Reducing Operating Costs and Improving Patient Comfort

Energy Efficient Capital Upgrades in Hospitals and Medical Centers

Edited by
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for
The National Association of Energy Service Companies
and
The United States Department of Energy, Rebuild America Program

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The National Association of Energy Service Companies

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NAESCO accomplishes this mission by encouraging high standards of quality and integrity among its members; disseminating information about developing technologies and their appropriate applications, participating in legislative and regulatory proceedings which affect energy policy; ensuring the best use of ESCOs in the delivery of energy services; providing opportunities to share and publicize ESCO project successes; and generally speaking on behalf of the Association membership when its welfare and that of the public requires a single voice.

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Rebuild America is a network of community partnerships made up of local and state governments, schools, universities, housing agencies, and private businesses that save money by saving energy. These voluntary partnerships, working with the U.S. Department of Energy, choose technical and investment approaches best suited to improving energy efficiency in the buildings they own and operate. Rebuild America supports the partnerships with business and technical tools, and customized assistance.

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Each of the companies whose projects are included in these case studies contributed a considerable amount of their principals' and employees' time in completing questionnaires, providing preliminary drafts, and being interviewed. While a list of the individuals involved would be too extensive to include here, I wish to express my gratitude to each company whose case study appears in this publication for their willingness to participate in this project.

Any errors are mine; no statement of fact or opinion in the Introduction or in the introductory text accompanying each study necessarily represents the views of the U.S. Department of Energy, Oak Ridge National Laboratory, or NAESCO or of any of its members.

Jessica S. Lefevre
September 1999

Foreword

This publication is part of an ongoing project to present case studies of energy efficiency retrofits in facilities in various sectors of the economy. The project is a collaborative effort of the National Association of Energy Service Companies (NAESCO) and the United States Department of Energy, Rebuild America Program. By providing an overview of energy efficiency retrofits already in place at hospitals and medical centers nationwide, these case studies demonstrate the capital upgrades and cost savings available to hospitals and medical centers through the use of performance-based energy efficiency contracting with an Energy Service Company (ESCO). The introduction contains information on the financial and administrative challenges confronting hospitals and medical centers, given today's economy and changes in the American healthcare system. With performance-based energy efficiency retrofits, hospitals and medical centers can undertake a variety of facility upgrades addressing all energy-related issues, including mechanical upgrades and the modernization of hospital power plants, as well as power plant maintenance contracts. These capital investments can be funded through guaranteed energy cost savings generated by the energy efficiency retrofits. The case studies provide a walk-through of six energy efficiency retrofits undertaken successfully in hospitals and medical centers located in New Jersey, New York, Connecticut, Texas, Washington, and Toronto, Canada.

Quick Reference

Glossary of Acronyms

DOE .....United States Department of Energy

ECM .....Energy Conservation Measure

EMS.....Energy Management (or Energy Control) System

ESCO .....Energy Service Company

ESPC.....Energy Savings Performance Contract

FEMP .....U.S. Department of Energy, Federal Energy Management Program

HVAC.....Heating, Ventilation, and Air Conditioning

IPMVP .....International Performance Measurement and Verification Protocol

M&V.....Measurement and Verification

NAESCO .....National Association of Energy Service Companies

O&M .....Operations and Maintenance

RFP.....Request for Proposals

RFQ.....Request for Qualifications

VFD .....Variable Frequency Drive

VSD .....Variable Speed Drives

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Introduction

Today's increasingly competitive healthcare environment places pressure on hospital administrators and facility managers to reduce operating costs, while improving the quality of patient care and comfort. Both the size and the nature of a hospital's energy consumption make energy and related costs a significant portion of every hospital's budget. Moreover, the importance of a hospital's energy profile, from a facility management perspective, is being magnified with the advent of competition in energy supply, making way for new rate structures and potential bargaining power for energy customers.

Unfortunately, hospitals must make substantial capital investments in their buildings and energy systems to reduce energy use and its associated costs. Given the size and value of hospital facilities, the cost of such investments may at first appear insurmountable. In the U.S. today, hospitals own and operate over 6 billion square feet of space with a replacement value of over $900 billion[1] According to the American Hospital Association, this translates into more than 6,374 hospitals currently housing more than 1.2 million beds.[2]

Facility costs in hospitals and medical centers are exacerbated by the fact that older equipment found in most medical care institutions consumes more electricity, is more labor-intensive to operate, and requires a higher level of maintenance than new equipment. Similarly, worn and poorly insulated buildings are subject to heat losses and gains, and air infiltration, all of which degrade the comfort of the facility. Rising healthcare costs, however, leave little or no room in most hospital budgets for the capital investment needed to cut energy consumption, and thus ener-

Rising healthcare costs, however, leave little or no room in most hospital budgets for the capital investment needed to cut energy consumption, and thus energy and operations and maintenance costs.

1 Paradis, Ronda Henderson, "The Strategic Planning Process and the CEO, Facilities managers need the tools, technology and new processes to provide top management with important information," *AFE Facilities Engineering Journal*, April 1996.

2 Ibid.

gy and operations and maintenance costs. Hospitals are facing these capital and operational issues at a time when the competition for patient healthcare dollars is on the rise. As a result, while quality patient care is always a primary mission, patient comfort is now more important than ever in the highly competitive healthcare market and cannot be compromised by cost-cutting measures.

Current Issues Facing Hospital Administrators and Facility Managers

Historically, hospital maintenance and management have not been an integral part of the hospital administration's planning process. Rather, facility maintenance has been made up of a number of different tasks, managed on an as needed basis – a task and solution model. In fact, in recent years, up to 85 percent of all maintenance and work orders were unscheduled and only 15 percent resulted from planned or programmed maintenance.[3] It is clear, however, that this "reactive" model of facility management hinders the ability of hospital administrators to meet the demands of today's healthcare market.

"Proactive" Facility Management Using Comprehensive Performance-Based Energy Efficiency Services

Hospitals and medical centers, like the rest of society, are adjusting to an era of limited funds, greater accountability, and increased technology demands.[4] This situation is likely to continue for the foreseeable future. Thus, the older "reactive" model of hospital management no longer is viable.

Administrators are finding that they can address their physical plant issues while at the same time reducing their operating costs and putting into place practices and technologies that give facility managers a substantially increased level of control over the operation of the facility's infrastructure. The key to this energy efficiency approach lies in the use of comprehensive performance-based contracting.

In contrast to the older reactive model, a sizable and growing number of hospitals and medical centers across the country are employing new energy conservation measures and equipment to create a proactive model of facility management. Here, administrators are finding that they can address their physical plant issues while at the same time reducing their operating costs and putting into place practices and technologies that give facility managers a substantially increased level of control over the operation of the facility's infrastructure. The key to this energy efficien-

3 Ibid.

4 Ibid.

cy approach lies in the use of comprehensive performance-based contracting. With this approach, a broad range of facility upgrades can be accomplished without investing a single dollar from the hospital's capital budget.

Performance-Based Energy Efficiency Services

By entering into contracts for performance-based energy efficiency retrofits, delivered by Energy Service Companies (ESCOs), these hospitals are reducing their energy consumption and associated operating costs by an average of 25 percent or more. The ESCO can provide any combination of project design, financing, installation, and maintenance services for all measures and equipment included in the energy efficiency retrofit.

Under a performance-based contract, the ESCO also measures, verifies, and reports on energy and energy cost savings. This information is reported to the hospital and provides the facility manager and the hospital administrator with a continuous source of current information on the facility's energy use profile.

The technologies used include energy management (or control) systems, high-efficiency fluorescent lighting, air handling units, boilers, and chillers, as well as motorized equipment, including energy efficient motors and variable speed drives (VSDs). These measures and technologies can be put into place without interrupting critical hospital functions. As a further bonus, many hospitals are reporting that the measures and equipment used in these projects actually increase comfort and productivity levels and can even improve indoor air quality.

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With a performance-based energy efficiency retrofit, the project is designed so that all project-related costs, including the ESCO's profit, are paid for out of the energy and related operational and maintenance cost savings realized. It is common for the financing of a comprehensive, performance-based retrofit to be structured so that other capital repairs and improvements – such as deferred facility maintenance, repairs to power plants, boiler or chiller housings, or the installation of cogeneration or distributed generation technologies – are folded into the project and paid for out of project-related savings.

Finally, and no less important from a facility management perspective, the installation of new equipment reduces down-time for unscheduled maintenance and reduces overall maintenance needs and costs. As part of the project installation, the ESCO provides a follow-on maintenance schedule for all installed equipment. The ESCO

Administrators and facility managers are finding that the combination of new equipment, scheduled maintenance, and an energy management system that offers constant monitoring and control of all energy operations within the facility, creates a powerful set of management tools for facility managers.

can provide follow-on maintenance or can train facility personnel to do so.

Administrators and facility managers are finding that the combination of new equipment, scheduled maintenance, and an energy management system that offers constant monitoring and control of all energy operations within the facility, creates a powerful set of management tools for facility managers. With these tools, the facility manager can provide the administrator with constant, up-to-date information on the facility's energy consumption profile and the status of the facility's energy systems.

Challenges Presented by the Hospital Environment

Hospitals offer many unique challenges for ESCOs and facility managers when they engage in capital improvements. The most obvious of these challenges is that hospitals must operate on a 24-hour basis with all hospital functions up and running at all times. There simply is no way to schedule an outage for a surgical unit or a critical care wing.

Some work on equipment, such as fan motors or hallway lighting in non-critical areas of the hospital can be accomplished after hours using "shift" (5:00 p.m. to 12:00 a.m.), or "graveyard" (12:00 a.m. to 6:00 a.m.) installation schedules. However, patients cannot be taken from their rooms to accommodate construction work. Therefore, the ESCO must be able to rotate crews through the hospital over a period of time sufficient for retrofit work, such as lighting, to be accomplished when those rooms are empty.

Hospitals offer many unique challenges for ESCOs and facility managers when they engage in capital improvements. The most obvious of these challenges is that hospitals must operate on a 24-hour basis with all hospital functions up and running at all times.

Surgical and critical care areas, however, must be available around the clock. Thus, ESCOs working in a hospital environment must guarantee that the systems relied upon to support these areas are never compromised. For example, the pressurization control required to maintain a sterile atmosphere in a surgical room cannot be taken off line, even for a brief period. ESCOs generally address these issues by building 100 percent redundancy into all essential systems. Thus, a new control system or variable speed drive may be installed in parallel with the existing system, enabling the old system to continue running while the new system is being installed. Once this is accomplished, components of the

old system then can be retained to work as emergency backup should a future failure occur or the new main control system need repair.

Operating the Hospital Power Plant on a Performance Basis

Finally, hospitals increasingly are getting out of the business of running their own power plants. New owners who acquire these hospital power plants are discovering that they can turn them over directly to a qualified ESCO and earn profit on the power plant without the need for any capital investment of their own. An ESCO operating in this area takes over the asset, invests in the needed capital upgrades, purchases utilities (electricity, gas, oil, and other fuel sources), runs the plant and delivers end-use commodities such as chilled water, hot water, steam, and emergency power to the hospital. In addition, the ESCO can deliver 100 percent redundancy for emergency power, using cogeneration and distributed generation technologies. The ESCO's capital investment, operating costs, and profit are covered by the energy and related operation and maintenance cost savings delivered to the new power plant owner.

The Case Studies

The following case studies represent the spectrum of benefits available through Energy Services Companies.

Case Study 1 shows how energy and related cost savings can be applied to address a number of specific issues, including high electricity rates and deferred maintenance. In Case Study 2, the ESCO worked with the facility's staff to increase patient comfort and staff productivity while reducing energy consumption and operating costs through the installation of energy efficiency measures. Case Study 3 demonstrates that energy efficiency retrofits can be used to benefit not only the hospital, but also the surrounding community and its environment. In Case Study 4, energy savings are increased by combining on-site generation and cogeneration with energy efficiency upgrades. In addition, the ESCO now operates the hospital's power plant on a performance basis. Case Study 5 offers an idea of the broad extent of services available through ESCOs. Here, the ESCO is providing ongoing training in the use and care of the new conservation equipment to ensure that the facility's staff remains up-to-date in this area. Finally, Case Study 6 indicates the type of teamwork that is the norm in the ESCO community, both among companies and with hospital staff. This approach to projects provides hospital personnel with a large degree of freedom when deciding on their level of involvement in the retrofit project.

To help ensure the highest level of quality within the Energy Services Industry, the National Association of Energy Service Companies maintains an ESCO accreditation program. Any ESCO receiving accreditation through this process should be considered qualified to provide for the delivery of services highlighted in this publication. For more information, contact NAESCO or its web site at http://www.naesco.org.

Case Studies

A performance-based energy efficiency project can address the competing demands of high energy bills, deferred maintenance, and facility expansion.

For older hospitals and for hospitals located in areas of the country with high energy costs, the competing demands created by the need to reduce operating costs and the simultaneous need to upgrade the facility lead to what appears to be an irreconcilable business dilemma. This was the situation facing the St. Barnabas Medical Center in Livingston, New Jersey, until administrators decided to investigate the opportunities for cost cutting and facility upgrades available through a comprehensive performance-based energy efficiency retrofit. This approach gave administrators a way to meet the competing demands of high energy bills, needed facility expansion, deferred maintenance, and old mechanical equipment. Moreover, the project met all of these demands while at the same time providing St. Barnabas with a positive net cash flow from the project.

Case Study #1	ST. BARNABAS MEDICAL CENTER Livingston, New Jersey

CUSTOM ENERGY, L.L.C.

St. Barnabas Medical Center is a 620-bed and 780,000 sq. ft. medical institution located in Livingston, New Jersey. As New Jersey's oldest and largest non-profit, non-sectarian hospital, it treats more patients annually than any other facility in the state. However, in the early 1990s, due to the facility's high energy bills and its age, St. Barnabas found itself saddled with energy costs in excess of $2.7 million per year and growing.

The Hospital's continued expansion caused electrical consumption to increase at a rate of 6 percent per year, stretching the capacity of its existing equipment. At the same time, rising electricity rates caused the cost of energy to increase at a rate of 11.5 percent per year during the 1992-1995 period.

Faced with plans for additional hospital expansion, increasing maintenance costs, the necessary replacement of old mechanical equipment, and high energy bills, the Hospital's Operations and Engineering Department turned to Custom Energy, L.L.C. for help. After evaluating the Hospital's energy consuming equipment and energy consumption patterns, Custom Energy proposed a plan that would allow the Hospital to replace most of its old mechanical equipment with new high-efficiency equipment, while providing a positive net cash flow.

PROJECT INFORMATION

620-Bed Medical Facility

St. Barnabas Medical Center Contacts
William J. Cuthill,
Director of Engineering
201/533-5364

Robert Carretta, Vice President
201/533-5396

Custom Energy Contact
Tim Nelson
913/888-8050

Project Type
Energy Savings Performance Contract/Guaranteed Savings

Facility Size
2 Buildings;
780,000 sq. ft.

Annual Energy Savings
Projected: 9,343,934 kWh
Actual: 11,477,264 kWh (1996-97)
10,972,532 kWh (1997-98)

Annual Energy Cost Savings
Projected: $650,000
Actual: $694,507 (1996-97)
$691,178 (1997-98)

Project Cost
$5,264,500

Custom Energy began work by first identifying energy saving opportunities and then developing a cost-benefit estimate for the identified measures. These potential savings were reviewed by a third-party engineering consultant to evaluate the feasibility and economics of each measure, and to confirm that the measures would conform to public codes while maintaining the existing comfort levels.

Custom Energy managed the installation of all equipment during the 10-month installation period, giving careful consideration to the need to avoid disruption of the Hospital's normal operations. In addition to the energy cost savings, the Hospital's maintenance costs were substantially reduced.

Measurement and Verification
All energy conservation measure (ECM) specific monitoring as specified by the PSE&G Standard Offer Rebate Program M&V Protocol, including end use measurement on the chiller plant, air handling unit VSDs, lights, and motors.

Financing
5.6 percent tax exempt bond issue; initial cost paid by owner and financed through a private bond issue, through their financial institution.

Contract Term
15 Years

Installation Period
July 1996 - October 1996
Project Entered Into Service
August 1996

Utility Incentives
PSE&G's demand side management Standard Offer Program will pay for the complete project in 12 years, while the customer will realize the complete savings in 8 years.

The Energy Management System. Custom Energy proposed installing a Landis & Staefa Energy Management System (EMS). This new state-of-the-art system uses direct digital controls with approximately 1,400 control points, replacing the outdated and inefficient fixed point pneumatic controls. Field processing units in each mechanical room have remote access to the EMS's central computer via modem.

The newly installed EMS provides excellent opportunities for improved equipment efficiency and control accuracy, using the System's centralized, automated control. Control strategies implemented by Custom Energy to generate energy savings included equipment outside air lockout, an enthalpy economizer cycle, supply air reset, chilled water temperature reset, condenser water temperature reset, and hot water temperature reset. With the new EMS, the engineering and maintenance staff now can invest more time in troubleshooting and maintaining equipment rather than performing manual equipment control.

With the new EMS, the engineering and maintenance staff now can invest more time in troubleshooting and maintaining equipment rather than performing manual equipment control.

Some control strategies implemented in the East Wing Medical Office Building included scheduled start/stop for fans and pumps, staging of chiller compressors, electric preheat control, optimum start/stop, and a controlled warm-up.

Variable Speed Drives, Efficient Motors. Custom Energy replaced constant speed motors – designed for the highest possible load – on many of the air handling units, pumps, and cooling tower fan motors, with variable speed drives (VSDs) so the motors can better match the load imposed upon them. In addition, several constant volume air handling systems were converted to variable volume operation, specifically to meet the loads imposed in individual zones. Finally, several standard efficiency motors were replaced with high efficiency motors.

Lighting. With the exception of patient rooms, Custom Energy performed a major lighting retrofit throughout the Hospital. Existing standard energy saving lamps were replaced with T-8 lamps; reflectors were installed and all magnetic ballasts were replaced with electronic ballasts. The lighting retrofit also included replacing incandescent bulbs with low wattage compact fluorescent lamps, which have a longer life, thus reducing both maintenance and disposal costs. In addition to saving energy, the new lamps preserved the pre-existing light levels and improved light quality.

To provide the Hospital with a more cost effective method for generating chilled water, Custom Energy replaced the existing electric chillers with steam absorption chillers, which now use the Hospital's formerly under-utilized boilers as an energy source. With this change, the Hospital no longer is dependent on CFC-based refrigerants.

HVAC. Several repairs were made to the older existing air handling units to correct problems with the coil control valves and air dampers, making the existing air handling units more efficient.

Chilled Water. To provide the Hospital with a more cost effective method for generating chilled water, Custom Energy replaced the existing electric chillers with steam absorption chillers, which now use the Hospital's formerly under-utilized boilers as an energy source. With this change, the Hospital no longer is dependent on CFC-based refrigerants.

The cost of operating the Hospital's two 750-ton and one 500-ton electric centrifugal chillers was exorbitant. As part of the performance contract, Custom Energy installed a new chilled water plant with two 1,000-ton two-stage steam absorption chillers. The electric chillers will remain available for emergency and off-peak operation when it becomes cost effective.

In addition to the steam absorption chillers, Custom Energy installed a new primary/secondary chilled water system. As part of this capital improvement, Custom Energy equipped two new 50 HP primary chilled water pumps and two 200 HP secondary chilled water pumps with VSDs. Two condenser water pumps of 150 HP each and a new matching four-cell cooling tower were installed to serve the newly installed steam absorption chillers.

Fuel Switch. To further reduce the Hospital's electric load, Custom Energy converted the electric chillers to gas. This saved the chillers' entire electric load. While gas consumption increased, the net savings to the Hospital are substantial.

Energy and Cost Savings. The energy conservation measures proposed and installed by Custom Energy provide the Hospital with energy cost savings of $650,000 and savings of more than 9 million kWh per year. In addition to the energy and energy cost savings, the Hospital also has enjoyed significant savings in its maintenance costs.

The energy conservation measures proposed and installed by Custom Energy provide the Hospital with energy cost savings of $650,000 and savings of more than 9 million kWh per year.

The Hospital is using rebates from the Public Service Electric and Gas Company's demand side management program over 12 years to fund this project. With this approach the Hospital now owns the new equipment and receives 100 percent of the $650,000 annual energy cost savings the project generates. This enables the Hospital to direct the savings to other important functions, and to avoid any investment risk. Custom Energy has guaranteed the project energy savings for 15 years. Should the hospital experience an energy savings shortfall during that period, Custom Energy will pay the Hospital the amount of the shortfall. During the 15-year period of the guarantee, the Hospital's net financial benefit from this project is $11.6 million.

During the 15-year period of the guarantee, the Hospital's net financial benefit from this project is $11.6 million.

Environmental Benefits of the Project

Using a national average for electric utility emissions, the energy savings from this project results in the following reductions in air pollution and greenhouse gas emissions:

Carbon Dioxide (CO_2):	6,975 tons	This is equivalent to:	
Sulfur Dioxide (SO_2):	71.61 tons	Removing:	1,302 cars from the road
Nitric Oxides (NOx):	25.575 tons	Planting:	2,697 acres of trees
		Conserving:	16,749 barrels of crude oil
		Conserving:	4,371 tons of coal

The change to a steam absorption-type chiller with lithium bromide-based refrigerant reduced CFC refrigerant leakage by approximately 750 pounds per year.

Customer Comments

The energy savings [provided] and rebate [arranged for] by Custom Energy will help our hospital to remain cost effective, which is important in this competitive marketplace.

Hospitals are increasingly pressed to reduce operating costs, while maintaining the quality of patient care. This project allows us to do that and use the cost savings to benefit the patients – our prime concern.

William J. Cuthill
Director of Engineering
St. Barnabas Medical Center

ESCO Address

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Another set of competing goals facing hospitals today and adressed through comprehensive performance-based energy efficiency retrofits is the need to improve comfort levels in hospital facilities while reducing operating costs.

An often unexpected side benefit of comprehensive energy efficiency upgrades is an improvement in the facility's overall indoor comfort levels. Many facility owners and managers are finding that an investment in an energy efficiency retrofit actually improves employee productivity levels.[5] Thus, the increase in the overall comfort of the work environment is coming to be seen as a major benefit of a comprehensive energy efficiency upgrade, while the combined benefits of energy cost reductions and increased productivity provide a double boost to the facility's bottom line.

The case study that follows demonstrates the steps taken by the U.S. Department of Veterans Affairs to reduce its operating costs and energy use while also improving patient comfort and employee productivity in the Veterans Affairs Connecticut Health Care System.

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5 Romm, Joseph J., *Cool Companies, How the Best Businesses Boost Profits and Productivity by Cutting Greenhouse Gas Emissions*, Island Press, 1999.

Case Study #2	U.S. DEPARTMENT OF VETERANS AFFAIRS CONNECTICUT HEALTHCARE SYSTEM West Haven, Connecticut

EUA Cogenex Corporation

In 1992, the U.S. Department of Veterans Affairs (VA) began to look for ways to reduce its operating costs and to comply with the Energy Policy Act of 1992, requiring a 30 percent reduction in energy consumption in Federal buildings by the year 2005. At the same time, the VA Medical Center in West Haven, Connecticut was investigating ways to improve the quality of its facility from the perspective of employee productivity and patient comfort. As it sought financing for needed building improvements, the Center also hoped to benefit from utility rebate monies offered by Southern Connecticut Gas and by United Illuminating Company.

In its effort to address these needs, the VA Medical Center decided to solicit the expertise of several different ESCOs. After reviewing vendors' proposals, the VA selected EUA Cogenex, based on the company's ability to address client concerns while also educating its clients about the financial aspects of energy services contracts.

The VA Healthcare System entered into an Energy Savings Performance Contract (ESPC) with EUA Cogenex, as provided for in the 1992 Energy Policy Act which refined the procurement process by which federal agencies obtain energy services from private sector providers. This enabled the VA to take advantage of the energy cost savings and utility monies available to make the needed improvements at the Medical Center.

PROJECT INFORMATION

590-Bed Medical & Surgical Facility

VA Healthcare System Contact
Robert Palazzi,
Chief Design Development
203/937-3861

EUA Cogenex Project Contact
Stuart Erhardt,
Senior Project Manager
978/441-0090 ext. 288

Project Type
Federal Energy Savings Performance Contract with Guaranteed Savings

Facility Size
1.2 Million sq. ft.

Annual Energy Savings
2,498 kW; 4,557,713 kWh

Annual Energy Cost Savings
$ 550,000

Project Cost
$2,744,172

Financing
EUA Cogenex

Contract Term
10 Years

Installation Period
February 1993 - July 1993

Under the Agreement, EUA Cogenex implemented the following energy conservation measures (ECMs):

- replaced approximately 8,500 existing incandescent and fluorescent light fixtures with T-8 lamps, electronic ballasts, and metal halide lamps and ballasts, following standardized lamp color, style, and ballast requirements;
- replaced incandescent exit signs with LED-type signs;
- replaced two 800-ton, 30-year-old electrical centrifugal chillers with a new 1,000-ton, two-stage, high-efficiency absorption chiller and with a new 800-ton high-efficiency electric centrifugal chiller;
- replaced the aging single speed cooling tower with a new efficient tower with dual speed fans;
- replaced inefficient chilled water and condenser water pumps with new efficient pumps with energy efficient motors; and
- installed a new Direct Digital Control (DDC) system to control the new chiller plant.

Utility Incentives

EUA Cogenex secured rebates totaling $310,966 from United Illuminating Company for lighting and high efficiency motors and $100,000 from Southern Connecticut Gas which provided an incentive for installing the absorption chiller.

Measurement and Verification

The VA agreed to a minimum number of hours of operation so EUA Cogenex could measure the lighting savings. EUA Cogenex obtains monthly ton-hour usage data by dialing into the Direct Digital Control System.

EUA Cogenex financed the project. Chiller plant savings are paid based on actual ton-hours delivered, adjusted annually for cooling degree days. Measured and verified energy cost savings were used to pay all project costs, including EUA Cogenex's profit. As payment, EUA Cogenex received a 90 percent share of the net savings (post amortization and maintenance allowance) actually realized. Once project costs are fully recovered, the government keeps 75 percent of the savings.

The project was so successful and achieved such dramatic results that the VA Healthcare System again worked with EUA Cogenex to install a 6,600-ton/hour ice storage system. Requiring eight months to install, and completed in May 1998, this project involved converting the facility's chilled water pumping system to operate primary and secondary loops, installing two new high efficiency electric 400 nominal ton ice building chillers and 11 ice storage tanks, and upgrading the original DDC Control System.

The project was so successful and achieved such dramatic results that the VA Healthcare System again worked with EUA Cogenex to install a 6,600-ton/hour ice storage system.

The new ice storage system delivers 40°F chilled water to the campus, thereby maintaining the cooling capacities needed to satisfy comfort cooling requirements, and to provide the dehumidification required for the operating room suites. Prior to the upgrade, the additional cooling loads added on the campus would raise the chilled water temperatures above that required to satisfactorily deliver comfort cooling to various locations on the campus. The $1,913,870 project was performed on a cash basis and included a $294,520 rebate from United Illuminating Company, secured by EUA Cogenex.

The combined benefits of the comprehensive lighting retrofit and the renovated chiller system substantially improved comfort in the facility for both staff and patients. Thus, the Medical Center met its goal of improving employee productivity and patient comfort at the same time that the VA moved closer to its goal of reducing operating costs and energy use in its facilities nationwide.

The combined benefits of the comprehensive lighting retrofit and the renovated chiller system substantially improved comfort in the facility for both staff and patients.

Customer Comments

The ESPC that has been initiated at VA Connecticut Healthcare System, West Haven Campus, has exceeded our original expectations. The results are, to name a few:

- updated our aging chiller plant with state of the art chilled water producing equipment, saving not only energy but also reducing maintenance and repair costs;
- maintenance responsibilities and operations are the contractor's responsibility;
- helps the Medical Center meet its energy reduction goals;
- conserves nonrenewable fuels achieving environmental, fuels and energy cost reduction goals as identified within the Energy Policy Act of 1992;
- stimulates the economy by allowing ESCOs to profit from their up-front investments through a share of the utility bill savings; and
- reduces utility costs without sacrificing service.

The ESPC that has been initiated at VA Connecticut Healthcare System, West Haven Campus, has exceeded our original expectations.

Robert Palazzi
Chief of Design Development
VA Connecticut Healthcare System

ESCO Address

EUA Cogenex
Boott Mills South
100 Foot of John Street
Lowell MA 01852
Phone: 978/441-0090
Fax: 978/441-9299
Web Site: http://www.cogenex.com

An energy efficiency retrofit can be employed to address energy cost and maintenance concerns in a facility as well as environmental concerns in the surrounding community.

Many hospital and medical centers are extremely large facilities whose energy use profile can affect the economics and environment of the surrounding community. Albany Medical Center in Albany, New York is one such facility. Therefore, with its commitment to the surrounding region and its concern for environmental issues, the Medical Center retained an ESCO to assist in reducing its energy use, easing pressure on resources and cutting power plant emissions in the region.

Case Study #3	ALBANY MEDICAL CENTER Albany, New York

SEMPRA ENERGY SERVICES (As CES/Way International, Inc.)

In what ranks as one of the nation's single largest energy conservation projects sponsored by a utility, CES/Way International, Inc. designed, installed, and financed improvements at the Albany Medical Center (AMC) that saved over $1 million per year in energy costs – a 35 percent reduction – and reduced undesirable power plant air emissions by over 24 million pounds per year.

AMC, the region's only tertiary care facility, is the largest medical complex in northeastern New York State and Western New England. With 20 buildings, AMC is a 655-bed, university-based hospital, medical college, and research center, occupying over 1.8 million square feet and employing 5,500 people. As such, AMC is one of the region's strongest and most important economic forces. Its size and the nature of business also make it one of the region's largest consumers of energy.

As a major employer and energy consumer, AMC has always respected the community that it serves and considered the impact of its operations on the region's environment. In this regard, AMC has taken a leadership role among hospitals in the United States in developing, implementing, and maintaining a long-term environmental policy. AMC recognizes that this commitment also must include a long-term energy program that will prevent its high energy use profile from having a negative impact on the region's economy and environment.

PROJECT INFORMATION

655-Bed College & Research Center

Albany Medical Center Contact
Claude M. Rounds, Vice President
518/262-3243

CES/Way Project Contact
Bob Kennedy, Vice President
518/783-8300

Project Type
Cost of Work Plus Fixed Fee

Facility Size
20 Buildings; 1.8 Million sq. ft.

Annual Energy Savings
3,376 kW; 11,330,704 kWh; 111,496 therms

Annual Energy Cost Savings
$1,032,445

Project Cost
$7,683,257

Financing
Tax Exempt Municipal Bonds Through Industrial Development Authority

Contract Term
15 Years

Installation Period
April 1992 - September 1993

For these reasons, in 1991, AMC employed CES/Way to prepare a detailed energy analysis. This analysis clearly showed that the Center's energy consumption was substantially greater than that of similar healthcare facilities located in areas with comparable weather patterns. It also confirmed AMC's need to develop and implement a comprehensive and aggressive plan to curb its energy use.

Utility Incentives

Niagara Mohawk Power Corporation, through its DSM program, contributed a $3.3 million incentive to Albany Medical Center.

Measurement and Verification

Niagara Mohawk Power Corporation required an M&V protocol analogous to the Federal Energy Management Program's Measurement and Verification Protocol Option B, with considerable Pre- and Post-Installation metering.

Environmental Benefits of Project

Reduced power plant greenhouse gas emissions by 24 million pounds per year, based on the EPA's Green Lights Pollution Prevention formulas.

In 1992, AMC, together with CES/Way, joined in Niagara Mohawk Power Corporation's (NMPC) 15-year Energy Partners Program, offering energy and cost reductions of 35 percent annually. Designed to address energy, economic, and environmental concerns at AMC and within the community, this program incorporates capital equipment improvements by AMC, Energy Conservation Measures (ECMs) implemented under NMPC's standard rebate and Power Partners Program incentive payment plans, and financing, warranty incentives, and engineering support services provided by CES/Way. The three major goals of the program are to 1) increase energy efficiency and reduce energy consumption at AMC, 2) provide economic value and reduce costs, and 3) promote the environmental quality of the community.

CES/Way's Project Responsibilities. CES/Way did a detailed, six-month energy analysis of all of the Center's buildings. This analysis included numerous site audits, equipment performance measurements, interviews with management personnel, heat transfer and run time calculations, energy consumption analyses, and modified operational calculations. Using this data, CES/Way created an energy use profile and an energy management program.

AMC reduced its level of energy use by a total of 40,000 Btu per square foot annually and now realizes approximately $1.5 million in annual energy cost savings.

Fourteen ECMs were identified and formed the foundation for AMC's project under the Energy Partners Program. After installation was completed in September 1993, AMC reduced its level of energy use by a total of 40,000 Btu per square foot annually and now realizes approximately $1.5 million in annual energy cost savings.

CES/Way coordinated installation of 14 ECMs including the following:

- expanding the 1,200-ton central chiller plant,
- replacing the existing air cooler and DX air conditioning with distributed chilled water,

- installing high efficiency lamps and electronic ballasts in more than 22,000 light fixtures,
- installing a new 1,000-control point energy management system,
- replacing over 150 motors with high efficiency motors,
- installing 35 VSDs on air handling and exhaust fans,
- installing microprocessor-based VSDs and controllers on four 150 HP secondary chilled water pumps,
- upgrading both the air handling units and boiler blowdown heat recovery units, and
- replacing 1,000 windows with energy efficient windows.

The AMC project not only provided for the purchase and installation of the ECMs, it also included the development and implementation of a long-term energy management program, involving performance monitoring, staff education and training, ongoing technical assistance, energy-efficient occupancy and operating standards, preventive maintenance requirements for building systems, and energy efficient design criteria for building and system modification and renovations.

Albany Medical Center is a prime example of what a comprehensive approach to an energy efficiency project can deliver. By combining quick payback and longer term payback ECMs, CES/Way enabled the Center to maximize both the project upgrades and its cost savings. This project received the 1993 New York Governor's Energy Award and was also recognized with the Department of Energy's Special Recognition Award under the 1994 National Awards Program for Energy Efficiency and Renewable Energy.

Albany Medical Center is a prime example of what a comprehensive approach to an energy efficiency project can deliver.

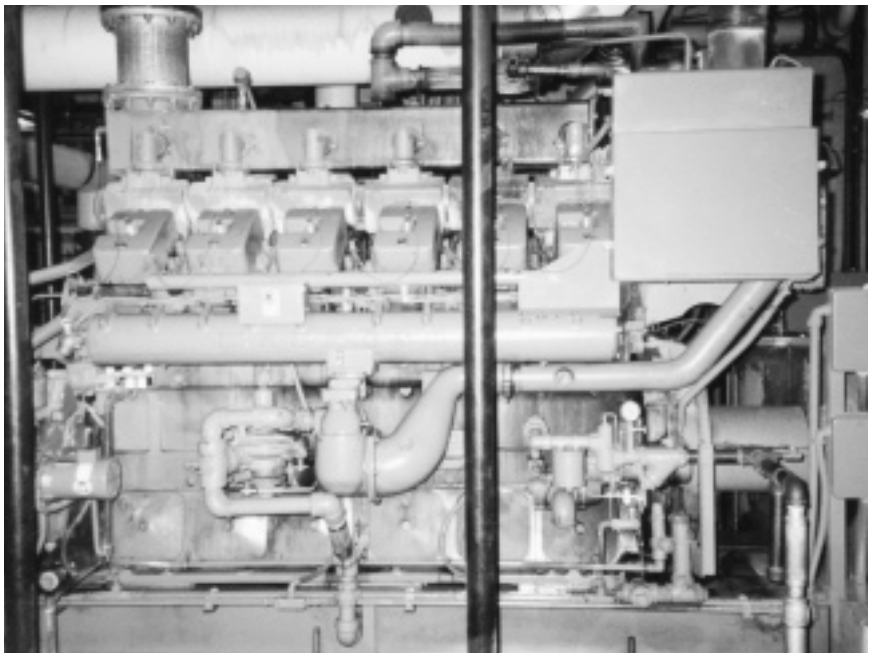
Customer Comment

This project allows us to come into the 21st century in energy technology.

Claude Rounds
Vice President
Albany Medical Center

ESCO Address

Sempra Energy Services
(formerly CES/WAY International, Inc.)
2500 City West Boulevard, Suite 1800
Houston, TX 77042
Phone: 713/361-7600
Fax: 713/361-7650
Web Site: http://www.cesway.com



On-site generation and cogeneration are available through energy savings performance contracting; hospital power plants can be operated on a performance basis.

Hospital power plants and cogeneration opportunities can help a facility to achieve significant energy savings through modernizing the hospital's energy systems. As Thomason General Hospital in El Paso, Texas discovered, a qualified ESCO can guide the hospital's administrative and engineering staff in soliciting cost-effective and innovative energy efficiency solutions that otherwise might be overlooked, including operation of the hospital's central utility plant on a performance basis.

Case Study #4	THOMASON GENERAL HOSPITAL El Paso, Texas

ONSITE SYCOM Energy Corporation

Thomason General Hospital is a full-service acute care facility complete with emergency rooms, operating rooms, intensive care area, patient rooms for around-the-clock care, diagnostic equipment, out-patient clinic, and medical and administrative offices. In 1993, the Hospital invited ONSITE SYCOM Energy Corporation to examine the Hospital's energy use and to recommend a plan of action to reduce its energy needs in both the short- and long-term. ONSITE SYCOM promised to evaluate energy efficiency measures and to recommend cost effective energy efficiency projects backed by guaranteed energy savings.

Encompassing 360,000 square feet, the Hospital consists of several wings constructed at various times to accommodate the growing needs of the hospital community. Primary hospital areas include an eight-story Main Hospital, constructed in 1963; a four-story Trauma Center adjoining the Main Hospital, constructed in 1987; a four-story Annex Building adjacent to the Main Hospital, constructed in 1971; a 1,600-car garage and laboratory; an 800-car garage; and a central utility plant.

ONSITE SYCOM performed an energy audit of the complex, focusing on improvements to lighting and mechanical systems. To ensure that it had the most complete, accurate, and current information – a key ingredient in such an endeavor – ONSITE SYCOM had principal operating personnel

PROJECT INFORMATION

Full-Service Acute Care Facility

Thomason General Hospital Contact
Luis Fonseca,
Central Plant Supervisor
915/521-7772

ONSITE SYCOM Contact
Keith Davidson,
Senior Vice President
760/931-2400

Project Type
Energy Savings Performance Contract/Direct Purchase

Facility Size
360,000 sq. ft.

Annual Energy Savings
330 kW; 3,800,000 kWh

Annual Energy Cost Savings
$150,000 – Energy Efficiency Projects
$460,000 – Cogeneration System

Project Cost
$900,000 – Efficiency Projects
$9 Million – Central Plant
$2 Million – Cogeneration System

Financing
Owner

Contract Term
4 Years

Installation Period
Efficiency Projects:
October 1993 – October 1994
Central Utility Plant:
April 1995 – January 1996

familiar with these systems actively involved in this audit. ONSITE SYCOM presented the Hospital with a list of energy efficiency measures, accompanied by an economic evaluation for each measure. The Hospital selected what they considered to be the most cost effective measures for implementation.

Measurement and Verification
Derived from the current NAESCO Standard Savings Measurement for Demand Side Management.

ONSITE SYCOM replaced the Hospital's existing lighting with high efficiency fluorescent lamps. Incandescent lamps and fixtures were replaced with new compact fluorescent lamps. ONSITE SYCOM also installed occupancy sensors throughout the Hospital.

HVAC control systems in the Main Hospital and the Annex Building were replaced with a new facility automation system to control chillers, pumps, supply and return fans, cooling and heating coils, and air handler dampers. ONSITE SYCOM replaced pneumatic actuators controlling air dampers with electric actuators. High efficiency motors were installed on selected fans and pumps within these areas.

Other energy efficiency measures included variable speed pumping and a crossover loop to integrate selected cooling systems. Three-way control valves were replaced with two-way control valves on 16 air handlers that serve the Main Hospital as part of the variable speed pumping project.

The Hospital's existing energy demand was 2,028 kW per year, with an annual consumption of 13.6 million kWh. ONSITE SYCOM projected energy savings of 330 kW and 3.8 million kWh per year.

The Hospital's existing energy demand was 2,028 kW per year, with an annual consumption of 13.6 million kWh. ONSITE SYCOM projected energy savings of 330 kW and 3.8 million kWh per year.

This work addressed the Hospital's short-term objective, reducing the growth of energy consumption in the existing facility. However, the Hospital's energy team faced new challenges presented by planned renovations, hospital expansion, and construction of an adjacent state-operated psychiatric center.

Design and Construction of a New Central Utility Plant and Cogeneration System. Following substantial completion of the previously described energy efficiency measures, the Hospital retained ONSITE SYCOM to perform the conceptual design of a new central utility plant and cogeneration system. The need for a new utility plant emerged as Thomason General Hospital's management examined the energy consumption of existing equipment and projected its demand growth. ONSITE SYCOM examined gas cooling to reduce peak electrical demand during periods of high cooling demand, which coincide with the utility's highest cost power. Since

the Hospital's electricity rates were among the highest in the state, ONSITE SYCOM included a cogeneration system to further reduce energy costs.

The Hospital Board of Directors adopted the results of ONSITE SYCOM's feasibility study and awarded the company a contract to design and procure the cogeneration system. The Board also retained ONSITE SYCOM as the design consultant for the balance of the central utility plant and as overall construction manager for the new plant. Based on the Hospital's level of electricity consumption, natural gas reciprocating engines were selected for both the cogeneration system and the chiller drives. ONSITE SYCOM was responsible for the specification and supply of the engine-driven generators, switchgear, and protective relays to allow interconnection and parallel operation of the engine driven generators with El Paso Electric. During the new utility plant's construction, ONSITE SYCOM was responsible for reviewing architectural and engineering design documents, establishing schedules, performing bid evaluations, overseeing workmanship, and tracking subcontractor performance.

The existing central utility plant, commissioned in 1996, supplies electricity, chilled water, and steam from a common fuel source – natural gas. The new utility plant includes 1,500 HP of dual-fuel boilers, 1,300 tons of reciprocating engine driven chillers, 1,300 tons of single-effect absorption chillers, and 2,400 kW of reciprocating engine generators. Waste heat from the reciprocating engines is recovered as low pressure steam and is used for comfort heating, domestic hot water, and single-effect absorption cooling. In addition, a new underground piping system between the Hospital and the central utility plant was installed for high-pressure and low-pressure steam and chilled water. ONSITE SYCOM also upgraded the 120V, 220V, 460V, 4160V, and 12kV electrical distribution system, including switchgear and transformers. Besides serving the Hospital's facilities, the new central utility system also supplies hot water and chilled water to the Texas Department of Mental Health and Mental Retardation Psychiatric Center, adjacent to the Hospital.

The relationship between Thomason General Hospital and ONSITE SYCOM is an excellent example of the accomplishments that can be achieved when customer and ESCO work cooperatively and fully appreciate the importance of energy services.

Operation and Maintenance of the Central Utility Plant. Based on ONSITE SYCOM's work, Thomason General Hospital decided to continue its relationship with the company, awarding it the O&M contract for the new central utility plant. ONSITE SYCOM's staff operates the facility around-the-clock, providing essential utility services to the Hospital. The company establishes the equipment operating set-points to meet the Hospital's thermal and electrical requirements. It also is responsible for preparing operating and maintenance budgets, sending invoices

to the psychiatric center, and developing operating histories to track energy consumption and systems performance. ONSITE SYCOM's mechanics perform engine maintenance, repairs, and overhauls. The staff strives to improve operating practices and maintenance techniques with a singular ambition of reducing costs while providing the Hospital with complete and professional service.

Measurement and Verification. The measurement and verification methodology is derived from the current NAESCO Standard Savings Measurement for Demand Side Management. The protocol organizes each energy efficiency measure into several categories depending on whether the measure is a constant load, a constant load with variable hours of operation, or a variable load dependent on external conditions such as weather. Energy cost reduction, defined as the difference between baseline energy use and post-installation calculations, is determined on a monthly basis.

As part of the verification process, ONSITE SYCOM conducts periodic inspections of the energy efficiency measures to ensure that they are properly maintained and operating according to contract specifications. Other inspection tasks include checking temperature set-points and calibrating controls associated with the facility automation system.

The energy efficiency measures that ONSITE SYCOM installed have conserved precious energy resources through reduced energy use. The cogeneration system is over 70 percent efficient because it effectively uses waste engine heat for the hospital's heating and cooling requirements. Since power is generated on-site, losses associated with transporting power over transmission and distribution lines from a remote utility power plant do not occur.

Beyond 2000

Thomason Hospital again is designing a new expansion project, with ONSITE SYCOM providing engineering assistance to recommend options for accommodating this load growth. The relationship between Thomason Hospital and ONSITE SYCOM is an excellent example of the accomplishments that can be achieved when customer and ESCO work cooperatively and fully appreciate the importance of energy services.

Customer Comments

It was strictly a matter of economics.... [The new central plant] definitely made sense for the hospital. It's yielding the type of returns that we need to demonstrate that this was a wise investment. As we in the healthcare industry continue to evolve, we need to look at true partnerships. We've had a very positive relationship with ONSITE SYCOM.

Chief Operating Officer
Thomason General Hospital

ESCO Address

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West Coast Office
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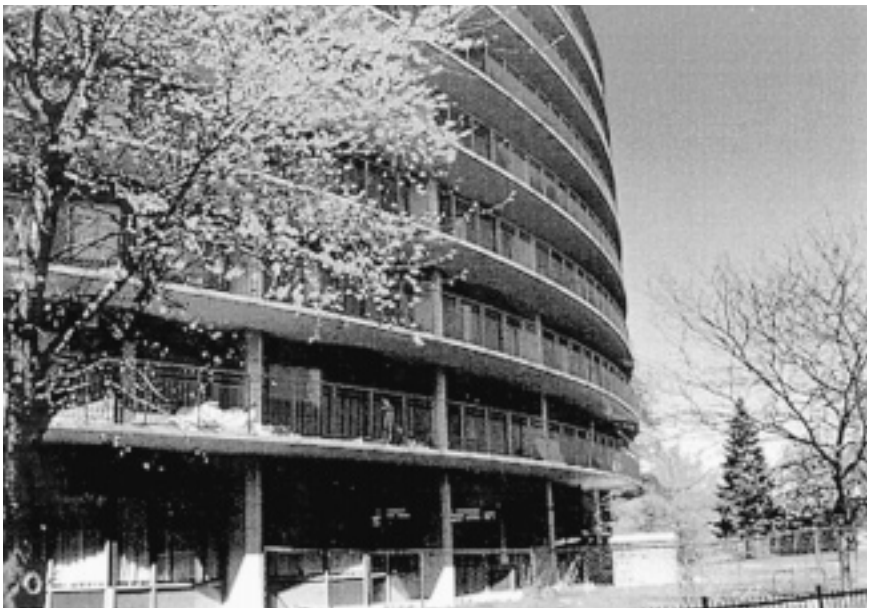
Carlsbad, CA 92009
Phone: 760/931-2400
Fax: 760/931-2952
East Coast Office
27 Worlds Fair Drive
Somerset, NJ 08873
Phone: 732/748-9600
Fax: 732/748-9631
Web Site: http://www.onsitesycom.com



As part of an energy efficiency retrofit, ESCOs will provide training for facility personnel in the use and care of new conservation equipment.

In some facilities, the staff may be unfamiliar with the operation and maintenance of new energy efficient technologies. As Riverdale Hospital in Toronto, Ontario, Canada found, ESCOs will provide training to the facility's staff. At Riverdale, the ESCO also is providing an annual seminar to ensure that Riverdale's staff remains up-to-date on the use and care of its new equipment.

Case Study #5	RIVERDALE HOSPITAL Toronto, Ontario, Canada

HEC Energy Services

Riverdale Hospital is a 780-bed rehabilitation and continuing care facility located in Toronto, Ontario. The facility is comprised of a 281,200 square foot hospital building, a 21,600 square foot office and support services building, and a 15,700 square foot Administration Building.

In 1993, the Hospital commissioned HEC Energy Services to implement a comprehensive energy efficiency and operating cost reduction program. This program covered several energy conservation measures, including replacing the aging CFC-type chiller and converting the boiler plant to unaltered or "guarded" status. Under a fixed price performance contract which guarantees operating cost savings in future years, the project was accomplished in two phases. Phase 1 consisted of an energy and water conservation program and Phase 2 provided for capital improvements to the chiller and boiler plants. HEC completed an energy use analysis, a feasibility study, and a design plan for the project. It also purchased the equipment, managed the project construction, and assigned installation services to a subcontractor.

The Performance Contract. HEC Energy Services (subsequently HEC Energy Consulting Canada) implemented the project under a fixed price, guaranteed savings contract. The analysis, feasibility study, and design were conducted by HEC's in-house professional engineers. A local consulting firm provided some design assistance

PROJECT INFORMATION

Rehabilitation and Continuing Care Hospital Facility

Riverdale Hospital Contact
William Grant,
Director of Maintenance & Engineering
416/461-8252 ext. 2190

HEC Contact
Robert Wilczynski
708/361-5620

Project Type
Fixed Price Performance Contract With Guaranteed Savings

Facility Size
3 Buildings: Approximately 318,500 sq. ft.; 780 Beds

Annual Energy Savings
2,136 kW; 1,739,863 kWh; 100,000 therms

Annual Project Cost Savings
Energy Savings: $191,500 (Canadian)
Maintenance & Operational Savings: $49,000 (Canadian)

Project Cost
$3.2 Million (Canadian)

Financing
Riverdale Direct Investment

Contract Term
Annual/Renewable

Installation Period
August 1993 – January 1995

under the direction of HEC's project manager. HEC's project manager also coordinated the purchasing of major equipment and its installation by subcontractors. Under this contract, HEC provided a savings guarantee to Riverdale Hospital to ensure that the Hospital realizes the projected cost savings. Should Riverdale incur a savings shortfall in any calendar year, HEC would write Riverdale a check to cover this short fall. The Hospital can discontinue the savings assurance services at any time.

Measurement and Verification
M&V measures were implemented using NAESCO and ASHRAE guidelines, as well as the federal protocols endorsed by the U.S. Department of Energy and the U.S. Department of Defense.

HEC tracks utility invoices monthly, checks for accuracy, and reconciles actual and guaranteed savings. The facility is electronically monitored, daily if necessary, through the energy management system. Periodic site visits provide an opportunity to follow up on anomalies in utility bills and monitoring reports. The Hospital receives a quarterly report of performance results and an annual in person presentation. HEC engineers also are available for consultation regarding anticipated changes that may affect energy and operating costs.

Project Economics. Phase 1 was implemented at a fixed cost of $950,000 (all costs are in Canadian dollars) with a 3.9-year simple payback period. Phase 2 was installed for $2,270,000. Total annual operating cost savings for both phases is $411,000 for a simple payback period of 7.8 years. HEC also arranged for Riverdale Hospital to receive a $19,000 rebate for the VSDs from Ontario Hydro.

Project Description - Phase 1

Energy Management and Control System. During the first phase of the project, HEC achieved the greatest energy cost savings by installing an Energy Management System (EMS) with Direct Digital Controls to replace the existing electric and pneumatic temperature control systems. Eleven major air handling systems, four sets of steam converters, and other miscellaneous HVAC equipment are now controlled by the EMS. HEC used the EMS to implement several other system control measures as well, including two-speed fans, system time-of-day control, night setback, optimized start time, air temperature reset, heating water reset, and chilled water plan optimization. HEC directly handled the temperature control work so that it could maintain direct control over this critical program component. An HEC subcontractor performed the mechanical and electrical work. HEC implemented other energy conservation measures to complement the savings achieved from the EMS.

Air Handling Units and Fans. Air handling units and the associated exhaust fans now are controlled through the new EMS. Fan control sequences were custom designed to maintain the proper pressure relationship between patient rooms and corridors. VFDs replaced fan motors in both the cafeteria and auditorium. The audi-

torium's air handling system was repaired and the controls were replaced with the EMS.

HEC converted the administration building air handler from 100 percent outdoor air to a recirculating system with a new return air fan. A chilled water coil had been installed in this unit years before, but the fan system alone was not large enough to handle the total cooling load. As a result, window type air conditioners were being used to supplement air cooling in many rooms. Most window units were removed, resulting in improved space conditions following project completion.

HEC also upgraded the outside air intake for one of the smaller air handlers. While this retrofit did not produce direct utility or operating cost savings, it did alleviate the Hospital's ongoing problem of drawing in automobile and generator exhaust fumes.

Heating/Cooling System. A VFD was installed for the induction system heating/cooling secondary pump and for the control air compressor. The speed of these devices is modulated to match the current load. A new 7½ HP multi-stage boiler feed pump replaced one of the existing 20 HP pumps.

Water Conservation Measures. Implemented as part of the project, water conservation measures substantially reduced city water and sewer charges and steam consumption for domestic water heating. These savings were so substantial that just a few weeks after full implementation, the City's water department made an unscheduled visit to confirm that the meters were functioning properly.

Lighting Retrofit. HEC performed a comprehensive lighting retrofit that improved the Hospital's lighting and significantly reduced its energy use. Most of the relamping work involved replacing standard magnetic ballasts with electronic ballasts and the 20 watt and 40 watt T-12 lamps with 17 watt and 32 watt T-8 lamps, respectively. This effort included wiring fixtures in tandem, where possible, so that a ballast in one fixture serves the lamps in its fixture and those in the adjoining fixture. The T-8 technology also improved lighting quality and footcandle levels. Most incandescent lamps were replaced with compact fluorescent lamps. Screw-ins, as well as hard-wired retrofits, were used.

HEC's comprehensive energy conservation program also included an extensive training program for the hospital operation and maintenance staff once the major equipment was installed.

Project Description - Phase 2

Boiler and Chiller Replacement. During Phase 2, HEC replaced the existing high pressure water tube boilers and chiller. The new coil tube boilers can be operated

without shift engineers, thereby reducing operating costs. This provides more time for the shift engineers to perform maintenance in the central plant and in the rest of the hospital. The EMS monitors all boiler functions and alarms and alerts the on-duty maintenance engineer by automatically telephoning his or her pager.

Construction Management. In September 1995, the project fell behind schedule because the hazardous materials subcontractor needed more time than expected to remove the asbestos. To keep the steam plant in operation with 70 percent capacity, as required by the Province of Ontario hospital codes, HEC redesigned the position of the third new boiler so that one existing boiler could remain fully operational until the new boilers were commissioned and accredited.

Operation and Maintenance Staff Training

HEC's comprehensive energy conservation program also included an extensive training program for the Hospital's operation and maintenance staff, once the major equipment was installed. This program covered the purpose of the new equipment, equipment specifications, and operation and maintenance requirements. Training for major new systems like the EMS included a classroom session at the manufacturer's training facility, with a second on-site session for staff selected by the Hospital.

In addition to the initial training sessions, each year HEC's project manager conducts a formal full-day seminar designed specifically for the facility and its operations and maintenance staff. The first two to three hours are dedicated to general information regarding the energy conservation program and the facility's energy consumption history. Other Hospital department heads are also encouraged to attend the first portion of the seminar.

Customer Comments

The seminar and training have helped to raise awareness among the Hospital's administrators and staff. All Hospital employees are encouraged to incorporate simple energy conservation practices into their normal workday. These suggestions include turning off lighting in unused areas, raising the cooling set point in unoccupied rooms, water conservation, reporting situations of energy or water waste, and many more.

From Interview With Facility Personnel

We're very pleased with the outcome of this project. The hospital already has realized a greater savings than we expected. We've contracted [with] HEC to help us with our continuing energy management efforts.

William Grant
Director of Maintenance and Engineering
Riverdale Hospital

ESCO Address

HEC Energy Services
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508/653-0456
Fax: 508/653-0266
Web Site: http://www.hecenergy.com

ESCOs often work together in teams and always consider the customer to be the most important member of the team.

Depending on the size and nature of a project, the prime ESCO may select one or more other ESCOs to join with it on the project, through subcontracts. The goal of this team approach always is to enhance the quality of the project for the customer.

Whether an ESCO handles the entire job itself or brings in other ESCOs, the customer always is viewed as the most important member of the team. As Madigan Army Medical Center, in Fort Lewis, Washington found, with qualified ESCOs, hospital personnel can choose a greater or lesser degree of involvement in the project depending upon their own preferences. Qualified ESCOs provide hospital personnel with a high degree of confidence in the outcome of the project, whatever the level of involvement by hospital staff.

Case Study #6	MADIGAN ARMY MEDICAL CENTER Fort Lewis, Washington

EMCOR Energy Services

(As Sub-Contractor to EUA Cogenex Corporation Under Agreement with Tacoma Public Utilities for the Fort Lewis Energy Efficiency Project)

For Fort Lewis, Washington's Madigan Army Medical Center, EUA Cogenex Corporation selected EMCOR Energy Services as its ESCO subcontractor. EUA previously had been selected as the prime ESCO contractor for all of Fort Lewis under a request for proposals (RFP) issued by Tacoma Public Utilities (TPU).

Madigan Army Medical Center, encompassing a floor area of more than 1.9 million square feet, is the western region medical training center for the Department of Defense. Under EMCOR's contract with EUA Cogenex, work was accomplished in two phases. Phase I involved installing electronic variable frequency drives (VFDs) and high efficiency motors and Phase II included upgrading surgical fan speed controls and energy management control systems. Energy conservation measures were chosen based on economic criteria and the customer's priority for capital improvements.

EMCOR's Project Responsibilities. EMCOR conducted the energy audit, identified the ECMs, and developed the project's scope of work. EMCOR then completed the project design and provided for the installation of the ECMs. Following project installation, EMCOR maintained the installed equipment and trained site personnel in its use and care. Finally, EMCOR was responsible for col-

PROJECT INFORMATION

Medical Center

Madigan Army Medical Center Contact
Chuck Cole
253/968-0311

EUA Cogenex Corporation Contact
Edward T. Liston, President
978/441-0090

EMCOR Contact
Ron Herbst, Project Engineer
253/858-8084

Project Type
Energy Savings Performance Contract/Guaranteed Savings

Facility Size
1,900,000+ sq. ft.

Annual Energy Savings

Projected:	758,669 kWh (Phase I only)
	435,257 kWh (Phase II only)
Actual:	905,109 kWh (Phase I only)

Annual Energy Cost Savings
$24,127 (estimated total for Phases I and II)

lecting data for the measurement and verification of energy services. TPU and Bonneville Power Authority reviewed the measurement and verification process.

Terms of the Performance Contract. This was a one-year contract with four option years, all of which were executed.

Terms of EMCOR Sub-Contract. EMCOR's Sub-Contract with EUA Cogenex, which includes a Professional Services Agreement and Master Articles of Agreement, as well as a Fee for Service Agreement, provided that 25 percent of EMCOR's professional services fee was contingent upon the project's achieving no less than 85 percent of the estimated project savings.

Cost Controls. EMCOR provided construction cost guarantees with its Energy Conservation Proposal. Pre-purchased equipment was used to reduce installation costs. The U.S. Army Medical Command (MEDCOM) and EMCOR, worked together to integrate the equipment. Start-up on the equipment was performed jointly by EMCOR and MEDCOM staff to ensure cross-training. EMCOR performed over 95 percent of the engineering, metering, construction, and operations and maintenance work.

After project completion, an EMCOR subsidiary, KDC Systems, Inc., asked Madigan Army Medical Center staff to complete a questionnaire about their satisfaction with this project. On a scale of 1 to 10, with 10 being the highest rating, the staff consistently gave this project 8s and higher.

EMCOR Project Fees

$49,826 (Phase I Professional Services)
$311,414 (Phase I Construction)
$20,083 (Phase II Professional Services)
$134,109 (Phase II Construction)
Total: $515,432

Financing

During construction, EUA Cogenex Corporation financed the project; Tacoma Public Utilities paid 85 percent of the construction cost to EUA Cogenex upon acceptance. The remaining construction cost was paid to EUA Cogenex after the M&V activities were completed. EUA Cogenex paid EMCOR for professional services and installation. Twenty-five percent of EMCOR's professional services fee was tied to the achievement of monitored and verified energy savings.

Contract Term

1 Year

Installation Period

Multiple Delivery Orders Starting January 1995 to Present

Measurement and Verification

ESPC performance data were based on FEMP M&V Protocols A and B. Work included developing an M&V plan to measure interactive cooling effects from a separate lighting efficiency project on chiller plant energy use. Metered data were collected by EMCOR, according to the M&V Plan, and independently evaluated by Tacoma Public Utilities

Environmental Benefits of Project

EMCOR recommended ventilation control systems to improve indoor air quality and coordinated construction activities using information from prior asbestos surveys to minimize the need for abatement. Fort Lewis was responsible for the asbestos abatement.

Customer Comment

In their comments, the Medical Center staff called this a “well run contract that had good support by all players,” including the multiple contractors, the utility company, and the facility staff that cooperated and assisted when possible.

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Appendix A

Supplementary Article

An Overview of the Key Elements of an Energy Efficiency Upgrade

By Jessica S. Lefevre

In existing buildings, energy conservation measures, including the replacement of old energy-using equipment with state-of-the-art high-efficiency equipment, can reduce energy consumption and associated costs by 25 percent or more, on average.

A performance-based energy efficiency retrofit project is designed so that the energy savings created repay the costs associated with the capital improvement in seven to 10 years, on average. Some building owners and other entities with in-house expertise in state-of-the-art energy efficiency technologies are in a position to consider taking on such projects themselves. However, most companies undertake this type of facility upgrade with the assistance of an energy service company, or ESCO.

In either case, the following definitions and explanations provide an introduction to the key concepts applicable to energy efficiency upgrades and to some of the terminology commonly used in this area.

ESCOs should not be confused with energy efficiency consulting firms or with equipment contractors. ESCOs are project developers who assume the risk that their projects, in fact, will perform as promised.

An **Energy Service Company** is an enterprise engaged in developing, installing, and financing comprehensive, performance-based projects centered around improving the energy efficiency and maintenance costs for facilities owned or operated by end use energy customers.

ESCOs should not be confused with energy efficiency consulting firms or with equipment contractors. ESCOs are project developers who assume the risk that their projects, in fact, will perform as promised. Consulting firms and suppliers accept no project risk.

In addition to the standard energy efficiency measures described here, many ESCOs offer fuel switching – typically electricity to gas or oil – as part of a comprehensive project. Similarly, in order to maximize their customers' energy savings, some ESCOs are beginning to design projects that combine energy efficiency measures with other energy-related technologies, such as cogeneration.

A **performance-based energy efficiency project or retrofit** is one in which energy savings are measured and verified. Project costs – including the compensation to an ESCO and the project's financing – are paid from the project's verified energy and related operations and maintenance cost savings. When an energy efficiency project

When an energy efficiency project is performance-based, in addition to providing for the design, installation, and financing of the project, an ESCO also will guarantee that the project will generate a level of savings sufficient to cover all agreed-upon project costs.

is performance-based, in addition to providing for the design, installation, and financing of the project, an ESCO also will guarantee that the project will generate a level of savings sufficient to cover all agreed-upon project costs. ESCOs use appropriate equipment and accepted protocols for monitoring energy use and for measuring and verifying the energy savings created by the project. In order to support the performance guarantee, ESCOs will offer to maintain all project equipment throughout the guarantee period. Their ability to offer performance-based services distinguishes ESCOs from consulting engineers specializing in efficiency improvements. The latter provide advice on energy efficiency measures but do not assume the risk that their recommendations will yield actual demand or energy cost savings.

An **energy savings performance contract** is an agreement between the host facility and an ESCO for a performance-based energy efficiency retrofit.

A **comprehensive energy efficiency project or retrofit** is a project designed to generate energy and energy cost savings using the broadest possible array of cost-effective measures. An ESCO should offer to design a comprehensive energy efficiency project where the customer agrees that this approach is appropriate. Contractors specializing in single measure installations, however, may disregard the potential for additional energy savings available through the use of equipment other than the equipment in which they specialize.

An ESCO should offer to design a comprehensive energy efficiency project.

The **baseline**, against which reduced energy use is measured, is the measure of pre-project energy use, established through an energy audit of the facility. The baseline must be established for each performance-based energy efficiency project.

An **energy audit** establishes an inventory of energy using equipment and a profile of energy use. The energy audit generally is a two-step process undertaken in preparation for a performance-based energy efficiency retrofit. An *initial energy audit* is conducted to obtain a general inventory of energy consuming equipment, with approximations of hours and patterns of use. This general information helps determine the potential scope of an energy efficiency project, and often forms the basis on which an ESCO and a customer agree to proceed with a project. If this agreement is reached, a more **comprehensive investment grade energy audit** must be prepared.

Unlike the initial audit, the comprehensive energy audit is the basis for financing the project, as well as the basis for projecting energy savings under a performance contract. Therefore, it is imperative that this audit be as detailed and reliable as possible. Because of their importance, ESCOs almost always perform their own comprehensive energy audits, or have them performed by an engineering subcontractor hired to provide the technical design for the project. It is rare for an ESCO to enter into an energy savings performance contract based on an energy audit conducted by an independent third party.

The comprehensive energy audit is the basis for financing the project, as well as the basis for projecting energy savings under a performance contract.

Energy savings is calculated as the difference between pre-project (the baseline) and post-project energy use. Monitoring and measurement technologies are used to verify energy savings for a performance-based project. This specialized equipment and software allow the real-time monitoring of actual energy use. Engineering-based protocols are available for the design of the monitoring and measurement component of a performance-based energy efficiency project. One of the best known of these protocols is the **International Performance Measurement and Verification Protocol**. This protocol is the result of a collaborative effort among the U.S. Department of Energy and a number of private concerns, including Energy Service Companies, engineers, and representatives of the financial community.

The **payback period** is the time required to recover the capital and labor costs associated with the new equipment. The payback period for an energy efficiency retrofit generally is independent of the contract term and varies for different types of equipment. For example, a high-efficiency lighting retrofit might pay for itself in two years, or even less; whereas a heating, ventilation, and air conditioning (HVAC) replacement or an energy management system (EMS) may require a payback of 15 years. It is common for an energy efficiency retrofit, at a minimum, to combine lighting and HVAC replacement. In this case, the shorter lighting payback can be used to subsidize the cost of the longer payback item, thereby providing a total payback period of perhaps seven to 10 years. In addition, other capital improvements – new boilers, generators, steam plants, CFC-free refrigeration units, or power plant housings – can be folded into a project and the costs covered, or at least partially subsidized, by the combined energy cost savings.

It is common for an energy efficiency retrofit, at a minimum, to combine lighting and HVAC replacement.

Technologies and Services Employed in a Comprehensive Performance-Based Energy Efficiency Project

Certain technologies form the core of the typical performance-based energy efficiency project: high-efficiency lighting, high-efficiency HVAC equipment, efficient motors and chillers, variable speed drives/variable frequency drives, and centralized energy management systems. A full array of weatherization services accompanies the core technologies where appropriate.

Depending upon the characteristics of a particular project, core technologies may fully exhaust the energy savings available for that project, or they may form the basis upon which other innovative energy-related applications, such as fuel switching, integrated cogeneration, distributed generation, or renewable energy technologies, are added. Similarly, an older facility may benefit from a renovation of its steam heating system or from a new on-site power plant. Work such as this can be accomplished within the context of a comprehensive performance-based energy efficiency project, and as discussed, the long payback period on the larger investments can be offset by the substantially shorter payback on many of the core energy efficiency technologies. These core technologies are reviewed briefly below.

Core technologies may fully exhaust the energy savings available for that project, or they may form the basis upon which other innovative energy-related applications, such as fuel switching, integrated cogeneration, distributed generation, or renewable energy technologies, are added.

Lighting can account for 50 percent or more of a facility's total electricity consumption. For most energy efficiency retrofits, **high-efficiency lighting** is a key consideration in reducing operating costs. In addition to reducing costs, new lighting technologies – including T-8 fluorescent lamps, compact fluorescent bulbs, electronic ballasts, and specular reflectors – offer a substantially higher quality of light. Change-outs to these new products are reported to greatly increase employee comfort and even productivity.

In addition to reducing costs, new lighting technologies – including T-8 fluorescent lamps, compact fluorescent bulbs, electronic ballasts, and specular reflectors – offer a substantially higher quality of light.

High-efficiency heating, ventilation, and air conditioning (HVAC) systems are also core energy efficiency technologies. The typical HVAC components of a comprehensive energy efficiency retrofit are chillers, cooling towers, variable frequency drives for pump and fan motors, cleaning or replacement of cooling coils, unitary prod-

ucts (rooftop units, heat pumps, and split systems), and boilers. The energy and economic analysis of potential retrofit measures must take into account the thermodynamic linkage between a lighting retrofit and the HVAC retrofit, since high-efficiency lighting generates less heat than older lighting technologies. Upgraded HVAC systems can also improve comfort and productivity by improving indoor air quality.

An energy management system (EMS) is a computerized system installed to control a facility's energy consuming equipment from a central location, usually a single personal computer. The EMS enables facility engineers or maintenance personnel to schedule energy-related services, such as HVAC, for different parts of a facility only during their hours of use. Equipment adjustments, such as temperature control, also can be made from the central computer, even for buildings that are spread over a large geographic area.

Modifying manufacturing and process equipment reduces the energy costs associated with manufacturing and other processes. High-efficiency motors typically reduce motor losses by 25 to 30 percent through the reduction of magnetic, heating, friction, windage, and stray load losses. Variable frequency drives (VFDs) or variable speed drives (VSDs) vary the power delivered to a motor so that it runs only when needed and at the minimum speed the process requires. In appropriate applications, this can multiply the savings from an investment in a high efficiency motor.

Building envelope enhancements (weatherization) include insulation, weatherstripping, double paned windows, and energy efficient window films. The latter reflect heat in the summer to reduce cooling needs and insulate the glass in the winter to reduce heating needs.

Waste heat recovery systems capture heat, such as from a motor or a cogeneration unit, and direct it to another system or piece of equipment that depends on heat input. One of the most popular applications of this technology is the use of waste heat to preheat boiler feedwater before it reaches the boiler so that less energy is required to run the boiler.

Gas-fired engines or steam turbines replace electric motors as part of the more general efficiency measures related to fuel switching, enabling a facility to use less expensive gas or oil in place of electricity.

In addition to the above, when necessary, ESCOs can be expected to provide for the removal and disposal of hazardous materials from a customer's facility. For example, existing fluorescent lighting equipment uses ballasts containing PCBs and fluorescent light tubes contain traces of mercury. Therefore, when existing lighting equipment is removed and replaced with new high-efficiency lighting, the old equipment must be disposed of as hazardous waste. Similarly, HVAC upgrades may involve the removal of asbestos or the use of installation techniques that avoid disturbing asbestos that cannot be removed.

Appendix B

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Additional Materials on Energy Efficiency Services and Performance Contracting

The Energy Project Manual — The Customer's Handbook to Energy Efficiency Retrofits: Upgrading Equipment While Reducing Energy Consumption and Facility Operations and Maintenance Costs, by Jessica Lefevre for the National Association of Energy Service Companies. Available from NAESCO, 1615 M Street, NW, Suite 800, Washington, DC 20036; Phone: 202/822-0950; Fax: 202/822-0955; Web Site: http://www.naesco.org.

Energy Savings in Hospitals, by Stefan Jakélius, published by the Center for the Analysis and Dissemination of Demonstrated Energy Technologies (CADDET), 1996. Available from the American Council for an Energy-Efficient Economy (ACEEE), 1001 Connecticut Avenue, NW, Suite 801, Washington, DC 20036; Phone: 202/429-0063; Fax: 202/420-01193; E-mail: ace3pubs@ix.netcom.com; Web Site: http://aceee.org.

The Energy Services Industry: Revolutionizing Energy Use in the United States, by Jessica Lefevre for the National Association of Energy Service Companies. Available from NAESCO, 1615 M Street, NW, Suite 800, Washington, DC 20036; Phone: 202/822-0950; Fax: 202/822-0955; Web Site: http://www.naesco.org.

"Energy Upgrades: Fictions And Facts," By Abigail Kelly, *Building Operating Management,* May 1999. Available from Trade Press Publishing Corp., 2100 W. Florist Avenue., P.O. Box 694, Milwaukee, Wisconsin 53209; Phone: 414/228-7701; Fax: 414/228-1134; Web Site: http://www.facilitiesnet.com.

How to Hire an Energy Services Company, by Daryl Mills for the California Energy Commission. Available from the Commission's Publications Unit at 1516 Ninth Street, Sacramento, CA 95814; Phone: 916/654-5200; Web Site: http://www.energy.ca.gov.

"Inside ESCOs," contributions by Terry E. Singer, Grant Gegwich, and Peter Funk, *Energy User News,* June 1999. Available from Business News Publishing, 755 W. Big Beaver Road, Suite 1000, Troy, Michigan 48084; Phone: 248/362-3700; Fax: 248/362-0317; Web Site: http://www.energyusernews.com.

"Power Players," by Abigail May, *Maintenance Solutions,* March 1998.Available from Trade Press Publishing Corp., 2100 W. Florist Avenue., P.O. Box 694, Milwaukee, Wisconsin 53209; Phone: 414/228-7701; Fax: 414/228-1134; Web Site: http://www.facilitiesnet.com.