Bi-level Induction Parking Garage Luminaires

University of California, Davis

The Problem

Most parking garages use high-intensity discharge light sources that operate continuously regardless of lighting needs. These facilities typically do not employ energy-saving control strategies such as daylighting or time clock scheduling, and no considerations are made for lighting control based on occupancy. Garage lighting, designed to only a single static level, wastes energy and contributes to peak demand during the day and light pollution at night.

The Solution

The California Energy Commission's Public Interest Energy Research (PIER) Program through the California Lighting Technology Center funded development of a bi-level parking garage luminaire that integrates state-of-the-art induction sources and occupancy-based dimming controls.

The Everlast® step-dimming parking garage luminaires automatically reduce to 50% power on vacancy and increase to 100% power on occupancy. The luminaire uses a fixture-integrated occupancy sensor. Bi-level products may be combined with traditional photocontrols to maximize energy savings, which is estimated to be 30–50% per fixture.

Features and Benefits

- Bi-level light output based on garage occupancy increases safety and savings
- Instant light level changes; no warm-up or hot restrike limitations
- Long-life light source, up to 100,000 hours reduces operating and maintenance costs
- Good color rendering, high color temperature, white light
- Excellent resistance to vibration

Technology Costs and Incentives

The cost of the bi-level induction luminaires generally is one to two times higher than common garage luminaires. The payback is between three to seven years, depending on occupancy rates and the size of the retrofit. Pacific Gas and Electric Company (PG&E) offers a 5-cent-per-kWh-saved incentive through the UC/CSU/IOU Energy Efficiency Partnership program. PG&E also offers a $25–125 rebate per fixture through the 2010 Lighting Rebate Catalog.

FIGURE 1: PARKING GARAGE LUMINAIRES
North Entry Parking Structure, UC Davis

Two high pressure sodium fixtures remain during the retrofit to replace the old luminaires with Everlast® step-dimming parking luminaires.

Demonstration Results

UC Davis North Entry Parking Structure

The California Lighting Technology Center (CLTC) partnered with Facilities Management at the University of California, Davis to replace high-pressure sodium fixtures with bi-level induction luminaires in parking facilities on campus. Initially, eight prototypes of the Everlast luminaires were installed in the North Entry Parking Structure in September 2007. After UC Davis officials saw the luminaires' advantages, they moved to retrofit other structures and lots.

"Data collected during the demonstration period illustrated the significant savings potential and provided a contrast with the existing light sources in the garage," said Christopher Cioni, Associate Director of Energy Services for UC Davis Facilities Management. "Based on these results … the decision was made to move ahead with a large-scale retrofit at all Transportation & Parking Services (TAPS) parking facilities."

The remaining fixtures in the north structure were replaced in November 2008, the West and South parking structures were retrofitted in September and October 2009, and parking lots were finished in November 2009.

FIGURE 2: PRE-RETROFIT LIGHTING—HIGH PRESSURE SODIUM
North Entry Parking Structure, UC Davis

FIGURE 3: POST-RETROFIT LIGHTING—INDUCTION
North Entry Parking Structure, UC Davis

The TAPS funded project cost under $1 million, with a $325,000 rebate from the Energy Efficiency Partnership. UC Davis' annual electrical energy savings are expected to reach 1.3 million kWh. The retrofit was part of the UC Davis Smart Energy Initiative, an agreement between CLTC, UC Davis Facilities Management, and the Energy Efficiency Center to increase safety, save energy, and reduce maintenance costs on campus.

The Energy Efficiency Partnership Program awarded UC Davis' Facilities Management Program its 2009 Best Practice Award at the UC/CSU/CCC Sustainability Conference for the parking structure retrofit.

Cioni said campus response to the retrofit has been positive. "The benefits include reduced maintenance costs as a result of extended lamp life … fewer incidences of light outages, decrease in waste generated by failed lamps, and less mercury in the waste stream."

Safety in the garage is also expected to improve—when motion is detected and the higher light mode is activated, the change in visual environment alerts occupants. Robin Parlow, crime analyst/prevention specialist for the UC Davis Police Department, said it's still too soon to determine if the retrofit has improved safety, but year-over-year statistics for the North structure, which was completed earliest, show crime did decline, with 14 reports in the first six months of 2008 and six reports in the first six months of 2009.

Product Availability

Everlast offers the step-dimming parking garage luminaire at www.everlastlight.com.

What's Next

CLTC continues to install and monitor demonstrations of bi-level induction parking luminaires as part of the PIER Program.

Demonstration projects are ongoing at the University of California, Santa Barbara, where one parking garage has been retrofitted with bi-level induction parking luminaires and a Wireless Interface for Photosensor and Motion Sensor system (WIPAM).

UC Davis also continues to retrofit fixtures throughout campus with Everlast induction luminaires.

Collaborators

The parking garage retrofit project was a collaboration between UC Davis Facilities Management, Transportation and Parking Services, and Energy Efficiency Center, CLTC, the California Energy Commission, EverLast Lighting, WattStopper/Legrand, and Pacific Gas and Electric Company (PG&E).

For More Information

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- To watch a video of Chris Cioni explaining the retrofit, go to www.cltc.ucdavis.edu/content/view/560/334.

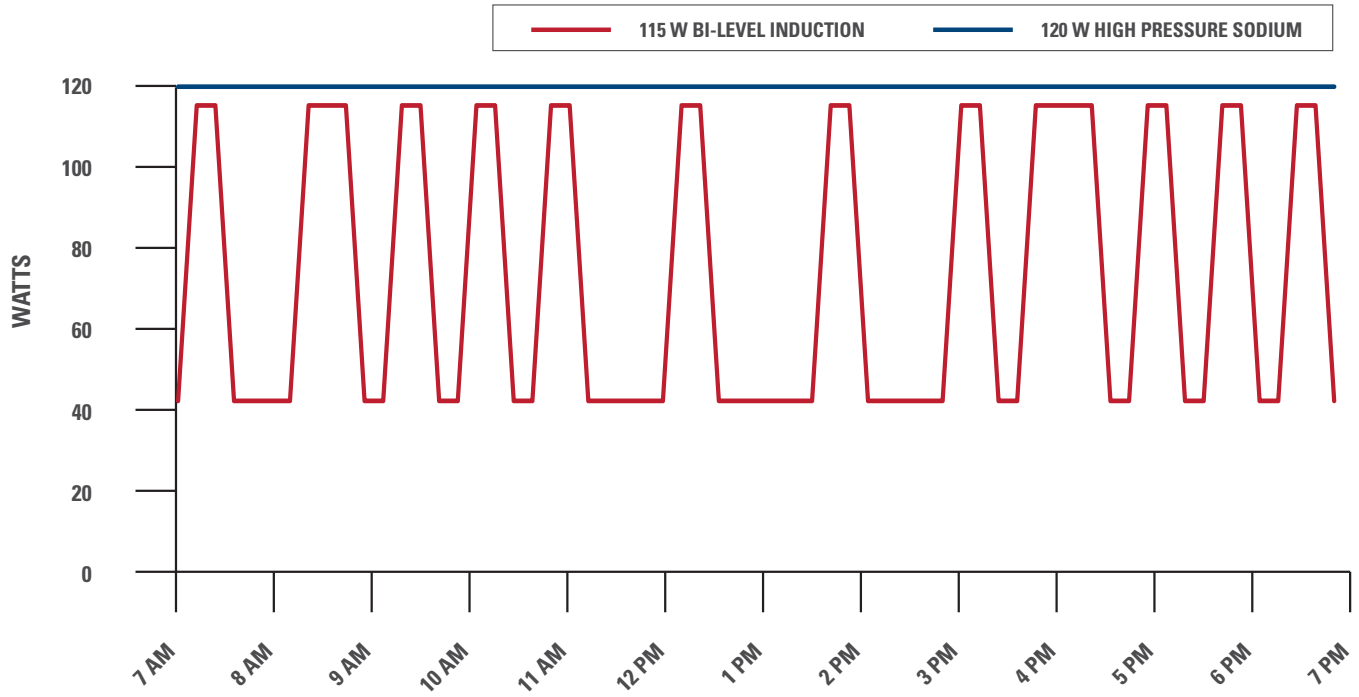
The reports on the bi-level induction parking garage luminaires project are available at:

- www.cltc.ucdavis.edu
- www.energy.ca.gov/research/reports_pubs.html
- www.sustainability.ucsb.edu/conference/presentations/Dave Weil_UC San Diego.pdf

More information on demonstrations in California is available at:

- www.pierpartnershipdemonstrations.com

TABLE 1: COMPARISON OF PRE- AND POST-RETROFIT LIGHTING
North Entry Parking Structure, Second Level
University of California, Davis



One Bi-level Induction luminaire was analyzed in the North Entry Parking Structure during a 24-hour period:

- When the luminaire is operating in high mode at 115 W, the area is occupied. This occurred 43% of the time.
- When the area is unoccupied, the luminaire runs in low mode at 43 W, which happened 57% of the time.
- With the previous HPS fixtures, the luminaire ran at 120 W continuously, regardless of occupancy.
- The retrofit resulted in a 32% energy savings and a $28 annual savings per unit.
- The HPS luminaires' power consumption was 2,880 W hrs/day, versus the induction luminaires' power consumption of 1,775 W hrs/day.

TABLE 3: ENERGY AND MAINTENANCE COST AND SAVINGS

TECHNOLOGY	ANNUAL ENERGY CONSUMPTION (kWh)	ANNUAL ENERGY COST	ANNUAL MAINTENANCE COST	TOTAL ANNUAL COST	LIFECYCLE ENERGY COST	LIFECYCLE MAINTENANCE COST	TOTAL LIFECYCLE COST
HPS	1,655.64	$211.92	$18.40	$230.32	$2,419.20	$210.00	$2,629.20
INDUCTION	692.04	$88.58	$0.00	$88.58	$1,011.20	$0.00	$1,011.20
SAVINGS	**936.6**	**$123.34**	**$18.40**	**$141.74**	**$1,408.00**	**$210.00**	**$1,618.00**

Years of use: ~11
Time to replace lamp: 0.5 hours
Annual hours of use: 8,760 hours
Cost of energy: $0.128/kwh
Cost of labor: $100/hour
Occupancy: 40%

About PIER

This project was conducted by the California Energy Commission's Public Interest Energy Research (PIER) Program. PIER supports public interest energy research and development that helps improve the quality of life in California by bringing environmentally safe, affordable, and reliable energy services and products to the marketplace.

Arnold Schwarzenegger, *Governor*

California Energy Commission

For more information, see www.energy.ca.gov/research

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