

For many years, Valparaiso University Physical Plant Services staff has worked at energy conservation and management. We have been able to flatten the increased consumption in natural gas and electric consumption even while adding renovated and new buildings. We continually look for opportunities to advance plans awaiting the right time to proceed.

There are certain constants that most institutions wish to achieve: be more efficient, decrease deferred maintenance, fund future known maintenance needs, improve customer service focus, and provide system reliability. Fundamentally, all of the paths save money or allow reallocations as a by product of reducing and simplifying an operation. "Plan the work—work the plan" is the overarching theme.

### Project 1

Because we continually evolve and develop our strategies, Valparaiso University (VU) was able to take the maximum advantage of opportunities in 2005-06. Our staff spent a year working with a design team planning new natural gas and high voltage electrical distribution systems. The desired outcome would be that the university would no longer own nor maintain the natural gas, the high voltage system, nor the substation.

### Project 2

In October 2005, as the heating season was just beginning; our first heating distribution system leak of the season occurred. Leaks in this system had been occurring over the previous five winters because the system was deteriorating. Our president stated he wanted a recommendation for a way to replace the heating distribution system as soon as possible, with the understanding that a way would be found to fund it, but it had to be operational by October 2006. Two events—

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# OUTSIDE THE BOX: Reduce and Simplify

by Frederick W. Plant



construction of a new natural gas system and the failure of the heating distribution system—had converged.

### Project 3

For some time, we had been considering the reengineering of our Physical Plant Services trades shop from several small shops for each trade to one maintenance shop. Events occurring relative to the new gas, electric, and heating system changes, coupled with several vacant positions, made the timing right to make this change as well. The replacement of the substation, high voltage, and natural gas systems were going to reduce the full-time equivalent staff required to maintain these systems, allowing these individuals to have a much greater focus on routine and preventive maintenance.

### The Convergence of Projects 1 and 2

The planning for a new high voltage system, substation, and a new 50-PSI natural gas main to all campus buildings was about to begin construction and was to be completed before August 2006.

This created the option for us to install high efficiency boilers in the 15 buildings served by the heating system and thereby to eliminate the 45-year-old boiler house.

The boiler house had been maintained well. Several boiler efficiency features had been added such as: electronic ignition, tube turbulators, stack sensors, energy management, aggressive management of system pressure and temperature. Our campus is southeast of Chicago in an area that has air pollution controls, thus stack emissions were monitored carefully. One of the boilers was a dual fuel (natural gas and fuel oil), thus a 20,000 gallon underground storage tank is present. This is our last UST on campus and is in the path of a future campus road project.

The boiler house operation had several operations of FTE, cost, and risk exposure. These systems require boiler water feed and chemicals, and in our area they also require the water to be softened. The distribution system also was chemically treated and the makeup water softened. The aspect of water treatment creates a potential for employee exposure to chemicals and accidents from heavy lifting. We used nitrogen

to maintain pressure on the system requiring the monitoring of volumes, switching tanks, and tank exchanges. There are costs for the consumption of electricity for the circulation pumps, pumps inside the boiler house, pump and motor maintenance. The boilers were annually cleaned, serviced, and inspected. We maintained an alarm system that provided pager signals 24/7.

The heating distribution system was a jacketed direct buried system in large part. It was of various vintages and the cathodes protection was largely spent. Such a system had manholes where valves were maintained and had to be pumped out from time to time. Another aspect to this system was the confined space requirements, training, and equipment that had to be accomplished.

System failures were occurring at the rate of one to three leaks per year. Since these occur during heating season, the impacts on residence halls as well as classrooms/offices was extremely disruptive. These leaks were costing from \$80,000 to \$280,000 per failure and were difficult to budget and were a significant distraction to staffing efforts. These repairs left scars on the campus landscape at a time when there is a focus on campus beautification. Even though insulated, the system heat loss was sufficient to melt snow and kill grass.

of the heat system down paid for the chiller in three cooling seasons.

Thus timing, opportunity, boiler efficiency, eliminating the last UST, and getting the distribution system out of the way of potential future construction all led us in the direction of a decentralized system.

Installing the high efficiency boilers, a decentralized system, seemed the best route.

In most of the 15 buildings space is available in the mechanical rooms. In those buildings where space was not available, it could be made available. The second task was for Valparaiso University to identify the boilers, their operating characteristics, warranty, factory willingness to install and train our personnel, and to meet our delivery schedule. This selection process included site visits for each supplier being considered.

It was critical these be condensing boilers, at least one set had to operate at temperatures to satisfy an absorption chiller. All controls had to allow connection to our energy management system and had to operate in groups. The objective was to develop a controls package that kept all units working in their highest efficiency range and to allow boilers to be added in the future if there was a building addition.

Courtesy Valparaiso University



We considered rebuilding the distribution system, but to take full advantage of the new life expectancy, the boiler house should also be updated. The cost to update both was beyond our financial capability. The lead time to develop plans for both was greater than the one year available. A new distribution system might be constructed along routes that would be considered for future building construction. Further, the ability to update a central boiler house might require additional real estate, the continued maintenance of the UST, and the maintenance of emissions permits.

The most attractive option was to decentralize heating production to the 15 buildings. This could be done in the time available. We knew from previous engineering studies that technology had improved package boilers in terms of size and efficiency. We also knew that we could quantify the range of heat loss in our distribution system. Two years earlier we had replaced an absorption chiller with a DX unit with no cooling tower, the financial savings paid by being able to shut that leg

This strategy provides boilers that are much easier to service and manage. The redundancy at each locations provides a spare parts inventory for emergencies. This strategy allows the reallocation of labor. These boilers are sort of “plug and play” in that the diagnostics gives us a pretty good idea of the component part that needs to be serviced or changed. This strategy eliminated all of the UST, emissions, chemical water, water softening, and confined space issues.

As a result of the new natural gas and electric systems, every building has pulse metering. Valparaiso University has access to these pulses so that we can capture real time consumption data. The energy management system allows us to identify and manage each building's consumption. As a result, we have the ability to measure the actual gas consumed by these new boilers.

Physical Plant Staff developed an RFP to pursue the decentralized system. The RFP specified condensing boilers that operated at 95 percent efficiency over a wide load range.

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The burner specified to have a 20-year life expectancy, factory start up, and factory training. Each site had no less than two boilers sized so that with any one boiler off line the remaining boilers could carry 70 percent of the load. The boiler controls to be programmable to allow load shifting between the boilers to maintain maximum efficiency. The boilers had to fit into the existing spaces without modification. Stack location had to be approved. (This could mean the boilers could be taken apart to arrive at the space, but in that instance, they had to be re-assembled by factory representatives.)

Installation sequence was important as one system had to be capable of absorption cooling, thus it had to be operational by May 2006. Residence halls had to be operational by August 2006, and the balance of the buildings by October 2006. The project had to be coordinated in terms of schedule, contractors, and paths with the natural gas and high voltage projects. All of this work was concurrent with all the same mechanical and electrical rooms as destinations. All respondents to the RFP had to attend a pre-bid meeting and walk through.

The RFP sought funding options that would allow the university to examine options as a performance contract and/or financing rates. This was also a means for respondents

to explore partners that might give each a particular advantage. To aid in this process the university provided unit costs for utilities (since this was changing as a result of natural gas and electric projects). Valparaiso University provided respondents with current system operating costs except we did not include labor or installation costs as those were being reallocated. Each respondent was to calculate the cost of operation of this new configuration and approximate payback. Each respondent was to offer the university financing options such as a Performance Contract, as a financed project, or cash where the university would secure its own financing.

Three firms completed the process. Our staff met with each respondent for: careful scope reviews, careful checking of delivery dates for the boilers, and careful checking of natural gas/electric project progress.

### Project Outcomes

This project has a guaranteed payback in seven years (consistent with our in-house estimates), which depends on the price of natural gas as well as the severity of winters. The project costs were financed independent of the contractor because of more favorable rates. Central boiler house distribution and distribution system were decommissioned in May





2006. The central boiler house is now being considered for a retro fit to some other purpose...sort of "found space."

Component parts are being offered for sale to help offset the costs. Boiler and system chemicals reallocated to other buildings or returned for credit. A portion of the boiler house is being used as a contractor office for another project (reducing the general conditions cost on that project). Removal of all manholes is now underway and with that maintenance and confined space issues. The distribution system path is being worked and seeded in some locations, while in others the system is being dug up and used to route a new water main. Parts of the old high voltage system route are being used for this new water main and a new section of the storm sewer.

The deferred and planned maintenance for the boiler house and distribution system have been removed from our ten-year capital plan. There is a Physical Plant Services operating savings because of this shift with a non-PPS savings in insurance premiums that are funding the project. The budget uncertainty caused by the large breakdowns from this source is now eliminated.

The "freed" labor is now available to service the new buildings we are adding and the new high efficiency boilers. We reduced our regulated exposure (UST and air pollution), confined space, and reduced our employee exposure to chemicals for boiler water treatment.

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### Natural Gas and Electric Replacement

The university owned its natural gas, substation, and electrical distribution systems which were, in large part, 40 to 50 years old. The system had some sections and components replaced in the last ten years. A consultant assessed the system as at its life's end. The natural gas system operated at 10 PSI and did not have capacity to add the anticipated future projects. The electric system was a 4160-volt system that was increasingly experiencing component failure resulting in at least single building outages about one time every six weeks and a circuit failure about three times per year.

The system was near its maximum capacity. The 4160 system was underground with switches and link boxes in manholes. Keeping manholes dry and confined space entry permits/training were a constant task. The university did not have sufficient staff or equipment to effectively maintain the high voltage or natural gas distribution systems. The universi-

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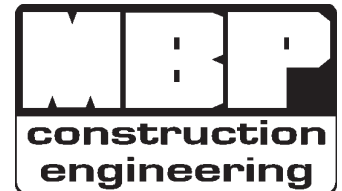
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ty did not have the necessary equipment or expertise to repair the natural gas distribution system. Both of these systems were resulting in large energy expenses, maintenance expenses, and service interruptions.

For about five years we looked for a partner who would:

- Provide the cash to replace these two systems.
- Provide the maintenance for these two systems.
- Bill us monthly for the capital investment, maintenance, and consumption.

The intended outcomes of our search had been to establish a larger substation at a higher voltage (12,500) and to establish capacity in both natural gas electric systems to service our facility's growth potential. Further, it was our desire to transfer the cost of labor to an outsourcer that was properly trained, equipped, and could manage the spare parts inventory to maintain reliable services. This would allow Physical Plant Services to reallocate our labor to a focus on our core mission. Secondly, personnel could focus on the maintenance of our existing buildings and the new/renovated ones planned.

Eventually the partner who presented the best opportunity was our local energy provider who provides both electricity and natural gas from a subsidiary of this provider. This provider had been the successful bidder in recent natural gas transactions. Electricity had been provided to the university substation via a single feed from their grid.

In order to advance this discussion Valparaiso University would grant a site for a substation to be owned by the provider along with all of the necessary easements via paths defined by the university. This substation would be served by two sources and would provide service to the neighboring community. The campus would also have the potential for service from a second existing substation from a third source.

Natural gas and electricity would be routed to each and every building. The capacity of the system would allow the construction, renovation, additions to all of the university plans over the life expectancy of these systems. Valparaiso

University would move these two utilities into the building and connect. Since this work would involve several contractors and subcontractors; since the natural gas system had to be in place for the decentralized boiler project; since all of this had to be done before students returned in August 2006, schedule management and coordination would be critical.

The payoffs for the university were that several systems old systems were replaced. All electric and heating distribution system manholes were eliminated, and with that all the con-

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fined space and maintenance issues. Many of the hours spent in chemical water treatment are now reallocated. The new electric rate structure avoids most demand rates, power factor correction, and maintenance of a capacitor bank.

Clearly, a long list of deferred maintenance and future planned maintenance has been wiped away. Future capacity issues are now gone. Reliability issues are now gone. The capital investment will be repaid over 30 or 36 months depending on the item. The "new business" construction of a new parking ramp and university union will also help offset the costs. The new union could not have been constructed without these new utilities.

The provider and university are now working together to produce an electronic billing system that can be downloaded into our spreadsheets for purposes of utility analysis. The pulse metering and energy management now allow the university to monitor consumption by building and to explore working with building occupants to influence consumption.

Valparaiso University has been able to sell many of the old high voltage system components and boiler house components to offset some of the costs. As a windfall, recent copper price increases made it feasible to pull all of the old 4160 wire and sell it, to help offset project costs.

The payoffs for the provider include a new substation that serves many other customers. This substation real estate was free with no zoning variance issues. They have locked in VU as a customer at standard rate structures, which was an aid in their relationship with the state regulatory agency. They also have a clear sense of the future campus growth and their potential revenue streams. Our work with this provider will now include exploration and testing of some new technologies.

### **Convergence of Projects 1 and 2 with the Physical Plant Services Reengineering Plan**

With the changes discussed, it was possible to consider the reengineered organization for our trades group. Thus our carpenters (including painters and locksmiths), plumbers, electricians, and HVAC are now divided into two maintenance teams.

With the elimination of the boiler house, HTHW distribution, natural gas, and high voltage we could offer a different type of service. This now allows Physical Plant Services to hire personnel with more general maintenance skills. The buildings the university is now constructing and planning are far more high tech, but there is less potential to require an increase in the size of our workforce.

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The ability to shift our current talent to the new technology and reduce the time they spend on utilities and utility emergencies would provide improved ability to focus on our core mission, more face time with customers, and recapture a focus on preventive maintenance.

Our reengineered trades group is now a team devoted to maintenance and a team devoted to preventive maintenance, with approximately half of the staff on each team. Each team has a mixture of skills and experience. There are times when workers will move to the other team to meet some focused need. There is one billing rate for both teams, making estimates much easier to prepare and much easier to explain to customers. We also now avoid the delays and coordination issues that passing a multi-trade work order among the shops creates.

Our outcomes have been a reduction from five supervisors to two. The two former supervisors have been reassigned. The third individual is now training on the energy management system. Many training and safety equipment needs are eliminated through the elimination of the manholes. We simplified our billing and rates.

Our schedules have been met, our budgets have been met, and our reengineered trades shop is complete. Gary Greiner,

associate director of maintenance; Bruce Monnier, assistant director of special services; Dick McNamara, associate director of construction and renovation; and Matt Maynard, assistant director of maintenance, represented VU in the execution of these plans. Clearly, the convergence of these plans at the implementation stage required the cooperation of many VU departments, companies, and service providers.

At the end of the summer of 2006 we held a "savor the moment" breakfast! 🍳



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