

# Thermal energy storage is a UA success

By Karen R. Smith

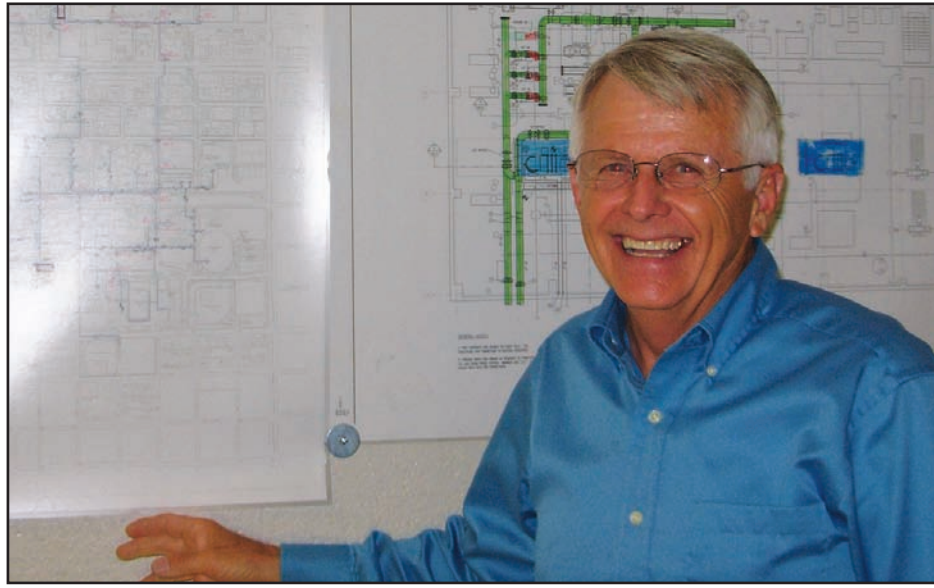
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Gordon Bush doesn't look like a farmer, yet each day he harvests 15,000 ton hours of ice. That ice is used to cool classrooms, labs and even the hospital at the University of Arizona during the heat of the day, when electrical rates are highest. Put simply, that's what thermal energy storage (TES) is all about.

UA's quest for a more efficient system began with monitoring electrical use over an extended period. "Our on-peak usage was considerable," Bush recalls. The Facilities Management team began investigating possible solutions. Ultimately, they selected TES as the technology, and chose Calmac Manufacturing's Ice Storage Tanks as the means to achieve their goals.

The tanks worked so well that they added a second group after the first, enlarging the ice storage capacity and increasing savings. In the process, Bush and his co-workers created one of the world's largest chilled water systems – over 5,000,000 gallons – which can be pumped at up to 62,000 gallons per minute. Engineers and designers from around the world visit the University to see this system up close and to learn how it evolved from the folks in the Facilities Management Department. Some of those visitors return to their home universities and replicate the UofA's design because it's efficient, environmentally friendly, adaptable and expandable.

Pointing to a map of the University, Bush explained the scope of the project. Everything starts with water and pipes. The school's expansion was rarely (if ever) in a straight line; some buildings were constructed with their own self-contained heating and cooling systems, while others needed to be hooked into the existing network of pipes, cooling towers and boilers – as well as the chilled water grid and the steam lines. There are three hydraulically connected central plants on the campus.



PHOTOS: Karen R. Smith  
Gordon Bush explains the massive scope of the University's cooling system (above) and, in the photo below, stands in front of the massive thermal storage tanks on campus.

Thanks in part to the TES system, ongoing maintenance and regular upgrades are continuous and non-intrusive so reliability and capacity are assured. The direct savings attributable to the ice storage system were easy to chart and the installation would have paid for itself in three years...would have, right until Bush realized that a former church abutting the tank site couldn't be torn down or moved. Turned out the building was a Joessler original, created for the Seventh Day Adventists in the 1920s. Bush (a native Tucsonan) remembered attending Bible Camp there as a child. "Although I hadn't originally planned for it, it turned out to be very gratifying to do the renovation on this lovely old building," he said, despite the fact that the cost of it skewed the return on investment (ROI) for the ice system. "It brought the ROI up to more like six and a half years," Bush said.

Thermal energy storage isn't a new technology. In fact, in its simplest form, TES was

practiced by Romans during Caesar's time. Winter lake and river ice was cut into blocks and stored in deep mountain caves. During the hot Italian summer, the ice was delivered to homes, where it was fanned to create cooling breezes. It's also how the Romans came to invent ice cream, but that's another story entirely! Calmac's Ice Storage Banks have been on the market for over 30 years. Bush recalled, "I visited the factory and frankly, I was delighted by the simplicity of the process and the durability of the system. It's a tried and true technology, ideal for the UofA."

Electric utility companies charge different rates for the power they provide, usually based on time of day and supply. Here in Tucson, TEP uses a block incline rate structure. The first 500 kWh are billed at a lower rate than the next 3,000 kWh, which are in turn billed at a lower rate than the even higher usage of 3,501 kWh. In addition, TEP has on-peak, shoulder and off-peak rates. In the summer, peak is defined as from 1 to 6 p.m.;

the shoulder period is from 6 to 8 p.m. and off peak is every other time. The rate for off-peak use is 5.8 cents per kWh; the on-peak rate is 300 percent higher at 18.4 cents per kWh.

Today's TES systems create large quantities of ice during off-peak periods when power is least expensive. That ice is used to chill cooling system water during the on-peak and shoulder periods. Moving the largest portion of a building's moveable load to off peak results in savings of roughly 40 percent on electric bills. In addition, TES enables overall system downsizing in many applications (smaller chillers and air handlers, even smaller motors, ducts and pumps), recouping other savings in those areas as well.

At the University, where the power bill can be \$1.3 million a month, savings with TES amounted to tens of thousands of dollars. There have been no problems of any kind with the 204 ice tanks, and the annual maintenance simply consists of adding a small amount of biocide. "Here in the desert, these tanks really work beautifully," Bush summed up.

Author: Karen R. Smith is a local freelance writer.



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