Exhibit No.:	
Issues:	LED Street Lighting
Witness:	Hojong Kang
Sponsoring Party:	MO PSC Staff
Type of Exhibit:	Surrebuttal Testimony
File No.:	ER-2011-0028
Date Testimony Prepared:	April 15, 2011

MISSOURI PUBLIC SERVICE COMMISSION

UTILITY OPERATIONS DIVISION

SURREBUTTAL TESTIMONY

OF

HOJONG KANG

UNION ELECTRIC COMPANY
d/b/a Ameren Missouri

FILE NO. ER-2011-0028

Jefferson City, Missouri
January 2011

BEFORE THE PUBLIC SERVICE COMMISSION

OF THE STATE OF MISSOURI

In the Matter of Union Electric Company d/b/a AmerenUE's Tariff to Increase its Annual Revenues for Electric Service	)))	File No. ER-2011-0028

AFFIDAVIT OF HOJONG KANG

STATE OF MISSOURI)
) **ss**
COUNTY OF COLE)

Hojong Kang, of lawful age, on his oath states: that he has participated in the preparation of the following Surrebuttal Testimony in question and answer form, consisting of 5 pages of Surrebuttal Testimony to be presented in the above case, that the answers in the following Surrebuttal Testimony were given by him; that he has knowledge of the matters set forth in such answers; and that such matters are true to the best of his knowledge and belief.

Hojong Kang

Subscribed and sworn to before me this 15th day of April, 2011.

Notary Public

SUSAN L. SUNDERMEYER
Notary Public - Notary Seal
State of Missouri
Commissioned for Callaway County
My Commission Expires: October 03, 2014
Commission Number: 10942086

SURREBUTTAL TESTIMONY

OF

HOJONG KANG

UNION ELECTRIC COMPANY
d/b/a
AMEREN MISSOURI

FILE NO. ER-2011-0028

Q. Please state your name and business address.

A. My name is Hojong Kang, and my business address is Missouri Public Service Commission, P. O. Box 360, Jefferson City, Missouri 65102.

Q. What is your present position at the Missouri Public Service Commission?

A. I am a Regulatory Economist in the Energy Department of the Utility Operations Division.

Q. Are you the same Hojong Kang that contributed to Staff's Class Cost-of-Service Report (CCOS Report) filed on February 10, 2011?

A. Yes, I am.

Q. Would you please summarize the purpose of your surrebuttal testimony?

A. I address the rebuttal testimonies of Union Electric Company d/b/a Ameren Missouri (Ameren Missouri or Company) witnesses Kyle F. Shoff and Wilbon L. Cooper, related to Ameren Missouri's position concerning a tariff for Light Emitting Diode (LED) Street and Area Lighting (SAL) systems. Mr. Shoff and Mr. Cooper both state in their rebuttal testimonies that Ameren Missouri should not add a LED SAL tariff to its non-metered standard street and outdoor lighting tariff offerings. Rather, customers desiring to install their own LED systems should be granted service only under the metered option of the

Company's Service Classification No. 6 – Street and Outdoor Area Lighting – Customer Owned (6M).

Q. What is the main reason Ameren Missouri does not want to propose a LED SAL tariff?

A. On page 2, lines 9 through 10 of Mr. Shoff's rebuttal testimony, he states that none of the new, cutting edge street lighting technologies are cost effective at this time.

Q. Is Staff's only reason for a recommendation to have a LED SAL tariff that LED SAL is the most energy efficient SAL system among current technology?

A. No. Some municipal customers in Ameren Missouri territory want to have other options, including LEDs, for their SAL system. In August 2010, Staff, Ameren Missouri, Missouri Department of Natural Resource, the Office of the Public Council, and St. Louis County Municipal League had a conference call regarding Ameren Missouri's SAL system. The LED SAL system was one of the topics discussed during this conference call[1].

In addition to the mentioned advantages of LED SAL systems in Staff's CCOS Report on page 34, Ameren Missouri states that LED SAL systems give not only measurable energy savings, but also noticeable light quality differences within its 2011 Integrated Resource Plan[2]. Also, Mr. Shoff shows the quality difference between a HPS lighting and a LED lighting in his presentation at the Rural Electricity Resource Council's conference in November, 2010 as shown below[3].

[1] See Question 3, Sch. HK – 1.
[2] See Sch. HK – 2, p. 95.
[3] See Sch. HK – 3, p. 7.

Therefore, the cost-effectiveness of the LED SAL system is not the only reason for the Company to prepare the LED SAL tariff.

Q. Is it sufficient for Ameren Missouri to offer the LED SAL system for only metered SAL systems under the 6M tariff?

A. No, the 6M tariff is not broad enough to cover all kinds of LED SAL systems owned by customers. Mr. Shoff and Mr. Cooper suggest using the metered rate in 6M for LED SAL systems. It may work for a new LED SAL installation; however, the metered rate cannot apply to the retrofit of current unmetered SAL systems.

The City of Los Angeles, California (City of LA) is operating one of the leading LED programs that will convert 140,000 SALs to LEDs. Even though they changed the cobra-headed lamp on the existing SAL system for 40% expected energy savings, the City of LA reported 55% in actual energy savings with positive feedback from community at the 2010 Illuminating Engineering Society's SAL conference[4].

In 2010, there are over 21,000 unmetered SAL systems on the 6M tariff in Ameren Missouri service territory[5]. If a customer wants to retrofit an existing unmetered light to a

[4] See Sch. HK – 4, p. 4.
[5] See Sch. HK-5.

LED light, he does not have that option under Ameren Missouri's current tariff, nor the Company's current proposal for the LED SAL systems.

Therefore, it is better to have a LED SAL tariff for both metered and unmetered systems.

Q. Is a LED SAL tariff beneficial for the customers under the Company's Service Classification No. 5 – Street and Outdoor Area Lighting – Company Owned (5M)?

A. Yes. In addition to the same reasons to have a LED SAL tariff for the customers under 6M, there are more saving benefits for the customers under 5M.

In Ameren Missouri's current proposal for SAL rate design, the company charges $0.126 per kWh under 5M, while customers under 6M only pay $0.0419 for metered SAL systems[6]. However, the customers under the 5M rate should also consider the Company's existing tariff charge of $100 for "early" termination of Company installed lighting facilities before converting their existing SAL system.

Q. Do you support Mr. Shoff's statement on page 6, lines 17 through 19 as below?

> ….Both Ameren Missouri and EPRI felt it was important to include multiple seasonal weather variances within the pilot to gauge and analyze the performance of the LEDs in different scenarios under different conditions.

A. I cannot, because I do not have enough information at this time. I submitted Data Request No. 0353.1 for this topic and only received two slides of a presentation in response. The slides did not provide enough information to support the inclusion of multiple seasonal weather variances within Ameren Missouri's pilot.

Q. Please summarize your conclusions.

[6] Id.

A. To give a better option to the customer, the Staff recommends that the Commission order Ameren Missouri to complete its evaluation of LED SAL systems, and no later than twelve (12) months following the Commission's Report and Order in this case file either a proposed LED lighting tariff(s) or an update to the Commission on when it will file a proposed LED lighting tariff(s).

Q. Does this conclude your surrebuttal testimony?

A. Yes, it does.

ST. LOUIS COUNTY MUNICIPAL LEAGUE

Linking Local Communities ▪ Strengthening Local Government

July 16, 2010

To: Wil Cooper, Ameren via email – wcooper@ameren.com
Phil Difani, Ameren via email – pdifani@ameren.com
Mike Scheperle, PSC via email – mike.scheperle@psc.mo.gov
Barb Meisenheimer, OPC via email – barb.meisenheimer@ded.mo.gov

From: Tim Fischesser, Executive Director, St. Louis County Municipal League

RE: Ameren Cost of Service Study on street lighting

While contacting consultants for proposals, the League staff has hurriedly tried to learn more about the proposed street lighting study and how it will impact future rate cases. We have developed the following list of questions regarding the Ameren methodology discussed with the PSC and OPC on July 8. We clearly need to retain a consultant who can assist us in better understanding and evaluating the proposed methodology and the responses to the questions below. We are pursuing this. Until such time as we can secure that assistance, we would like Ameren to attempt to answer the questions below. We will follow up with comments on the methodology as soon as we receive answers to the questions below and have them reviewed by a consultant.

1. The higher cost of 5M service, when compared to 6M service seems to focus on Ameren cost recovery for the original installation of the poles and wires, which I will refer to as the local backbone. What are the cost factors that make up this local backbone and if billed every month for years is there a time when Ameren has fully recovered or depreciated these costs? If so, should the 5M rate be reduced to the 6M rate at some point?

   AmerenUE response:

   The cost differential, i.e. $5.81 for 9500 lumen, reflects the cost recovery of the fixture, bracket, minor materials and labor to install the light. The same differential for the 9500 lumen post-top is $13.13, which includes the 17 foot standard pole and connecting wire in addition to the aforementioned items.

   Cost factors include a return on our investment in the lighting system, production plant, transmission and distribution systems. It also includes an allocated apportionment of depreciation expense, operations and maintenance expenses, customer service expense, administrative and general expenses and taxes.

   The costs will likely never approach the 6(M) rate because 1) new installations, and 2) at some point the depreciated asset must be replaced at current cost. The rate reflects the revenue requirement (i.e., expenses, taxes, depreciation and return on plant) of all investment, operations and maintenance expenses, and administrative and general expenses associated with same.

2. Is there a logically priced local option that would allow cities to buy local street lighting systems from Ameren? If so, what is the basis of these selling prices?

   AmerenUE response:

   The options available to the customer are to pay for the facilities up front and own them, or to have AmerenUE incur the cost of its investment and maintenance and the customer to pay based on AmerenUE ownership - 5(M) rate. However, over the past twenty years the Company has occasionally sold underground lighting systems, negotiated at reproduction cost depreciated or higher —a commonly utilized and equitable method for the sale of utility owned facilities.

3. How can cities achieve energy efficiency and also reduce street lighting costs? Are bulbs rated on a chart by efficiency? LED street lights do not seem to have or fit into a category. Can this be explored? Since 5M is unmetered, how can more energy efficient technology result in lower bills? For example, will Ameren lower fees if more energy efficient bulbs are installed on unmetered systems? Is migrating to measured service worthwhile? If so, what "best practices" could be used to make this change?

   AmerenUE response:

   AmerenUE is currently conducting pilot projects on LED lighting. As you have discovered, the amount of energy for the lights is small, the main part of the cost is service and facilities. However, should LED lights become a standard offering the cost of electricity consumed will be reflected in the rate. Switching to LED lamps currently requires an entirely new fixture to be used. The economics of migrating to measured service will need to be evaluated on a case-by-case basis.

4. One way to save energy and taxpayer money is to decommission/remove lights but we have been told that there is a $100 fee for this. Is that fee logical and justified? What specific work is performed for this fee? What if any portion of the 5M fee would continue to be charged if this is performed.

   AmerenUE response:

   At the customer's request, AmerenUE invested in the lighting fixture based on the assumption that the customer would fulfill its contract with the Company. The $100 tariff charge is considered just and reasonable as it has been approved by the MPSC and is simply an early out charge that reflects our removal costs and, also, the loss of the remaining life of said fixture. As long as the customer has successfully completed their contract, there is no charge from AmerenUE to disconnect (and remove) a light. Should a light fixture be disconnected and removed from our system it would terminate 5M service for said light.

5. Is there a reason that signing a 20 year municipal franchise lowers lighting costs by 10%? Is this appropriate policy? If lighting can be billed at a 10% discount with the signing of a franchise, are rates too high?

   AmerenUE response:

   Quantification of the tangible value of municipal franchise agreements is difficult. A municipal franchise offers numerous business benefits to AmerenUE and the municipality. The relationship between discounted lighting rates and franchises is subjective. However, this longstanding discount has been approved by the MPSC and has been in effect since 1988. Clearly, there is no basis to conclude that the mere presence of this discount indicates that lighting rates are too high.

6. Document/justify the portion of the 5M & 6M bills attributed to maintenance. Are there "best practices" that could lower costs, e.g could regular change out/preventative maintenance, as opposed to call in service, result in savings.

   AmerenUE response:

   As part of the proposed lighting class-cost-of-service study the Company will be evaluating the maintenance expense differential between 5M and 6M service. We will provide documentation/justification once the result of the analysis is available. AmerenUE continually evaluates its and other company's best practices. To this end, we have developed procedures that lower the overall cost of lighting including operating and maintaining such lights while continuing to maintain superior customer satisfaction. This process will continue to evolve and change over time. There really is no preventative maintenance that could be done more cost effectively than just replacing a component upon failure. In either case, all maintenance usually involves replacing some component. Preventative maintenance could actually increase cost if you are pro-actively replacing components based on expected life rather than simply waiting until it fails.

7. Is there a pole rental charge on muni bills in addition to the 5M charge that appears to charge for the local poles and wires? If so, explain the difference between this separate pole rental charge on the bill and the charges included in the 5M rate that seems to cover the local backbone, including the poles.

   AmerenUE response:

   Prior to 1989, instead of charging a customer in advance for the installation of new underground street light cable, new overhead streetlight wire, new poles or whatever needed to be installed to add new lights to the system at a customers request we had in place monthly rates to account for those installations. Since 1989, as opposed to monthly billing customers for such facilities required solely to serve streetlights, we require payment up front.

8. Explain the cost difference between a pole that only holds a street light, and a pole that also holds many wires (cable, phone, electric, and lights, etc.)?

   AmerenUE response:

   The underground served street light pole is 100% used by the street light and has essentially no other uses by the electric distribution system. Wood distribution poles on the other hand, are for the purpose of extending the distribution system to our customer base, and may incidentally support shared facilities such as cable, phone, and lighting. Overhead supplied wood distribution poles are sometimes used simply because it is already installed and has the capability to hold the light. If a wood pole is needed just for a light, then that falls under the special facilities category and must be paid for up front (the cost of the pole is not included in the lighting rate). Except for special situations customer owned 6(M) lights are not allowed on distribution poles as the liability of non-AmerenUE personnel climbing these energized poles is unacceptable.

9. Explain the difference in 1) bills that cover street lighting such as 5M and 2) bills for lights that are installed on multipurpose poles, such as the large poles along major roads?

   AmerenUE response:

   Regardless of the type of pole the fixture is attached to (a dedicated pole just for the light, or a multipurpose distribution pole), there is no difference in the monthly billing rate for the same type of 5(M) lights (excluding post tops). If a light is installed on a dedicated pole and a distribution extension is required, it is paid for up-front as a special facility. Therefore, the monthly rate for the light would be the same as if the same light were installed on an existing AmerenUE distribution

pole where no up front special facility charge was required. All are available in 5(M). Of course, the rate for post top fixtures includes a fiberglass pole which includes the pole and has a higher rate. The light's monthly fees reflect energy production, transmission and delivery costs along with costs, initial capital, labor, and O&M investment that we invest to stock, install, and operate and maintenance expenses.

10. To whom are lights on County or state highways but within a municipality's corporate limits billed?

    AmerenUE response:

    Lights can be billed to either, depending on which entity requested and agreed to pay for the light.

11. Provide an accurate list of lights by address that appear on municipal bills to assure accuracy of bills.

    AmerenUE response:

    AmerenUE currently has this information spread across different software systems, some information such as location, is in our mapping system while different information such as billing attributes, is in our billing system. AmerenUE is actively updating all municipal lighting accounts and merging the data from all systems in order to provide the list of lights by address by type so that a customer can easily follow how their monthly bill is calculated as well as be aware of the locations of the billing light locations. Additionally, at the same time we are also field verifying that the lights that we are maintaining in the field are reflected in the summary.

12. Explain each part of the July 8, 2010 proposed methodology in more detail so that we can better understand the proposed methods and goals.

    AmerenUE response:

    We are willing to answer any specific questions you may have but this question is so generic we do not know what additional information you are requesting. May we suggest a book published and available from the National Association of Regulatory Utility Commissioners, 'Electricity Utility Cost Allocation Manual'.

13. We are generally under the impression that the 5M bill consists of 1) charges for energy; 2) charges for maintenance of the light, sensor, glass, & 3) charges for the local poles and wires. The first cost category, energy, would seem to consist of many costs that must be apportioned to the various classes. How is this apportioned to the street lighting classes? How does off peak usage of street lighting affect this apportionment? For the second cost category, maintenance of fixtures, how are the costs determined? How are the capital costs for the fixtures captured? For the third cost category, charges for the local backbone, what methodology is used to develop this portion of the 5M bill?

    AmerenUE response:

    Your general impressions are partially correct. In addition, the lighting charges consist of a return on our investment in production plant, the transmission and distribution systems, along with associated depreciation expense, operations and maintenance expenses, customer service expense, administrative and general expenses and taxes.

    In a class-cost-of service study the cost of energy is typically allocated to classes by use of a variable allocator. That allocator is traditionally class kilowatt-hours use at the generation level. However, this approach does not equitably reflect the material proportion of off-peak energy usage

of the Lighting class vs. all other customer classes. As a result, AmerenUE will then, for lighting, adjust the average price to accurately reflect lighting's mainly off-peak use. We have proposed to utilize the relationship of on-peak and off-peak commercial or market energy prices to adjust the previously discussed class cost of service allocation of variable production costs to the lighting class.

Lighting maintenance work is charged directly to Lighting, and the embedded General Ledger (GL) amounts are the inputs in our class cost of service study. However, these are mass accounting records and therefore, these costs are not kept in the GL by individual light fixture. As part of the proposed lighting class-cost-of-service study the Company will be evaluating the maintenance expense differential between 5M and 6M service and will use this relationship to allocate the embedded GL maintenance expense to 5M and 6M respectively.

Capital costs are tracked by work orders and construction work accounting to the GL. The local backbone, consisting of post top (depending on if there is one), internal post top wiring, bracket and fixture, is in the GL at actual cost (including capitalized labor) for the year of installation. These are massed accounting records and as such are not individually depreciated or otherwise tracked. Therefore, we price them at current cost and ratio the current cost to the GL record.

14. Does the fact that Ameren was forced to lower all rates except street lighting rates about 10 years ago factor into the proposed study?

AmerenUE response:

No, the study will examine our current revenue requirement and allocate same in an equitable fashion to our respective customer classes.

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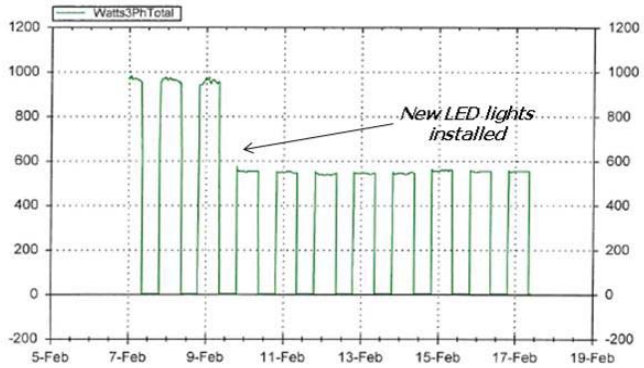
Measuring the photometric performance of the LEDs is a challenge. EPRI has pioneered a unique methodology to quickly, and more importantly, accurately measure the luminance levels of the new lights. EPRI has developed a mobile metering device capable of capturing up to 10,000 different data points. This feature is coupled with functionality to link to software and generate a photometric plot of the test fixture. This type of data is cutting edge for the market space and will allow for large quantities of data to be stored and analyzed.

Figure 7. 24: Street Lighting Comparison

Thus far, the project has yielded measurable energy savings and noticeable light quality differences (as seen above). The energy savings associated with the project are in the graph below. The values represent 3 lights on a single circuit indicating the baseline units are using roughly 300 watts per unit (with ballast). The efficient replacement is using approximately 185 watts per unit, equating to a 40% energy savings on the three metered lights.

Figure 7. 25: LED Street Light Energy Savings



The LED pilot will continue until the fourth quarter of 2011. The data that Ameren Missouri gathers from this program will assist in future decision making processes about

LED LIGHTING:
THE ROADWAY TO THE FUTURE

11.04.10 RURAL ELECTRICITY RESOURCE COUNCIL KYLE SHOFF

AGENDA

- Existing Street Lighting Profile
- Pilot Overview
- Site and Equipment Selection Process
- Installation
- Monitoring Performance
- Future Plans
- Conclusions/Recommendations

AMEREN MISSOURI STREET LIGHTING OVERVIEW

- **Ameren's existing street light scheme**
  - 5M – company owned
  - 6M – customer owned
- **Recently replaced 1,019 Incandescent roadway lights**

Ameren Missouri Street Lighting Stock					
Bulb Type	Wattage	Rate Class			Total
		5M	6M E&M	6M E Only	
Mercury Vapor	100	4,988	7	88	**5,083**
	175	49,932	9,168		**59,100**
	250	808	39	117	**964**
	400	6,457	64	147	**6,668**
	700	11		206	**217**
	1,000	969	22	20	**1,011**
Metal Halide	400	4,543	123		**4,666**
	1,000	973			**973**
High Pressure Sodium	100	55,900	16,411		**72,311**
	175	49,932	9,168		**59,100**
	250	808		209	**1,017**
	400	6,457	64		**6,521**
	700	11		28	**39**
	1,000	969	22		**991**
GRAND TOTAL		**182,758**	**35,088**	**815**	**218,661**

Taken from CSS Query 08/2008

WHY ARE WE DOING THIS?

- **Value to Ameren Missouri**
  - Collect primary data on this cutting edge technology
    - Energy usage
    - Photometric measurements
    - Gauge customer perception
    - Measure Quality of Products
  - Find ways for our customers to potentially save energy
  - Become a national best practice leader in outdoor/area LED lighting
  - Show to our customers we are their **Trusted Energy Advisor**

- **Value to customer**
  - Public Relations opportunities
  - Assess viability of LED technology as a potential means to reduce roadway lighting expense

PROJECT OVERVIEW

- **National Demonstration Project**
  - 9 national sites, 12 LED lights per site (11 at Ameren)
  - Started in Summer of 2009 and will end sometime in Q4 2011
- **Host Site Responsibilities (Customer)**
  - Physically "host" the lights for approximately 2 years (Site Selection)
  - Coordinate metering and photometric measurement times and procedures with Ameren Missouri
  - Potential to help track public perception of LEDs
  - Potential to purchase LEDs after project completion if it is determined they represent good value and acceptable luminance levels
- **Ameren Missouri Responsibilities**
  - Project Management
  - Site Selection
  - Installation and Maintenance of Equipment
    - EPRI provides training on LED installation
  - Metering and Photometric Measurement Data Collection
    - EPRI providing one meter that must be able to interface with communication protocol
  - Decommissioning
    - Take unit out and put original unit back in place (if desired)
  - Customer Service and Public Relations
- **EPRI Responsibilities**
  - Data Collection (interface with Ameren Missouri fieldmen to provide data)
  - EPRI will provide a final report
  - Procure Lights

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SITE SELECTION

- **Reach out to various municipal customers**
- **Determine link between customer desires with corporate goals**
  - What does each party want to get out of the project?
- **Travel to site and look for**
  - Obstructions
  - Extraneous light sources (signage, stop lights, residential dusk till dawn lights, etc.)
  - Special needs for future installation/maintenance/metering
  - Pole Spacing/Arm Height
- **Contracts**

Ameren MISSOURI

MANUFACTURER SELECTION PROCESS

- **EPRI measured baseline lighting characteristics – CRITICAL!**
- **Sent specifications to manufacturers**
  - Average max : min lumen ratios
  - Pole spacing, mounting height, number of lights, type of lights
- **Other considerations**
  - Must be compatible with existing photocells
  - Lights too heavy for existing arms?
- **Scored each bid**
  - Different departments within Ameren (Delivery, Corporate Planning, District representatives, etc.)

EXAMPLE	Efficacy (lm/w)	Delivered Lumens	CRI	Industry Reputation	Matches Existing Lighting Scheme	Total
Weighting	20%	15%	15%	20%	30%	100%
Manufacturer 1	5	4	4	5	4	4.4
Manufacturer 2	4	5	5	5	5	4.8

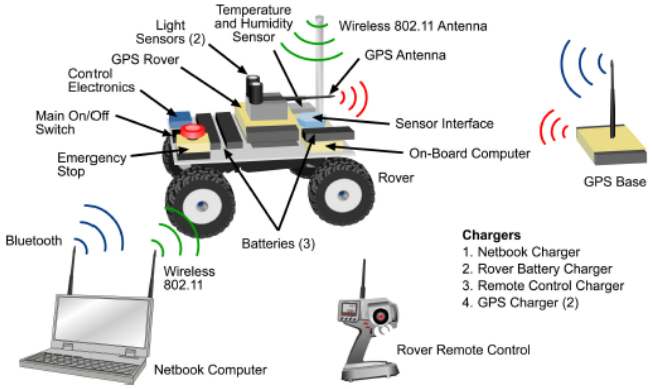
- **Sent out for procurement**

INSTALLATION

- **Coordinate with manufacturer and EPRI on delivery schedule**
- **Work with District Operations to schedule installation**
- **Maintain open lines of communication**
  - LEDs are unique and new for many linemen
- **Install lights**
  - GE = Great
  - Matched existing mounting brackets, photocells
  - Linemen had previous experience with LEDs
  - Installed 11 lights in 1 day

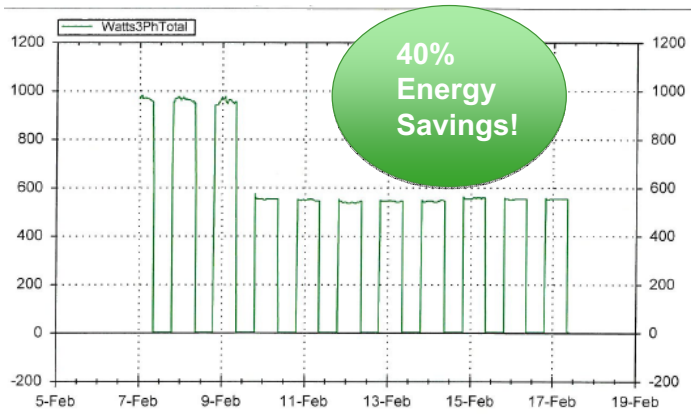
MONITORING PERFORMANCE

- EPRI's Rover System
- Power Meter
- Coordination with Ballwin PD to shut down street



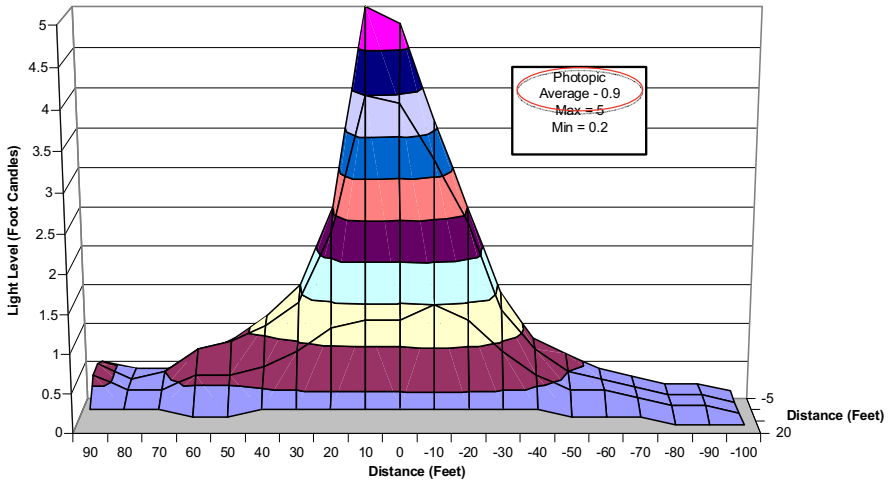
RESULTS

- Noticeable energy savings
- When asked about the new lights, a local resident remarked, "I didn't even know that you changed them."
  - This is the best feedback possible



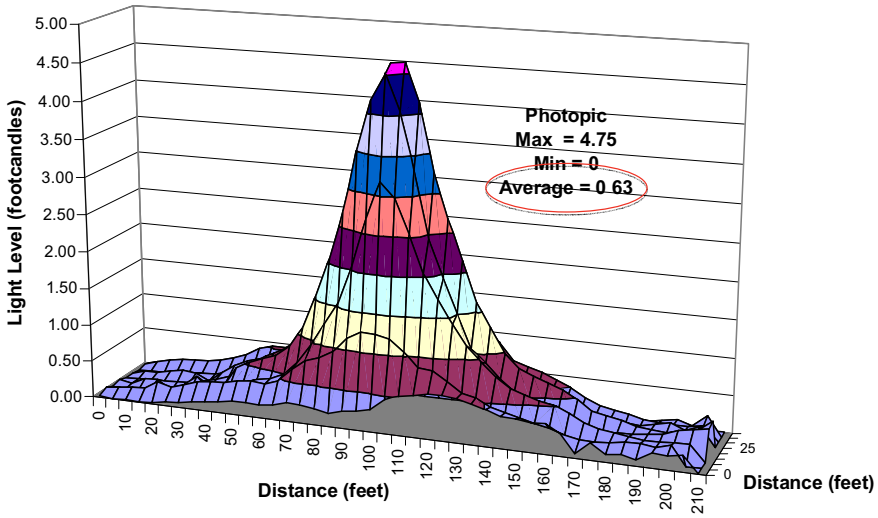
PHOTOMETRIC RESULTS – BASELINE

- **Roadway**
  - **In between intermediate and residential (IESNA 0.9 – 0.6 AVG. FC recommended)**
  - **250 W HPS lights**



PHOTOMETRIC RESULTS – LED

- **LEDs are producing slightly less average foot-candles, but still provide sufficient lumen levels**



CONCLUSIONS

- Energy savings are evident and sustainable
- Lights are fully operational in drastically different weather
- Existing lighting components (photocells, mounting equipment, etc.) interact well with the selected LED technology
- Lots of coordination necessary if conducting a roadway pilot
- More data needed
  - Verify manufacturer's energy savings claims
  - Test LED driver performance (already witnessing failures in some cases)
  - Energy draw as a function of temperature?

Ameren MISSOURI

FUTURE PLANS

- **Use results to evaluate if LEDs are a cost-effective energy efficiency measure**
- **Potential carbon mitigation strategy**
- **Continue to research and investigate LED technologies and monitor market trends**

Ameren MISSOURI

RECOMMENDATIONS

- RESEARCH, RESEARCH, RESEARCH!!!
- Think of all parties involved before you start, make sure they are aware of the commitments
  - Does the street need to be shut down to take measurements?
  - Is the customer willing to have these lights up for an extended period of time?
  - Will there be training involved for the line crew? New mounting equipment needed?
  - Will the lights require a new tariff?
  - What level of support is the manufacturer willing to provide?
- Test equipment BEFORE you get into the field

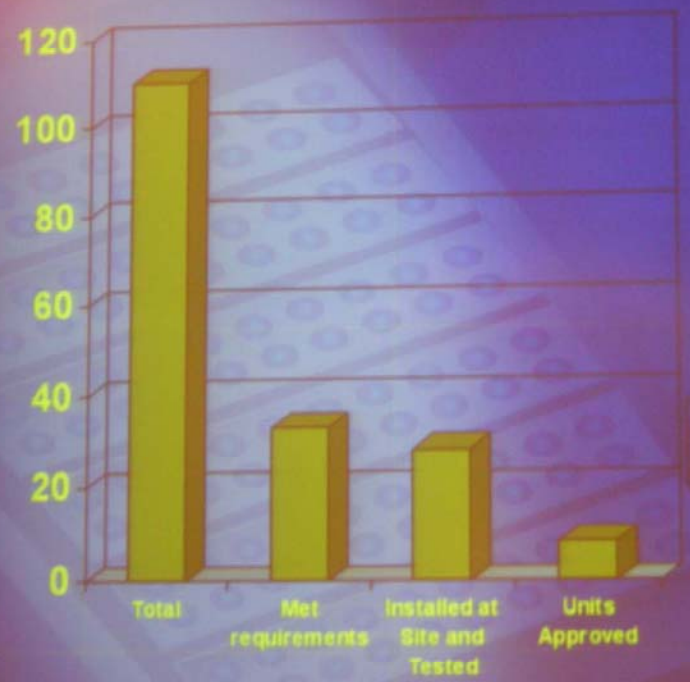
CONTACT INFORMATION

- Kyle Shoff
  - 314-554-4325
  - kshoff@ameren.com

City of LA - LED PROGRAM

- Convert 140,000 streetlights to LED
- Install Remote Monitoring System
- Timeline – 5 years
- 20,000 in first year 30,000 2nd to 5th
- Total Cost - $57 million
- Loan $40 million
- City crews
- Program payback – 7 years
- Launched – February 2009

TESTING AND EVALUATION



- **Testing Phases**
  Process done every six months
- **Specifications**
  Revised based on testing results and technology improvements

TESTING AND EVALUATION

Lighting Evaluation
Illumination, Luminance, Uniformity Ratio, Brightness

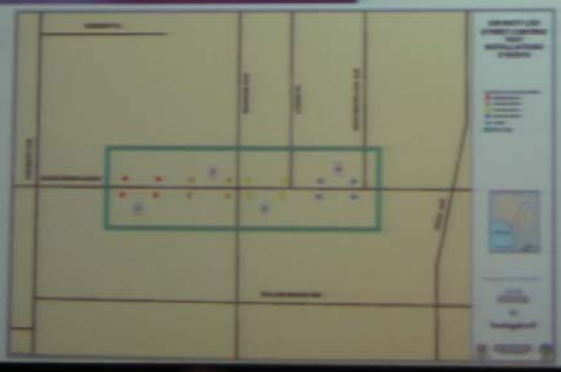
Electrical Evaluation Power consumption, Power Factor, Harmonic Distortion, etc.

Mechanical Evaluation
Disconnects, fixture assembly and ease of installation

Phase I – Local streets

Phase II – Local and Collector streets

Phase III – Local and Major streets

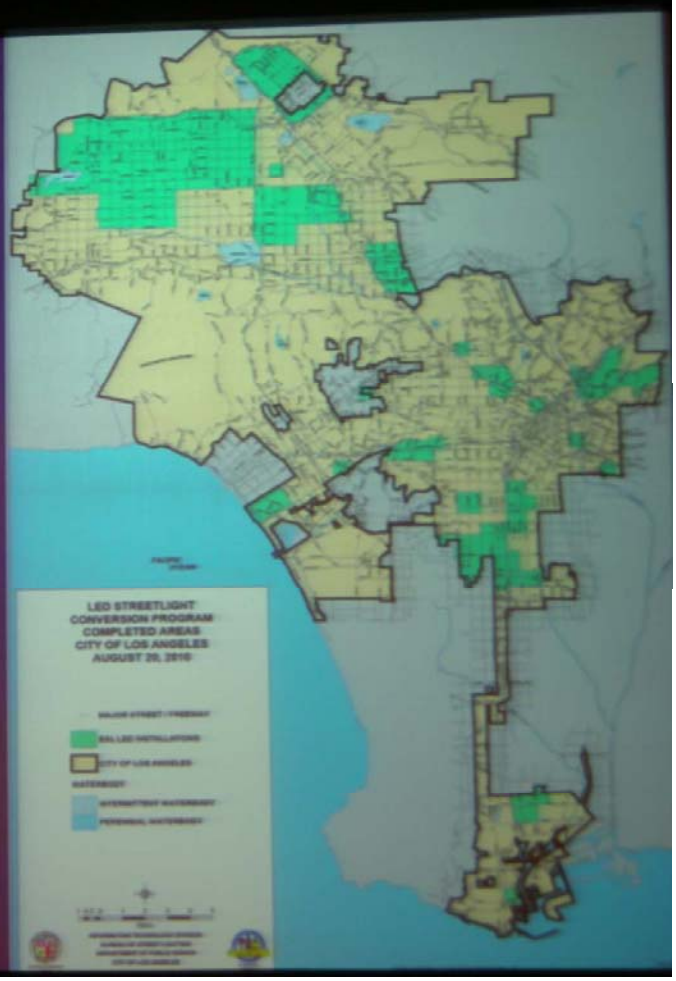


Summary of City of LA Specifications

- 4300° K TEMPERATURE
- Warranty 6 years
- 70% delivery of initial lumens at 50,000 hours
- Minimum of 40% energy savings
- 3-prong twist-lock PE receptacle
- House-side light control
- Size, Weight, Initial Lumens and Efficacy
- Bureau's Webpage: http://bsl.lacity.org/

Current Status of LED Program

- **23,770** fixtures installed up to date
- **2190 KW** TOTAL Energy savings
- Mostly on residential, local streets
- $821,000 Annual Energy Savings



"Lessons Learned"

- **"TRUST BUT VERIFY"** – Not all claims manufacturers make are true.
- **"REALITY VERSUS THEORY"** – The change from HPS to white light with the LEDs is being perceived as a significant increase in lighting levels.
- **"ENERGY SAVINGS ARE REAL"** – As the LEDs improve, and the manufacturers develop the technology, the energy savings are being realized and continue to increase.
- **"IMPROVED VISIBILITY"** – The change from HPS to white light have improved visibility as noticed by residents and encouraged by the Police Department.

"Lessons Learned"

• "HANDLING AND INSTALLATION"

- Smaller/lighter units, easy to install and transport
- No need to carry components in trucks for maintenance
- Reduction in warehousing space - No need for components

• "LED ADVANTAGES"

- Improved uniformity ratios – "Carpeted Effect"
- Allows for smaller wire and conduit sizing
- Circuits with LED/ROAM allow for faster troubleshooting of streetlight outages during the day – savings of 50%.
- Compatible with Remote Monitoring Systems
- Option of dimmable driver

• "PERFORMANCE"

- Use of Type II light distribution on local streets instead of the historically Type III
- House-side shield available
- Improved visibility and reduction of hot-spots
- Ornamental/post-top fixture's LED technology is slower to develop

"Lessons Learned"

	FIRST YEAR PROGRAM GOALS	ACTUAL
TOTAL UNITS INSTALLED	20,000	20,072
ENERGY SAVINGS	40%	55%
PERFORMANCE	Uniformity a Concern	Good Uniformity, better than HPS
COMUNITY FEEDBACKD	Anticipated Negative	Mostly Positive
CREW PERFORMANCE	20 units/day/crew	30 units/day/crew
REMOVED UNITS	Recycle old units	Auction units to generate Revenue

Description	Type	Lumens	Input Watts	EnergyOnly Per kWh	EnergyOnly Per Month	Maintenance Per Month	Poles, Fixtures Per Month	Total Calc. Rate Value	Adjusted Billing Units	Current	Current (calc.) RR	Adjusted Current RR	Increase	New Rate	New RR
5M RATE															
Horizontal - enclosed on existing wood pole	HPS	9500	117	0.126	$ 4.93	1.572	3.470	9.974	11,428	$ 8.59	1,246,134	1,177,954	261,634	10.500	$ 1,439,874
Horizontal - enclosed on existing wood pole	HPS	25500	306	0.126	$ 12.90	1.583	4.261	18.745	12,122	$ 12.41	1,909,750	1,805,261	400,964	15.170	$ 2,206,754
Horizontal - enclosed on existing wood pole	HPS	50000	473	0.126	$ 19.94	1.583	4.250	25.773	2,928	$ 22.12	822,333	777,341	172,654	27.030	$ 949,888
Horizontal - enclosed on existing wood pole	MV	6800	206	0.126	$ 8.68	1.549	3.253	13.486	13,301	$ 8.59	1,450,439	1,371,080	304,529	10.500	$ 1,675,942
Horizontal - enclosed on existing wood pole	MV	20000	477	0.126	$ 20.11	1.557	3.390	25.055	5,259	$ 12.41	828,442	783,115	173,937	15.170	$ 957,281
Horizontal - enclosed on existing wood pole	MV	54000	1095	0.126	$ 46.16	1.680	4.756	52.599	73	$ 22.12	20,439	19,321	4,291	27.030	$ 23,609
Horizontal - enclosed on existing wood pole	MV	108000	2160	0.126	$ 91.06	1.583	3.790	96.432	1	$ 44.26	531	502	112	54.090	$ 614
									-			-			$ -
Open bottom on existing wood pole	HPS	5800	70	0.126	$ 2.95	1.561	2.189	6.700	4	$ 6.95	334	315	70	8.490	$ 385
Open bottom on existing wood pole	HPS	9500	117	0.126	$ 4.93	1.572	2.189	8.693	50,372	$ 7.60	4,859,866	4,593,966	1,020,360	9.290	$ 5,615,519
Open bottom on existing wood pole	MV	3300	118	0.126	$ 4.97	1.786	2.063	8.824	4,116	$ 6.95	363,124	343,256	76,240	8.490	$ 419,315
Open bottom on existing wood pole	MV	6800	206	0.126	$ 8.68	1.549	2.044	12.277	20,346	$ 7.60	1,962,989	1,855,587	412,142	9.290	$ 2,268,211
									-			-			$ -
Post top including 17 foot post	HPS	9500	117	0.126	$ 4.93	1.572	6.228	12.732	36,163	$ 15.91	7,303,836	6,904,218	1,533,488	19.440	$ 8,436,078
Post top including 17 foot post	MV	3300	118	0.126	$ 4.97	1.786	6.783	13.544	220	$ 15.04	42,052	39,751	8,829	18.380	$ 48,579
Post top including 17 foot post	MV	6800	206	0.126	$ 8.68	1.549	6.659	16.892	11,325	$ 15.91	2,287,413	2,162,260	480,257	19.440	$ 2,642,008
									-			-			$ -
Directional	HPS	25500	306	0.126	$ 12.90	1.583	4.261	18.745	3,256	$ 15.75	650,916	615,302	136,664	19.250	$ 752,036
Directional	HPS	50000	473	0.126	$ 19.94	1.583	4.414	25.937	3,553	$ 24.91	1,123,640	1,062,162	235,916	30.440	$ 1,297,961
Directional	MH	34000	450	0.126	$ 18.97	1.893	4.352	25.216	4,530	$ 15.75	905,688	856,135	190,155	19.250	$ 1,046,387
Directional	MH	100000	1077	0.126	$ 45.40	2.198	5.889	53.490	916	$ 49.80	579,074	547,391	121,580	60.860	$ 668,961
Directional	MV	20000	294	0.126	$ 12.39	1.557	4.408	18.358	354	$ 15.75	70,875	66,997	14,881	19.250	$ 81,885
Directional	MV	54000	1095	0.126	$ 46.16	1.680	4.756	52.599	28	$ 24.91	8,968	8,477	1,883	30.440	$ 10,359
									-			-			$ -
Prior to April 9, 1986									-			-			$ -
11,000 Lumens, Mercury Vapor, Post-Top		11000	286	0.126	$ 12.06	1.562	6.659	20.278	9	$ 15.91	1,718	1,624	361	19.440	$ 1,985
11,000 Lumens, Mercury Vapor, Open Bottom		11000	286	0.126	$ 12.06	1.562	2.062	15.681	257	$ 7.60	24,806	23,449	5,208	9.290	$ 28,664
11,000 Lumens, Mercury Vapor, Horizontal Enclosed		11000	286	0.126	$ 12.06	1.562	3.911	17.530	534	$ 8.59	58,240	55,054	12,228	10.500	$ 67,295
42,000 Lumens, Mercury Vapor, Horizontal Enclosed		42000	700						-	$ 22.12	-	-	-	27.075	$ -
5,800 Lumens, H.P. Sodium, Open Bottom		5800	70						-	$ 6.95	-	-	-	8.507	$ -
16,000 Lumens, H.P. Sodium, Horizontal Enclosed		16000	202						-	$ 8.59	-	-	-	10.514	$ -
34,200 Lumens, H.P. Sodium, Direc ional (2)		34200	360	0.126	$ 15.18	1.583	3.773	20.533	8	$ 15.75	1,512	1,429	317	19.250	$ 1,747
140,000 Lumens, H.P. Sodium, Directional		140000	1000	0.126	$ 42.16	1.772	5.889	49.818	23	$ 49.80	14,342	13,558	3,011	60.860	$ 16,569
20,000 Lumens, Metal Halide, Directional		20000	294						-	$ 15.75	-	-	-	19.278	$ -
									-			-			$ -
2500 INC Wood			202	0.126	$ 8.52	2.528	-	11.044	1	$ 11.11	133	126	28	13.580	$ 154
6000 INC Wood			448	0.126	$ 18.89	2.626	-	21.512	4	$ 14.23	683	646	143	17.390	$ 789
									0.945286636		$ 26,538,276	$ 25,086,278	$ 5,571,884		$ 30,658,847
Prior to September 27, 1988															
Wood pole								-	$ 7.68	$ 1,437,327		$ 1,358,686			
Ornamental Concrete Pole								-	$ 17.21	$ 783,330		$ 740,472			
Steel Breakaway Pole								-	$ 51.77	$ 182,645		$ 172,651			
Standard Two-Conductor Overhead Cable								-	$ 2.38	$ 324,099		$ 306,366			
Underground Cable Installed In and Under Dirt									$ 0.0706	$ 199,397		$ 188,488			
All Other Underground cable Installations									$ 0.1345	$ 19,988		$ 18,894			
SPEC. Facilities CHG										$ 68,341		$ 64,601			
										$ 3,015,127		$ 2,850,159			
6M RATE										$ 29,553,404		$ 27,936,437			
Description	**Type**	**Lumens**												**Rate**	
Metered service (cust charge per meter)				1.968	$ 1.97	-	-	1.968	1333	$ 5.17	87,502	82,715	11,755	$ 6.20	$ 99,194
Energy charge (per kWh)				0.126	$ 0.13	-	-	0.126	5,122,735	$ 0.0349	2,269,577	2,145,401	304,904	$ 0.04190	$ 2,575,711
									-		-	-	-		
Customer charge per account									756	$ 5.17	49,632	46,916	6,668	$ 6.20	$ 56,263
											-	-	-		
Energy & Maintenance	HPS	9500	117	0.126	$ 4.93	0.561	-	5.493	9706	$ 2.78	342,540	323,799	46,018	$ 3.33	$ 387,860
Energy & Maintenance	HPS	25500	306	0.126	$ 12.90	0.572	-	13.472	648	$ 4.84	39,785	37,608	5,345	$ 5.81	$ 45,145
Energy & Maintenance	HPS	50000	473	0.126	$ 19.94	0.572	-	20.512	50	$ 6.98	4,439	4,196	596	$ 8.38	$ 5,038
Energy & Maintenance	MH	5500	122	0.126	$ 5.14	1.046	-	6.189	4	$ 4.02	193	182	26	$ 4.82	$ 219
Energy & Maintenance	MH	12900	206	0.126	$ 8.68	1.247	-	9.932	37	$ 4.81	2,251	2,128	302	$ 5.77	$ 2,553
Energy & Maintenance	MV	3300	118	0.126	$ 4.97	0.849	-	5.824	1	$ 2.78	33	32	4	$ 3.34	$ 38
Energy & Maintenance	MV	6800	206	0.126	$ 8.68	0.537	-	9.222	8,652	$ 3.62	397,606	375,852	53,416	$ 4.33	$ 449,569

Energy & Maintenance	MV	11000	286						-	$	4.89	-	-	-	$	5.87	$	-
Energy & Maintenance	MV	20000	477	0.126	$	20.11	0.545	-	20.654	112	$	6.49	9,190	8,687	1,235	$	7.79	$	10,427
Energy & Maintenance	MV	54000	1095	0.126	$	46.16	0.521	-	46.683	20	$	13.86	3,493	3,302	469	$	16.63	$	3,961
										-			-	-	-				
Energy Only	HPS	9500	117	0.126	$	4.93	-	-	4.932	150	$	1.35	2,576	2,435	346	$	1.62	$	2,922
Energy Only	HPS	16000	202	0.126	$	8.52	-	-	8.516	4	$	2.29	110	104	15	$	2.75	$	125
Energy Only	HPS	25500	306	0.126	$	12.90	-	-	12.900	208	$	3.45	9,108	8,610	1,224	$	4.14	$	10,332
Energy Only	HPS	50000	473	0.126	$	19.94	-	-	19.940	26	$	5.41	1,818	1,718	244	$	6.49	$	2,061
Energy Only	MV	3300	118	0.126	$	4.97	-	-	4.975	81	$	1.43	1,476	1,395	198	$	1.72	$	1,678
Energy Only	MV	6800	206	0.126	$	8.68	-	-	8.684	202	$	2.32	5,958	5,632	800	$	2.78	$	6,748
Energy Only	MV	11000	286							-	$	3.30	-	-	-	$	3.96	$	-
Energy Only	MV	20000	477	0.126	$	20.11	-	-	20.109	139	$	5.10	8,996	8,504	1,209	$	6.12	$	10,205
Energy Only	MV	42000	700							-	$	8.49	-	-	-	$	10.19		
Energy Only	MV	54000	1095	0.126	$	46.16	-	-	46.162	20	$	12.13	3,057	2,890	411	$	14.56	$	3,468

Type	Lumens	
INC	1000	103
INC	2500	202
INC	4000	327
INC	6000	448
INC	10000	670

INC	1000	103
INC	2500	202
INC	4000	327
INC	6000	448
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Total 5M & 7M