

## Energy Efficiency Upgrades for Little Rock AFB

*Innovative partnership with local utility reduces energy costs and consumption.*



### Utility Services Case Study

#### Overview

Little Rock Air Force Base (LRAFB) has developed a strong partnership with Entergy, the local utility, as part of the base's efforts to reduce energy costs and use savings from investments in high-efficiency equipment to maintain and improve the condition of base housing and other facilities. The U.S. Department of Energy's Federal Energy Management Program (FEMP) provided advice and technical assistance to both utility and LRAFB site personnel.

Thus far, three projects have been completed, with over \$10 million invested. Major accomplishments include replacement of air-to-air heat pumps with high-efficiency ground-source heat pumps (GSHPs) in more than 1,500 base housing units, lighting modifications to 10 buildings, upgrade of HVAC equipment in the base's enlisted club, and energy-efficient lighting retrofits for LRAFB's flight simulator. LRAFB asked Entergy to manage the system design and installation of the heat pumps, and the innovative contracting and procurement process significantly reduced the project's cycle time compared to traditional Federal procurement processes. The heat pump project is expected to reduce electricity consumption of the residential housing units by about 28%. Since the installation, electricity costs have actually decreased by about 25% at LRAFB, due primarily to peak demand reductions from the new heat pumps as well as a rate reduction in peak demand charges.

#### Background

LRAFB is located 12 miles north of Little Rock, Arkansas, and has about 100 buildings and 1,535 residential units. The base's annual electricity bill was approximately \$6 million and base housing accounted for about 30% of total consumption. LRAFB was particularly interested in upgrading its aging, air-to-air heat pump systems that provided heat and cooling to residential units and in reducing service calls (and maintenance costs) from a contractor who responded to repeated customer complaints about inadequate heat or cooling. LRAFB and Entergy were both interested in developing a more streamlined procurement process that enabled the base to develop comprehensive energy efficiency projects.

#### Project summary

The existing air-to-air heat pumps were at the end of their useful life; LRAFB was considering alternatives and asked Entergy to manage the system design and installation of geothermal ground-source heat pumps. Entergy hired a local engineering firm (Tinsley-Mullen Engineers) to do contract administration and perform design review and bid evaluation. A contractor hired by Entergy through a competitive solicitation installed the new heat pumps in two phases: a pilot phase of 10 units, followed by installation of heat pumps in 1,525 units beginning in August 1997 with completion by April 1998. During the first summer after the new heat pumps were installed, the base received complaints from about 200 housing units regarding uncomfortable temperature conditions during very hot weather. The contractor had used specifications provided by LRAFB indicating that there was R-30 insulation in all residential attics, that all heating/cooling system ductwork was in good condition, and that the heat pumps should be designed to cool houses to 78°F when the outdoor air temperature was at its maximum of 99°. Summer temperatures during that year exceeded the design conditions by four to seven degrees on several days.



Workers drilling well outside of the base for the ground-source heat pump.

LRAFB called Entergy back to address these issues, initially suspecting problems with the ground-coupling system. After a number of meetings, the partners (Entergy, LRAFB, Tinsley-Mullen, and the heat pump installation contractor) agreed on the following plan. Starting with a list of units that had reported two or more service calls, Entergy and Tinsley-Mullen inspected about 5% of the housing units and discovered that there was little or no attic insulation in many units and that there was inadequate airflow in the air distribution system and a few units had low pressure in the ground loops or mechanical problems. The subcontractor installed new attic insulation, repaired or replaced air duct

Entergy Services, Inc./PIX06087

U.S. Department of Energy  
Office of Energy Efficiency and Renewable Energy



systems, corrected ground-loop pressures, and remedied mechanical problems. The repair of ductwork and addition of insulation solved the problems in the vast majority of units; ground-source heat pumps were undersized in a few units. The cost of the ductwork and insulation was added to the GSHP project via a Change Order and subsequently added to the 10-year loan.

**Lessons learned**

A number of lessons can be drawn from this project, some of which apply specifically to successful ground-source heat pump installations.

**Move toward Model Agreement** — LRAFB and Entergy negotiated a modification to the base's existing electric service agreement for each project. This approach, although more streamlined than traditional Federal procurement, required negotiating detailed terms and conditions. Since then, Entergy and its other Federal customers prefer to start from the Department of Defense/Edison Electric Institute "Model Agreement" and customize it as necessary for the specific agency. With this approach, a general agreement, including major terms and conditions, is put in place, and subsequent projects require only delivery orders. Entergy has found that a general contract agreement provides a useful framework for continuing the partnership arrangement between the utility and Federal customer, given the realities of turnover and changes in key base personnel.

**Problem-solving and dispute resolution processes** — Not all projects will be trouble-free; thus, truly successful partnerships often emerge from the ability to solve problems that arise during or after installation of new equipment. In this project, every member of the team was involved in developing methods to address and resolve tenant complaints. One lesson that emerges is the value of having dispute resolution processes in place to resolve issues that might arise during the "shakeout" period after installation of new, innovative equipment.

**Integrated, phased approach for GSHP installations** — GSHPs are an innovative, highly efficient, yet evolving technology. LRAFB personnel strongly recommend a two-stage approach with a pilot and full-scale implementation. Given the performance uncertainty and complexity of this technology, LRAFB personnel believe that other facilities might want to consider a performance guarantee. Accurate sizing of the depth of wells is a critical element of the design of a successful GSHP installation. In this project, the Entergy team conducted three soil tests in order to characterize accurately the thermal conductivity of the major soils found on the base.

**High-efficiency ground-source heat pump yields significant energy savings.**

Other facilities need to ensure that an adequate number of well depth tests are performed, given variations in local soil conditions. It is critical to pay close attention to the relationship between GSHP sizing and the actual condition of the building envelope and duct system. The contractor was instructed to size the GSHP equipment based on the insulation levels in the original building specification. Given the age and condition of most military housing, it is critically important to assess the current condition of the building envelope through visual inspection of a sample of units to minimize problems that may arise after new equipment is installed.

**Looking ahead**

The partners recommend that a comprehensive tenant education campaign accompany the installation of high-efficiency GSHPs, because some of the tenants' initial complaints were attributable to the fact that they did not understand the different operating characteristics of the new equipment. Educating base personnel about the project and how to use and operate the new equipment, is likely to lead to higher customer satisfaction.

In assessing customer satisfaction with new technology, it is also important to collect baseline information on service calls in response to customer complaints. About 10% of the tenants called in two or more times complaining about a problem in their unit. However, upon investigation, it turned out that complaint levels were about 30% higher prior to the retrofit, indicating the extent of dissatisfaction with preexisting comfort conditions in the base's housing. As the tenants become educated about the operation of the new heat pumps, the complaints continue to decrease.

**For more information**

Brad Gustafson  
Utility Services Program Manager  
DOE FEMP  
202-586-2204

David Burnette  
National Accounts Manager  
Entergy Services, Inc.  
870-541-4747



Entergy Services, Inc./PIX06088

FEMP Help Desk:  
800-DOE-EREC  
(363-3732)  
Internet:  
<http://www.eren.doe.gov/femp>



Produced for the U.S. Department of Energy by the National Renewable Energy Laboratory, a DOE national laboratory

DOE/GO-102000-1123  
November 2000