BEST PRACTICES 2005

Cal Poly San Luis Obispo Chiller Relocation Project

By relocating two oversized chillers into the centralized distribution loop, Cal Poly has increased its cooling capacity while saving energy. The campus is now utilizing its existing capital investment more effectively by exploiting the chiller's full capacity and running the equipment in its optimal operating range.

Award Category

Load Management

Campus Loop Features

Serves 12 buildings

Conditions 533,000 ft^2, about 20% of the campus core

330,000 ft^2 currently conditioned by stand-alone chillers will be connected by 2020

Annual Energy Savings

151,122 kWh

Over $15,000

Annual CO_2 Emissions Avoided

64,982 kg

Cost

$559,000

Completion Date

April 2004

Cal Poly San Luis Obispo has taken innovative steps towards reducing its energy consumption by utilizing existing equipment in a more efficient manner. By incorporating two 300-ton chillers into the centralized energy loop, the university gained 600 tons of additional chilling capacity with minimal equipment purchases.

The two stand-alone chillers involved in the project were installed in 1996 to supply the Performing Arts Center. At that time the campus did not have a centralized energy plant and used self-contained package units. Under this configuration, the Performing Arts building required sufficient cooling capacity to cover its peak load as well as extra backup capacity that could be brought online should one chiller need repairs. This resulted in a combined chiller capacity far in excess of the building's normal daytime load. In fact, the building's maximum design load was less than 300 tons, resulting in only 50 percent utilization of the chiller equipment at any time.

Converting a campus's cooling system from dispersed HVAC units to a centralized chilled water loop can be a cost-effective way to increase equipment operating efficiency, accommodate load growth, increase reliability, simplify maintenance, reduce noise, and save space.

The mismatch between available chilling capacity and the building's actual load requirements resulted in inefficient load management. During low load conditions the compressor in an oversized chiller tends to surge and stall, an unstable situation that compromises the basic functionality of the system. This excessive cycling during partial loads also results in poor energy performance.

In order to maintain a minimum flow rate through the compressor during low loads, Facilities Services had to implement a hot gas bypass, a form of a false load. False loading entails discarding the portion of the chiller output that is not required to cool the building. This process consumes energy needlessly, since a large quantity of energy is used to create wasted cooling output.

Chiller equipment used at the Performing Arts Center. Photo: Cal Poly Engineering Services.

In 1997, Cal Poly finished constructing a new central plant with hot and chilled water to provide the campus with a more efficient system for heating and air conditioning. Upon its completion, however, the plant had already reached full capacity with connected load, leaving no capacity for new buildings and prohibiting further campus growth.

Several years later in 2002, the Performing Arts Center underwent renovation. The university used this opportunity to simultaneously execute a chiller relocation project, thereby minimizing the disturbance to building occupants. By relocating and integrating the chillers into the centralized distribution loop, the campus could capture the stranded investment and make better use of its existing equipment. The project enabled the campus to take full advantage of the existing capacity for the benefit of the entire university. The Performing Arts Center could draw from the central plant, and the campus could utilize the Center's excess capacity.

2005 BEST PRACTICES

Contacts

Assistant Director for Engineering Services/ Project Manager: Robert Pahlow, rpahlow@calpoly.edu 805.756.5223

Energy and Utilities Manager: Dennis Elliot, delliot@calpoly.edu 805.756.2090

More Information

www.calstate.edu/eo/EO-917.html

Calculate CO_2 emissions at: www.nef.org.uk/energyadvice/co2calculator.htm

Incorporating the stand-alone chillers into the campus loop yields further benefits because a centralized utility configuration allows chiller equipment to be run within its optimal operating range. This significantly improves the equipment's energy performance and reduces energy costs incurred by the campus.

View of the Performing Arts Center. Photo: Cal Poly Engineering Services.

In addition to reducing energy consumption, integrating the campus energy system simplifies and expedites maintenance. When one chiller requires maintenance the others are available to act as backups without compromising the functionality of the system. The ability to take a chiller offline for repairs at any time helps ensure that the chillers are always functioning properly and efficiently.

The relocation project proceeded smoothly over a thirteen-month period, with minimal disturbance to building users due the construction taking place at the building simultaneously. Robert Pahlow, Assistant Director of Facilities Services and Project Manager, found the most amusing part of the relocation to be the frenzied struggle for the now empty mechanical room. "I get a kick out of the politics," Mr. Pahlow laughs. People vying for the space "were like hungry animals going for the kill."

The chiller relocation project saves 151,122 kWh annually, which generates over $15,000 in energy cost savings for the campus. The reduction in energy use results in approximately 65,000 kg of avoided carbon dioxide emissions each year.

The 65,000 kg of carbon dioxide emissions avoided by the chiller relocation project is equivalent to the amount of carbon sequestered by 1,667 tree seedlings grown over a ten year period.

Energy conservation is a significant component of CSU's long-term plan for sustainability. Executive Order 917, issued in late 2004, mandates that CSU campuses reduce energy consumption by 15 percent by the end of fiscal year 2004/05, as compared to the baseline year 1999/2000. Since the chiller relocation project constitutes a small portion of Cal Poly's total energy use, less than one percent reduction in energy consumption was achieved. However, this project highlights the substantial benefits of innovative thinking when approaching energy issues with sustainability in mind.

More on Central Plants

The capacity required to supply a campus using a central plant is determined by the peak simultaneous campus load. This amount is always less than the sum of the peaks for each building, due to factors like occupancy patterns and varying solar loads which cause buildings to peak at different times of the day. Using a centralized distribution loop to account for diversity lowers the capacity necessary to supply a campus and reduces investments in capital.

Best Practices is written and produced by the Green Building Research Center, at the University of California, Berkeley.

The Best Practices Competition showcases successful projects on UC and CSU campuses to assist campuses in achieving energy efficiency and sustainability goals. Funding for *Best Practices* is provided by the UC/CSU/IOU Energy Efficiency Partnership.