not agree with the advertised benefits of a chiller energy optimization system. The optimization system and BAS installer need to coordinate details of "tuning" the systems, such as valve closing speeds and time durations to ramp up or slow down pump speeds. It's important that both system installers work closely together to bring their best products and installation practices to a successful project for the owner.

When does energy optimization make sense?

A chiller energy optimization system is an added expense and is not crucial to the operation of a chilled water system. There is a practical lower boundary of when an optimization system adds value above its cost. Therefore, it "needs to pay for itself." For a custom written specification with site-specific installed equipment, some general guidelines are:

- There are at least three chillers in the plant, totaling at least 1,500 tons.
- Electricity costs are above national norms, either in energy or demand charges.
- A chiller energy optimization system is more likely to prove its worth when the chiller system operates year-round, as opposed to a system that does not run in the winter because the air handling units have airside economizer and do not use chilled water when the outside air temperature is below 50°F.

Recently, some chiller vendors developed standardized systems applicable to chilled water plants smaller than 1,500 tons with three chillers.

Asking "How much does it cost?" is akin to asking, "How long is a rope?" because systems differ in size, number of chillers, characteristics of the BAS, location of the project, etc. For example, a chiller for a chiller plant with three 500-ton chillers and variable primary flow costs in the range of $90,000 to $140,000 to install and start up. (These costs would be for a new installation with a new BAS that is prepared to interface with a chiller. Cost to add a chiller as retrofit may be higher if modifications to the existing BAS are needed to interface with the chiller.) Additionally, annual maintenance costs average 15%, depending on vendor, to provide continuing services, such as software updates or implementation on other host equipment.

When comparing systems and selecting a chiller energy optimization system, a presentation in person or in print is helpful to understand the scope of what will be provided. Important points to consider include:

- Features and advantages of the system. Ask what the system does that a BAS won't do. They won't tell you their proprietary algorithms but they should provide enough information that shows they are making real-time decisions based on-site specific equipment operating characteristics. Ask for an example, such as the pump or chiller examples above.

- A sample report or screen shot. See if they show a dynamic, real-time "dashboard" or something similar that shows current chiller plant kilowatt/ton.

- A list of equipment and control points that are monitored and adjusted.

- First cost and what is included in that scope. What requirements must already be on-site (such as BAS interface) for them to communicate? What else will be needed outside of the scope included in the first cost?

- Are there any annual system maintenance or upkeep costs? If so, how much and what is included?

- References for systems in buildings of similar size and occupancy.

A chiller energy optimization system is appropriate when the owner prioritizes long-term operational cost savings over first cost of installation. For the three 500-ton chillers example, the simple payback would range from three to four years assuming year-round operation and electricity costs 10% above national norms.

There are many successful optimization system installations with which owners are very satisfied. There are also installations that have not been successful. The consulting engineer needs to evaluate the owner's priorities, plant capacity, expected time of plant operation and electric utility rates to advise the owner accordingly. The engineer should also enlist the owner's influence with the BAS and chiller energy optimization system installers to work together.

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ADMINISTRATION BUILDING
68°
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Floor 2
Floor 1
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Four demand factors beyond COVID-19 prevention for smart buildings

Smart building technologies have gained more visibility due to COVID-19, but the long-term benefits they provide will last long after the pandemic subsides.

Smart building technologies gained popularity during the pandemic as office tenants turned their attention toward health and safety. These include mobile apps to ensure social distancing at office properties, sensors for monitoring space occupancy and indoor air quality (IAQ) and thermal imaging cameras to screen visitors' temperature. These technologies offer benefits that extend far beyond the prevention of COVID transmission. They'll continue to gain traction in the post-pandemic landscape. The four biggest reasons are highlighted.

1. Cost savings

Sensors, a fundamental component of smart buildings, promote savings in two ways — through automation and through occupancy analytics. Many people have probably encountered examples of automation in many kinds of buildings such as light sensors that automatically turn on when someone enters a room or touchless faucets and hand dryers that respond to motion. Some buildings even feature smart thermostats like those used in high-end residences. Such thermostats turn off and on to coincide with arrivals and departures of inhabitants, whose whereabouts are tracked through GPS.

Sensors coupled with computerized systems also offer fault detection and diagnostics, which alert staff to potential equipment malfunctions, enabling rapid fixes that prevent mechanical failure and avoid downtime. A stitch in time saves nine. So does an alert that an HVAC system needs attention before it goes out, leading to a tenant exodus for 24 hours (and unhappy tenants who are less likely to renew their leases).

Just how much can landlords save by adopting smart building technologies? The American Council for an Energy Efficient Economy (ACEE) reports they can reduce annual energy consumption by as much as 33% for lighting, 28% for plugged equipment and 18% for HVAC systems. Fault detection and diagnostics for HVAC can increase the savings by an additional 11%.

Occupancy analytics yield even greater savings in the longer term. The data reveals occupant behaviors, allowing landlords to adjust systems and increase efficiencies. Furthermore, analysis enables better budgeting and planning.

2. Environmental sustainability

The World Green Building Council reports operational emissions from buildings (from energy used for heating, cooling and lighting) account for 28% of all carbon emissions in the world. Many landlords concerned about climate change are already taking steps to reduce the carbon footprints of their buildings. Others will have no choice but to act because of governmental mandates such as New York City's Local Law 97, California's Title 24 and New York State's 2050 Net Zero challenge. Smart building technologies will help real-time energy efficiency monitoring. They'll help show landlords where and what they need to upgrade to meet the legislated standards.

3. Improved occupant experience

COVID-19 increased attention on IAQ. However, occupants of office buildings want good indoor air quality all the time; not just during pandemics. Thanks to smart building technologies, occupants can find out — often via an app or dashboard — whether the several common volatile organic compounds (VOCs) and substances exceed threshold limit values. Examples include PM2.5/10, carbon monoxide (CO), carbon dioxide (CO_2), radon, polycyclic aromatic hydrocarbons (PAHs), formaldehyde, methylene chloride, nitrogen dioxide (NO2), etc. As landlords and employers strive to persuade tenants and employees to return to the office, they can emphasize this data. WELL certification further supports such efforts.

Smart buildings have many different elements and aspects that come together to help ensure tenant safety and comfort. Courtesy: Syska Hennessy Group Inc.

Employees also appreciate touchless and personalized experiences on-site. It's convenient for them to present their ID card/mobile credential apps at a lobby turnstile, prompting an elevator call and, subsequently, a quick trip to the correct floor, no buttons required. If employees are hot-desking, they can use apps on their cellphones to see where the free desks are and reserve the one they want. Wayfinding apps can help them get there quickly. Once they arrive, they can control the lighting and temperature around the desk to ensure personal comfort.

All of these features contribute to a workplace environment that is appealing and, in many cases, more comfortable and inspiring than a home office. They also support the agility and flexibility critical to the success of a hybrid work model (combining remote and on-site), which many experts believe will be the "new normal."

4. Enhanced security

It's unpleasant to consider, but the safest buildings are equipped to minimize casualties from mass shootings, which are far too common across the U.S. Smart building technologies can once again play an important role. Sensors recognize the sound of a gunshot. Security systems respond by locking all the doors in the area where the shooter is, restricting his or her free movement and blocking escape. Cameras capture the scene and pinpoint the exact location for local authorities, who are immediately alerted.

New expectations post COVID-19

The pandemic will eventually abate and so will concerns about virus transmission. However, tenants and employees will still seek safe, healthy and personalized environments that enhance the workplace experience. Landlords will still aim for cost savings, energy efficiency and tenant retention. That's why smart building technologies are going to stick around post-COVID. Owners who want to optimize their portfolios and attain a high return on investment know what they have to do — get smarter.

Val Loh

***Val Loh** is senior principal at Syska Hennessy Group Inc., a CFE Media content partner.*

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Make Your Building Data Work Better for You

Improve data access and visibility for better real-time decision making with Desigo Optic building automation software. Desigo Optic enables integrators to work with multiple system protocols from a single, easy-to-use front end. Upgrade your building to the latest IoT technology and system protocols and experience simplified engineering workflows.

How to Make Smart Buildings Even Smarter

Simplified building management with improved data access and visibility across devices takes a giant step forward.

Smart cities. Smart buildings. Smart cars. Smart phones.

The technology fabric of our modern world has become increasingly sophisticated and integrated. It's now possible to run an entire factory or manage all the systems in a Manhattan office tower from the palm of your hand and from just about anywhere in the world. Robotic surgery can be done remotely. Drones can fly over hundreds of miles of pipelines inspecting them for corrosion and leaks. The list of today's tech wonders is quite long and growing.

Of course, for all this we can thank advances in basic technologies, such as ever-denser microcircuits, artificial intelligence (AI), sophisticated software, edge and cloud computing, and ubiquitous Internet of Things (IoT) connectivity. Together in diverse and truly innovative combinations, they have accelerated vast gains in capabilities for a wide range of products and industries. The latter include aerospace, automotive, engineering, financial services, healthcare, manufacturing, science, and many others.

Open standards are keys to interoperability

But, for all those varied technologies, let's not forget the role that open standards and open software and system architectures have played and will continue to play in the communications and interoperability of it all. This is especially relevant for building owners, facility managers and engineers, and systems integrators.

While technology trends make it more and more cost-effective to add instrumentation and collect data about building operations and energy use, the resulting tsunami of data is of little value without being able to normalize, analyze, and visualize it across building systems. In short, we need to make better sense of it. In fact, there appears to be a consensus that buildings and facilities could still benefit from even greater measures of openness to ease integration challenges, some quite costly:

- 82 percent of decision-makers confirm that building automation is important or very important – and 64 percent plan investments in integration solutions in the next year.[1]

- 30 percent of system integrators estimate they lose up to $1 million a year due to integration-related issues, resulting in them seeking solutions in open-source data-integration tools that will drive $12.24 billion in global growth of the data integration market by 2022.[2]

So, despite the widespread deployments of building management system (BMS) and building automation system (BAS) solutions over the years, they can fall short of what a true "smart building" model requires – namely, the better optimization of a structure's performance without making its operation overly complex and too complicated to manage. At the same time, building owners and facility engineers face challenges with the amount of data that must be stored in the BMS. They need easy-to-use tools and processes to help manage all this data and, most importantly, to derive insights that can drive greater operational efficiencies.

To fill this need, Siemens introduced Desigo Optic. It is an easy-to-use, truly open market software application designed and engineered for mid-market and larger commercial buildings as well as K-12 schools and higher-education campuses.

Because of its open architecture and adherence to open industry standards, Desigo Optic can be easily integrated as a complementary solution to an existing BMS/BAS platform.

Desigo Optic: Redefining Openness. Redefining Building Automation.

1. Built on openly distributed FIN Framework, Desigo Optic provides one of the first completely open solutions offering a system that avoids vendor lock-in and improves serviceability.

2. Offers an array of open protocols to communicate with field and edge-level devices.

3. Delivers a fully open, yet solid and secure enterprise-level system for seamless and scalable solution to FIN-enabled devices.

4. Enhances real-time data visualization by integrating systems and devices through BACnet and an open Haystack application programming interface (API).

5. Control your building on-the-go with Desigo Optic's web responsive mobile first design – information when you want it, where you want it.

The advantage: Desigo Optic preserves both existing legacy BMS/BAS investments and the skills and experience of operators. Browser-based, it makes BMS/BAS building data accessible from virtually anywhere on any web-enabled device.

Sustainable path forward

Alternatively, should a key BMS/BAS component be nearing its end-of-life support, the open architecture of Desigo Optic provides building operators with a future-proof, sustainable path forward. So, when a new technology from Siemens or a third-party developer debuts, they can incorporate its capabilities much more quickly and easily than what current BMS/BAS platforms allow.

Desigo Optic provides better data visibility and more informed decision-making to enhance a building's performance and lifecycle operation.

What's more, Desigo Optic will soon be able to scale its distributed architecture as new buildings are added to a management portfolio.

Desigo Optic is highly scalable, enabling fleet management of systems across buildings, whether they're located in a single campus or office park or across wide distances. It offers high availability and remote access to powerful analytics across an entire property portfolio, including different building types.

Because of its openly distributed architecture and APIs, Desigo Optic makes it easy to add capacity, capabilities, and connected devices and equipment. It is also cloud-ready, so users can integrate it with different cloud platforms. This creates unique opportunities for consulting engineers, control contractors, and building owners/operators to develop value-adding applications and flexible deployment options.

Built-in semantic tagging harmonizes data from different sources to deliver data-driven insights, plus automated workflows accelerate commissioning speeds by more than 33 percent while also reducing labor costs dramatically.

Haystack 4 via FIN 5 Framework

For example, with Haystack 4 semantic tagging natively written into its code using the FIN 5 Framework (see sidebar on last page) Desigo Optic greatly simplifies building management by standardizing tag-based workflows across different building systems. Built-in wizards and a wide range of templates that apply to all the key features can automatically generate graphics, trends, alarms, and user navigation for common "single-pane-of-glass" dashboards across a building's systems. Native tagging facilitates shared data histories and common point types across systems, too.

Overall, standardized tagging provides better visibility of systems and deeper insights into zone-by-zone data from those systems – HVAC, lighting, electric, and other utilities and facilities. This way, data across all these systems is made more accessible to building managers and facilities engineers, who can then make more informed decisions about how to operate their structures most efficiently and cost-effectively.

Predictive maintenance for cost-savings

For example, data analytics of a building system's key performance indicators (KPIs) can provide for the condition-monitoring and predictive maintenance of a building's various systems and equipment. Anomalies, such as air handling unit operations or chiller faults that exceed preset parameters, can trigger alerts on a Desigo Optic operating dashboard, so technicians can look into them – before disruptions occur. Root causes can be investigated, too, by looking into the operating histories from system data logs, to prevent system, equipment, or device malfunctions from recurring.

These approaches can actually reduce the costs of scheduled maintenance because maintenance is conducted as needed, saving labor. They also can prevent

Standardized Point Tagging: More Benefits for Stakeholders

Building Owners

- More enhanced building performance via greater interoperability across systems.
- More building and system visibility and utilization to maximize ROI and reduce risk.
- More OPEX reductions to boost profitability.

Facility Managers and Engineers

- More consistency in the data fed from a wide variety of point sources to BMS/BAS platforms, even from multiple campuses.
- More actionable intelligence from deeper insights drawn from that data.
- More visibility into systems performance to improve their operational efficiency and streamline staff workloads.
- More accessibility to data via secure anytime, anywhere, any device web-enabled dashboards.
- More predictive maintenance models to quickly identify equipment or devices needing replacement and minimizing occupant disruptions.

Systems Integrators

- More wizards and templates to apply key features to differentiate BMS/BAS solutions in less time, improving time to market.
- More simplified commissioning of increasingly complex and smarter systems, saving time and costs.
- More streamlined access to building data to improve work flows and processes across different building systems.
- More visibility into system operations, improving responsiveness to client needs and client retention.

downtime, which can either disrupt, or inconvenience a building's occupants, such as the case should an HVAC or elevator system go out. But should a building system or device outage occur, the actionable intelligence Desigo Optic can provide the facility's managers and engineers can help them identify and resolve the problem much quicker, minimizing owner and occupant issues.

Desigo Optic's growing market momentum: Easy to use. Easy to get started.

The Siemens network and systems integrators specializing in BMS/BAS development, engineering, and deployments are quickly supporting Desigo Optic as the most open, scalable, and easy-to-use building management and automation software on the market. When obsolescence occurs with other legacy technologies, Desigo Optic is a new, future-proof choice, with its native semantic-tagging and mobile-first, HTML5 web-responsive advantages.

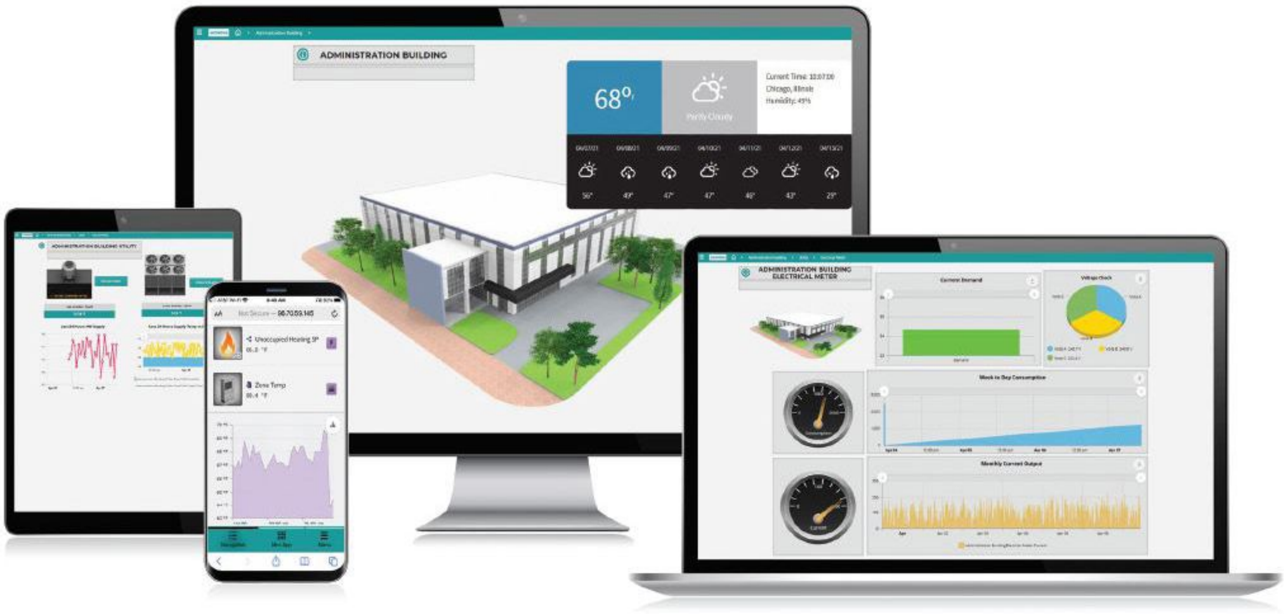
Two deployment options

Desigo Optic comes in two packages. One is front-end software hosted on any networked standard PC, edge computer or on a physical or virtual server. Alternatively, for smaller buildings, system integrators or facility engineers can choose to use the ultra-compact Siemens CFG3.F200 supervisory controller with Desigo Optic software embedded. Each delivers normalized, graphic data trending, reporting, and alarming via single-pane-of-glass, integrated dashboards on any web-enabled device anytime and anywhere.

Both approaches provide native Haystack over RESTful, BACnet IP, Modbus, TCP/IP, SNMP and many other protocols via the FIN 5 Framework from J2 Innovations, a Siemens company. However, a PC/server implementation scales to 100,000 data points while the software controller implementation can manage up to 2,000 data points. Both types of implementations can be connected to a local server using the Haystack API to extend the Desigo Optic system in a modular way, so as to support even more data points.

Native tagging built-in for streamlined workflows

Although other BMS/BAS platforms feature tagging capabilities, Desigo Optic provides a native tagging system, which tags data at its point of integration. In addition, the software is a component to better automate the process of applying tags to data.



The tagging is then tied to common implementation tasks such as alarm creations, historic data archiving and, most importantly, applying graphics. This not only offers a more efficient approach to building automation, but also results in a more standardized and consistent model of data management across various systems, equipment, and devices.

30 percent of system integrators estimate they lose up to $1 million a year due to integration-related issues, resulting in them seeking solutions in open-source data-integration tools that will drive $12.24 billion in global growth of the data integration market by 2022.[2]

Within the Desigo Optic software, all components are built on HTML5, which makes it possible to implement, commission, and access the solution from anywhere on the network. This also easily adapts its dashboards to the smaller screens of tablets and smart phones. Highly secure, anywhere, anytime accessibility makes it easier for users to track changes, adjust setpoints, and have the clearest views possible on building activity without being tied to a desktop or laptop. This capability can be especially important with COVID-19 causing a greater need for many building management staff members to work from home.

82 percent of decision-makers confirm that building automation is important or very important – and 64 percent plan investments in integration solutions in the next year.[1]

Today and tomorrow, Desigo Optic will set the pace of expectations by building owners, facilities managers, engineers, and systems integrators as to what truly open smart building software should be. Being openly available, easy to use and scalable will become benchmarks to measure competitive offerings. Desigo Optic pushes the boundaries of what features and capabilities that conventional BMS/BAS solutions have traditionally provided. Now integrators can design comprehensive smart building solutions around their customers' specific requirements, not around the limitation of yesterday's platforms and tools.

Technical Snapshot

Simplifying Data Collection and Analysis Through FIN 5 Framework and Haystack Project Haystack, an open-source organization that Siemens and its subsidiary, J2 Innovations, helped co-found in 2014, with Intel and several other companies, provides a standardized data-tagging model for all the diverse data generated by the many legions of devices that operate throughout modern buildings. These include various automation and controls for HVAC, lighting, energy, fire, security, water and wastewater, elevators, and other environmental systems. For more information on Project Haystack, visit www.project-haystack.org.

Haystack tags help normalize data by describing what the data is – metadata, in other words. They can describe a data source's site, location, equipment type, and point type. With Haystack tagging, systems integrators can streamline their work involving point setup, graphic creation, and programming. It also can help them build consistent data and workflow models that are more efficient and informative, the latter by providing context and meaning that would otherwise require time-consuming, costly, and error-prone manual deciphering.

Using the FIN 5 Framework from J2 Innovations, Desigo Optic applies Haystack 4 tagging natively over RESTful, BACnet IP, Modbus, TCP/IP, SNMP and many other protocols. To add to its flexibility and utility, custom DXR templates are available to make integration easier and faster. There's no need for special commissioning and engineering tools or software – or their associated licensing and costs. For more information, visit www.j2inn.com.

nHaystack is an open-source module available from Project Haystack. It allows integration of Tridium's legacy AX and newer N4 systems; and provides a truly open system. In addition, nHaystack enables Niagara systems to act as either servers or clients in the Project Haystack format via a RESTful protocol. Using nHaystack, external applications receive data that includes essential metadata (tags) to describe the meaning of the data.

When to use cooling plant optimization controllers

Use of specialized controls packages can unlock cooling plant equipment efficiency for improved performance

Cooling systems account for 15% of the electricity use in U.S. commercial buildings, according to the U.S. Energy Information Administration. Improving cooling efficiency in both new construction and retrofit applications can reduce operational expenditure while striving to exceed environmental stewardship targets.

Addressing this challenge has attracted the attention of industry professionals across the spectrum of equipment manufacturers, system design engineers, facility operators, commissioning agents and controls professional. A cooling plant optimization controller, known as CPOC, is a class of dedicated plant controllers intended to achieve peak cooling plant performance.

Consider a retrofit chiller plant using the below sequence of operations for controlling two 800-ton chillers with variable-flow primary pumping and variable-speed cooling tower fans. What is the best setpoint for staging on the second chiller?

A review of the chiller performance map shows that the best efficiency point shifts based on both the condenser water temperature and the load. Below is an illustrative sequence of operations:

1. Cooling plant is enabled, lead equipment activates:

- Lead condenser water pump activates to 100%.
- Lead cooling tower fans modulate to maintain a condenser water temperature setpoint of 7°F over the ambient wet bulb temperature, but no more than 85°F.
- Lead chilled water pump enables and modulates to maintain a differential pressure setpoint.
- Lead chiller enables and maintains a chilled water setpoint on an outdoor air reset schedule between 44°F and 49°F.

2. If the lead chiller exceeds 85% load for 10 minutes:

- Lag condenser water pump activates to 100%.
- Lag chilled water pump activates and synchronizes with lead pump.
- Lag cooling tower is enabled and the fan modulates similarly to the lead tower fans.
- Lag chiller enables and maintains a chilled water setpoint.

The illustrative sequence of operations offers several features familiar to operators and designers. It is relatively easy to look at the system and to know if it is operating as intended with pumps paired with chillers. The sequence limits run-hours and chiller starts, promoting longer equipment service life. The variable speed drives on the cooling tower fans, chilled water pumps and chillers are all able to modulate with building load.

In a nutshell, the sequence of operations checks many of the customary high-efficiency boxes (or literal boxes if utility rebates are involved). However, significant performance opportunity has been left on the table:

Figure 1: This photograph shows a 2,100-ton cooling plant serving a multitenant commercial office high-rise building. Courtesy: Raths, Raths & Johnson Inc.

- Chillers staged on capacity rather than best efficiency operating points significantly impacts the power needed to meet the load.
- Pumps also have peak efficiencies in certain ranges on their curves. Running two pumps at part load is often more efficient than one pump at full load when meeting the same head and flow requirements. In some cases, parallel part load operation also can improve reliability and maintenance.
- No automation is present analyze and prioritize resets between the condenser water flow, temperature and chiller compressor lift.

- Maintaining boundaries for stable chiller operation at part load values.

All of these points beg the question: How can smarter plant controls, capable of integrating high-performance equipment, be systematically implemented? A strong solution is a cooling plant optimization controller.

When and why to consider a CPOC

A CPOC is a dedicated controller for the plant, housing the logic for staging equipment to meet the load while minimizing energy consumption. It comprises specialized software package, typically housed on building automation controller hardware. Vendors typically offer several CPOC packages tailored to support plants of varying complexity and size, ranging from two chillers up to large plants with thermal storage.

The major building automation system companies each has its own CPOC systems and there are several third-party companies competing in the marketplace. It should be noted that CPOC systems tend to be proprietary, often referencing patented algorithms for each manufacturer's nuanced approach to optimization (see Figure 2).

There are many strategies for optimization, the technical details of which are beyond the scope of this article. At its core, the CPOC endeavors to:

- Provide a means for customizing the sequence of operations to meet the needs of specific projects. In other words, perform the traditional plant control function.

- Integrate chiller performance curves, including kilowatts/ton data for both varying loads and varying condenser water temperatures.

- Integrate chilled and condenser water pump curves and/or pump power draw.
- Integrate cooling tower fan energy.
- Manage reset schedules for chilled and condenser water temperature setpoints and pressure setpoints.
- Include an open protocol (BACnet or other) means such that the plant can be integrated into a supervisory BAS.

Figure 2: A cooling plant optimization controller is mounted in the plant adjacent to the chillers. Courtesy: Raths, Raths & Johnson Inc.

While the optimization logic and aspects of the staging control functions are prepackaged, it is still something that requires project by project configuration. Additionally, the CPOC may require additional inputs beyond what a traditional plant sequence of operations would need, including current transducers, flow meters, temperature sensors and differential pressure sensors.

In fact, the CPOC hardware is a portion of the overall cost of the system. Time spent adapting the packaged logic to the site, adding in sensors and integrating with the existing automation system are influential on the project cost.

The following list provides considerations to guide whether a CPOC upgrade is applicable to a facility.

- Confirm the plant is suitably complex that it will benefit from advanced controls. A CPOC will typically benefit multichiller, multipump plants that have varying loads and flows.

- The return on investment for CPOC upgrade depends on significantly improving plant performance. If a plant is already performing well, the cost of the upgrade may not be justified. Plants where investments in modern pump controls, good chilled water delta T and automatic temperature and pressure reset strategies should be reviewed carefully before allocating funds for an upgrade.

- For retrofit applications, review the existing chiller equipment. If one chiller operates at 0.4 kilowatts/ton while an older chiller operates at 0.9 kilowatts/ton, preferential efficiency order may be obvious and a sophisticated controller will not tell the operator anything they don't already know. In such circumstances, a CPOC can be a source of frustration and will end up overridden. Reviewing the chiller performance maps and pump curves in detail is required to determine the opportunity.

- Variable speed drives on all equipment are not a prerequisite for a CPOC project. Depending on the pumping configuration, a plant with multiple single speed pumps and one variable frequency drive-driven pump could achieve the necessary modulation without the cost of multiple VFDs.

- A CPOC project may have nontrivial upfront costs and should be considered in the context of payback and energy efficiency goals for the facility.

When the decision has been made to undertake a cooling plant modernization project that could include a CPOC component, the following items may be considered as part of the design and implementation process:

- Review the condition of equipment and capital plans associated with replacement, repair and/or maintenance on equipment associated with the control upgrades. For example, communication card upgrades for vintage chillers can have a significant cost and lead-time.

- The operations team is recommended to be part of the decision process. Operating a fully automated plant means that the operations team may need support from the design and construction team to receive comprehensive training. For retrofit applications, the historical knowledge of the facility can be invaluable in setting design parameters.

- Involving the controls contractor and CPOC vendor in the project budgeting phase can be beneficial. Particularly in central plant modernization projects, the cost for integration can vary greatly based on what systems are already on an existing BAS. Different vintages and features for VFDs may include points for real-time power use, reducing integration cost.

- Assessment of pumping opportunities and challenges including load side valves, low delta T syndrome, primary versus primary-secondary or tertiary flow configurations.

Table 1: Chillers stage based on capacity

AHRI time allocation	Load %	Load, tons	No. of chillers operating	Load per chiller	Kilowatts/ton	Kilowatt-hour
1%	100%	1,785	3	595	0.639	17,120
42%	75%	1,339	2	669	0.526	443,656
45%	50%	893	2	446	0.345	207,961
12%	25%	446	1	446	0.345	27,728
					SUM:	**696,466**

Table 1: Estimated energy use where chillers are sequentially staged based on capacity the demand capacity. Courtesy: Raths, Raths & Johnson Inc.

- Cooling tower fan staging and minimum condenser water flow requirements.
- Obtain and analyze chiller performance maps across multiple loads and varying water temperature.
- Consider how the users will interact with the CPOC. If there is an existing supervisory BAS, it could be preferred to have all controls accessible through a unified "single-pane-of-glass" interface. Alternatively, the CPOC plant graphics accessed on a standalone interface for the plant. Integration into the existing BAS may mean sacrificing some specialized graphics on the CPOC, but integration onto a unified interface will help make the

Table 2: Estimated energy use where chillers stage on in parallel, based the best efficiency points from the equipment performance map. Courtesy: Raths, Raths & Johnson Inc.

Table 2: Chillers stage on in parallel

AHRI time allocation	Load %	Load, tons	No. of chillers operating	Load per chiller	Kilowatts/ton	Kilowatt-hour	Savings
1%	100%	1,785	3	467	0.621	17,120	0%
42%	75%	1,339	3	350	0.460	390,258	12%
45%	50%	893	3	350	0.328	197,705	5%
12%	25%	446	1	350	0.328	27,728	0%
					SUM:	**632,811**	**9.1%**

system easily accessible for the operations team. Depending on the vintage of an existing BAS, a hybrid approach could also be taken, where key performance indicators are passed through to a BAS plant graphic, but a native CPOC interface is also made available.

- It is recommended that the manufacturer/controls integrator be a part of the commissioning team, providing support for developing functional performance tests, participating in testing the CPOC and integration with a supervisory BAS.

Monitoring cooling plant performance

Knowing the efficiency of a cooling plant allows teams to make informed decisions around plant performance operation and capital improvement project prioritization. In older systems, it is rare to find real-time wire-to-water plant power use, which is a key tool in enabling operators to know if their adjustments are working. The 2016 and 2019 versions of ASHRAE Standard 90.1: Energy Standard for Buildings Except Low-Rise Residential Buildings have added section 6.4.3.11, requiring chilled water plant energy use and efficiency monitoring in new buildings and for new plants in existing buildings under the following conditions:

- Water-cooled chilled water plants larger than 1,500 tons peak cooling capacity for Climate Zones 5 through 8, 3C and 4C and larger than 1,000 tons peak cooling capacity for all other zones.

- Air-cooled chilled water plants larger than 860 tons peak cooling capacity for Climate Zones 5 through 8, 3C and 4C and larger than 570 tons peak cooling capacity for all other zones.

The efficiency must be calculated in kilowatts/ton and configured to trend and graphically display three years of 15-minute, hourly, daily, monthly and annual data. The 2018 and 2021 versions of the International Energy Conservation Code have requirements for energy consumption data recording by source under section C405.12.4: Meters with requirements for data retention and graphical energy reports in the following sections.

Cooling plant performance for electrically driven plants is most often expressed in terms of kilowatts/ton or the unitless coefficient of performance. The former is the amount of electricity required to induce 1 ton of cooling while the COP is the ratio of the work completed over the work applied. Each metric can be calculated as follows

$$COP = \frac{\omega \times (T_2 - T_1)}{6.826 \times \sum kW}$$

$$kW/ton = \frac{24 \times \sum kW}{\omega \times (T_2 - T_1)}$$

Where:

ω is the flow in gallons per minute

T_2 is the chilled water return temperature in Fahrenheit

T_1 is the chilled water supply temperature in Fahrenheit

$\sum kW$ is the sum of the plant equipment including chillers, pumps and cooling tower fans.

ASHRAE Guideline 22-2012: Instrumentation for Monitoring Central Chilled-Water Plant Efficiency provides technical guidance for methods and devices for measurements, as well as procedures for data collection and calculations. The guideline "allows the user to monitor chilled-water plant efficiency and make modifications to the set-points of the system such that the overall efficiency of the chilled-water plant is improved.” Guidance for instrumentation accuracy to achieve a recommended total plant performance calculation within 5% of the true efficiency value is included.

In a three-chiller cooling plant, each motor is equipped with a means for monitoring power draw, which could be accomplished through specification of a VFD that includes a point for real-time power draw or with a standalone power meter. The delivered cooling capacity is established by monitoring leaving water temperature, return water temperature and the chilled water flow.

A CPOC offers an opportunity to unlock cooling plant equipment efficiency, offering long-term performance improvements. A challenge to upgrading the controls is that it requires additional investment beyond the minimum scope required for controlling a plant to the current code.

Design teams and operations teams can work together to assess the opportunity for improvement and the associated ROI. In the future, advances in machine learning and artificial intelligence are expected support additional innovations in plant operation.

Daniel McJacobson, PE, LEED AP, BCxP

Daniel McJacobson *is a senior project engineer with Raths, Raths & Johnson Inc. where he focuses on making buildings healthy, efficient and resilient.*

Case study: Office chiller and cooling plant controls replacement

Chillers, pumps, and plant controls were replaced at a high-rise commercial office building in downtown Chicago

A prominent downtown Chicago high-rise office building was facing high repair and maintenance costs for the three 28-year-old chillers that provided cooling for the more than 30 floors of commercial office tenants. Given the increasing cost of maintenance, risk of extended downtime and poor efficiency, the decision was made to replace the chillers and modernize the cooling plant infrastructure in 2016.

The original cooling plant design used constant-speed pumping to distribute chilled water to air handlers. Each air handler had two-way control valves and a central plant bypass valve allowed excess flow to recirculate in the plant. The existing configuration lent itself well to a conversion to variable primary flow chilled water distribution, where the existing bypass was changed to a minimum flow bypass.

The three chilled water pumps and three condenser water pumps were beyond their typical useful service life. Each pump was replaced with new, variable frequency drive driven pumps on a common header. New magnetic bearing oil-free chillers were selected for their high efficiency and low turndown capability. The cooling tower fans had previously been retrofitted with VFDs.

An existing supervisory building automation system controlled the old plant, as well as the air handling systems and terminal units throughout the building. As part of the bid package, a cooling plant optimization controller with BACnet communication was

Courtesy: CFE Media and Technology

specified to control the new cooling plant equipment including the chillers, chilled water pumps and condenser water pumps. To support consistency for the operations team, the graphic user interface was developed on the existing BAS with point integration via BACnet.

The CPOC is mounted adjacent to the chillers in the basement mechanical room. The plant has now been in operation for four cooling seasons and is viewed as a success with the operations team. The controller handles chiller staging, pump staging and a variety of temperature and pressure resets. The cooling tower fans continue to be managed by the base building automation system.

Like most VFD driven centrifugal chillers, a 700-ton centrifugal chiller operates most efficiently when partially loaded. As the condenser water temperature increases, the increase in chiller lift results in more work for the same amount of cooling. Note that ASHRAE 90.1-2019: Energy Standard for Buildings Except Low-Rise Residential Buildings section 6.5.4.4 requires that either the leaving chilled water temperature be reset based on load or outdoor air temperature, with an exception allowing for constant leaving water temperature if the chilled water flow varies with load. The 2018 and 2021 editions of the International Energy Conservation Code has similar requirements under section C403.4.4.

In contrast, a non-VFD driven chiller performance map has a very different profile. Unlike the case study system, a plant with multiple types of chillers or different vintages of chillers presents a challenging scenario for staging based on efficiency without the help of sophisticated software.

To demonstrate that there is a notable difference in plant performance when staging chillers based on efficiency rather than capacity, we can analyze the performance map from the case study VFD driven chiller using AHRI 550/590 part load distributions. Take Table 1 where chillers are staged on only when necessary to meet load as compared with Table 2, where chillers are staged on earlier. The data is provided at a constant leaving chilled water temperature of 42°F as part of a variable flow system. Assuming a partially occupied building peak cooling load of 1,785 tons and 1,500 occupied cooling hours per year, we can estimate the chiller energy use at the two scenarios.

Comparing the two scenarios, the CPOP saves an estimated 63,655 kilowatt-hour, a 9.1% improvement on chiller energy alone. The savings could be better given real-time decision-making factoring in load, condenser water temperature and variable speed pump control. During the design process, cooling load software was used to iterate and optimize chiller selections and perform a cost-benefit analysis from different manufacturers. Entering manufacturer chiller performance maps and analyzing plant staging options in energy modeling software can provide insight into the performance for different equipment configurations.

In the case study project, the CPOC controls both chiller staging, pump staging, resets and operation items like modulating the low flow chilled water bypass. Given that all new plant controls were required as part of the project, the incremental increase in cost for a CPOC was justified when factoring in the cumulative savings of improved chiller staging, optimal pump staging, pump pressure setpoint resets and cooling tower fan control.

While this case study emphasized the opportunity in VFD driven chillers, a 2016 case study conducted by Pacific Northwest National Laboratory for the General Services Administration at a facility with constant speed compressors indicated that "this technology, as demonstrated, may be cost-effective because the energy savings justify the installed costs ..."

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24 hours in a Smart Hospital

A look at what defines a smart hospital and how patients can benefit from the advances in smart and integrated technology during a 24-hour stay.

In July, Syska's Val Loh published an article about smart building technologies at office properties. This month, he tells us about hospitals.

What is a Smart Hospital?

According to Loh, a hospital is "smart" if it uses applicable technologies in clinical care and facility management to ensure that patients have the best possible experience. Let's imagine what that experience would be like through the hypothetical case of Patient X, who goes to a smart hospital for a surgical procedure that requires an overnight stay. Here's how X's day would unfold:

24 Hours in a Smart Hospital

9 a.m. X arrives at the hospital. There's no need to check in at the front desk because X is already registered through the hospital's mobile app or web portal. The app, which offers wayfinding through GPS and real-time location services (RTLS), tells X exactly where to go — G Wing, eighth floor, room 810 — and how to get there. X follows the instructions and enters the appropriate reception area.

9:10 a.m. X "signs in" by placing his palm on a biometric scanner or by entering a PIN code. A nurse brings X to an exam room and takes the patient's vital signs, all of which are automatically registered in the hospital app and shared immediately with X's doctor, who is notified that X awaits a preliminary consultation. The doctor enters and pulls up X's information on a large monitor, explaining the status and next steps. Subsequently, X is brought to the OR and the surgery begins.

1 p.m. The surgery was successful. Following several hours in the recovery ward, X is ready to be taken to a patient room. An aide brings X to the designated room and demonstrates how to use the integrated remote control. This is not your everyday remote control: It represents advanced "internet of things." By using it, X can adjust the temperature and lighting in the room, call a nurse, lower or raise the window shades, or watch TV, all without having to move from the bed and incur the risk of a fall.

24 HOURS IN A SMART HOSPITAL

BY SYSKA HENNESSY

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X ISN'T THE ONLY ONE WHO'S SATISFIED.

So are the doctors, nurses, and operations staff, who appreciate the efficiency of smart technologies. In the upcoming years, the capabilities of these technologies will incorporate more robotics, artificial intelligence, and data analytics. The more data collected by sensors, the better decisions hospitals can make – decisions that streamline operations, save money, conserve energy, and improve patient outcomes. That's a prescription for progress.

SYSKA HENNESSY GROUP

3 p.m. X, who needs assistance with getting to the restroom, presses the call button on the remote control. The nurses' station is immediately alerted via an audio alarm and a flashing light. A nurse arrives shortly to help.

7 a.m. the next day. X's doctor sees on the app that the patient's vital signs are fine – they've been automatically recorded on the app throughout the night – and comes to the room to initiate a discharge. No paperwork is necessary. The post-op instructions are saved in the app for X to review. In the upcoming days, X will communicate with the doctor via the app. Meanwhile, the app will automatically report readings from the blood pressure and oxygen monitors that X uses at home, both of which are wireless-enabled.

7:15 a.m. An aide uses the hospital app to request a wheelchair to take X to the hospital exit. Facility management knows exactly where the closest available wheelchair is because it is equipped with an RTLS tag and appears on the hospital's digital twin model. Consequently, the staff can immediately bring it to X's room.

9 a.m. X completes a patient satisfaction survey via the app, giving high scores across the board for service, facilities and quality of care.

X isn't the only one who's satisfied. So are the doctors, nurses and operations staff, who appreciate the efficiency of smart technologies. In the upcoming years, the capabilities of these technologies will expand exponentially to incorporate more robotics, artificial intelligence and data analytics. The more data collected by sensors, the better decisions hospitals can make – decisions that streamline operations, save money, conserve energy and improve patient outcomes. That's a prescription for progress.

Syska Hennessy

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