BEST PRACTICES 2008

University of California, Berkeley Wireless Lighting Controls Retrofit

The wireless lighting controls installed by UC Berkeley in two campus libraries allow staff to set operation schedules for fixtures that previously could not be turned off. The control devices are simple to install and require no rewiring, making it a highly convenient system for in-house staff to implement.

Award Category

Lighting and Controls

System Features

Enables scheduled lighting operation where previously not possible

Granular and flexible control of individual or groups of fixtures

Custodial staff have after-hours control

Installation requires no rewiring

Quick and convenient for in-house staff to implement

Annual Energy Savings

Doe: 70 MWh

Moffitt: 100 MWh

Total: $14,300

Scope

Doe Library North Reading Room

Moffitt Library 4th and 5th floors

Cost

Doe: $5,100

Moffitt: $23,000

Completion Date

Doe: January 2008

Moffitt: August 2007

Improving the controllability of interior lighting systems can be highly cost effective. Many buildings have fixtures that are on for long periods of time and serving no useful function, but remain lit due to inadequate controls. Researchers at UC Berkeley developed a wireless lighting control system that offers a low-cost way to provide flexible control over existing fixtures regardless of ballast type or circuitry configuration. The campus retrofitted areas of Doe and Moffitt libraries to enable staff to program operation schedules for lights that were burning 24/7 at full power and could not be turned off.

Enough daylight enters Doe Library's North Reading Room that fixtures installed within the skylights are often redundant. Photo: Charlie Huizenga.

Interior lighting draws more than a third of all electricity used in university buildings, according to the 2006 California Commercial End-Use Survey. This figure shows just how large the opportunity is to save energy and money with better lighting controls. However, commercially-available products can be expensive and are sometimes impractical to install with existing ballasts or circuit wiring. The wireless lighting controls implemented at UC Berkeley bypass these issues by using a radio mesh network to control luminaries.

To create a mesh wireless network, each light fixture is outfitted with a control device containing a low-power radio that can communicate over distances of one hundred feet or more. A radio in the wall switch communicates with the radios in the nearest fixtures, which in turn communicate with other fixture devices nearby. The redundancy and adaptability of a wireless mesh network make it a highly reliable means for controlling lighting systems in many types of environments.

Fixtures can also be programmed to turn on and off automatically according to a schedule set via a password-protected website. The control devices store the last programmed schedule and will continue to operate lights accordingly should the energy management software or internet be disrupted. Since scheduled lighting control is independent of occupant behavior, it is a more reliable strategy for generating consistent energy savings.

While fixture scheduling is the most important control method used in the UC Berkeley library retrofits, it is not the only energy management strategy afforded through the wireless controls system. Since each fixture is equipped with its own device, it can be controlled independently of every other light. Occupants or building managers can target a single fixture or group of fixtures, allowing lighting to be adjusted according to daylight levels or occupant preferences.

Retrofitting an existing fixture with the wireless control device is a simple task that takes just five to ten minutes. First the ballast cover is removed, then the two wire nuts that connect the ballast are removed, and lastly the controller is connected between mains power and

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More Information

www.cbe.berkeley.edu/research/wireless_lighting.htm

www.aduratech.com

www.energy.ca.gov/ceus

the ballast. The device draws regular AC electrical power and uses a power supply to convert 120 VAC or 277 VAC to the low voltage it requires to operate.

In-house staff at UC Berkeley installed the wireless lighting controls in the North Reading Room of Doe Library to provide control over high-output fluorescent lamps that hang within the skylights. Prior to the retrofit these fixtures burned 24 hours a day even though plenty of daylight entered the two-story space through both the skylights and large windows. Controlling the fixtures was virtually impossible, since there was no wall switch. The only way to turn the lights on or off was to access circuit breakers located up in the skylight.

Fixtures in the North Reading Room are now controlled by an astronomical time clock that turns lights on 30 minutes before sunset when the library is open. The wireless controls turn lights off when the library closes for the night.

The Moffitt Library lighting retrofit saves over 3 kWh per square foot per year. Photo: Charlie Huizenga.

A similar situation existed on the fourth and fifth floors of Moffitt Library. Lights could only be turned off by accessing circuit breakers located inside locked electrical closets. The wireless controls retrofit allows the campus to schedule lights according to the business hours for the academic year, taking holidays, weekends and finals week into account. A wall switch enables custodial staff manually override the system and turn lights on after hours. The switch illuminates fixtures for two hours and automatically shuts them off.

Campus staff can monitor the electricity consumption in retrofitted areas using the control system's web-based energy management software. The software provides real-time energy metering and historical data trending, which is very useful for monitoring the effectiveness of control strategies and for performing building commissioning.

The lighting control retrofits in Doe and Moffitt save 5 kWh/ft²/yr and 3 kWh/ft²/yr, respectively. With an incentive of $0.24/kWh saved offered by the Energy Efficiency Partnership, both projects had nearly an instant payback.

The wireless controls are saving both libraries an impressive amount of energy. Annual lighting electricity use has dropped by over 70 MWh at Doe Library, and by over 100 MWh at Moffitt. This translates into annual energy cost savings of roughly $14,300.

Intrigued by pilot installations of the wireless controls on campus, two graduates of UC Berkeley's Haas School of Business approached researchers with the idea of creating a business. The group formed Adura Technologies, a unique partnership that propelled the wireless controls out of the lab and into the commercial market. Adura has refined the original device and developed additional functionalities, making the controls useful in a range of retrofit and new construction projects.

LESSONS LEARNED

The importance of engaging Information Technology staff early in the project became clear in the course of the library retrofits. Network communication issues, such as firewalls, can be anticipated and resolved more effectively when IT staff are on the project team.

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