In the winter of 2012-2013, the Lighting Research Center (LRC) evaluated the field performance of an LED construction lighting product at the new campus of New York City’s Police Academy. The construction site was a 50,000 ft² (4625 m²) gymnasium with a 27.5 ft (8.4 m) ceiling height.

Objectives

- Evaluate photometric conditions
- Evaluate worker acceptance
- Evaluate installation and maintenance

Manufacturer-reported product features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
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<tbody>
<tr>
<td>Light source</td>
<td>Light-emitting diode</td>
</tr>
<tr>
<td>Manufacturer</td>
<td>Clear-Vu Lighting</td>
</tr>
<tr>
<td>Watts per luminaire</td>
<td>33.1 W*</td>
</tr>
<tr>
<td>System voltage</td>
<td>24 Vdc</td>
</tr>
<tr>
<td>Additional feature</td>
<td>“T-Connector” quick disconnect</td>
</tr>
<tr>
<td>Rated light output</td>
<td>2400 lumens</td>
</tr>
<tr>
<td>Rated life</td>
<td>50,000 hours</td>
</tr>
</tbody>
</table>

* Assuming power supply efficiency of 0.86 and optimal loading of power supply

Lighting Layout

The construction manager requested that the construction lighting provide an average illuminance of 10 footcandles (fc) (110 lux). The electrical contractor, with the assistance of the manufacturer, selected the layout of the construction lighting; LED luminaires were spaced in a regular array at approximately 20 ft x 12.5 ft (6.1 m x 3.8 m) apart. The luminaires were suspended from chains at approximately 19 ft (5.8 m) above the floor. Power supplies providing 24 volts of direct current (Vdc) were also suspended from chains; one power supply was provided for each row of 14 lights.

Photometry Results

LRC researchers measured illuminance at night, in open areas and in the aisles between construction materials, directly under and between luminaires. As shown at right, illuminance at the construction site met the target (10 fc [110 lx]), but exceeded the requirements (5 fc [54 lx]) established by the Occupational Safety and Health Administration (OSHA). It would have been possible to install about half as many luminaires and still meet the OSHA requirements.

Power and Energy Results

The LRC verified the number of operating luminaires on three site visits. The quantity varied (199 to 203 luminaires) during the study period. Assuming 203 luminaires were operating, the total installed power was about 6700 W. These construction lights were left on 24 hours a day, resulting in approximately 4900 kWh of energy use per month. The energy cost to operate this system was approximately $780 per month. For matched illuminances, the LRC calculated that the LED system used about 60% less energy than construction lighting with a conventional 400 W pulse start metal halide lamp. If fewer LED luminaires had been installed, energy use would have been lower.

2 Month calculated as annual use divided by 12 months
3 Assuming local utility’s charge of $0.129/kWh and $23/kW monthly demand
Worker Response

The LRC interviewed a sample of 20 workers, including plumbers, steam fitters, sheet metal workers, and other trades people, to gather feedback about the LED luminaires. All workers answered the questionnaire when daylight was present. Most of the workers (80%) indicated that they had enough light to do their work. A few workers commented that the electric lighting was not noticeable due to plentiful daylight. Glare from the LED luminaires was not a major concern of these workers (80% “disagree”). Occasional use of supplemental lighting was reported by a quarter of respondents. Overall, the LED luminaires were rated as “better” than other construction lights by 40% of respondents, and were rated “same” by 50% of respondents.

Installation and Maintenance

The LRC interviewed two site representatives for the electrical contractor. Their impression was that the LED luminaire was “not as powerful” as conventional pulse start metal halide construction lighting. They believe that the LED luminaires required more work to install at this site because they must be spaced more closely together than conventional sources (partly because of the higher light levels requested for this project). None of the electricians commented about quick-disconnect wiring, a potential labor-saving feature of the product. One electrician stated that additional installation time was also required because the LED luminaires require two mounting points, as well as leveling, unlike conventional construction lighting.

Lessons Learned

- Energy savings were estimated at approximately 60%.
- Measured illuminances in open areas were about twice the minimum required by code. By reducing the quantity of luminaires by about half, energy use and installation costs could have been reduced commensurately.
- Worker feedback was generally positive.
- According to this electrical contractor, the LED luminaires required more work to install than conventional construction lighting.