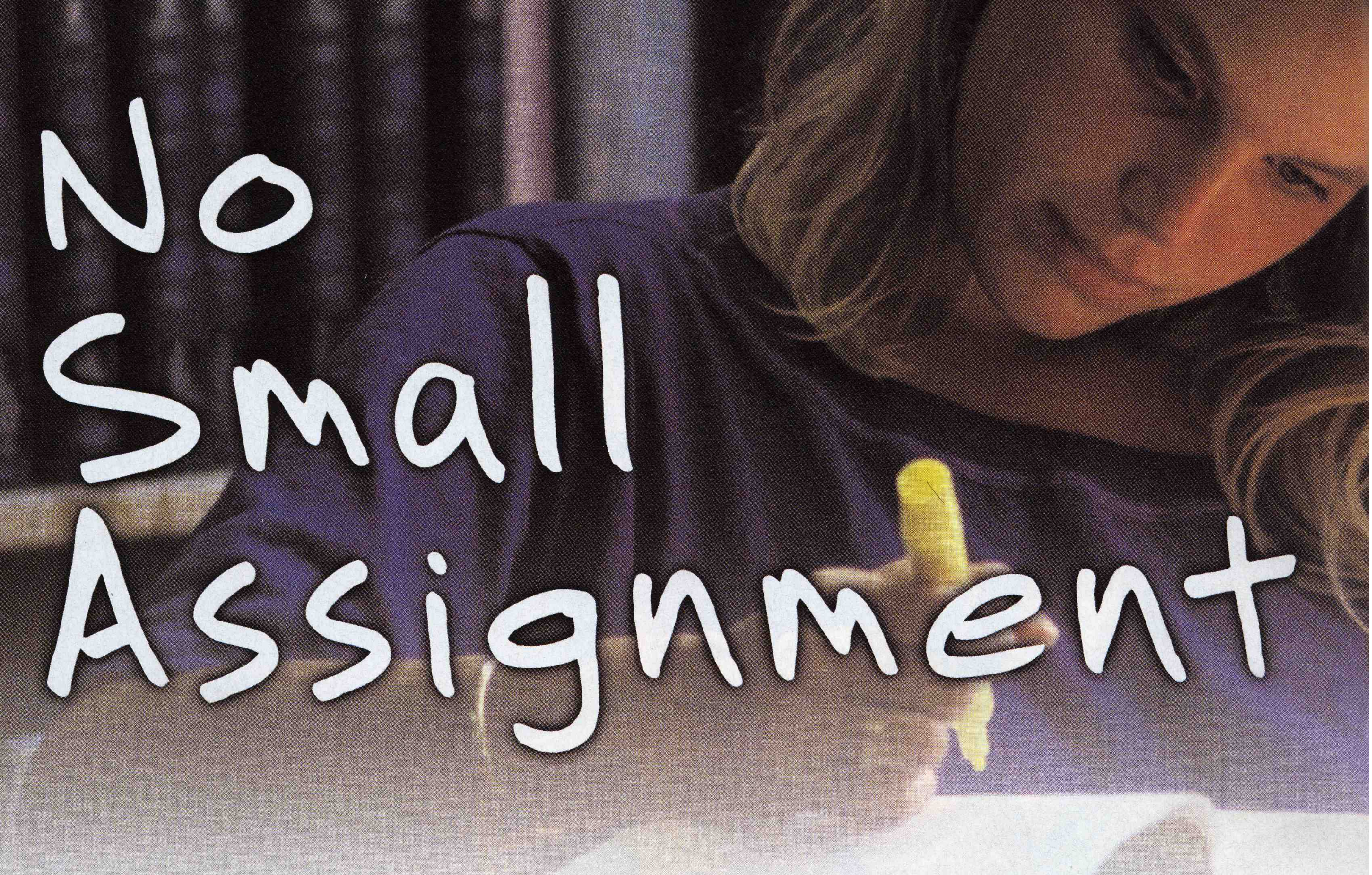
No Small Assignment



When the University of Arizona embarked on its integration project, it signed up for one tough course in controls, vendors, and protocols. The syllabus also included cogeneration, thermal storage, and even condensate return systems. Show your work by installing metering, then reconcile the BAS with the life safety system for extra credit, and that's the class.

BY JOANNA R. TURPIN

Like many other universities around the country, the University of Arizona in Tucson is trying to do more with less. A burgeoning student population is straining the infrastructure of the university at the same time the state keeps cutting funding for higher education. University personnel must be creative in order to maintain the high standards expected by the students and demanded by the community.

U of A officials decided that it could decrease its overhead costs by better managing its energy. This was a difficult proposition, as the university's 450-plus buildings are spread over a wide area and employ devices and systems manufactured by over 35 different vendors. These systems utilize protocols such as ModBus, LonWorks, and Simplex, so it would not be easy to integrate all the energy meters, fire alarm panels, HVAC equipment, and other devices to the BACnet IP network used throughout the campus.

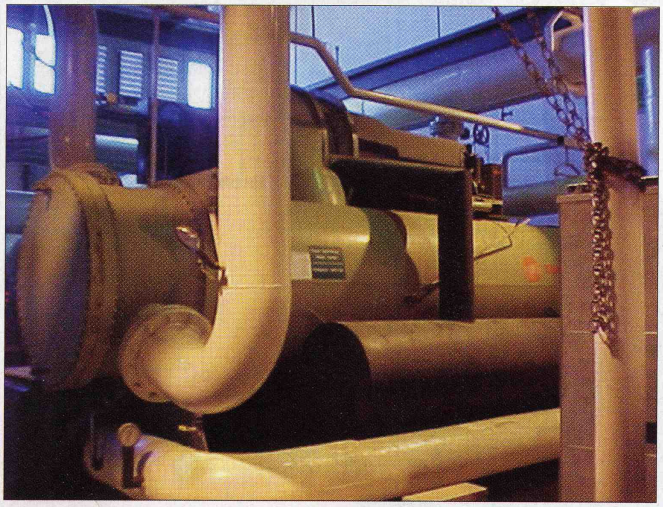
But the university was determined to find a way to manage the campus as a virtual single system, rather than operating each individual building and plant separately. In 2001, U of A embarked on an extensive retrofit and integration project, which would include incorporating the energy meters into the campus Supervisory Control and Data Acquisition (SCADA), which is resident on the BACnet IP campus wide area network (WAN).

The project would also involve integrating the information from all the other systems into the BACnet IP network. In addition, new mechanical equipment and extensive upgrades were made around campus. Three years later, most of the larger buildings on campus have been integrated into the network, and campus personnel are looking to the future to see what changes still need to be made.

CAPITAL IMPROVEMENTS

In 1999, U of A started thinking about how it could better conserve energy, but it wasn't until 2001 that the actual design and implementation began. Originally, the university was just going to convert two proprietary campus-wide energy management systems to a non-proprietary system.

"We analyzed both BACnet and LonWorks at the building level and determined that LonWorks was the right solution at the building level and BACnet was the right solution for the high end. Once we'd established where we were going to go, we were able to convert the two existing systems over to BACnet," stated Joe Branaum, manager of the Integrated Systems Group, Fire Safety and Security Systems Shop, Centralized Computer Command and Dispatch



The University of Arizona installed a BAS along with cogeneration turbines to quantify the money-saving improvements they made.

Center, and Facilities Management at the University of Arizona.

Branaum found that one of the benefits of moving to BACnet was the fact that the university can reuse many of its existing sensors. "We're taking some heat detectors from the fire system that gives us real-time data, and we're mapping that into the energy management system. We now have, for example, fire alarm systems that control the air handlers and raised floors. BACnet has given us the ability the reuse whatever has the most intelligence at any given location to get the job done. We can also lose multiple layers of infrastructure and still have everything run as planned."

Analyzing the BAS almost meant taking a look at U of A's three production plants, which generate chilled water, power, steam, deionized water, and domestic water. The analysis showed that changes should be made to the existing plants, so through a request for qualifications, the university chose Trane to upgrade all three plants. Trane uses BACnet as its native tongue, which worked out well with the university's move to a non-proprietary system.

The retrofit involved the installation of new Trane chillers and controls, which were in addition to the university's existing York chillers. Several boilers were removed and some were upgraded, and cogeneration turbines were installed, which produce both power and steam.

"Those turbines have been a big benefit for the university, because we're buying gas for those at a really good wholesale rate, and we're harvesting steam from them," stated Branaum. "We also added an ice plant for thermal storage, so that we can base load one of our turbines all the time by coupling and decoupling the chillers from it, so that we can make ice whenever we need to balance our load, then draw off the ice to help reduce our peak consumption."

TYING IT ALL TOGETHER

Once all the new equipment was in place, the university found that it had no way to quantify any of its money-saving improvements. As a result, the next step involved incorporating real-time metering data into the automation system so that university personnel could better automate plant production and building consumption.

After evaluating all its options, the university decided the utility metering would use ModBus RTU for the communication language. Veris Industries provided the power meters, and Controlotron and Metron-Farnier would be used for the liquid meters.

In order for university personnel to bring the information provided by these various systems into the Automated Logic front-end system, the data had to be converted into BACnet. FieldServer Technologies was able to convert the LonWorks building data and the ModBus energy data into BACnet through the use of its "FS-B4010" bridge.

According to Steve Ferree, vice president of marketing, FieldServer, the installation involved running the wires from the legacy systems to the FieldServer FS-B4010 then connecting the FieldServer to the BACnet network. "They had to program the FieldServer to map the data points from one protocol to another, then commission the devices, test each device for communication to the FieldServer, and then test the communication from the device through FieldServer to the web based SCADA network."

Once that conversion was finished, the university asked FieldServer to also incorporate the Simplex fire alarm infrastructure. That took some tweaking, noted Richard Theron, business unit manager, FieldServer. "Some of these buildings are fairly remote, and it didn't make sense to run a cable out there when an Ethernet network was already in place. We put a FieldServer bridge at the remote building, took that data through the field and the bridge, through the Ethernet network, and then put it back out again into the fire alarm panel network."

Based on NFPA rules, FieldServer is not allowed to take information from a fire panel and cause initiation or suppression of the alarm system. "However, FieldServer can take the information and provide it to the building control, so that when a fire or smoke [event] occurs they can make adjustments in pressurization due to ventilation, or simply just have that information available in a central panel, so people know what's going on," noted Ferree.

All of the different systems and protocols are going through the FieldServer bridge and into the Automated Logic system. Right now, there are about 1.5 million data points that the university is processing each month, and it's adding about 7,000 points a month.

Collecting all this data has given Branaum a much clearer picture of how energy is being used across campus. He is now able to see exactly how much energy is being utilized by each building, which has led to some surprises. For example, some buildings he knew were large energy users, but the data have shown that some buildings use two to three times as much energy as Branaum originally thought.

This information is now being used to best determine how a particular building can cut back its energy use. This may include anything from air filters being changed more often to changing inefficient valves or replacing faulty heat exchangers. One of the biggest finds to date involves the check valves on condensate return systems.

Branaum and his staff found that the valves were letting the water flow out the pipe and then go right back into the tank. This resulted in the pumps turning on, pumping the water down the pipe, then the water flowing right back into the tank as soon as the pump turned off. Not only was this wasting electricity, but the condensate was not returning at the appropriate temperature.

"The water was just moving back and forth in the same pipe in the building before it even got back into the return system, so it was heating up the building, and we had to use chilled water to cool off

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Officials at the University of Arizona have campus-wide control of the BACnet system recently installed. The capital improvements were financed through performance contracts.

the building. We were losing the maximum amount of energy possible on that little exchange, and something as simple as a check valve fixed the problem," stated Branaum.

This problem was caught thanks to the design and method of installation for the university's new condensate meters. Personnel could immediately see the problem and then get it repaired. "You start adding that up across buildings, and that turns into an impressive amount of energy that we were losing and that we're now able to identify the problems immediately and correct them."

Thanks to these problems being identified and fixed, Branaum estimates the university is saving $100,000 to $120,000 each month in energy costs.

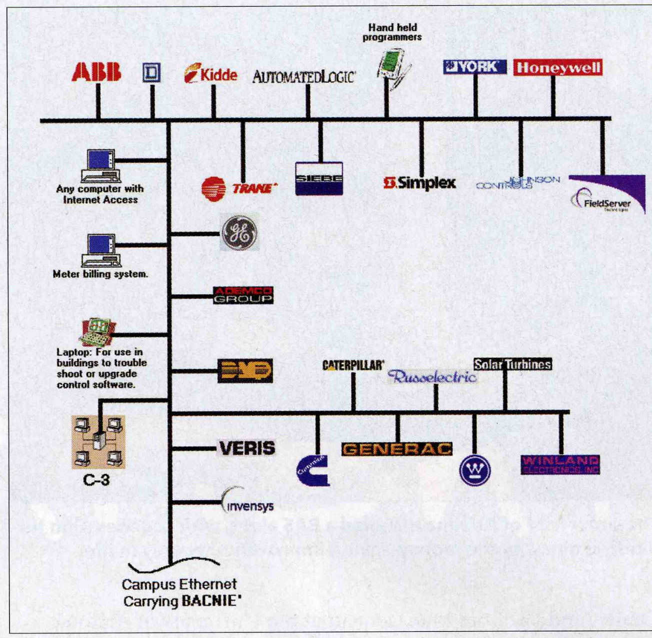
THE PAYOFF

So how could the university afford such expensive upgrades during a time of belt-tightening? Mostly through performance contracts. The initial investment, which included some basic software and hardware, was approximately $22,000. From that point on, however, every retrofit or upgrade was based on energy savings.

"We're either paying for the financing from the energy savings, or we decide where energy savings will be and then invest the money upfront and get a return on it. We've aimed for a five-year payback across the board. Our best payback was two months and our worst payback is probably seven years," said Branaum.

The U of A has 490 buildings spread out across the state of Arizona and currently 77 buildings have undergone some level of conversion, whether it's fire, energy management, security, lighting control, or utility metering. That may sound like a small percentage, but it's important to note that many of the buildings are small, so extensive upgrades will often not provide a good payback.

According to Branaum, those 77 upgraded buildings represent 98% of the major buildings at the university. Even though he admits that he may not be getting all the information he wants out of those buildings yet, he's getting much more than he's ever received in the past. "If we were to compare where we are today to three years ago, three years ago we were using stone knives and bearskin rugs and now we're running on computers. It is a lot better," he said.



Campus-wide systems are tied into the University of Arizona's BACnet BAS. This has given officials a clearer picture of how energy is being used across campus.

Obviously, if energy costs increase significantly, it may be cost effective to upgrade some of the small- to medium-sized buildings. Deferred maintenance also plays a role, because sometimes maintenance has been deferred so long that the equipment has gone into a replacement cycle. Whenever it is time to replace a component, it is upgraded at that time.

The next challenge for Branaum is determining where the university infrastructure will go in the future. He says it is a challenge, because technology is constantly changing, and the goals and missions of both the state of Arizona and the U of A are changing and evolving as well.

"My goal is to be able to forecast both production and consumption energy five days out," he said. "Right now we're forecasting about five hours out, but as we store more data and adjust to the environments of the real world, I think we're going to hit that goal. I think it's a good goal to motivate us and keep us pushing ahead."

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Turpin is ES' contributing editor.