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GATEWAY Takes on Another Challenging Outdoor Application

Although the adoption of LED lighting has been accelerating at a blistering pace in many exterior applications, there are a number of them where LED luminaires have yet to show that they can match the photometric and economic performance of incumbent high-intensity discharge (HID) systems. This is particularly true of high-mast lighting, which is area lighting with a mounting height of 65' and higher. High-mast lighting generally requires output levels that exceed those of most LED luminaires currently available for exterior applications — and, on top of that, the high drive currents often used in higher-output LED luminaires can reduce luminaire efficacy, due in part to thermal effects related to the higher drive current.

To learn more about the performance of LED high-mast lighting, DOE's [GATEWAY program](#) documented a trial installation of LED apron lighting at Philadelphia International Airport (PHL). Apron lighting is critical to airport operations, because it provides task lighting for baggage loading and off-loading in the aircraft belly, tow tractor hookup, fueling operations, preflight check by the pilots, and minor maintenance at the gate. This poses an especially difficult lighting challenge, not only because high light levels are required, but also because — unlike in other large-area lighting applications, where light poles can be placed throughout the area — luminaire locations are limited to one side of perimeter zones, and long throws are needed to provide the light required for visual tasks that extend the entire length of aircraft that are parked at airport gates. Consequently, luminaires with very high lumen packages and good optical control are required.



In the summer of 2013, PHL staff, with assistance from GATEWAY, began examining ways to reduce the energy consumption of the airport's apron lighting, while also reducing maintenance and light pollution and increasing safety. After reviewing many alternative products and approaches, PHL selected an LED luminaire for a trial installation in the apron area at one of the airport's seven terminals. An evaluation of an initial trial installation of three luminaires (Trial 1), conducted in October 2014, led to recommended improvements in the system design and evaluation procedures. Consequently, a second trial installation (Trial 2) was evaluated in May 2015.

The actual energy savings realized by a full implementation of LED luminaires was calculated to fall somewhere between 24.5% and 51.5%, depending on the mix of high- and medium-output LED luminaires installed. Although the average illuminance measured for the Trial 1 LED system exceeded that of the HPS system, the measured data showed that the illuminance distribution of the LED system wasn't acceptable, with many measurement points having lower illuminance than the HPS system produced. This finding reinforces the limitations of using the average illuminance to characterize complex distributions.

Trial 2 demonstrated that the LED solution provided higher illuminances than the incumbent HPS system throughout the key task area from 45' to 180' from the terminal building, which encompasses the work areas for baggage handlers and other grounds crew members for the various plane sizes that arrive at and depart from PHL. In fact, from 60' to 135' the illuminances produced by the LED system were more than 100% higher than those from the HPS system, even with two of the five LED luminaires functioning at less than their full output. This demonstrates the potential for greater energy savings with medium-output LED luminaires for the majority of gates with smaller apron areas, rather than the high-output luminaires used in the Trial 2 installation.

At most throw distances beyond 195', the LED system produced lower illuminances than did the HPS system. While the luminaires that were functioning at less than full output during the trial are expected to contribute additional illuminance to these points, it's unlikely that even a fully functioning LED system would equal or exceed the HPS system at all of the grid points with these longer throws. Since there are few if any demanding visual tasks occurring at these throw distances, the illuminances provided are expected to be considered acceptable by PHL. One possible exception is that for gate areas where longer planes are expected, using high-output LED luminaires may be necessary to ensure adequate illuminances along the entire length of the plane.

Part of the difficulty in assessing the adequacy of the illuminances throughout the evaluation area comes from the lack of any established design criteria for the apron areas at airports, since the Illuminating Engineering Society (IES) withdrew its relevant Recommended Practice, RP-14. Until new guidance is provided by the Federal Aviation Administration or the IES, airport facility managers and designers

must rely on past guidance and their own experiences in establishing lighting-performance criteria for airport aprons.

The PHL trial evaluations show opportunities for lighting-system optimization that could produce substantial additional savings in energy use by leveraging inherent advantages of LEDs. LEDs offer the possibility of optimizing the distribution of light to address specific task needs, with lower illuminances throughout much of the apron and higher illuminances only where necessary to address visual task needs. In addition, the inherent dimmability of LEDs provides opportunities for reducing the illuminances in the areas around certain gates where no activity is scheduled, resulting not only in deeper energy savings but also in a reduction in any contributions from the apron lighting system to light pollution. Although it wasn't considered at PHL, an apron lighting control system with some combination of motion detection, time scheduling, and manual override capability could provide substantial benefits in these areas.

For the complete details, including lessons learned, see the [full report](#).

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