SSL Postings
U.S. DEPARTMENT OF ENERGY

May 20, 2015

GATEWAY Demonstration of LED Lighting in a High-Temperature Environment: One Year Later

You may recall that last year, DOE's GATEWAY program published the initial report on a demonstration involving an LED retrofit of the incumbent quartz metal halide (QMH) area lighting along a 7.2-mile stretch of the Yuma (Arizona) Sector Border Patrol Area along the U.S.-Mexico border. The high temperatures often reached in the desert, coupled with the high-flux needs of the application, make for a unique opportunity to document the long-term performance of the LED system in this challenging environment. The first report described how the new LED system was found to equal or better the QMH system in terms of both uniformity and illuminance, when comparing the initial output of the LED system and the maintained output of the QMH system; and now DOE has just published a follow-up report that reviews performance a year later.

The initial demonstration of the six LED luminaires installed on three poles in February 2014 was intended as a short-term trial before proceeding with the complete installation of more than 400 luminaires. Unexpected delays in the full installation have prevented the detailed evaluations that were planned, but ongoing tracking of the performance of the trial installation provides useful insights.

Measurements taken at the time of installation, again at about 2,500 hours of operation (September 2014), and again at about 5,000 hours of operation (March 2015) indicate that illuminance is changing more rapidly than anticipated. The distribution of illuminance has also changed, with values nearest to the pole increasing while the values have decreased farther away from the pole. The average horizontal illuminance decreased by 18% near the primary fence marking the border, and the vertical illuminance decreased by 25% on the primary fence. These changes in the illuminances delivered by the lighting system occurred after 2,500 hours of operation and persisted after 5,000 hours of operation. There was no measured shift in the color of the light.

Although the field measurements document the overall effects, they don't provide insights into the causes, which is the focus of ongoing research. The most likely causes for the changes observed are dirt accumulation combined with possible changes to the luminaire optical elements, such as the lenses.

The Yuma site is located in an extreme environment, where the luminaires rarely get a break from the heat. High ambient temperatures and direct solar radiation heat them up throughout the day, and then at sunset — just as the solar radiation stops and the ambient temperature begins to decrease — they turn on and generate their own internal heat. Between the initial measurements taken in February 2014 and the 2,500-hour measurements taken in September 2014, the daily high temperature exceeded 100° F on 116 days. In contrast, there were only 12 days above 100° F between the 2,500-hour and 5,000-hour measurements.

A full understanding of the causes for the observed changes depends on understanding the effects of the ambient thermal conditions on the internal operation of the luminaire. DOE researchers are exploring plans for thermal simulation of the luminaires as well as removal of one or more of them from the site for detailed laboratory analysis. We also plan to collect additional data from the site to more fully assess possible effects from dirt accumulation and other site-specific causes.

The Yuma Sector retrofit is a DOE Federal Energy Management Program Energy Savings Performance Contract ENABLE project administered through the General Services Administration. For details on this project, see the full report, which is available on the DOE website.

As always, if you have questions or comments, you can reach us at postings@akoyaonline.com.