NLPIP
NATIONAL LIGHTING PRODUCT INFORMATION PROGRAM

Response to correspondence sent by Pacific Northwest National Laboratory to the National Lighting Product Information Program regarding *Specifier Reports: Streetlights for Collector Roads*

October 29, 2010

On October 21, 2010, PNNL wrote to NLPIP:

> *DOE's SSL program strongly emphasizes throughout its published materials and presentations that interested parties need to do their own homework, and understand the products they are interested in purchasing. This includes confirming that the products are suitable for the application in which they are intended to serve. In contrast, LRC's recent Streetlights report took product claims of distributors at their face value and did not independently confirm that the specific models would fit the requirements of the test site simulated, falling prey to the consequence DOE warns about….*
>
> *LRC commits a critical error at the outset of the study which then permeates the remainder of the report. The issue is easily visible in the figure below, which plots "street-side output in lumens" (LRC's measure of choice) against total luminaire output for the various products evaluated.*
>
> *The nearly linear distribution of points in the graph reveals that the LED and induction products selected by NLPIP for this analysis were simply (and dramatically) underpowered for this application. Selection of higher powered LED and induction products appropriate for this application, which are widely available in the market, would have offered correspondingly higher luminaire output, and made possible a fair comparison with the selected HPS products.*
>
> *As it stands, this basic flaw in the LRC methodology cascades through the report's conclusions and entirely undermines the general statements made about LED performance. The conclusions about LED systems needing more luminaires and poles, and consequently having much higher first costs, follow directly from this selection error and are thus baseless.*

As discussed on page 8 of the report, the models of the luminaires tested by NLPIP were determined by manufacturer representatives, not by distributors. In the same process used by many lighting specifiers, including those employed by municipalities, we asked these representatives to identify a model equivalent to an HPS luminaire with certain specifications. Rather than negate the findings, this methodology leads to real-world results that occur when manufacturers and their representatives claim "underpowered" luminaires to be equals to existing fixtures, even though "higher powered" models might be available. We believe that this is an issue in the LED outdoor lighting industry at the moment, as demonstrated by the fact that all six of the LED manufacturer representatives identified "underpowered" streetlights to NLPIP as equivalent to the given performance specification.

In the passage above PNNL calls street-side lumens "LRC's measure of choice." This is not correct because NLPIP did not use street-side lumens in its pole-spacing, power, or economics calculations. Rather, the measured intensity distributions of the luminaires were used. As noted on page 22 of the report, "NLPIP performed application-specific analyses using the photometric files in the Roadway Optimizer tool and created point calculation grids in the lighting software program AGi32 version 2.04 to determine the following: pavement illuminance, illuminance uniformity ratios, veiling luminance ratio (a measure of disability glare), pavement luminance, and vertical illuminance used for the calculation of discomfort glare." The report simply notes that among the luminaires tested there was a correlation between street-side lumens and pole spacing.

PNNL's correspondence also contained a list of critiques presented in six bullet points. In the first of these, PNNL wrote:

> *LRC has tested all HPS and PSMH luminaires using relative photometry and the LED and induction luminaires using absolute photometry. A side bar on page 11 explains the difference between absolute and relative,*

and states, "NLPIP tests showed that the measured lumens of the four HPS lamp and magnetic ballast combinations (measured independently of the streetlight) were, on average, 10% lower than their rated lamp lumens…" Yet, the report does not de-rate the results of the relative photometry on the luminaires by this 10% (although it does go to lengths in Appendix A to explain other factors taken into consideration). CALiPER absolute testing has similarly shown that in the majority of cases for conventional light source technology fixtures, actual luminaire performance (based on absolute photometry) is less than predicted by relative photometry by a factor of 10-15%. The report's failure to apply a correction factor to the results for this known discrepancy introduces a significant bias.

NLPIP's reason for not using absolute photometric data for the HPS and PSMH luminaires is that these types of data are not available to specifiers. However, even when the absolute photometric files were used in the AGi32 analysis, the pole spacing changed by five feet or less, or 2 to 3%, because the pole spacing was limited by the horizontal uniformity ratio or the veiling luminance ratio for these luminaires. (In other words, the average horizontal illuminance level was higher than the standard required.) This small change is inconsequential to the cost and therefore does not change the analysis.

In the second bullet, PNNL wrote:

The authors fundamentally assume that house-side lumens are by definition wasted lumens. There are many applications where the house-side lumens actually provide superior roadway visibility, e.g., in wet pavement where the house-side lumens are not reflecting towards the driver so provide better visibility of the edge of the road. House-side lumens also don't result in veiling glare for the driver the way that street-side lumens do. Some might even contend that given the presence of headlights on cars, a street lighted with house-side lumens would provide superior roadway visibility than a street lighted only with street-side lumens (e.g., see Rea, M. S. 2001. The Road Not Taken. The Lighting Journal 66(1):18-25.)

NLPIP did not assume that house-side lumens are wasted. We used the measured intensity distribution from the luminaires to determine the pole spacing necessary to meet the RP-8 roadway criteria based on the procedure that a typical specifier would use. The street-side lumens correlation simply showed that pole spacing was more dependent on downward street-side lumens than on luminaire lumens. The analysis did not address the sidewalk lighting criteria in RP-8 because most lighting specifiers do not design streetlight systems to meet it, nor did we report on light trespass or façade lighting or aesthetics.

In the third bullet, PNNL wrote:

IES explicitly discourages over-reliance on the Type classification system established in TM-3. If LRC selected LED luminaires on the simple basis of Type III Medium rating, there's a good chance superior products were inadvertently eliminated from consideration.

NLPIP used the given mounting height and typical AASHTO roadway geometry to determine that a Type III classification was the most appropriate distribution. Many municipalities use the type-classification-system to describe the performance of the streetlights used in their jurisdictions, many specifiers use it to communicate with manufacturer representatives, and many manufacturers use it to differentiate between their product lines. We therefore included this method in the report because we followed the procedure that a typical specifier would use.

In the fourth bullet PNNL wrote:

LRC inadvertently ordered a Type I luminaire and never caught the mistake. This is why the Holophane luminaire produced the shortest HPS pole spacing.

It's true that the Holophane streetlight has a Type I distribution, but it's not correct that NLPIP didn't realize this problem. As noted above, NLPIP relied on manufacturer representatives to identify the luminaire models to order. In this case, NLPIP asked the representative to check that the specified luminaire model was an equal to the Type III HPS base case several times, and each time was assured that it was an equal. NLPIP further questioned if the luminaire needed to be tilted to provide a Type III distribution but was told that a horizontal mounting would provide this distribution. If NLPIP had insisted on a more appropriate luminaire, this would have broken the methodology of the study. Again, this highlights the problem that manufacturer representatives may fail to

identify appropriate luminaires, which is likely to lead to problems in actual installations. Also, as discussed in the "Labeling Problems" section on page 17 of the report, "only six of the fourteen streetlights had a Type III IES lateral classification."

In the fifth bullet PNNL wrote:

> *The authors are apparently unaware that the (recently deprecated) cutoff classification system cannot be applied to absolute photometry, e.g., LED luminaires tested per LM-79. Unfortunately, the Photometric Toolbox software NLPIP used for the analysis reports a modified version of the cutoff classification system when it encounters absolute photometry, simply replacing lamp lumens with luminaire lumens for the divisor, without utilizing a different naming convention. A consequence of this non-standard calculation is that an HID luminaire classified Full Cutoff when tested using relative photometry can be classified Cutoff or worse when tested using absolute photometry. (LED luminaires are thereby put at an unfair disadvantage in the study.)*

NLPIP is aware that cutoff classification is calculated with lamp lumens, which is unavailable for LED luminaires. However, it is common practice to report the nominal cutoff classification using luminaire lumens for LED luminaires. Specifiers, including those in the employ of municipalities, continue using this nominal classification system to characterize the optical performance of LED streetlights, which is why NLPIP used this term. The report also includes Luminaire Classification System values for each streetlight, which is the current IES method that supersedes the cutoff classification system.

Please note that it's not just Photometric Toolbox that reports this modified calculation of cutoff. In fact, the photometric testing laboratories that conducted the testing for NLPIP, which are DOE CALiPER approved, report the nominal cutoff classification irrespective of the photometric software they employ.

In the last bullet PNNL wrote:

> *The Hadco and elumen luminaires appear to be the same product, effectively reducing the number of LED luminaires evaluated by one. Additionally, both products allow field-adjustment of light distribution (setpoints of 0, 4.5, 9, 13.5, 18, or 22.5 degrees), but LRC does not indicate which setting was used during testing. According to Hadco, the luminaire changes from Type II to Type III by changing the tilt of the light sources from 13.5 degrees to 18 degrees.*

The Hadco and elumen luminaires have very similar exterior appearances, but performed differently. NLPIP recognizes that the tilt angle of these luminaires changes their distributions and for that reason tested each product using the wing tilt angle specified on the manufacturer's datasheets to produce a Type III distribution. The elumen streetlight was tested with a tilt angle of 22.5 degrees, the Hadco streetlight was tested with a wing angle of 18 degrees.