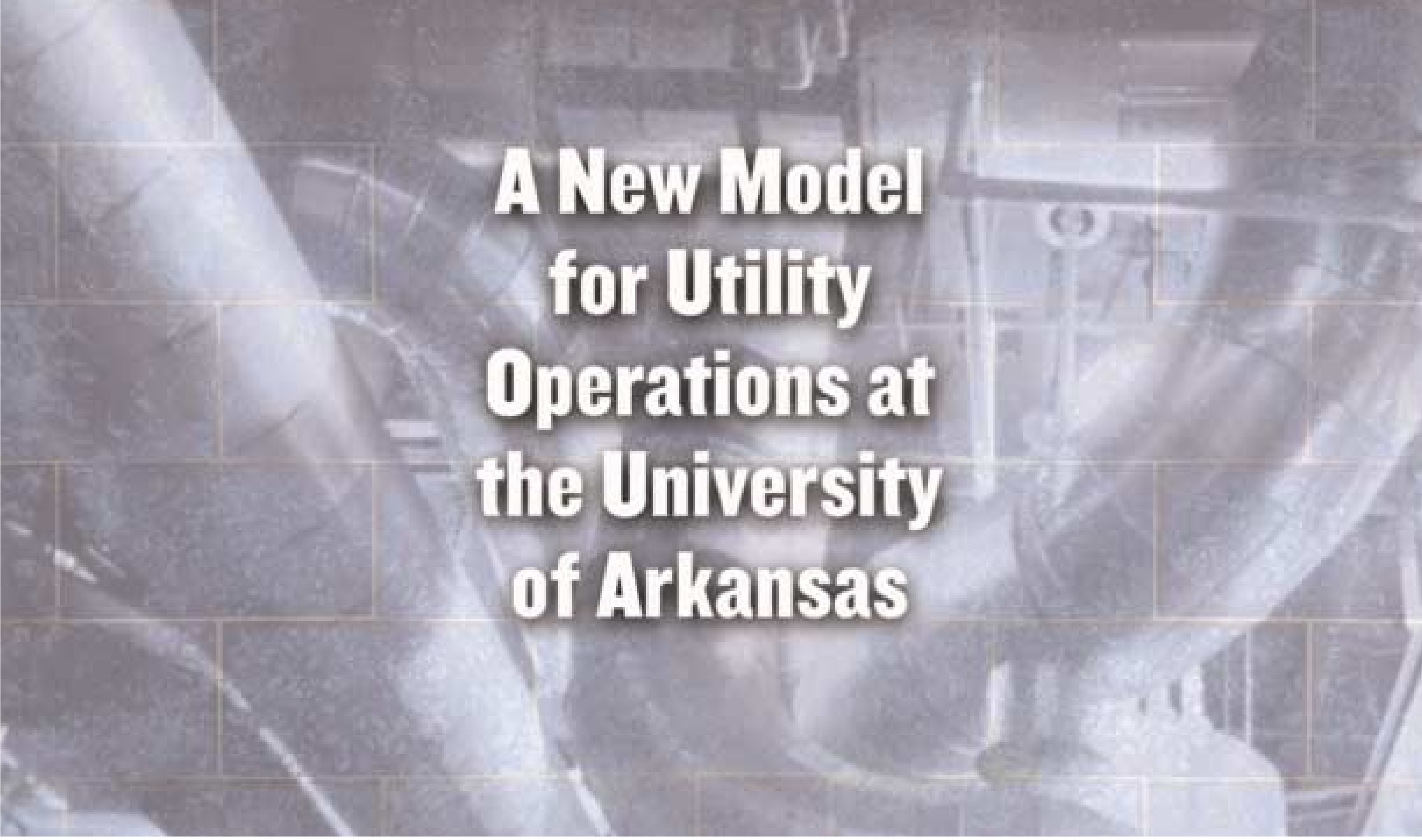

A New Model for Utility Operations at the University of Arkansas

by L. Scott Turley

Let's face it—addressing the growing list of deferred maintenance projects is one of the most difficult challenges we have as campus facilities managers. Within Utility Operations, the problem can be even more acute as our work is often out of the limelight. The impact of water dripping on a faculty member's desk will get first priority—that is, of course, until the lights go out or the air conditioning fails on a hot August afternoon. But for the most part, as long as our facility staff continue to work their magic and keep the utility plant and the HVAC (heating, ventilating, and air conditioning) systems functioning at acceptable levels, the only causalities are likely to be the utility budget and some sleepless nights on behalf of yours truly.

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The Rubik's Cube that is Deferred Maintenance Funding

The cold hard truth is that investment solves capital renewal and deferred maintenance (CRDM) issues. You can insert your own favorite cliché at this point about something for nothing, but it takes resources to address needs. If your organization has no hope of obtaining some form of financial support, then this article may not be of great help. But if there are resources out there, be they operating funds, revenue bonds, or performance contracts, then I think we have a story to tell that can help you convince the decision makers in your organization to support investment in your utility systems.

A Business Model for Campus Utilities

As the team responsible for utility system operation at the University of Arkansas began to take a hard look at the factors keeping us from making a quantum leap in improving energy efficiency, we faced the fact that we had a credibility problem with our administration. It was not as if we were using the "Enron Guide to Utility Management," but we needed the university administration's support for a major investment in utility infrastructure. They needed confidence that investment in these unseen capital assets was a fiscally responsible use of our limited capital resources and was in direct support of the university's mission and objectives. We needed a new game

Growth drives water and sewer infrastructure needs

plan for energy management and utility system operation.

Zen and the Art of Motorcycle Maintenance was a pop culture book from the 1970s that encouraged thinking in terms of the whole, not just the component parts. In the case of Utility Operations, we began to think not of chillers and air handlers, or in terms of the utility plant operators or HVAC crews, but as a whole team-driven enterprise that produces, distributes, and consumes energy.

One organization has "burner tip to air register" responsibility. Simple in concept? Sure it is. Common sense? Absolutely. Easy to put together and implement? Well that's a different matter….time will ultimately measure our success. But what I know is that over the past several years an integrated plan has emerged that combines targeted capital improvements, reinvestment of energy savings, and a hybrid organizational structure that is fundamentally changing Utility Operations here at the University of Arkansas.

The most crucial and distinctive change has not been the physical improvement program but the philosophical restructuring. The Physical Plant Department, in effect, has adopted an entrepreneurial business model for its Utility Operations. After all, we are a $10 million a year company for the university! This business unit within Physical Plant purchases raw utilities and delivers electricity, steam, and chilled water to 85 buildings and across six different customer groups.

The unit has developed rate structures for each utility, analogous to a public utility, and treats all customers the same, regardless if they are academic, housing, athletics, or other auxiliary operations. The new rate process provides financial incentives for energy efficiency, and sends monthly price signals on the cost of energy to encourage conservation. The result is a clear pattern of cash flow and cost allocation that clarifies the value utility operations provides to the campus, and greatly assists in explanations to the administration of what systems need improvement.

Strategic Utility Planning

Our first tasks were to develop a vision of what we wanted our utility operation to be and a roadmap that laid out the necessary utility infrastructure projects to get there.

In 1998, Chancellor John A. White called for creation of a campus master plan to support the university's academic goals. The campus master plan basically told us how much space was needed (square feet), what type of space it would be (research, office, classroom), and where it would be located on the campus. Armed with high-level information about future space requirements, Physical Plant began working with GLHN Architects and Engineers in 2000 to develop a utility infrastructure master plan. The full implementation of the utility development plan would require about $50 million—$26 million for existing utility infrastructure improvements, and the rest to accommodate student and programmatic growth. The sidebar on page 46 lists some of the specific projects that resulted from the utility master plan.

Besides the intuitive benefits of planning our infrastructure growth, there were two specific issues the utility development plan brought to light:

- It brought into focus for our administration the associated cost for infrastructure to support the academic plan. Now the academic mission is linked to enrollment, which is linked to facility needs, which is linked to specific infrastructure projects and associated capital costs.
- A less obvious result was that by linking the utility and growth plans together, the Administration is motivated to build out specific areas of campus just as a subdivision developer would, in order to maximize the value of their investment in utility infrastructure.

New 600-bed housing, dining, and commons complex

The Perpetual Financial Model

The second element of the new organization involved changing the financial perspective of Utility Operations. We needed accounting processes that clearly showed our admin-

Main chiller plant: the far tower will be replaced in 2004

Boiler controls slated for replacement using CRDM funds

istration where the utility dollars were going, how specific investments were linked to the overall campus energy management effort, and reporting tools that documented the effect of the investments. The new plan involved more sophisticated utility rate schedules, implementation of a new automated metering and accounting system, and financial separation of the utility operation from the general facilities budget. No longer are utility dollars comingled with general Physical Plant operating funds, so financial and management accountability is clearly maintained. But the more significant financial changes were a result of this new holistic approach to energy management. The key features were an ongoing capital funding stream for new construction and a perpetual infrastructure renewal plan.

With this new level of financial accountability, the administration had confidence to "invest" in this new company, to the tune of $23 million in bonded capital for expansion and system replacement over the last four years! Note too that holistic planning takes a long-term commitment by decision makers, as utility infrastructure has a useful life of 25 years or more. Donald O. Pederson, our vice chancellor for finance and administration, and Leo Yanda, director of physical plant, emerged as strong advocates of the utility

Main chiller plant: 1969 vintage 2000-ton machine slated for replacement

New main plant air compressor

reorganization plan and the need for significant renewable investment.

These bonds are being repaid in one of two ways:

- New construction pays for new capacity.
- All utility customers pay to renew the overall utility system.

Regarding the utility master plan list of growth-related projects, each new construction project pays a "remote utility fee" based on the energy demands it will place on the district utility system. Capacity is not free, and our consultants know to include these charges as a part of the project budgeting process. The connection fees are set to reflect the value of the boilers, chillers, etc., that a project would normally have to fund were it a stand-alone facility. The growth triggers the necessary funds for the utility systems to keep pace.

The annual payment on the bonded debt to renew existing plant capacity or distribution assets is included in the utility rates as a debt service charge. That way everyone on the system helps support its energy efficiency and reliability. Because E&G (Education & General) is by far the largest customer of Utility Operations, it is noteworthy that the university administration showed 0their commitment by placing the annual

Southwest Chiller Plant condenser pumps

debt service for bonds into the utility rates in a time of tight budgets.

This addressed the "burner tip" in terms of production and distribution systems, but what about the "air register" aspect? We cannot optimize the energy management loop unless we address the building-side systems. We needed to establish an ongoing building mechanical system renewal stream as we did with plant and distribution assets.

Physical Plant had been undergoing a reengineering effort that included transitioning to a zone maintenance concept. In order to staff the zones and establish a facility condition baseline, the consulting team did a facility condition assessment, which included an equipment inventory and a cost estimate for the related CRDM backlog. This gave us the missing piece of the perpetual financial model—which is that we need to invest $1.2 million each year to keep our building mechanical systems performing at high efficiency.

Energy efficiency gains from the physical improvements to the plant and building systems now on the books will fund roughly half the building-side CRDM need. Again our administration has committed to "boot strap" the difference in the short run. Over the next five years, we expect that this ongoing mechanical system CRDM investment, implementation of continuous commissioning, and further cost reduction efforts will allow us to effectively self-fund ongoing needs and protect the efficiency gains we will have worked so hard to achieve.

A Hybrid Organization

Finally, we needed an organizational structure that gave our technicians and operators the best opportunity for success in implementing this aggressive energy management program. It only made sense if we were looking at the utility systems as a whole that this would be reflected in the organization. Again working with our consultants, we considered several different structures of how to integrate HVAC and utility staff into one

An Array of Energy and Utility Improvements

The University of Arkansas Utility Master Plan identified a wide variety of needs, opportunities, and growth-based projects. Many of the plan's improvements have been accomplished, but many more remain to be done. The primary components of the plan, and their approximate costs of implementation, are:

- **New Southwest Chilled Water Plant:** $7 million. The plant has 3000 tons of high-efficiency water chillers, variable-primary pumping, variable-volume tower water, hydronic free cooling, and new distribution infrastructure. It includes an open-protocol control system that allows communication between equipment purchased from different manufacturers.

- **Automated Metering and Cost Allocation System:** $1 million. A combination of metering, software, and hardware integration that will allocate all utility-related costs to users in a manner that provides prompt and accurate price signals and incentives for good behavior. It further provides real time tools for energy monitoring and continuous commissioning.

- **Consolidated Energy Procurement:** Purchasing of electricity and natural gas for all users on campus has been consolidated to achieve significant savings by reductions in coincident energy demands (not all facilities peak at the same time) and by taking advantage of declining block-rate structures (bulk purchasing lowers unit costs). Along with the consolidation of procurement, the university continues to hedge gas costs by purchasing futures contracts.

- **Central Chilled Water Plant Renovation:** $9 million. Replacement of an inefficient 3000-ton water chiller with two new high-efficiency chillers, conversion to variable-primary, variable-volume tower water, and replacement of the plant control systems.

- **Building HVAC Conversion to High Delta T/Low Flow:** $3 million. A retrofit of the entire chilled water system based on a system hydraulic model, replacing control valves, upgrading building control systems, modifying coil piping and modifying pumping systems. The changes will increase the chilled water Delta T (the differential between outgoing and returning water temperatures) from 10 degrees F to 16 degrees F, substantially reducing pumping energy and improving occupant comfort.

- **Cooperative Performance Contract with the Athletic Department:** $3 million. Still under negotiations, this contract will fund retrofits for lighting, controls, HVAC, connection to campus district utility system, and more in Athletic Department facilities. Under a special-rate utility contract, Utility Operations will "buy" a 1600-ton chilled water plant from the Athletic Department and operate it as a part of the university's district system.

overall utility operation, yet still respect the need to establish zone maintenance shops. To that end, the separate functions of the Heating Plant (production and distribution) and the HVAC Electronics Shop (building controls) were merged into a new unit, Utility Operations, that truly has "burner tip to air register" responsibility.

Each maintenance zone still has HVAC staff to allow prompt customer response, which is one of the hallmarks of the zone concept. But since the digital controls and central building EMCS (energy management control systems) monitoring is a part of the utility plant operation, we can more effectively manage the effects of building system alteration, field retuning, or emergency triage, and monitor the consequences on the energy efficiency of the system.

Where Utility Operations is Today

Our first major phase of new construction has been completed with the start-up of a new 3000-ton chilled water plant that will save us $200,000 a year in natural gas costs. A total of $4 million in new distribution infrastructure, water system improvements, and power grid capacity upgrades are in the ground to support current master planned growth. In early 2004 we expect to bid for installation of 4500 tons of replacement chilled water capacity that should yield $125,000 in electrical savings. Also, a comprehensive controls and metering project will improve chilled water Delta T, yielding an additional $150,000 per year. At the completion of all programmed system and building improvements, we expect a total annual savings of $600,000, which will be reinvested back into the mechanical systems to retire building CRDM.

I would like to tell you that we are all old hands at this new management paradigm and that the experience has been a rousing success. The truth is that we are just getting started. By the time you read this, we will have had our new team together for about a month. Much work remains to set up the accounting processes, to automate our reporting systems, and set up our ongoing CRDM program. Being a fan of military history, I have often said that large gains in energy efficiency can be had by waging large-scale epic battles with capital investment, but it is the day-to-day trench warfare of maintenance and operation that hold those gains. We've learned we must do both to be successful.

In summary, we now have an ambitious plan of what we need to do, a means to pay for it based on a real commitment to facilities by our administration, and a group of talented employees to make it all happen. I think I'll sleep much better tonight!