BEST PRACTICES 2010

UCB LeConte Hall Monitoring-Based Commissioning

An MBCx effort reduced energy consumption at LeConte Hall by 25 percent. Improvements to control schedules and economizer operation allowed for 24-hour chilled water for research needs, yet still exceeded the project's electrical energy savings goals by a factor of four.

Award Category

Monitoring-Based Commissioning

Opportunities Identified from MBCx

Optimized CHW pump

Optimized HW pumps

Filters procured on life cycle cost basis

Zone level re-schedule AHU1 and AHU2

Optimized condensate pump

Eliminated valve leakage

Size

148,000 ft^2

Cost

$$50,500 (in-house fees)

$54,500 (consultant fees)

Annual Energy Savings

3564 MWh (estimated)

1.1 M therms (est.)

$43,400 (est.)

Completion Date

December 2010

Monitoring Based Commissioning (MBCx) uses whole-building metering and trend data to target and verify energy savings. The MBCx process frequently uncovers unexpected operational challenges, requiring diligent diagnostics and creative solutions. Such was the case when LeConte Hall on the UC Berkeley campus was selected for retro-commissioning through a UC system-wide energy conservation program.

LeConte Hall. Photo: UC Berkeley.

LeConte Hall, which was built in 1924 and now houses UC Berkeley's Department of Physics, had undergone previous renovations from 2004 to 2007 to address deferred maintenance, and mechanical, electrical, and seismic issues. In 2009 the campus selected Facility Dynamics Engineering (FDE) to lead an MBCx project to improve the building's operations and reduce energy use. This commissioning process included the following steps:

- Establishing electrical and steam consumption baselines.
- Reviewing existing building operations, controls, and sequences.
- Executing functional tests to verify system operation.
- Developing operational improvements and installation requirements.
- Verifying post-implementation energy consumption.
- Training facility staff on the system modifications and recommended operations.

The project was established with a tight schedule that created several challenges. The MBCx process requires a minimum of three months of baseline data, and three months of post-implementation data to verify energy savings due to improvements. This requirement, and challenges associated with ongoing meter upgrades, left the team with less than a month to implement the proposed modifications.

One of the key MBCx challenges was reducing the hours of air-handler operation, while allowing for continuous chiller operation to meet the building's research needs.

With such a limited time frame, the team focused on the simple targets such as repairing a leaking preheat valve, optimizing filters, and changing the operation of an air handling unit (AHU-2) from 24-hour operation to a demand-based schedule. The team planned to defer to a following phase more complex issues, such as converting AHU-2 from non-integrated economizer operation to an integrated economizer cycle, and other control system improvements.

However, separating the short-term from the long-term goals proved to be difficult, since AHU-2 was the only load on the building's chilled water system. Because the unit was equipped with a non-integrated economizer, the chiller operated at any time that AHU-2 operated with an outdoor temperature above the economizer setpoint of 60°F. Therefore, a reduction in air handler operating hours would also reduce the chiller operating hours. The constant volume/reheat nature of the system further compounded the potential energy savings.

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Project Team

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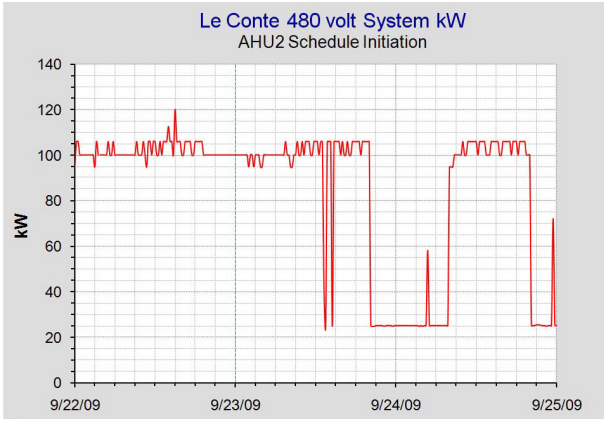
More Information

http://www.facilities.berkeley.edu/GreenBuildings/leconte/le_conte_renovation.html

http://www.ucop.edu/facil/fmc/uc_enrg_eff.html

The control requirements became more complicated when a physics professor began research that would require chilled water around the clock. The cooling demand for the research was only 3-5 tons, a small fraction of the 50-60 tons the chiller provides when fully loaded. However, the newly installed "Obvious" electric meter revealed that the chiller was running at full load whenever AHU-2 operated. The problem was identified to be related to the chilled water valve operation for the air handler, resulting in excessive chiller operation and in turn, and excessive reheat.



Electrical consumption before and after modifications to AHU-2 operation. Image: David Sellers.

Several fixes were made to correct AHU-2 operation, including modifying software, changing piping, and repairing valves. Once those changes were completed, the unit could finally be set to run only when needed, but at the same time the chiller was allowed to run around the clock efficiently to accommodate the physics research underway in the facility.

Accurate metering was a critical tool throughout the discovery and commissioning process. It helped piece together often conflicting, missing, and confusing information into a complete picture.

The changes have had profound effects on HVAC operation and energy use. Prior to the MBCx process, the baseline building electrical load was approximately 100 kW, with AHU-2 operating on a 24/7 basis. As the trend data shows, (above right) turning off AHU-2 resulted in a large drop, to approximately 24kW. When completed in December 2010, the energy savings far exceeded expectations. LeConte's annual energy consumption was reduced by 348 MWh, over four times the targeted savings. Gas savings of 11,100 therms were also achieved, giving the project a 3.8-year simple payback. Additional measures identified by the MBCx process that were too complicated to be achieved in first year, are now underway, with completion anticipated in late 2011.

LESSONS LEARNED

Eleanor Crump, Operations Manager with the UCB Physics Department, reports that the project's success was due in no small part to FDE's ability to communicate in a physicist's language. This created mutual respect between the faculty and the commissioning agent, and facilitated implementation of the measures. The MBCx effort was successful not only in improving the energy efficiency of the building, but at the same time providing a stable environment for researchers. The success of this work has paved the way for MBCx projects at other campus laboratories.

David Sellers of Facility Dynamics Engineering suggests sticking to simple goals, especially with a limited schedule. Also, using a discovery process to develop questions often reveals things you wouldn't normally look for. He notes that by "following your nose," one can create an ongoing process that continuously improves performance and saves resources, meeting the fundamental goals of the MBCx program.

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

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