Technology Specification Project: High-Efficiency Lighting for Parking Structures

Converting traditional lighting in parking structures to high-efficiency lighting technologies and controls can lead to significant energy savings. The U.S. Department of Energy (DOE), its national laboratories, and Commercial Building Energy Alliance (CBEA) members are focused on making reliable, energy-efficient, and competitively priced parking structure lighting more widely available.

Parking structures operate long hours, sometimes all day and night. Some spaces are infrequently occupied and open to daylight, making additional lighting unnecessary. Significant energy savings can be created in these spaces by using controls, such as occupancy sensors and dimmers. Fluorescent, induction, and light-emitting diode (LED) lighting sources work much better with these controls than traditional high-intensity discharge (HID) parking lighting sources. Moreover, each of these high-efficiency sources has the same, if not longer, rated life spans as HID sources.

CBEAs help commercial building owners and managers cut energy costs by working with appliance, heating, cooling, and lighting manufacturers to improve energy efficiency. Lighting improvements offer immediate returns because they can be made without major changes to the structure. The introduction of new technologies and enhancement to existing technologies creates more options for retrofitting or constructing parking structures with lighting that reduces energy usage and lowers costs.

High-efficiency lighting from fluorescent, induction, and LED sources could offer immediate returns without requiring major changes to parking structures, such as the one pictured above. A CBEA Project Team studied the lighting technology to create a performance specification.

A CBEA Project Team was formed in May 2009 to investigate the use of high-efficiency lighting and controls for CBEA member parking structures. The Project Team of more than 60 members seeks to address alliance member lighting performance requirements and accelerate the availability and use of high-efficiency lighting technologies. Thus far, the Project Team has identified candidate luminaires with potential for improved energy efficiency when compared to traditional lighting and has developed product performance specifications and evaluation procedures based on CBEA member needs.

The CBEA-developed specifications for high-efficiency fluorescent, induction, and LED lighting in parking structures include recommendations for controls and daylighting practices, which can lead to even greater energy savings. To see the full performance specification, visit http://apps1.eere.energy.gov/buildings/publications/pdfs/alliances/creea_parking_structure_spec.pdf.

DOE Support

This DOE-sponsored effort is being implemented by the Pacific Northwest National Laboratory.

DOE provides technical assistance in support of this performance specification project, including:

- Product performance testing
- Product demonstration
- Analysis of energy cost savings
- Analysis/quantification of maintenance cost savings
- Investigations into life measurements and other performance indicators
- Development of a CBEA product performance specification.

Overview of the CBEA Specification

Typically, technology specifications focus on a product rather than an application. In order to maximize the benefits of converting traditional HID technology to high-efficiency alternative technologies, the CBEA team developed a performance specification that should be applied to specific sites. Ideally, luminaire manufacturers would work with either DOE or commercial building organizations (e.g., large retailers, hospitals, educational organizations, municipalities, or developers) to provide lighting solutions for various locations. The performance specification provides information about both the luminaire and how the site should be lighted. Key details include:

- A five-year warranty covering the luminaire, finish, and power supply
- Identification of testing requirements
- A lighting power density (0.18 W/ft^2) that is 10 percent less than the Standard 90.1-2010 limit (making the site eligible for the maximum Energy Policy Act of 1992 tax deductions)
- Uniformity metrics with both the standard maximum-to-minimum ratio and a weighted average of relevant illuminance measurements.

Product Feature	Fluorescent	Induction	LED
Overall Lighting System Efficiency	Most efficient of the sources listed in the performance specification. Due to the optical nature of luminaires designed around this light source, more fixtures probably needed than for other sources.	The light source is efficacious and used in efficient light fixtures.	Very efficient because of LED directionality, meaning nearly 100% of light leaves the luminaire.
Life	Expected life of 24,000 to 46,000 hours. Actual value depends on ballast plus lamp pairing and controls.	Expected life of 100,000 hours. Generator may not last the entire period and have to be replaced.	Expected long life of 50,000+ hours but actual end-of-life performance not completely understood.
Light Output Depreciation	Extremely low depreciation rate. Approx. 5% after 12,000 hours and then 3% more during the course of the lamp's life.	Roughly 20% at 20,000 hours and then a continual depreciation for the remainder of the lamp life.	Low lumen depreciation rate. 30% over the 50,000 hours.
Maintenance	More maintenance than compared to the other sources in the performance specification. However, maintenance is not as expensive in a parking structure compared to a parking lot.	Very low maintenance expected due to long life and durability.	Very low maintenance expected due to long life and durability.
Environmental Impact	Contains a very limited amount of mercury (less than the amount allowed in fish). Some lead in glass.	Contains a very limited amount of mercury (less than the amount allowed in fish). Some lead in glass.	Contains NO mercury. Possible lead in solder.
Use with Controls	Fully dimmable and easy to use with occupancy sensors.	Fully dimmable.	Fully dimmable.

Area of Parking Structure	Horizontal Illuminance Requirement (footcandles)	Vertical Illuminance Requirement (footcandles)	Uniformity Max:Min	Uniformity CV
Covered Parking Areas	1.25 (Min)	0.5	7:1	0.38
Ramps	1.25 (Min)	0.5	10:1	0.41
Vehicle Entry/Exit (Day)	50.00 (Min)	25.0	10:1	0.41
Vehicle Entry/Exit (Night)	1.25 (Min)	0.5	10:1	0.41
Uncovered Parking Areas (Top Deck)	0.75 (Min)	0.4	10:1	0.41

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

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Commercial Building Initiative

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July 2011