

# Bright Tomorrow Lighting Competition (L Prize™)



08NT006643

**June 26, 2009**

Revision 1

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## REVISION HISTORY

### Revision 1 – Release Date June 26, 2009

#### Revision 1.1: Revision to Eligibility Requirements

As a result of industry/stakeholder feedback, current state-of-the-art of SSL technology, and lessons-learned through practice of SSL products, the eligibility requirements for the competition have been revised. The change reflects current approaches available on the market and allows for greater participation in the L Prize competition. Related changes can be found in Section III – Eligibility Requirements and are as follows:

In addition to meeting technical performance specifications discussed in Section IV, qualified entrants must meet one of the requirements from Section A and the requirement of Section B:

A1) A majority ( $\geq 75\%$  by count) of the LED die or chip, defined as the solid-state semiconductor material that converts electrical energy directly into light, must be manufactured in the United States.

or

A2) The LED must be packaged in the United States. Packaged LED (also known as an LED device) refers to an assembly of one or more LED dies possibly including the mounting substrate, encapsulant, phosphor if applicable, electrical connections, and optical components along with thermal and mechanical interfaces.

or

A3) A majority ( $\geq 75\%$  by subsystem and assembly cost) of the final product assembly/integration must be carried out within the United States. This includes all of the applicable: final assembly of the LED die or chip, packaged LED, optics, heat sink or cooling components, and driver and electronics.

and

B) In the case of a private entity, the entity shall be incorporated in and maintain a primary place of business in the United States; and in the case of an individual, (whether participating as a single individual or in a group), the individual shall be a citizen or a lawful permanent resident of the United States.

Related to this revision, the following dependent sections have been modified:

- Section V.A – Technical Review Committee
- Section V.B.6 – Commercial Manufacturing Plan
- Section V.E.5 – Evaluation of Commercial Manufacturing Plan
- Attachment 1 – Data Release/ Certification of Eligibility Form

#### Revision 1.2: Revision to the Correlated Color Temperature

In order to maintain the competition's intent for high quality light, the Correlated Color Temperature (CCT) specification has been complimented with a specification for chromaticity which limits the

allowed distance from the black body curve. The revision is relative to both the 60-Watt Incandescent and PAR 38 product categories. The revision can be found in Section IV – Technical Performance Specifications and is summarized below:

On the CIE 1976 (u', v') chromaticity diagram, the target distance from the Planckian locus (Duv) is 0.000 with a tolerance of  $\pm 0.004$ . For complete definition of Duv, please see ANSI\_NEMA\_ANSLG C78.377-2008.

**Revision 1.3: Revision to the PAR 38 Minimum Center Beam Candle Power (CBCP)**

Based on additional analysis of baseline technologies and benchmark testing through the DOE CALiPER testing program, the minimum Center Beam Candle Power specification has been revised for the PAR 38 lamp category. The revision more accurately reflects those products which the L Prize is intended to replace. The revision can be found in Section IV – Technical Performance Specifications:

Products shall consist of the following:

Beam angle	Minimum CBCP (candela)
10°	13245
15°	8284
20°	5414
25°	3697
30°	2638
40°	1533

## **I. INTRODUCTION**

The Bright Tomorrow Lighting Competition (L Prize™), as authorized in the Energy Independence and Security Act of 2007 (EISA); Subtitle E; Section 655, is intended to encourage development and deployment of highly energy efficient solid-state lighting (SSL) products to replace several of the most common lighting products currently used in the United States, including 60-watt A19 incandescent and PAR 38 halogen incandescent lamps. To significantly impact the national market and lighting use, the SSL products selected must perform similarly to the incandescent lamps they are intended to replace in terms of color appearance, light output, light distribution, and lamp shape, size, form factor, appearance and operating environment. They must be reliable, available through normal market channels, and competitively priced.

## **II. THE PRIZES**

### **A. Cash Prize**

EISA authorizes cash prizes for the first successful entrant in each prize category. Cash prizes will be based on the availability of funding from future appropriations and private funding contributions as authorized by the EISA. Funding for the cash prizes is not available during fiscal year 2008; however, due to the required duration of the evaluation process, the DOE does not anticipate declaring successful entrants prior to fiscal year 2009. Consequently, and subject to the availability of appropriated funds, as provided for in section 655 (g)(1) and 655(g)(2) of the EISA, prize amounts are anticipated to be up to the statutory maximums of \$10 million for the 60 watt incandescent replacement lamp and \$5 million for the PAR 38 halogen incandescent replacement lamp.

Nothing contained herein shall be construed to obligate the DOE to any expenditure or obligation of funds in excess or in advance of appropriations in violation of the Anti-Deficiency Act, 31 U.S.C. Section 1341.

### **B. Federal Procurement**

In addition to cash prizes, the L Prize authorization provides that the Secretary of Energy is to consult with the Administrator of General Services to develop federal purchase guidelines with the goal of conducting a Federal procurement of SSL products from the winner under the 60-watt incandescent and PAR 38 halogen categories.

### **C. Energy Efficiency Program Promotion**

In partnership with Energy Efficiency Programs (EEPs), multiple qualifiers from each prize category may be selected to participate in promotion, product incentives, and other supports for market development. As such, it is anticipated that entry information may be made available to participating EEPs under a confidentiality/non-disclosure agreement. Resulting energy efficiency programs may be administered by electric utilities, state agencies, regional authorities, and other public purpose organizations. Actual programs are offered at the discretion of individual EEPs.

Complete text of the Memorandum of Understanding between the DOE and the EEP partners, up-to-date information on participating partners, and available programs can be found at [www.lightingprize.org](http://www.lightingprize.org).

## **D. Energy Star Designation**

All products designated as winners in the competition will automatically earn the right to carry the ENERGY STAR SSL label. Continuing participation in the ENERGY STAR SSL program is voluntary and will be subject to the following:

- Manufacturers must sign and abide by the ENERGY STAR SSL partner agreement.
- Qualified products are subject to ENERGY STAR SSL product quality assurance thereafter.

## **III. ELIGIBILITY REQUIREMENTS**

In addition to meeting technical performance specifications discussed in Section IV, qualified entrants must meet one of the requirements from Section A and the requirement of Section B:

A1) A majority ( $\geq 75\%$  by count) of the LED die or chip, defined as the solid-state semiconductor material that converts electrical energy directly into light, must be manufactured in the United States.

or

A2) The LED must be packaged in the United States. Packaged LED (also known as an LED device) refers to an assembly of one or more LED dies possibly including the mounting substrate, encapsulant, phosphor if applicable, electrical connections, and optical components along with thermal and mechanical interfaces.

or

A3) A majority ( $\geq 75\%$  by subsystem and assembly cost) of the final product assembly/integration must be done within the United States. This includes all of the applicable: final assembly of the LED die or chip, packaged LED, optics, heat sink or cooling components, and driver and electronics.

and

B) In the case of a private entity, the entity shall be incorporated in and maintain a primary place of business in the United States; and in the case of an individual, (whether participating as a single individual or in a group), the individual shall be a citizen or a lawful permanent resident of the United States.

## **IV. TECHNICAL PERFORMANCE SPECIFICATIONS**

This section addresses technical performance specifications for the two categories of SSL-based lighting products, as listed below. These product categories are for integrated SSL lamps, intended to replace the most common incandescent general service and halogen reflector lamps in the consumer market. These products will allow direct replacement of incandescent and reflector lamps in existing lighting fixtures with medium screw-in (Edison) sockets. As such, winning products must be similar to the products targeted for replacement, in terms of size, shape, operating environment, and light quantity, distribution, and quality. The performance criteria detailed below seek to ensure that winning products will meet consumer and user expectations for products of the types specified. Two product categories are offered in this release:

- 60-Watt Incandescent Replacement Lamp
- PAR 38 Halogen Replacement Lamp

The third product category authorized by EISA, 21st Century Lamp, calls for products that will exceed 150 lumens per watt, among other performance criteria. The DOE anticipates release of this third category at a future time.

The following sections detail full specification requirements that must be met in order to win the cash prize and the Federal purchase options. These same specification requirements will be used to qualify for the voluntary ENERGY STAR SSL labeling and available promotion programs from the EEPs. Detailed requirements are based upon the statutory requirements of the EISA and compliance with existing lighting industry reference standards and test procedures, as well as new or revised standards and test procedures currently being developed by the DOE, lighting industry organizations, and other organizations. All technical performance specifications will be individually evaluated on a pass/fail basis.

The following general requirements apply to both product categories. Additional requirements specific to each category are listed by category below.

### All Products

<b>Product Requirements:</b>	
Color Spatial Uniformity	The variation of chromaticity in different directions (i.e., with a change in viewing angle) shall be within 0.004 from the weighted average point on the CIE 1976 (u',v') diagram.
Color Maintenance	The change of color over the lifetime of the product shall be within 0.007 on the CIE 1976 (u',v') diagram.
Color Rendering Index (CRI)	Products shall have a Color Rendering Index (CRI) greater than or equal to 90.
Off-state Power	Products shall not draw power in the off state.  <b>Exception:</b> Luminaires with integral occupancy, motion, photo-controls or individually addressable fixtures with external control and intelligence are exempt from this requirement. The power draw for such luminaires shall not exceed 0.5 watts when in the off state.
Thermal Management	Product manufacturers shall adhere to LED device manufacturer guidelines, certification programs, and test procedures for thermal management.
Dimming	Products shall meet the following requirements: - Must be compatible with at least three (3) widely available residential dimmers. - Must be continuously dimmable to at least 20% of maximum light output without visible flickering.
Incompatibility with Controls and Application Exceptions	Included documentation must clearly state any known incompatibility with photo-controls, dimmers or timing devices.
Starting Time	Light source shall illuminate within 0.5 seconds after power is applied.

<b>Power Supply Requirements</b>	
Operating Voltage	Power supplies for the 60W incandescent replacement and PAR 38 products shall be capable of operation on 120 Volts alternating current circuits.
Power Factor	Power supply shall have the following power factors: Residential $\geq 0.70$ Commercial $\geq 0.90$
Minimum Operating Temperature	Power Supply shall have a minimum operating temperature of $-20^{\circ}\text{C}$ or below when used in luminaires intended for outdoor applications.
Output Operating Frequency	$\geq 120\text{ Hz}$  <b>Note:</b> This performance characteristic addresses problems with visible flicker due to low frequency operation and applies to steady-state as well as dimmed operation. Products shall meet the requirements at all light output levels when operated with compatible dimmers.
Electromagnetic and Radio Frequency Interference	<ul style="list-style-type: none"> <li>Power supply designated by the manufacturer for residential applications shall meet FCC requirements for consumer use (FCC 47 CFR Part 15/18 Consumer Emission Limits).</li> <li>Power supply designated by the manufacturer for commercial applications shall meet FCC requirements for non-consumer use (FCC 47 CFR Part 15/18 Non- consumer Emission Limits).</li> </ul>
Noise	Power supply shall have a Class A sound rating.
Transient Protection	Power supply shall comply with IEEE C.62.41-1991, Class A operation. The line transient shall consist of seven strikes of a 100 kHz ring wave, 2.5 kV level, for both common mode and differential mode.
Safety Ratings	Power supply shall meet applicable safety ratings for self-ballasted lamps, lamp adapters, portable fixtures, and hardwired fixtures.

### **Product Category Requirements**

The following section details technical requirements which are specific to the respective product categories.

#### **60-Watt Incandescent Replacement**

<b>Product Requirements</b>	
Light Output	Products shall deliver a luminous flux greater than 900 lumens (initial).
Wattage	Products shall consume less than or equal to 10 watts.
Luminous Efficacy	Products shall have an efficacy greater than 90 lumens per watt.
Luminous Intensity Distribution	Products shall have an even distribution of luminous intensity within the $0^{\circ}$ to $150^{\circ}$ zone (axially symmetrical). Luminous intensity at any angle within this zone shall not differ from the mean luminous intensity for the entire $0^{\circ}$ to $150^{\circ}$ zone by more than 10%.
Correlated Color Temperatures (CCTs)	Products shall have correlated color temperatures of not less than 2700 K ( $2725 \pm 80$ ) and not more than 3000 K ( $3045 \pm 100$ ). On the CIE 1976 ( $u'$ , $v'$ ) chromaticity diagram, the target distance from the Planckian locus (Duv) is 0.000 with a tolerance of $\pm 0.004$ . For complete definition of Duv, please see ANSI_NEMA_ANSLG C78.377-2008.
Dimensions	Product size and shape shall fit within the maximum dimensions and form factor of an A19 bulb in accordance with ANSI C78.20-2003, figure C78.20-211.
Base Type	Products shall consist of a single contact medium screw base E26/24.



Product Lifetime - Lumen Maintenance	Products shall have a lifetime exceeding 25,000 hours defined as $L_{70}/C_{95}/B_{10}$ , where: <ul style="list-style-type: none"> <li>- <math>L_{70}</math> refers to 70% lumen maintenance</li> <li>- <math>C_{95}</math> refers to 95% statistical confidence</li> <li>- <math>B_{10}</math> refers to no more than 10% of the products dropping below 70% of their initial (defined as the maximum) lumen value after 25,000 hours.</li> </ul>
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### PAR 38 Halogen Replacement

Product Requirements															
Light Output	Product shall deliver a luminous flux greater than 1,350 lumens (initial).														
Wattage	Products shall consume less than or equal to 11 watts.														
Luminous Efficacy	Products shall have an efficacy greater than 123 lumens per watt.														
Luminous Intensity Distribution	Products shall provide an even distribution of light without irregular spikes and be axially symmetrical. The ratio of maximum to minimum luminous intensity in any 10° section of the intended beam angle shall not exceed 2:1.														
Allowable Beam Angles (2 times the angle from nadir at which luminous intensity is 50% of maximum)	Products shall consist of following: Spot: 10° to 20° Flood: 25° to 40°														
Minimum Center Beam Candle Power (CBCP)	Products shall consist of the following: <table border="1" style="margin-left: 40px;"> <thead> <tr> <th>Beam angle</th> <th>Minimum CBCP (candela)</th> </tr> </thead> <tbody> <tr> <td>10°</td> <td>13245</td> </tr> <tr> <td>15°</td> <td>8284</td> </tr> <tr> <td>20°</td> <td>5414</td> </tr> <tr> <td>25°</td> <td>3697</td> </tr> <tr> <td>30°</td> <td>2638</td> </tr> <tr> <td>40°</td> <td>1533</td> </tr> </tbody> </table>	Beam angle	Minimum CBCP (candela)	10°	13245	15°	8284	20°	5414	25°	3697	30°	2638	40°	1533
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Dimensions	Size and shape shall fit within the maximum dimensions and form factor of a PAR 38 lamp in accordance with ANSI C78.21-2003, figure C78.21-238.														
Base Type	Products shall consist of a single contact medium screw base E26/24.														
Product Lifetime - Lumen Maintenance	Products shall have a lifetime exceeding 25,000 hours defined as $L_{70}/C_{95}/B_{10}$ , where: <ul style="list-style-type: none"> <li>- <math>L_{70}</math> refers to 70% lumen maintenance</li> <li>- <math>C_{95}</math> refers to 95% statistical confidence</li> <li>- <math>B_{10}</math> refers to no more than 10% of the products dropping below 70% of their initial (defined as the maximum) lumen value after 25,000 hours.</li> </ul>														

## V. EVALUATION OF APPLICATIONS

### A. Technical Review Committee

EISA requires DOE to establish a Technical Review Committee (TRC) composed of non-Federal officers to review entries submitted under this competition to determine on a pass/fail basis whether product performance data successfully meets the prize specifications detailed in this document. The TRC will review all eligibility qualifications and technical performance

specifications for submitted products. In addition, the TRC will evaluate the ability of the entrant to manufacture its product in large scale production quantities, as well as, its ability to rapidly move quantities of products to market. It is anticipated that the TRC may be composed of individuals who collectively are knowledgeable of lighting sciences, SSL technologies, lighting manufacturing processes, and corporate business and marketing strategies.

## **B. Submission Requirements**

Entrants are limited to one product per entry. Entrants wishing to submit products for both categories must do so in separate entries. In order to be considered a complete package, the following must be included with each entry:

- 1) Notification of Intent to Submit. Entrants must provide to the DOE a notification of their intent to submit a product for each product category. The notification must be submitted to the DOE a minimum of 30 days prior to full product submission. Notification must be sent electronically to [SSL@netl.doe.gov](mailto:SSL@netl.doe.gov). At a minimum, the notification must include the following information:
  - Names and full contact information of the proposing organization and team partners including suppliers of all major components
  - Product entry category
  - Anticipated performance characteristics of the replacement lamp product, including light output, wattage, luminous efficacy, color rendering index, correlated color temperature, and lifetime
  - Certification that the entrant has accessed the L Prize website to download the most recent competition document and reference the date of that document (found on the front cover)
  - Anticipated submission date

The intent of the notification is to allow the DOE sufficient preparation time for the acceptance of product entries. Following the 30-day notification, the entrant may continue with the remaining entry processes detailed below.

- 2) Data Release Form. In conducting the evaluation of product entries, the DOE may obtain and share performance data from various testing laboratories involved in performance testing and other organizations involved in product field assessments. The DOE will seek the advice of the TRC which will be composed of qualified non-Federal personnel. The DOE may also make performance and marketing data available to the EEP partners. Entrants must complete the Data Release section of Attachment 1, stating their agreement to share data with these parties.

All non-Federal parties requiring product information for the purposes of this competition must sign conflict of interest and non-disclosure agreements prior to receiving entry information. Entrants must clearly mark all data in their entry package considered to be patentable, trade secret, proprietary or sensitive information.

- 3) Certification of Eligibility. The entrant must provide a certification that the eligibility requirements detailed in Section III – Eligibility Requirements are fully met. Entrants must do so by completing the Eligibility Certification section of Attachment 1.

- 4) Two thousand (2,000) commercially acceptable quality control units which meet the full criteria specified in Section IV – Technical Performance Specifications for the respective entry category. Units must be packaged to ensure safe and intact arrival at the designated address identified in Section C – How to Submit Entries. The DOE assumes no responsibility for delivery or condition of units at receipt.
  
- 5) A technical product specification factsheet which, at a minimum, clearly details the following information, as determined by the entrant:
  - Product category, which must be one of the following:
    - 60-watt incandescent replacement lamp
    - PAR 38 halogen replacement lamp
  - Potential restrictions with regard to totally-enclosed fixtures, insulation contact, air-tight (ICAT) recessed fixtures, damp location fixtures, wet location fixtures, and incompatibilities with controls, etc.
  - Wattage and operating voltage
  - Correlated Color Temperature (CCT)
  - Color Rendering Index (CRI)
  - Color Spatial Uniformity
  - Estimated color variation over lifetime
  - Power factor
  - Photometric test reports based on LM-79 test procedure
  - Test data demonstrating useful lifetimes exceeding 25,000 hours defined as  $L_{70}/C_{95}/B_{10}$ , where:
    - $L_{70}$  refers to 70% lumen maintenance
    - $C_{95}$  refers to 95% statistical confidence
    - $B_{10}$  refers to no more than 10% of the products dropping below 70% of their initial (defined as the maximum) lumen value after 25,000 hours.
  - Dimming properties as follows:
    - Estimated minimum dimming level, as a percentage of maximum light output
    - Model numbers of at least three (3) widely-available, residential, wall-mounted dimmers with which product will dim continuously to at least 20% of highest light output without visible flicker.
  
- 6) A Commercial Manufacturing Plan which details the plan for mass production and distribution for a competitive commercial market. Entrants must provide evidence that they are fully prepared to begin production at a capacity which exceeds 250,000 units per year for the first year of production and increased production in subsequent years. The units shall meet all technical performance specifications called out in Section IV – Technical Performance Specifications of this document. The discussion of the Commercial Manufacturing Plan must, at a minimum, include the following information:
  - Detailed and quantifiable evidence to verify eligibility as specified in Section III – Eligibility Requirements.
  - A full description of production capacity for the proposed product, including owned manufacturing and/or contracted manufacturing facilities. Written evidence of the entrant's capability to direct that capacity to the purposes of this product must be provided, including any letters of commitment or contact agreements.
  - A detailed description of how the product will be brought to market, including target market description, product price information, value proposition, expected sales and

distribution channels. Written evidence of the entrant's capability to direct that capacity to the purposes of this project must be provided.

- Identification of corporate officers and management team responsible for the proposed product.

As examples, target retail prices for the two L Prize replacement lamp categories are provided below. These are target retail prices to the consumer or end-user, after potential utility or retailer incentives are applied. These target retail prices are based on typical hours of use in residential applications, typical current electricity prices, and reasonable diminishing simple payback periods from energy savings.

Target Consumer Retail Prices After Incentives			
Product	Year 1	Year 2	Year 3
60-watt incandescent replacement	\$22	\$15	\$8
PAR 38 halogen replacement	\$30	\$22	\$14

Cost-effectiveness is influenced by additional considerations including avoided lamp replacement costs, avoided maintenance costs, time value of money, actual electric rates, local market conditions, and other factors. The target prices above are provided as a rough guide only. Manufacturers are strongly encouraged to offer products at prices that will prove cost effective and attractive to buyers, and therefore more successful in the market.

### C. How to Submit Entries

A complete entry package that includes all items listed in Section B - Submission Requirements, must be delivered to the following location/address where they will be time stamped and dated upon receipt:

Entrants must complete and sign Attachment 1 – Data Release/Certification of Eligibility. Electronic copies of the completed Data Release/Certification of Eligibility Form, Technical Product Specification Factsheet, and Commercial Manufacturing Plan, must be submitted to [SSL@netl.doe.gov](mailto:SSL@netl.doe.gov).

For product units, submit to:

National Energy Technology Laboratory  
Solid-State Lighting L Prize Competition  
3610 Collins Ferry Road  
Morgantown, WV, 26505

If your chosen method of delivery requires phone verification, the number (304) 285-4453 may be used. However, please do not direct technical questions to this number.

After a preliminary review by the DOE, the DOE reserves the right to request additional or missing information. The entrant's response will be time stamped and dated prior to initializing the performance testing phase.

The DOE will accept entries to the 60-watt incandescent and PAR 38 product categories beginning May 28, 2008. The full competition for each category will remain open until one winner and, for the purposes of the voluntary EEP promotions, two additional qualifiers are declared in each category, or until 24 months have elapsed since the winning award in a given

category, whichever comes first. In each category and subject to other guidelines of this document, all prizes will be awarded to the winner, which will be the first entrant to successfully meet the full competition requirements. Up to two additional qualifiers may be determined to have met or exceeded the L Prize criteria; however they will not be named a winner nor receive a cash prize.

#### **D. Timestamp**

Entries will be time stamped and dated when a complete entry package is received, including requests for additional or missing information. All requirements listed in Section B - Submission Requirements must be fully satisfied to be considered complete.

#### **E. Evaluation Process**

Entry evaluation will be a multi-step process designed to balance the need to move quickly in identifying and selecting winning products and the need to ensure performance and reliability of winning products. Significant and important information about entries can be gained in a relatively short time frame through photometric, electrical, and thermal testing. Information about longer term performance will be acquired through simultaneous field assessment, laboratory lifetime testing, and limited stress testing to determine failure modes. Entries will not be stamped as received or proceed to any part of the evaluation process until a complete entry package, as defined in Section B – Submission Requirements, has been received. The following will be conducted as part of the evaluation process:

##### **1) Laboratory Performance Testing**

To the extent possible, laboratory performance testing will be conducted by independent testing laboratories, such as those participating in the DOE CALiPER test program. Photometric and electrical testing will use the IESNA LM-79-2008 test procedure. The following data will be measured or calculated:

- luminous flux
- luminous intensity distribution
- CCT/chromaticity coordinates
- CRI
- power factor
- wattage in ON and OFF states
- spectral power distribution

In addition, the following measurements will be made:

- Thermal imaging
- Verification of output operating frequency at full power and throughout dimming range
- Verification of dimming performance

It is anticipated that the DOE will announce in a press release the first product to successfully complete the short term testing for each category.

## 2) Field Assessment

Field assessments will be conducted to determine field-of-use suitability as a replacement lamp for each category. Example field assessments may include:

- Installation in host customer facilities, such as homes, commercial spaces, or outdoor locations.
- Installation in utility technology demonstration facilities.
- Focus group testing with retailers, builders, and/or consumers.

The objectives of the field assessments are:

- Evaluate energy use of the products when installed in-situ as compared to the existing technology(ies) and generate reproducible energy and demand savings data.
- Characterize the lighting system performance of the products installed in-situ as compared to the existing technology(ies).
- Assess reliability of the products during the test period.
- Identify any operational or performance problems not revealed in laboratory testing.
- Assess customer acceptance of the products.
- Assess criteria for cost-effective deployment of the product through a utility energy efficiency program.

## 3) Product Lifetime-Lumen Maintenance Testing

It is anticipated that lumen and color maintenance testing will be conducted on a sample of 200 lamps, oriented base up in a 45°C environment, randomly drawn from a population of at least 2,000 lamps. Using a non-parametric methodology for establishing confidence intervals, the lower 95%/10% ( $C_{95}/B_{10}$ ) tolerance limit is the 13<sup>th</sup> worst performing product, when results are ranked in order of lumen maintenance performance, from lowest to highest.  $L_{70}$  is estimated using a best fit exponential decay function extrapolation, based on data collected from the point in time at which the product reaches its maximum flux ( $t_{max}$ ) to a point in time 5,000 hours later ( $t_{max} + 5000$ ).

Compliance with the 25,000 hour color maintenance requirement will be tested in a similar manner. When rank ordered from most color shift to least, the 13<sup>th</sup> worst performing product must not exhibit color shift of more than .004 ( $u',v'$ ) over the time from  $t_{max}$  to  $t_{max} + 5000$ .

## 4) Stress Testing

Stress testing will be conducted to identify potential failure modes. Tests may include but are not limited to the following:

- High ambient temperature
- Voltage and current fluctuation
- High humidity environment
- Frequent switching
- Electro-magnetic interference

## 5) Commercial Manufacturing Plan for Mass Production and Distribution

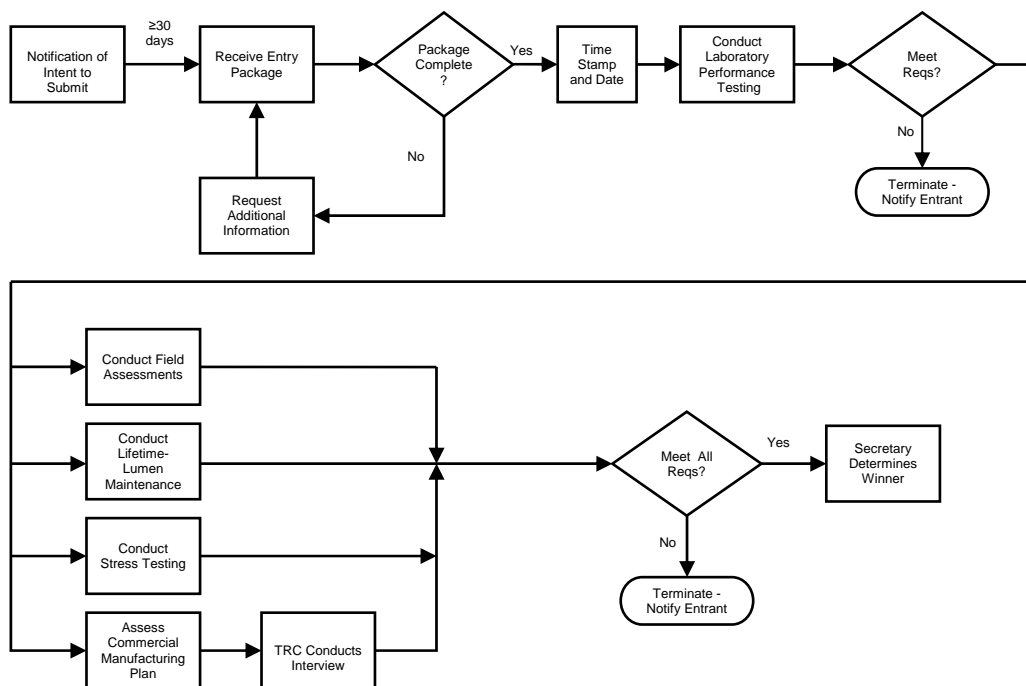
The intent of the L Prize is for products to be available on a mass production basis in a competitive commercial market of quality control lots. The entrants' capabilities to rapidly produce and bring to market large quantities of lighting products meeting the L Prize technical specifications will be evaluated by the TRC. Entrants must provide evidence that they are fully prepared to begin production at a capacity which exceeds 250,000 units per year for the first year of production and increased production in subsequent years. The units shall meet all technical performance specifications called out in Section IV – Technical Performance Specifications of this document. Information to be reviewed by the TRC includes, but is not limited to, the following:

- Evidence verifying eligibility as specified in Section III – Eligibility Requirements
- Experience and capabilities of corporate officers and management team members responsible for the proposed product
- Manufacturing capability
- Distribution and sales capability
- Experience with similar products and markets
- Quality and completeness of production and marketing strategies
- Other evidence, as chosen by the entrant, which demonstrates the entrant's capability to compete and succeed with commercialization of the submitted product(s).

In order to verify the entrant's capability to mass produce, entries successfully completing the laboratory performance testing and the initial production and distribution assessment will be personally interviewed by the TRC at the location of final product assembly or other location as deemed suitable by the DOE.

## F. Process Flow Sheet

It is anticipated that the flow of the evaluation process will proceed as illustrated below:



## **G. Selection**

Selection of the winner to each product category for the L Prize will be determined based on the TRC's findings.

## **VI. QUESTIONS/COMMENTS**

Questions and/or comments regarding this competition, its requirements, technical specifications or test procedures can be addressed to [SSL@netl.doe.gov](mailto:SSL@netl.doe.gov).



## Data Release/Certification of Eligibility Form

### Data Release

The entrant does hereby accept release of all technical performance and commercial manufacturing information provided in the entry package or gained through product testing, as necessary, to each of the following:

- The Technical Review Committee (TRC)
- Product testing laboratories (no commercial manufacturing information)
- Host sites for field assessments (no commercial manufacturing information)
- EEP partner organizations

### Certification of Eligibility

The entrant does hereby certify that the entrant meets one of the requirements from Section A and the requirement of Section B (select applicable):

- A1) A majority ( $\geq 75\%$  by count) of the LED die or chip, defined as the solid-state semiconductor material that converts electrical energy directly into light, must be manufactured in the United States.  

or
- A2) The LED must be packaged in the United States. Packaged LED (also known as an LED device) refers to an assembly of one or more LED dies possibly including the mounting substrate, encapsulant, phosphor if applicable, electrical connections, and optical components along with thermal and mechanical interfaces.  

or
- A3) A majority ( $\geq 75\%$  by subsystem and assembly cost) of the final product assembly/integration must be carried out within the United States. This includes all of the applicable: final assembly of the LED die or chip, packaged LED, optics, heat sink or cooling components, and driver and electronics.  

and
- B) In the case of a private entity, the entity shall be incorporated in and maintain a primary place of business in the United States; and in the case of an individual, (whether participating as a single individual or in a group), the individual shall be a citizen or a lawful permanent resident of the United States.

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

Print Name of Responsible Signatory

Name:

Title:

Phone: