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Big Chiller Cuts Cooling Costs in Southern California

by Harry M. Mays, Administrative Officer, San Bernardino County, California

Recognizing that operations represent 92 percent of a jail's lifetime costs, San Bernardino County officials emphasized energy and operational efficiency when they began designing the West Valley Detention Center. The huge facility, which opened last year, is part of a multifaceted program to bring the county into compliance with court-mandated expansion of its jails to help relieve chronic inmate overcrowding.

The West Valley Detention Center was designed to house 1,781 inmates initially, with a maximum potential capacity of nearly twice that number. The distance from one end of the facility to the other is more than 1,300 feet—longer than four football fields. It is a self-contained facility that includes administrative offices, housing, food service, laundry, inmate programs, maintenance, warehousing, recreation areas, visitation, courts, and a full-service health care delivery system.

The heart of the ice storage system is a 1,500-ton electrical, centrifugal chiller plant that provides sufficient coolant capacity to condition the facility's air twenty-four hours a day.

Studying the Feasibility of an Alternative Cooling System

The focal point of the search for ways to minimize operational costs was an electro-mechanical system and the possibility of using an anti-freeze-based fluid to cool the facility during off-peak hours. Through a technique known as ice storage, energy is used at off-peak hours to cool a water/glycol fluid, which is then circulated through stored water to create ice. During the day, the water/glycol fluid system transfers stored cooling to the facility.

A smaller version of such a system had been in use in the county museum for several years and had given excellent service with only minor maintenance. Never before had such a large-scale ice storage system been utilized in a correctional environment.

In a cooperative gesture, Southern California Edison officials agreed to pay half the cost of an independent study to determine the system's feasibility. The utility pointed out that if such a system could be used, the facility would qualify for the "super off-peak" tiered rate schedule, which promised even greater savings as power rates are based on when as well as how much energy is used.

In the final analysis, the selected system had a simple payback of less than five years and was estimated to save the county an additional $2.5 million in energy costs over the expected twenty-five-year life of the system, based on current trends in energy cost increases. If energy costs increase at a faster-than-expected rate, the potential for savings is even greater. With such a rapid payback and promise of ongoing savings, the county simply couldn't afford not to integrate the ice storage system into the West Valley Detention Center.

Cooling System Components

The heart of the detention center's ice storage system is a 1,500-ton electrical, centrifugal chiller plant that provides sufficient coolant capacity to condition the facility's air twenty-four hours a day. Unlike other systems, the chillers run only between the hours of midnight and 6:00 a.m. During these off-peak hours, a water/glycol solution circulates first through the chillers and then through coils contained in water-filled tanks, where about a

half an inch of ice forms around the tank coils.

During the peak hours of noon to 6:00 p.m.—when local energy use is at its maximum and most costly—the chillers are not used. Instead, the water/glycol solution recirculates through the ice storage tanks and the facility, using the stored ice to cool the facility. The system is designed in such a way that even on the hottest Southern California afternoons, the chillers remain idle.

A highly sophisticated energy management computer controls the system. Using a variety of compiled weather data, the computer calculates how much ice will be required to cool the facility during the next demand period. It then cycles the chillers each night to produce the correct amount of ice for the following day. Using direct digital electronics, a single maintenance technician can modify virtually any aspect of the system's operation by simply reprogramming the computer. Regular printouts on system status are provided on a preassigned schedule. Despite the system's complexity, it is designed to run virtually independent of human intervention.

The center has other energy-saving features that both enhance the effectiveness of the ice storage system and operate independently to take advantage of other system characteristics. For example, a variable speed pumping system pumps only as much coolant as is needed to cool or heat the buildings. Computerized controllers automatically advance or retard the speed of the high-efficiency circulation motors to match the facility's demand. In addition, "airside" economizers automatically switch to ambient air for cooling whenever outside air is in the 55-to-60 degree range. These economizers double as life safety devices by exhausting smoke to the outside.

Using a variety of compiled weather data, the computer calculates how much ice will be required to cool the facility during the next demand period.

Finally, the availability of back-up generators at the facility allows Southern California Edison to remove the jail from the normal power grid during peak demand periods, with ten-minute notice to the jail operational staff. In return for this added element of flexibility, the utility placed the county on a special "interruptible" electric rate, thereby providing even more savings.

In this age of rapidly increasing energy and capital costs—especially in a corrections environment—every effort must be made to prudently integrate available technology into county construction programs.

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