BEST PRACTICES 2011

Chico State Student Services Center Monitoring-Based Cx

A recently LEED-certified building provided unexpected opportunities for energy saving though effective HVAC and end-load management. By correcting previous construction oversights and optimizing control sequences the project team reduced the payback time from over seven years to less than one year.

Award Category

Monitoring-Based Commissioning

Opportunities Identified with MBCx

No isolation dampers on cooling supply fans

VAV set point temperatures could not be over-ridden

Mixed air temperature readings off by >10 °F

Economizer and return air damper controls not coordinated

Annual Energy and Cost Savings

Electricity (excluding space cooling): 37% 360 MWh

Space heating: 65% 14,500 therms

Space cooling: 30% 75,000 ton-hours

Total Cost Savings: $66,000

Size

71,950 ft²

Cost

Consultant fees: $54,500

In-house: $39,700

Completion Date

December 2010

Monitoring-based commissioning (MBCx) has been shown to generate significant savings even in recently constructed buildings. Such was the case with the Student Services Center (SSC) at Chico State University, which houses a wide variety of departments focused on student life, academics, and career planning. The center was recently completed in 2007, it had been commissioned per CSU construction guidelines, and was LEED Silver certified. With this background, the MBCx team initially aimed to achieve only two to three percent savings. As a starting point, a number of energy performance issues had already been identified by the facility staff prior to the MBCx project. The MBCx contractor, EnerNOC, created a list of efficiency and optimization opportunities, with a "findings log" that included concerns previously identified, as well as new issues discovered during the three-step MBCx investigation. These opportunities offered significant savings, in fact, most of the project's savings (65% reduction in central plant steam and a 30% reduction in chilled water) came from implementation of a new sequence of operations that allows the HVAC system to operate at near peak efficiently.

A successful MBCx effort realizes continuous, persistent savings, and enables staff to monitor ongoing efficiency and performance.

The first opportunity was fixing previous construction oversights. The mechanical contractor had failed to complete all punch list items, including the installation of an isolation damper between two parallel fans in the cooling AHU. (The building is served by separate variable-air volume [VAV] air handlers for cooling and heating.) As a result, both fans ran simultaneously, even at low-load conditions. Once the mechanical contractor returned and installed an isolation damper, the fans could operate separately or in tandem as needed.

Significant savings also came from reprogramming the heating and cooling operation sequences. Prior to MBCx, the controls sequence was based on "out-of-the-box" programming provided by the manufacturer of the air handing units. After detailed building trend analysis, in close coordination with EnerNOC, CSU Chico controls staff reprogrammed the control sequences so that the heating and cooling AHUs could operate separately. Prior to the MBCx, during winter periods cold outside air was being heated to 72 °F. By reprogramming the VAV terminals, heating now uses mostly return air, with the minimum fresh air coming through the cold duct system to minimize the heating load. During functional testing, the EnerNOC corrected the fact that return air escapes through the heating AHU outdoor air damper which made that portion of the system work excessively. Another change was turning off the heating AHU completely during summer. From these programming changes, CSU facilities staff has noticed that the second cooling fan is rarely needed even during summer.

The SSC houses a wide range of departments that support student academic and career needs. Photo: Chico State.

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Additional Awards

LEED-NC Silver

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More Information

http://www.uccsuiouee.org/mbc.html

http://cx.lbl.gov/MBCx.html

The MBCx process also yielded a 38 percent reduction in electrical savings, largely a result of the fan energy savings. Additional electrical savings (though not all related to the MBCx) resulted from installation of occupancy sensors to shut computers off in computer labs when not in use. Some of the building's spaces are occupied on defined time schedules, however equipment and lighting were found to be on after-hours. After MBCx, occupancy sensors detect when equipment is on outside of the defined time schedules, and sweeps are conducted to turn off lights and equipment. Occupancy sensors are also now used to change temperature setpoints at the zone level. Through integration with the Energy Management System (EMS), the energy savings from these measures is now visible to building operators, who can better monitor the building's ongoing energy performance.

Project Economics Summary

Component	*Estimated*	*Actual*
Annual Cost Savings Achieved	$6,603	$66,045
Simple Payback Before Incentive	9.5 years	1.4 years
Incentive Requested	$11,972	$75,283
Incentive As Percentage of Total Cost	19%	80%
Simple Payback After Incentive	7.6 years	0.3 years

An O&M plan provided at the conclusion of the MBCx project provides a roadmap for future equipment upgrades and retro-commissioning work, and is intended to ensure energy savings for the life of the building.

The MBCx team knew that accurately measuring performance is the key to success of any commissioning effort. Chilled water, hot water, and electrical demand and consumption data were collected using permanent flow meters, hydronic supply and return temperature sensors, and current transducers at the building level. These data also fed into the direct digital control EMS used for energy management. These metering systems were initially installed to meet the LEED credit for measurement and verification, however the information was not being used effectively prior to the MBCx project. Only with increased visibility of building performance, enabled by the comprehensive metering and training of building facility staff, was the great efficiency increase possible as well as sustainable.

LESSONS LEARNED

Neil Nunn, Chief Engineer at Chico State, stresses the importance of educating occupants about how the building operates, and the reasons behind the indoor conditions they experience. Before the MBCx project, building users had become accustomed to constant air movement, not the intermittent air movement customary with VAV systems. As a result of the MBCx, the VAV operation caused temperatures to fluctuate more than people were used to. Nunn advises that facility managers may need to spend time explaining to occupants these features and their energy efficiency benefits. The project also illustrates the importance of having a controls system with the capability to handle data from various controllers throughout the building. This can enable operators to tailor building equipment usage to match demands that result from changing seasonal loads and dynamic building occupancies, and to enable load shedding in low-demand areas.

Best Practices case studies are coordinated 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.