BEST PRACTICES 2014

MBCx at Cal State University Dominguez Hills Welch Hall

Effective project management by campus staff and consultants expedited a stalled MBCx process, and in the process corrected scheduling errors, inaccurate sensor readings, and equipment faults. The combined energy saving measures resulted in total energy savings of 25 percent.

Award Category

Monitoring-Based Commissioning

Opportunities Identified with MBCx

Changed AHU schedules for unoccupied hours

Calibrated and relocated temperature sensors

Repaired or replaced non-functional valves, damper linkages and actuators

Raised economizer lockout temperature

Size

179,222 ft^2

Annual Energy and Cost Savings

Electricity: 568 MWh

Chilled water: 3,788 MMBtu

Hot water: 1,485 MMBtu

$108,306

Cost

Campus cost $70,000

EnerNOC cost $67,000

Completion Date

2012

James L. Welch Hall at CSU Dominguez Hills houses multiple functions including administrative offices, computer labs, server rooms and a police station. Although relatively new, completed in 2001, inadequate controls prevented facilities staff from effectively managing building energy use or identifying problems. A monitoring-based commissioning (MBCx) process was launched in 2008 to address this and other concerns, but the project did not advance effectively until it was assigned to CSUDH Energy Manager Kenny Seeton and EnerNOC Project Engineer Nick Millar. Their collaboration and persistence achieved an impressive 25 percent reduction in annual savings, yielding a cost-effective simple payback of slightly over one year.

Welch Hall houses multiple functions, including computer labs and the campus police. Image: CSU Dominguez Hills.

The project illustrates how buildings may benefit greatly from MBCx, especially in cases when the initial project delivery was not ideal. In the case of Welch Hall, it was completed during a time when state funding for capital improvements was tight, and consequently the control system was value-engineered. The controls were initially programmed with fixed set points, and did not provide the ability to analyze trends in ways that allow operators to effectively monitor the building's performance. As part of the MBCx project, the project team replaced the building automation system (BAS) with a new system from Johnson Controls, and added additional meters to monitor the use of hot and chilled water from the central plant. The new BAS provides useful building performance trend data, warnings when systems are operating inefficiently, and allows building operators to perform maintenance tasks remotely.

A successful MBCx program provides a refined, time-tested framework that can benefit challenging buildings such as Welch Hall, leading to energy-efficient operations.

EnerNOC's phased MBCx process includes pre-functional, functional, and monitoring-based testing. Some of the issues identified during the pre-functional phase included air handling units (AHUs) operating when the building was unoccupied, outside air dampers not opening or closing to take advantage of economizer cooling, and control loops reacting slowly, thereby allowing fans to run faster and longer than needed and chilled water valves to remain open longer than needed. The success of the MBCx process led to a 24% reduction in total electrical consumption, a 31% reduction in chilled water use, and a 51% reduction in hot water use.

One of the key reasons for the large cooling savings was that the outside air temperature sensor in one of the AHUs was installed improperly. The sensor, installed on the air handler in a confined area, was influenced by the warm exhaust air. Consequently the air handler rarely switched to economizer mode (taking advantage of free cooling when temperatures permit) because it always sensed the warmed building return air even when outside air was cool. Due to the inadequacy of the control system, the problem was not readily

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Project Team

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More Information

http://www.csudhnews.com/2014/06/best-practice-awards/

http://www.csudhnews.com/2014/04/greening-csu-dominguez-hills/

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

identified. In fact, the problem wasn't apparent even during the MBCx pre-functional tests. Not until EnerNOC performed in-field functional testing was the problem identified, and this required great attention to detail from the project engineer. When the air handler started up, the sensor was slow to show the accurate outside air temperature, and quickly heated up due to the exhaust air, showing the incorrect warmer temperature.

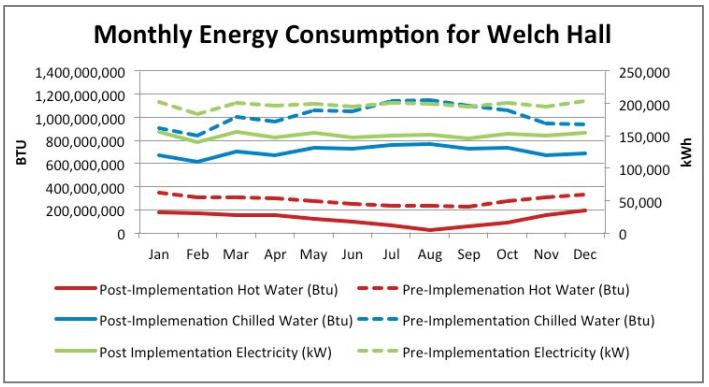

Chart of annual energy consumption for major building loads during pre- and post-commissioning time periods. Image: EnerNOC.

As Energy Manager Kenny Seeton notes, "Until you do an MBCx project, you would never know one outdoor sensor is located in the shade and another one in direct daylight. Clearly those sensors were installed in poor locations and providing inadequate information."

Completing this successful MBCx project provided a moral boost to the facilities department and provided motivation to seek other saving opportunities on campus.

Additional issues with economizer operation resulted from faulty control signals due to temperature sensors that were not accurately calibrated, and from broken or stuck dampers and actuators. As a result, dampers weren't able to bring in outside air for cooling, or stop the intake of cool outdoor air during heating months.

Finally, the project also resolved another important AHU issue related to scheduling. The building is served by three air handlers, one of which serves a police department that operates continuously day and night. However, the other two air handlers were also operating continuously but for no reason. By reprogramming the scheduling for these two air handlers, the project produced significant savings in electricity and heating energy.

LESSONS LEARNED

The project had a long time frame of nearly three years. During this extended schedule, new problems arose that weren't identified in the pre-functional testing phase. A second phase of testing then became necessary to verify that all problems were captured, creating inefficiencies. The campus facilities staff is now determined to avoid drawn-out schedules by prioritizing repairs and then assigning work orders on an accelerated schedule.

In spite of challenges, completing this MBCx has helped the facilities department to become more knowledgeable about the building, and to better appreciate the energy saving benefits of proper sequencing and operation of equipment. The campus staff are now working to identify and fix similar problems on other buildings, and working to locate funding for needed repairs.

For EnerNOC Project Engineer Nick Millar, an important lesson of the project was to learn to understand the unique communication needs of each campus. He notes that some facility managers prefer problems to be simplified and put into categories, while others prefer a list with all the details spelled out. Once a commissioning agent learns how to best communicate with campus managers, subsequent projects are faster and easier to complete.

Best Practices case studies are coordinated by the Green Building Research Center, at the University of California, Berkeley.

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