Prepared by: **Prepared for:**

BPA Energy Efficiency:

Outdoor Lighting Center Final Report

January 2011

Background

During FFY 2010, the Washington State University Extension Energy Program (WSUEP), under contract with the Bonneville Power Administration (BPA), assisted BPA to launch several initiatives to promote the awareness of and adoption of advanced lighting technologies in the Pacific Northwest. One of the most exciting ideas that came out of the Lighting Initiatives was the concept of establishing a facility where advanced outdoor lighting fixtures could be tested and demonstrated for the benefit of utilities, local governments, commercial building developers, outdoor lighting designers and others. Stakeholders would be able to arrange to test lighting fixtures that they are evaluating and to visit the facility and see for themselves how various street lights and parking lot lights performed.

Results

Start-up funding for this project was provided by BPA. WSUEP subcontracted with the Lighting Design Lab (LDL) in Seattle to help set up the project. LDL is a regional resource funded by BPA and regional stakeholders including Seattle City Light (SCL), the Energy Trust of Oregon, and public and investor-owned utilities.

LDL identified a suitable site at a former aviation runway on the campus of South Seattle Community College (SSCC). The community college was approached about the idea, and was enthusiastic about the training opportunity it would leverage for them with their ongoing energy efficiency curricula. A three-year licensing agreement was developed to allow LDL use of the concourse for the Outdoor Lighting Center (OLC). It was determined that site preparation would be needed to ready the site for the erection of lighting towers, and SSCC agreed to do the work. An additional subaward was authorized so that WSUEP could contract directly with SSCC for this construction project.

While agreements were being made to authorize this construction work, LDL designed and found a supplier for the lighting towers. The purchase of the towers leveraged almost $50,000 of additional funding from SCL. Additional testing was also performed on various light fixtures at LDL's laboratory in Seattle, as detailed in Appendix A.

Site improvements were completed and towers were erected by the end of September 2010. Combined cost for SSCC and LDL were $135,428. The OLC will now move into its next phase: operating as a resource for regional stakeholders to gain practical, valuable data about advanced outdoor lighting through testing and demonstration.

Conclusions and Recommendations

The project goals had originally extended to include an assessment of LED street lighting. However, the short funding period (six months) was not sufficient to both set up the OLC and to set up protocols and conduct an assessment of particular lighting technologies. The work of establishing legal agreements, identifying funding mechanisms, awarding contracts, construction of site improvements, and design, purchase, delivery and erection of lighting towers took every bit of the six-month funding period. Given the complexity of the project and the short time period, this was a successful outcome.

The idea behind the OLC is to have the testing and demonstration facility serve as a resource for the many utilities and governmental organizations that are in the process of considering next-generation outdoor lighting for their service territories and jurisdictions. These organizations are considering a switch from existing high pressure sodium (HPS) street lights to light emitting diode (LED), induction, or plasma sources in residential neighborhoods and on arterial streets. The switch is being considered due to perceived energy savings and the decreased maintenance issues and costs. The big question is whether these broader-spectrum light sources perform better than, equal to, or poorer than yellowish HPS in the varied rain, fog, snow, and dry conditions of the Pacific Northwest.

These are important issues, and the OLC can potentially answer them. As such, the existence and availability of the facility needs to be promoted to this constituency. Initial funding for actual testing and assessments will be provided by SCL, but a survey of the needs of other stakeholders would be beneficial to ensure that subsequent assessment projects meet the needs of the target beneficiaries. Funding for additional assessments will need to be found. Also needed is a plan and funding to transfer the results of these demonstrations to the target audience who can benefit from the knowledge obtained.

In the future, an evaluation should be undertaken regarding whether and how stakeholders applied the results from OLC testing to their decision-making, what technologies were purchased to replace the current generation of street and parking lot lights, and what energy savings estimates can be attributed to the OLC.

Appendix A:

Lighting Design Lab Final Report

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11/29/2010

RE: Lighting Design Lab (LDL) Outdoor Lighting Center – Report

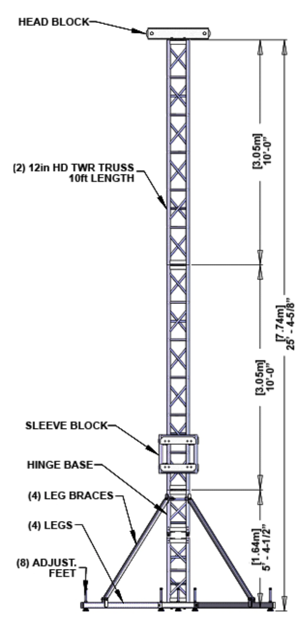
INTRODUCTION

Regionally and nationally there is a big push to switch from existing HPS (High Pressure Sodium) street lights to LED (Light Emitting Diode), Induction or Plasma sources in residential neighborhoods and on arterial streets due to perceived energy savings and the decreased maintenance issues and costs. One big question is unanswered in the general discussion: Will these broader-spectrum light sources perform better than, equal to, or poorer than yellowish HPS in the varied rain, fog, snow, and dry conditions of the Pacific Northwest? The LDL proposes creating *The LDL Outdoor Lighting Center* to conduct a study to help answer this question.

Work performed:

Phase 1

1. **During Phase 1 a site license agreement with South Seattle Community College (SSCC)** was developed allowing the Lighting Design Lab (LDL) to use the South end of the "concourse" at SSCC shown below, from September 1, 2010 through August 31, 2013.



2. **LDL developed a flexible/modular "tower" to hold the street lights for testing.** 5 towers were purchased from Applied Electronics (image at right). The towers come with a sleeve block, which we will attach the street light to, that can be raised from ground level up to 35 feet high
3. **SSCC installed 7 pad locations for locating the 5 towers**. Pad locations are at 0', 100', 150', 200', 300', 400', 450' which allows spacing 5 towers 100' on center and 4 towers at 150' on center. The initial setup is towers located 150 feet apart.

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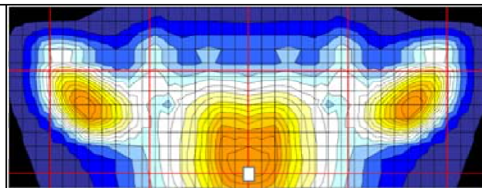
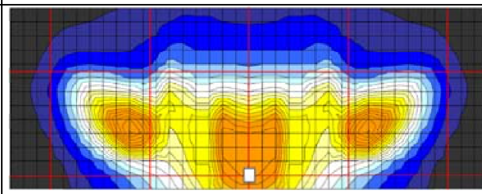
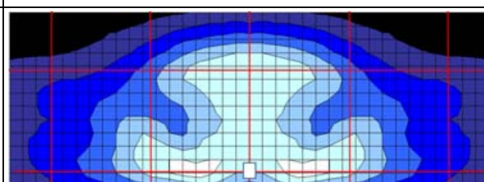
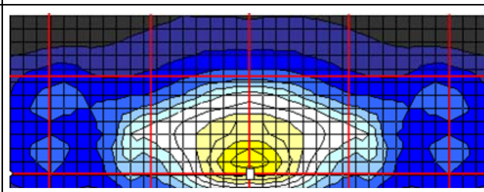
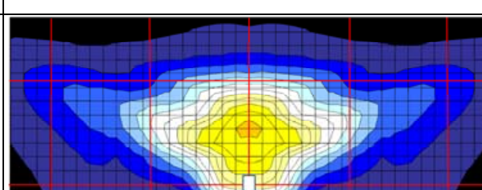
4. **LDL setup an indoor testing facility in the LDL mockup room and tested 15 street light fixtures.** The tested fixtures included the following. The colored diagrams shown below are the footcandle distribution of each fixture mounted at 14.5 feet and can be used to compare one fixture distribution to the next (the red lines in the diagrams are one mounting height). However, the footcandle levels do not necessarily represent good lighting in the field.

100 watt HPS fixtures that is used by Seattle City Light street lighting department.		
A second newer 100 watt HPS fixtures that is used by Seattle City Light street lighting department. American Electric fixture # 115 10S R2 FG		
The BETA LED fixture that SCL is using in their 2010 LED conversion. Fixture # BXSL0204C-UAR7 (STR-LWY-2M-HT-04-C-UL-SV-PD-R-43K)		
The Leotek LED fixture that SCL is using in their 2010 LED conversion. Fixture # GC1-40C-MV-NW-2M-XX (530 MA)		
A Cooper Lighting LED fixture #LDRC-T2S-A02-E		

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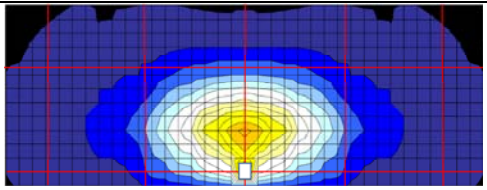
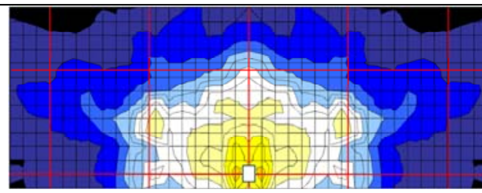
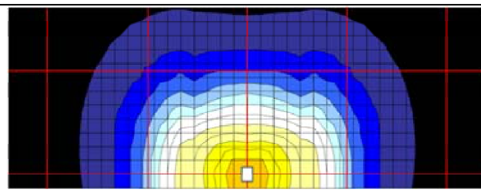
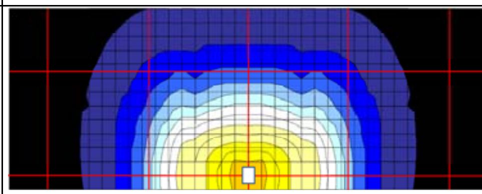
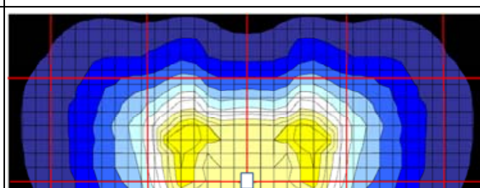
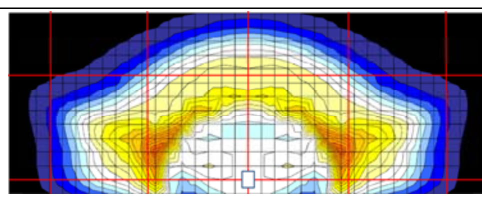
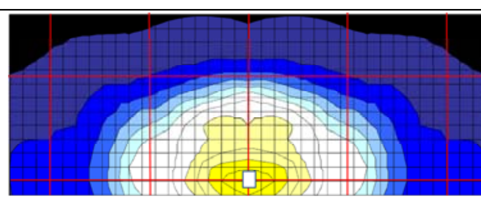
A GE Lighting LED fixture # ERMC-0-A8-43-A-1-GRAY		
A Gardco Lighting fixture # G13 1 2XL60CMPE 120V NP		
A US Lighting Tech induction fixture #Jersey		
A US Lighting Tech induction fixture #Jersey w/ house side shield		
A LSI LED fixture Crossover #XAS3 2 LED 63		
A Lighting Science Group LED fixture #LSR4 CW R3 2B GR PCR		
A Leotek Electronics LED fixture # SLN-48C-MV-NW-2M-GY		

Additionally a 400 Watt HPS street light, a StrayLight – Luxim, and a US Lighting Tech 200 watt Induction were tested indoors in the LDL mockup room.

5. Initial conclusions

- During the indoor testing it was determined that a number of the fixture IES photometry DO NOT match the measured light levels of the test fixture. The concern here is that if the photometry does not match the actual fixture distribution then using a computer simulation will not accurately represent the lighting on the street.
    - HPS fixture photometry was not close to the measured light levels in the indoor test.
    - Beta LED published photometry is based on an 80 LED product while the fixture tested uses 40 LEDs. To use the photometry the file is “scaled” down to 40 LEDs. While the distribution calculated closely matched the measured light levels, it would be more accurate if the 40 LED would have been tested by the manufacturer.
- To accurately use a computer simulation it is important to “field” test each proposed fixture to see if it matches the IES photometry.
- In testing an inaccuracy was found in the IES BUG and LCS rating methods. Because the LCS diagram averages the light distribution through 180 horizontal degrees it can mask intense light distributions. Backlighting calculations should be added to any evaluation of a new fixture.
- None of the LED/Induction/Metal Halide fixtures have the same lighting distribution as the 100 watt HPS fixture. Therefore “LED/Induction/Metal Halide replacement fixtures will NOT produce the same footcandle distribution as a 100 watt HPS fixture”. However, this does not mean that the HPS distribution is correct.
- The tested batch of LED product used approximately 50% of the energy of the tested American Electric 100 watt HPS street light fixture (SCL standard fixture).

- LED street lights show a lot of promise in replacing HPS street lights. The energy savings is close to 50%. The life is 50,000 hours which is twice the length of HPS. The cost that we have heard from the SCL installation is around $300, which is 3 time what they pay for the HPS street light. Assuming 70 watt savings, $0.05 kWh, and 12 hours per day operation, LED street lights would save $15.33 per year – or $175 over the LED 50,000 expected life. Maintenance savings to relamp the HPS luminaire or longer than expected LED life would make this technology have a positive payback.

Sincerely,

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