University of Cincinnati Modernizes Coal-Fired Utilities With Addition of FactorySuite™ HMI, Database Modules

Cincinnati, Ohio – The University of Cincinnati is one of the oldest higher education institutions in the United States, tracing its origins back to 1819 when it was founded as Cincinnati College and the Medical College of Ohio. The university has always been a leader among educational institutions. Many of the campus buildings were designed by avant-garde architects from various eras. This includes designers such as Samuel Hannaford in the early 1900s and Cambridge 7 today. The university is now part of Ohio's state university system and is one of only 88 institutions classified as a Research I University by the Carnegie Commission.

The university's campus is situated in the heart of downtown Cincinnati, near the banks of the Ohio River and the border with the neighboring state of Kentucky. With about 35,000 students who populate well over 100 buildings situated on more than 420 acres of land, the University of Cincinnati is like a small city within a city. And like any city, it operates its own utilities department to make sure that its resident population of students, faculty and administration are served with appropriate levels of heating, ventilating, air conditioning, electrical power and water and wastewater systems. The university has three central utility plants that deliver up to 635,000 pounds of steam per hour for heating and nearly 22,000 tons of chilled water for use in classrooms and laboratories at both the school and its affiliated University Hospital.

As impressive as these facilities are, the university was faced in recent years with a problem of aging equipment and inefficient control systems. The Facilities Management department had to upgrade systems for meeting growing demand for heat and power while making the most efficient use of energy sources. They also had to reduce the cost of operating the utility plants. They wanted to convert from proprietary distributed control systems, which tied them tightly to a proprietary equipment supplier, and install open control systems that the university staff could maintain on its own.

They accomplished both goals with the design of new control and computing systems by Fosdick & Hilmer, an engineering and systems integration firm based in Cincinnati. They based the new operations on Wonderware's FactorySuite automation software products, including the InTouch human-machine interface (HMI) software, the IndustrialSQL Server real-time relational database, ActiveFactory and AlarmSuite. The new system uses nine

InTouch workstations in the three major utility plants to provide open control capabilities to facilities staff. IndustrialSQL Server handles real-time data collection so operators can better supervise plant operations. It also provides historical data so facilities managers can perform a variety of trending tasks that were previously impossible, so they can make the most efficient use of equipment and energy resources.

One of the keys to the success of the system was the ability to interconnect new control systems with a wide variety of existing instrumentation and control equipment, including chiller control networks, single loop controllers, underground chilled water storage tanks, water treatment and coal-handling controllers. The network of 11 programmable logic controllers (PLCs) and nine process automation controllers uses the latest in fiber optic wiring for the high speed Ethernet network that links all utility plants and campus facilities. The system use three different networks, including a GE Host Communications Server, a Modbus Ethernet I/O Server and an Allen-Bradley ABTCP I/O Server, for high speed communications that let staff operate the system as if it were all at one plant site.

Easier Operation, Lower Cost

"We knew back in 1998-99 that we would have to upgrade our systems and move to a more up-to-date and user-friendly control system, mainly due to the growth of the campus," said Everett Wolverton, associate director of Facilities Management and director of utilities and technical support. "We chose the Wonderware software because we thought it would be easy to install and let us mix our existing equipment with new equipment, but out long-range plan was to integrate the campus for better energy accounting systems, which would let us better match production capabilities to what's actually used on the campus and increase our overall efficiency ratings for the university's energy use.

"One of the first savings achieved from not having a proprietary DCS system, which required an annual service contract, was that we could immediately reduce the university's annual maintenance and support costs by 90 per cent," he said. "In addition, we've already achieved a five to six per cent savings through integration of our facilities across the academic campus, which is probably worth up to $1.5 million a year."

The savings haven't stopped there. Thanks to the new control logic developed by Fosdick & Hilmer, one of the two workhorse coal boilers used to produce steam for heating was salvaged for continued use as part of the new system. With the old control system, the aging coal-fired boiler had experienced monthly shutdowns. With the new control system this boiler has run continuously for a year without even being shut down for preventive maintenance. The cost savings that resulted from this upgrade alone have nearly paid for the cost of the new system.

Another significant cost saving was the upgrade of the coal handling and control systems for the two legacy coil boilers used to generate steam. The university upgraded its coal receiving dock and added an air conveyor system to transport the coal from ground level to a pair of elevated bunkers that feeds both boilers. Trucks make coal deliveries about every half hour during cold winter months. They unload the coal into a grating, from which it's blown through piping into the silo. In addition to streamlining handling operations for about 30,000 tons of coal per year, the unusual design and artistic colors of the facility combined to win yet another architectural award for the university.

The system has also helped at the outgoing end of the coal-fired boilers as well. The university now recycles ash from the boilers by having it trucked to a local cement kiln where it's used as an ingredient in the making of Portland cement. "This is about 3,300 tons of ash that we're recycling now, instead of having it go to a landfill as waste," Wolverton noted.

The new control systems that have been outfitted for the coal boilers fully automates their operations. Operators in the master control room or at a remote control panel can use the HMI screens on the workstation computers to monitor and adjust the coal-fired boilers as well as the natural gas fired boilers. The only manual labor involved now is the periodic checking of the coal boiler fires to be sure they're burning evenly, with no hot spots. By being able to use the single control system to monitor all boilers, the facilities managers now have the ability to switch between gas or coal fired boilers as they need to. This lets them use the lowest cost energy on any given day, thus reducing costs for steam production for heating classrooms.

The same results have been achieved with the water chiller systems. These provide purified, chilled water to classrooms, laboratories and the University Hospital. Two large, 16-cylinder, gas-fired engines drive a pair of Trane chillers to provide 13,000 tons of refrigeration for chilling water. Using the natural gas-fired engines helps cut electric demand during the summer, when energy costs peak. In addition, by using a 3.5 million gallon thermal storage tank for underground storage of chilled water – so water can be produced at night, in off-peak energy cost hours – the university is able to trim another 1.7 megawatts of electricity off peak summer demand just with this one system.

Enhanced Power Management

In addition to the retrofitted utility systems, the university has built a new-from-the-ground-up utility station that has two massive new natural gas-fired boilers, plus water treatment systems for reclaiming condensate water formed as the steam cools in the facility heating system. The condensed steam or water is pumped back through the pipes to large

tanks at the central utility plant. It's then cleaned in "polishers" that remove any minerals and soften the water so it can be re-used in the boilers without causing any damage to them. Each of the two boilers in the central plant are the latest models that use natural gas most efficiently. Each one is capable of producing more than 150,000 pounds per hour of steam for the campus.

As happy as the university facilities staff is with the efficiencies and enhancements they've installed so far, one of the nice byproducts of the re-control project is that it's so easy to use. In fact, very little training was required for the engineers who use InTouch and IndustrialSQL Server. University personnel can now make all the needed changes in the process – raise and lower controls on boilers, turn fans on and off, control steam and chilled water distribution and everything else – all while sitting at the control room computers. The InTouch screens provide high quality graphics so that users don't have to visualize anything. It's all available to them on the workstation screens. In most cases, they don't have to leave the control room to take any control actions – and they can monitor any of their three utility plants from any of the control workstations.

When Utilities Director Wolverton reflects on the changes that have been made with the new re-control upgrade, allowing him and his staff to combine old equipment and new in a single, unified utilities operation, he is exuberant about the results the university has achieved. The university's total electrical consumption in a typical year is about 44 megawatts of demand. Using the new re-control systems to operate more efficiently has allowed management to shave about 7 megawatts off that demand level in peak summer periods – which is a 15% annual savings on a $12 million a year budget for electricity.

That should improve in the future as well. The utility group's plans call for expanding their activities to include electrical power co-generation facilities within five years. Wolverton and his team are laying out plans to add waste heat boilers to their existing systems, install a 25 megawatt steam generator and back this up with a pair of 15 megawatt generators to provide electrical generating capacity of about 50 megawatts for the university. When that project is completed, not only will the university be producing its own reliable energy in an unreliable marketplace, but it will most likely be able to generate huge cost savings by being able to sell power back to the public utilities that serve it.

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