U.S. Marine Corps Camp Lejeune, NC

1 Background

Located on a 156,000-acre site on the coast of North Carolina, Camp Lejeune is the largest U.S. Marine Corps base in the world and uses about one-quarter of the total energy consumed by the Marine Corps. On any given day, about 45,000 Marines are on active duty at Camp Lejeune. Residential areas of the base include a total of 4640 homes that house about 11,000 Marines and family members.

By the mid-1990s, Camp Lejeune's family housing was consuming 91 million kWh of electricity per year on average. At 19,600 kWh per residence, this was about 30% higher than the average residential electricity use for this region of the United States. Part of the problem was that in much of the housing heating and cooling was supplied by minimum-efficiency air source heat pumps that had been installed in the early 1980s and were nearing the end of their service life. The maintenance and repair costs for this equipment were also a problem. After considering several options, officials at Camp Lejeune decided to replace the air source heat pumps with ground source heat pumps (GSHPs).

2 The Project

Camp Lejeune received three proposals for financing and implementing the energy retrofit, two for ESPC projects and the third from a subsidiary of the local utility for a project financed and carried out under a utility energy services contract (UESC). U.S. Federal agencies are allowed under several authorities to finance energy projects through UESCs offered by their utility providers, which are similar to ESPCs. Both ESPCs and UESCs allow private, third-party capital to be used to purchase and install ECMs, which is repaid over time using the energy cost savings generated by the ECMs. A primary difference between the two financing vehicles is that UESCs are not required by law to include performance or savings guarantees or M&V. Also, Super ESPC terms can be as long as 25 years, whereas UESCs have generally been limited to 10-year terms. Agencies' policy makers and contracting officers commonly set strict upper limits on contract terms to minimize the government's long-term commitments (and financing costs).

Camp Lejeune decided to fund the project through a UESC contract with a subsidiary of the local utility. Camp Lejeune personnel indicated that a primary reason for selecting the UESC over an ESPC was the 10-year contract term offered by the utility.

Beginning in May of 2000, air source heat pumps were replaced with GSHPs in 2054 residences. Altogether the new installed equipment provided 3450 tons (12,130 kW) of heating and cooling capacity at a total construction cost of $12.7. Camp Lejeune paid a portion of this cost to the utility on completion of construction and the utility financed the remainder. Over the 10-year contract term, Camp Lejeune was to pay the utility a total of $15.5 million.

3 Measurement and Verification

Although UESC contracts do not require savings guarantees or verification, Camp Lejeune insisted on a savings guarantee that would be verified annually through analysis of the previous year's utility bills. Using 5 years of pre-project utility billing data, the baseline electricity consumption in family housing for a TMY was estimated to be 91.1 million kWh, and the total annual demand (defined as the sum of the monthly billing demands for the 12 months of the TMY) was estimated at 734,000 kW. In each year of the post-retrofit period, the utility was to normalize electricity use and billing demand for the previous 12 months to the same typical year. Normalized post-retrofit electricity use and total demand were then subtracted from the baseline electricity use and demand to estimate the annual savings.

The guarantee was based on an electricity savings of 20.9 million kWh per year and demand savings of 83,500 MW. Using energy and demand prices from 2002 ($0.033 per kWh and $9.25 per kW of billing demand) the energy cost savings was estimated at $1.5 million. Camp Lejeune was to pay one-twelfth of this amount to the utility each month. If the normalization showed the actual energy cost savings to be less than 90% of this value, the payment to the utility was to be reduced by the amount of the shortfall.

4 Project Results

It was clear in the first year after installation that the savings targets were not being met. In addition, heat pumps in more than half of the residences were unable to maintain heating setpoints during very cold weather because of undersizing of both the heat pumps themselves and the ground heat exchangers. An analysis of utility bills performed by a third party after the second year of the contract estimated the normalized energy savings at 13.8 million kWh and total demand savings at 40,000 kW. Using the contract energy prices, this translated into a savings of $873,000 — about 60% of the guaranteed cost savings. Over the 10-year contract period, the shortfall in savings would amount to nearly $6 million dollars.

Following the completion of the 2-year billing analysis, Camp Lejeune and the utility began a lengthy period of negotiations. Camp Lejeune's position was that it was the utility's responsibility to repair and/or upgrade the heat pumps that were unable to meet heating setpoints and that its monthly payments to the utility should be reduced for the remainder of the contract to reflect the $6 million shortfall. Utility company representatives presented its own analysis claiming that the majority of the shortfall was due to excess energy use by the residents of Camp Lejeune family housing.

Nevertheless, a simple calculation might have raised concerns that the utility's original savings estimate was too optimistic. Before the retrofits, each residence was using on average 19,600 kWh of electricity per year. The estimated savings of 20.9 million kWh per year amounts to more than 10,000 kWh per residence, which is about 51% of the pre-retrofit electricity use.

However, conventional wisdom in the GSHP industry would predict about 33% savings for a residential retrofit, which agrees with independently verified savings of 33% from a similar retrofit project in military housing at the U.S. Army's Fort Polk. These facts might have led to the conclusion that the Camp Lejeune project was unlikely to reduce electricity use by 51%.

Ultimately, the utility installed backup resistance heating to allow undersized heat pumps to meet peak heating loads. This resolved the problem in these residences, but increased electricity use and demand during the winter months and reduced savings. Camp Lejeune accepted partial responsibility for the savings shortfall, and total payments to the utility were reduced by $3 million rather than the $6 million originally requested.

5 Lessons Learned

Despite the problems that occurred in this project, Jim Sides, utility manager at Camp Lejeune, remains positive. "We learned a lot, and those lessons have made us smarter consumers of performance contracting services." The first thing Sides recommends is to make certain the project is well-designed. "Have designs reviewed by a third party subject matter expert who has no ties to the ESCO and will tell you the hard truth. If necessary design changes render the project unfeasible because of payback, don't do the project."

Sides also recommends that savings guarantees be well-written and iron-clad. "One of the benefits of a performance contract is that the ESCO assumes the technical risk. Without a savings guarantee, technical risk shifts to the customer." Finally, Sides urges potential customers to personalize the project. "Think about it. If this were your money, would you do the project?"