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Wireless Pneumatic Thermostats Deliver Smoother Upgrade

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Operating and maintaining one of the nation's top hospitals requires knowledge and experience; Walt Dubois has both. He has spent the last 13 years working at St. Joseph's Hospital and Medical Center, a 673-bed, not-for-profit teaching hospital in Phoenix. It is composed of nine interconnected facilities and six additional onsite buildings, totaling more than 2.7 million sq ft. Holding both a principal engineer (P.E.) and certified healthcare facility manager (CHFM) designation, Dubois has been an invaluable asset. "This is a dynamic environment," the facility manager says. "There is no room for complacency here."

The standards are high, and pressure to provide a positive patient experience at St. Joseph's is great. The outside environment is one of the most challenging in the world, coupling 118°F summertime temperatures with surprisingly high humidity in the rainy season. The facility is among the 17,000 health care organizations accredited by the Joint Commission and is part of Catholic Healthcare West, the eighth largest hospital provider in the nation. Additionally, St. Joseph's has been ranked number eight for neurology and neurosurgery by U.S. News & World Report in its 2010-2011 study of the best hospitals in the United States.

Figure 1: St. Joseph's Hospital and Medical Center. Nine interconnected facilities and six additional onsite buildings total over 2.7 million sq ft.

The 17,000 tons of cooling gives DuBois the clout he needs to condition the space. With this comes the mandate to control the crushing costs that would result from a lack of accurate control and coordination. Typical of older hospitals, the facilities at St. Joseph's contained layers of legacy systems. The original hospital was built in the 1950s, with subsequent

additions and modifications constructed in the 1960s, late 1970s, mid-1990s, and 2006. The buildings have a combination of pneumatic controls in the older facilities and DDC in the newer buildings. This makes sophisticated modern cost-cutting strategies such as time-of-day control difficult, if not impossible, with terminal equipment that lacks central DDC.

OLD PNEUMATIC THERMOSTATS ARE PROBLEMATIC

In 2006, the hospital completed a 420,000-sq-ft addition and conducted $500,000 in DDC upgrades to existing thermostats on five floors of two separate buildings as functions were relocated into the new facility. When the recession hit, the DDC upgrades were halted.

"When you try to convert to DDC on a floor that is still operating, it is very cumbersome. It adds another 30% in cost," says Dubois of the additional expense required due to infection control risks. Without the funding or ability to close off areas to conduct a DDC retrofit, old legacy pneumatic thermostats continued to control temperatures on three floors of the Nursing Tower. He needed a digital solution that did not require a gut renovation to install. He found it with Silicon Valley-based Cypress Envirosystems wireless analog-to-digital technology.

This new technology has resulted in wireless pneumatic thermostats (WPTs) that offer fast, clean, and effective replacement of legacy pneumatic technology with state-of-the-art DDC. Patients stand to benefit from the increased accuracy of digital technology. Patient room loads can vary quickly due to visitors, equipment, and changes in activity. DDC allows adjustments to be made from a central location, keeping the patient and their guests in their comfort zone. When post-operative patients need warmer or cooler rooms immediately after surgery, those changes are made quickly and accurately from the dashboard.

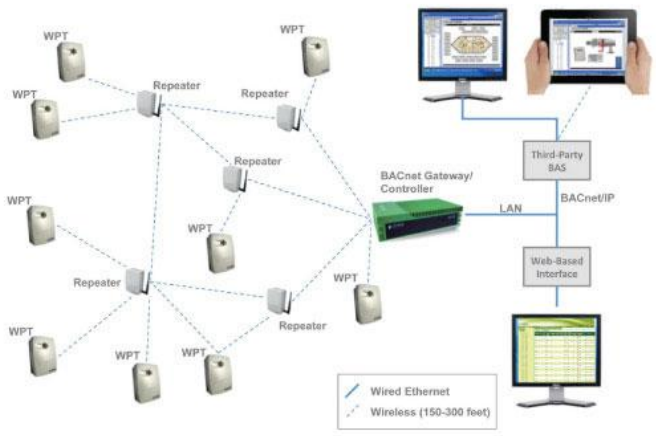

Figure 2: The WPT system can stand alone or be integrated with existing BAS through BACnet/IP.

Patients are not the only people who stand to gain; the additional functionality offered by the WPTs will help Dubois and his team better manage the facility's operations. Whereas the hospital's legacy pneumatic thermostats required manual setpoint control and calibration and wasted energy by heating and air conditioning unoccupied areas, WPTs enable zone-by-zone scheduling of temperature setpoint changes and remote monitoring of temperature and branch pressure. Additionally, automated calibration results in tighter temperature control and lower labor. This additional functionality will help the facilities team better manage and optimize the load on St. Joseph's chillers.

Ongoing commissioning saves energy and maintenance. Trend log diagnostics and monitoring generate graphic displays that make sure room temperatures match setpoints. This makes it easy for maintenance technicians to detect problems sooner and quickly address thermostat zones in need of repair.

"This system allows you to troubleshoot with just the readouts," explains Dubois. Having the ability to diagnose problems with more accuracy dramatically reduces maintenance costs. Before the WPTs were installed, Dubois' team was guessing about what was causing the problem, often wasting their time with a marginal outcome as access is always restrained. Shortly after the installation, Dubois received a call at home about a patient room that could not be brought under temperature control. After the technician read DuBois the data from the DDC graphic display, he immediately diagnosed a terminal unit damper problem. The loose damper shaft set screw was tightened, and the room was brought under control with a minimum of disruption and downtime. By periodically reviewing trend log information, Walt and his team can plan the replacement and repair of marginal equipment when rooms are unoccupied. This allows technicians to work above ceilings in critical areas without any loss of room availability.

The three graphs of Figure 3 illustrate how a digital monitoring trend is worth a thousand words. In the top graph, the room setpoint, thermostat setpoint and branch pressure to the VAV box are right in line. This is stable temperature control and a comfortable patient. The middle graph indicates the room is too warm. The branch

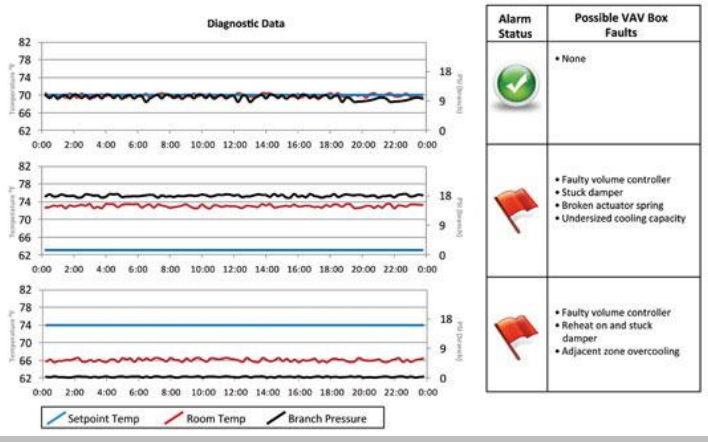

Figure 3: The WPT's diagnostic data enables remote evaluation of patient rooms.

pressure shows the thermostat is trying, without success, to correct the overheating. This malfunction could be caused by the controller/actuator/damper faults shown. In the bottom graph, the room is too cool. Possibly, a stuck damper is flowing too much air while the room reheat is on. This recipe for wasted energy needs to be corrected as quickly as possible.

The successful installation of the WPTs at the hospital's Nursing Tower is the first of several such projects at St. Joseph's. Dubois will finally get the opportunity to complete the remaining floors of the Nursing Tower. He will then move on to the Peppertree Building, which houses administrative offices. Because this facility operates based on standard office hours during the workweek, Dubois can take advantage of energy strategies that are not feasible in patient rooms, such as automatic setpoint changes based on time-of-day schedule and nighttime setbacks. Zone control will enable temperatures in patient rooms to be maintained while offices are dialed back, resulting in significant savings.

Dubois was gratified when he said, "We can finally afford to complete our retrofits to have the visibility and control that we need in all our zones."

When temperatures in Phoenix spiked last summer, the hospital's chillers were strained to supply the chilled water necessary to condition the campus. Dubois knew that he would have to address the facility's remaining pneumatic thermostats. "It was apparent that the current pneumatic thermostats were not providing the service and control that is expected from a facility known to provide world-class service in healthcare," says Dubois.

Dubois established a hit list of issues to be addressed by the new digital technology:

- Establish a proactive O&M environment and eliminate discomfort for patients caused by the lack of visibility of pneumatic thermostat information. Because they are not connected to a centralized BAS, the facilities team is often unaware when malfunctions occur. At times, the information regarding the need to adjust room temperature does not make it to the facilities maintenance team. Analog-to-digital technology changes thermostats from maintenance drains to maintenance enablers.

- Stop wasting energy because of limited functionality. The legacy pneumatic thermostats supply heating and air conditioning to unoccupied areas because they require time-consuming manual setpoint control and calibration. This also precludes other energy-saving strategies enabled by DDC thermostats, such as temperature resets, duct static control, and more.

- Free up maintenance technicians for more important tasks. Occupants experiencing discomfort often take matters in their own hands and adjust the thermostat and, in extreme cases, remove

the cover if they feel the temperature is not changing, rendering the thermostat defective. “These are fine-tuned mechanical devices, the moment you open it up and start fiddling with it, they’re no longer calibrated,” says Dubois. Maintenance routinely finds it a challenge to access the patient rooms for a number of reasons. A lot of time is lost trying to get to the thermostats and it is problematic to perform troubleshooting, as this can be very disruptive to the patients.

TEST RUN: TRUST BUT VERIFY

While Dubois is no stranger to cutting-edge technology and was drawn to the idea of virtual DDC functionality without the need to change out pneumatic tubing, run wires, replace actuators, or disturb building occupants, he is also very methodical and thorough. This facility manager was not going to install the WPTs on an entire floor until he did a test to verify their ease of installation, confirm their operation, and document their output accuracy. He coordinated with the facility’s in-house radio frequency authorities to confirm the WPT’s communication network would not interfere with any health care equipment and was safe for Joint Commission controlled environments.

Gauging the severity of the problem with the existing pneumatic controls, he and his team monitored temperatures in five rooms for two weeks using both the old and new technologies. “Clearly, the temps with the old pneumatic thermostats were all over the place,” explains Dubois. With the existing thermostats directly accessible and controlled by the occupants, temperatures ranged anywhere from 67° to 78°. At the end of the two weeks, Dubois was able to prove — and justify — that the WPTs provided better temperature control and, as a result, improved patient comfort. He emphasized, “The temperature swings were readily corrected when we brought the WPTs online.” The initial installation took place on the top floor of the 182,573-sq-ft Nursing Tower.

SEVEN-MINUTE SOLUTION

Parker Design & Construction, the Goodyear, AZ-based general contractor who won the project, began installing the WPTs on the top floor of the Nursing Tower in April 2010. The installation was quick and simple.

“Basically, you remove the old stat, put the new one in its place, give it its unique address, find it on the system, and then, at that point, it’s very easy to set up zone control and name

these stats however you'd like to name them (by room number or zone number)," says John Vigh, vice president of Parker Design & Construction.

The site survey to identify the location of the repeaters for reliable communications was also fast and simple. "Once you have done the first one and the second one, then all of sudden you don't have to look at the manual anymore; you can do it by heart," says Dubois. "It's not rocket science."

With installation taking so little time, it is even possible to install the WPTs in occupied rooms with minimal disruption. "We were in and out of a room in seven minutes," adds Vigh.

Figure 4: The WPT installation time of 10 minutes or less means floors do not need to be closed off to patients.

Parker Design & Construction did the initial setup of St. Joseph's graphical user interface, installed eight WPTs and brought the system online. They also provided training for in-house technicians to complete the installation in the remaining rooms as they became open between patients. Instead of waiting years until a major renovation is possible, the retrofit happened immediately. Because WPTs can be installed in 10 minutes or less, entire floors do not need to be closed off to patients to conduct the work. Dubois began saving energy immediately, instead of years later, and was assured that patients were comfortable.

AND THE BOTTOM LINE IS …

The financial benefits of installing WPTs at St. Joseph's have been great. To replace the 31 old legacy pneumatic thermostats with traditional DDC on a 30,000-sq-ft patient care floor with 30 to 40 patient rooms would have a price tag of approximately $80,000 to $100,000, based on the floors done previously. At an average installed cost of $500 to $600 per WPT, the cost to retrofit one floor of the Nursing Tower was a mere $15,000. A tremendous amount of money is saved in labor that does not have to be spent removing and replacing walls, installing wire and conduit, and making tedious wiring terminations.

The WPTs will help patients focus on their recovery, instead of whether the room is too hot or too cold. Nurses and maintenance technicians can monitor and adjust temperatures remotely to ensure that patients remain comfortable.

Figure 5: A WPT works with original equipment and controls like native DDC.

"Patient satisfaction from better environmental/comfort controls has a positive effect on the overall experience that our customers perceive from their stay at St. Joseph's," emphasizes Dubois. **ES**

Wilkinson is chief engineer for e4 inc., a sustainable-buildings consultancy in New York. He is the author of the first commissioning training program for the Leadership in Energy and Environmental Design for New Construction and Major Renovations Green Building Rating System, the chair of the commissioning advisory committee of The American Institute of Architects (AIA) Committee on the Environment, and the recording secretary for ASHRAE Guideline Project Committee 0.2/1.2, The Commissioning Process for Existing Building Systems and Assemblies/The Commissioning Process for Existing HVAC&R Systems. An ASHRAE Distinguished Lecturer and an AIA Continuing Education Lecturer, he has spoken on commissioning practices nationally and internationally.