DEPARTMENT OF ENERGY

10 CFR Parts 429 and 430

[Docket No. EERE–2011–BT–TP–0071]

RIN 1904–AC67

Energy Conservation Program: Test Procedures for Integrated Light-Emitting Diode Lamps

AGENCY: Office of Energy Efficiency and Renewable Energy, Department of Energy.

ACTION: Supplemental notice of proposed rulemaking.

SUMMARY: This supplemental notice of proposed rulemaking (SNOPR) proposes a test procedure for light-emitting diode (LED) lamps (hereafter referred to as LED lamps) to support the implementation of labeling provisions by the Federal Trade Commission (FTC), as well as the ongoing general service lamps rulemaking, which includes LED lamps. The SNOPR proposes test procedures for determining the lumen output, input power, lamp efficacy, correlated color temperature (CCT), color rendering index (CRI), power factor, lifetime, and standby mode power for LED lamps. The SNOPR also proposes a definition for time to failure to support the definition of lifetime. This SNOPR revises the previous proposed test procedures for LED lamps by referencing two recently published industry standards that describe a process for taking lumen maintenance measurements and projecting those measurements for use in the lifetime test method.

DATES: DOE will accept comments, data, and information regarding this SNOPR, but no later than August 10, 2015. See section V, ''Public Participation,'' for details.

ADDRESSES: Any comments submitted must identify the SNOPR for Test Procedures for LED lamps, and provide docket number EE–2011–BT–TP–0071 and/or regulatory information number (RIN) 1904–AC67. Comments may be submitted using any of the following methods:

1. *Federal eRulemaking Portal: www.regulations.gov.* Follow the instructions for submitting comments.

2. *Email: LEDLamps-2011-TP-0071@ee.doe.gov* . Include the docket number and/or RIN in the subject line of the message.

3. *Mail:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, Mailstop EE–2J, 1000 Independence Avenue SW., Washington, DC, 20585–0121. If possible, please submit all items on a CD. It is not necessary to include printed copies.

4. *Hand Delivery/Courier:* Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, 950 L'Enfant Plaza SW., Suite 600, Washington, DC, 20024. Telephone: (202) 586–2945. If possible, please submit all items on a CD. It is not necessary to include printed copies.

For detailed instructions on submitting comments and additional information on the rulemaking process, see section V of this document.

Docket: The docket is available for review at regulations.gov, including **Federal Register** notices, public meeting attendee lists and transcripts, comments, and other supporting documents/materials. All documents in the docket are listed in the regulations.gov index. However, not all documents listed in the index may be publicly available, such as information that is exempt from public disclosure.

A link to the docket Web page can be found at: *www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/18.* This Web page will contain a link to the docket for this notice on the regulations.gov site. The regulations.gov Web page contains simple instructions on how to access all documents, including public comments, in the docket. See section V for information on how to submit comments through regulations.gov.

For further information on how to submit a comment, review other public comments and the docket, or participate in the public meeting, contact Ms. Brenda Edwards at (202) 586–2945 or by email: *Brenda.Edwards@ee.doe.gov.*

FOR FURTHER INFORMATION CONTACT: Ms. Lucy deButts, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Program, EE–2J, 1000 Independence Avenue SW., Washington, DC, 20585–0121. Telephone: (202) 287–1604. Email: *light_emitting_diodes@ee.doe.gov.*

Ms. Celia Sher, U.S. Department of Energy, Office of the General Counsel, GC–33, 1000 Independence Avenue SW., Washington, DC, 20585–0121. Telephone: (202) 287–6122. Email: *Celia.Sher@hq.doe.gov.*

SUPPLEMENTARY INFORMATION:

DOE proposes to incorporate by reference the following industry standards into 10 CFR part 430.

1. ANSI [1]/IES [2] RP–16–2010, ''Nomenclature and Definitions for Illuminating Engineering.''

2. IES LM–79–08, ''Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products.''

3. IES LM–84–14, ''Approved Method: Measuring Luminous Flux and Color Maintenance of LED Lamps, Light Engines, and Luminaires.''

4. IES TM–28–14, ''Projecting Long-Term Luminous Flux Maintenance of LED Lamps and Luminaires.''

Copies of the industry standards can be obtained from *http://www.ies.org/*, or can be reviewed in person at U.S. Department of Energy, Building Technologies Program, 950 L'Enfant Plaza SW., Suite 600, Washington, DC 20024. For further information on accessing IBR standards, contact Ms. Brenda Edwards at (202) 586–2945 or by email: *Brenda.Edwards@ee.doe.gov.* See section III.M for a further discussion of these standards.

Table of Contents

[1] American National Standards Institute

[2] Illuminating Engineering Society.

I. Authority and Background

Title III of the Energy Policy and Conservation Act of 1975 (42 U.S.C. 6291, *et seq.;* ''EPCA'') sets forth a variety of provisions designed to improve energy efficiency. (All references to EPCA refer to the statute as amended through the American Energy Manufacturing Technical Corrections Act (AEMTCA), Public Law 112–210 (Dec. 18, 2012)). Part B of title III, which for editorial reasons was redesignated as Part A upon incorporation into the U.S. Code (42 U.S.C. 6291–6309, as codified), establishes the ''Energy Conservation Program for Consumer Products Other Than Automobiles.''

Under EPCA, this program consists of four parts: (1) Testing, (2) labeling, (3) Federal energy conservation standards, and (4) certification and enforcement procedures. This rulemaking proposes test procedures that manufacturers of integrated LED lamps (hereafter referred to as ''LED lamps'') would use to meet two requirements, namely, to: (1) Satisfy any future energy conservation standards for general service LED lamps, and (2) meet obligations under labeling requirements for LED lamps promulgated by the Federal Trade Commission (FTC).

First, test procedures in this rulemaking would be used to assess the performance of LED lamps relative to any potential energy conservation standards in a future rulemaking that includes general service LED lamps. DOE is developing energy conservation standards for general service lamps (GSLs), a category of lamps that includes general service LED lamps. 79 FR 73503 (Dec. 11, 2014).

Second, this rulemaking supports obligations under labeling requirements promulgated by FTC under section 324(a)(6) of EPCA (42 U.S.C. 6294(a)(6)). The Energy Independence and Security Act of 2007 (EISA 2007) section 321(b) amended EPCA (42 U.S.C. 6294(a)(2)(D)) to direct FTC to consider the effectiveness of lamp labeling for power levels or watts, light output or lumens, and lamp lifetime. This rulemaking supports FTC's determination that LED lamps, which had previously not been labeled, require labels under EISA section 321(b) and 42 U.S.C. 6294(a)(6) in order to assist consumers in making purchasing decisions. 75 FR 41696, 41698 (July 19, 2010).

DOE previously published three **Federal Register** documents pertaining to the test procedure for LED lamps. On April 9, 2012, DOE published a test procedure NOPR (hereafter the April 2012 NOPR). 77 FR 21038. Following the publication of the NOPR, DOE held a public meeting on May 3, 2012, to receive feedback from interested parties. On June 3, 2014, DOE published a test procedure SNOPR (hereafter the June 2014 SNOPR) primarily revising its proposal for lifetime measurements. 79 FR 32020. Then on June 26, 2014, DOE published a second SNOPR (hereafter the lifetime SNOPR) revising the definition of lifetime for LED lamps. 79 FR 36242.

II. Synopsis of the Supplemental Notice of Proposed Rulemaking

This SNOPR builds upon both the June 2014 SNOPR and the lifetime SNOPR by proposing a method for determining power factor and revising the proposed method of measuring and projecting the time to failure of integrated LED lamps based on public comment and the 2014 publication of industry standards IES LM–84–14,[3] ''Measuring Luminous Flux and Color Maintenance of LED Lamp, Light Engines, and Luminaires,'' and IES TM–28–14,[4] ''Projecting Long-Term Luminous Flux Maintenance of LED Lamps and Luminaires.'' DOE reviewed the procedures provided in these Illuminating Engineering Society (IES) standards and determined that IES LM–84–14 and IES TM–28–14 contain the most relevant test procedure and projection method based on written comments submitted by interested parties and discussions with industry experts. DOE also proposed minor changes in response to comments received to date.

III. Discussion

A. Scope of Applicability

EPCA defines LED as a p-n junction [5] solid-state device, the radiated output of which, either in the infrared region, visible region, or ultraviolet region, is a function of the physical construction, material used, and exciting current [6] of the device. (42 U.S.C. 6291(30)(CC)) In the June 2014 SNOPR, DOE stated that this rulemaking applies to LED lamps that meet DOE's proposed definition of an integrated LED lamp, which is based on the term as defined by ANSI/IES RP–16–2010. This standard defines integrated LED lamps as an integrated assembly that comprises LED packages (components) or LED arrays (modules) (collectively referred to as an LED source), LED driver, ANSI standard base, and other optical, thermal, mechanical and electrical components (such as phosphor layers, insulating materials, fasteners to hold components within the lamp together, and electrical wiring). The LED lamp is intended to connect directly to a branch circuit through a corresponding ANSI standard socket. 79 FR 32020, 32021 (June 3, 2014).

B. Proposed Approach for Determining Lumen Output, Input Power, Lamp Efficacy, Correlated Color Temperature, and Color Rendering Index

The June 2014 SNOPR proposed to incorporate IES LM–79–2008 for determining lumen output, input power, CCT, and CRI with some modifications. 79 FR 32022. IES LM–79–2008 specifies the test conditions and setup at which the measurements and calculations must be performed. IES LM–79–2008 also specifies the methodology for measuring lumen output, input power, CCT, and CRI. Sections III.B.1 through III.B.3 discuss comments received on these requirements.

1. Test Conditions

In the June 2014 SNOPR, DOE proposed that the ambient conditions for testing LED lamps be as specified in section 2.0 [7] of IES LM–79–2008. 79 FR

[3] ''Approved Method: Measuring Luminous Flux and Color Maintenance of LED Lamps, Light Engines, and Luminaires.'' Approved by IES on March 31, 2014.

[4] ''Projecting Long-Term Luminous Flux Maintenance of LED Lamps and Luminaires.'' Approved by IES on May 20, 2014.

[5] P-n junction is the boundary between p-type and n-type material in a semiconductor device, such as LEDs. P-n junctions are diodes, active sites where current can flow readily in one direction but not in the other direction.

[6] Exciting current is the current passing through an LED chip during steady-state operation.

[7] IES standards use the reference 2.0, 3.0, etc. for each primary section heading. Sub-sections under each of these sections are referenced as 2.1, 2.2, 3.1,

Continued

32023. These conditions include setup and ambient temperature control, as well as air movement requirements. Both are discussed in further detail below.

Section 2.2 of IES LM–79–2008 specifies that photometric measurements shall be taken at an ambient temperature of 25 degrees Celsius (°C) ± 1 °C, and that the temperature shall be measured at a point not more than one meter from the LED lamp and at the same height as the lamp. The standard requires that the temperature sensor that is used for measurements be shielded from direct optical radiation from the lamp or any other source to reduce the impact of radiated heat on the ambient temperature measurement. The June 2014 SNOPR stated that this setup for measuring and controlling ambient temperature is appropriate for testing because it requires that the lamp be tested at room temperature and in an environment that is commonly used for testing other lighting technologies. 79 FR 32023.

DOE received comment from ASAP, ACEEE, and NRDC (hereafter referred to as the Joint Comment) recommending that directional LED lamps and those lamps labeled ''suitable for use in enclosed fixtures'' be tested under the elevated temperature conditions [8] required by the ENERGY STAR® Program Requirements Product Specification for Lamps (Light Bulbs) Version 1.0.[9] (Joint Comment, No. 34 at p. 2)

The operating temperature of LED lamps varies depending on the application for which they are installed. However, testing at an ambient temperature of 25 °C ± 1°C is consistent with other lighting products such as general service fluorescent lamps (GSFLs), compact fluorescent lamps (CFLs), and incandescent reflector lamps (IRLs). Therefore, DOE maintains its proposal from the June 2014 SNOPR that photometric measurements shall be taken at an ambient temperature of 25 °C ± 1 °C, and that the temperature shall be measured at a point not more than one meter from the LED lamp and at the same height as the lamp. Measuring at an ambient temperature of 25 °C ± 1°C will enable DOE, industry, and consumers to compare general service lamp products across different technologies.

In the June 2014 SNOPR, DOE also proposed that the requirement for air movement around the LED lamp be as specified in section 2.4 of IES LM–79–2008, which requires that the airflow around the LED lamp be such that it does not affect the lumen output measurements of the tested lamp. 79 FR 32023. These requirements would apply to lamps measured in both active mode and standby mode.

Cree, OSRAM Sylvania, Inc., (hereafter referred to as OSI), and the National Electrical Manufacturers Association (hereafter referred to as NEMA) submitted a comment supporting DOE's proposal to reference IES LM–79–2008 for all photometric testing of integrated LED lamps. (Cree, No. 31 at p. 1; OSI, No. 32 at p. 2; NEMA, No. 30 at p. 3) However, other stakeholders suggested additional requirements for air movement. The Joint Comment indicated concern that section 2.4 of IES LM–79–2008 does not provide informative procedures for measuring air movement and could yield distorted test results that are not representative of typical field conditions. It recommended that DOE revert to the April 2012 NOPR proposal that included considerations for specifying a method for determination of a draft-free environment, such as in section 4.3 of IES LM–9–2009, which requires that a single-ply tissue paper be held in place of the lamp to allow for visual observation of any drafts. The Joint Comment indicated that the procedures described in section 4.3 of IES LM–9–2009 provide a simple, inexpensive method for determining a draft-free environment without adding significant additional burden on manufacturers. (Joint Comment, No. 34 at p. 1)

DOE believes that additional requirements for a visual inspection of a single-ply tissue would not improve measurement accuracy relative to current industry practice. Therefore, in this SNOPR, DOE maintains its proposal to use the requirements in IES LM–79–2008 to ensure that air movement is minimized to acceptable levels.

2. Test Setup

In the June 2014 SNOPR, DOE proposed that LED lamps be positioned such that an equal number of units are oriented in the base-up and base-down orientations during testing. 79 FR 32025. As discussed in the June 2014 SNOPR, DOE collected test data for several LED lamps tested in base-up, base-down, and horizontal orientations, and analyzed the data to determine the variation of input power, lumen output, CCT, and CRI in each of these three orientations. The analysis of the test data revealed that some lamp models exhibited variation between the three orientations. Of the three orientations, analysis indicated that the base-up and base-down orientations represent the best (highest lumen output) and worst (lowest lumen output) case scenarios, respectively. Therefore, there is no need to test horizontally. Testing LED lamps in the base-up and base-down orientations would apply to lamps measured in both active mode and standby mode. *Id.*

While NEMA and OSI agreed with DOE's proposal to test LED lamps in the base-up and base-down orientations, they both recommended that DOE add language to acknowledge that for LED lamps with restricted positions, the sample only be tested in the manufacturer-specified position. (NEMA, No. 30 at p. 2; OSI, No. 32 at p. 2) NEMA also stated that this is consistent with the existing practices of ENERGY STAR. (NEMA, No. 30 at p. 2) Alternatively, Soraa recommended that DOE only test LED lamps in the base-up configuration to reduce testing burden. (Soraa, No. 28 at p. 1)

Because DOE's analysis of lamp orientation indicated that the base-up and base-down orientations represent the best (highest lumen output) and worst (lowest lumen output) case scenarios, respectively, DOE maintains its proposal that LED lamps be positioned such that an equal number of units are oriented in the base-up and base-down orientations. *See Id.* However, DOE agrees with NEMA and OSI that LED lamps with restricted positions only be tested in the manufacturer-specified position. Therefore, for an LED lamp that is developed, designed, labeled, and advertised as restricted to a particular position, DOE proposes that the lamp only be tested in the manufacturer-specified position. DOE requests comment on this proposal.

3. Test Method

a. Lumen Output Metric

DOE proposed in the June 2014 SNOPR that goniophotometers may not be used for photometric measurements. As a result, DOE proposed in the June 2014 SNOPR that the method for measuring lumen output be as specified in sections 9.1 and 9.2 of IES LM–79–2008, and proposed the same lumen output measurement method for all LED

3.2, etc. This SNOPR refers to each IES section exactly as it is referenced in the IES standard.

[8] Directional lamps must be tested in an EPA-approved fixture or directional lamps ≤ 20 watts must be tested at 45±5 degrees Celsius and directional lamps > 20 watts must be tested at 55±5 degrees Celsius.

[9] ''ENERGY STAR Program Requirements Product Specification for Lamps (Light Bulbs) Version 1.0.'' U.S. Environmental Protection Agency, August 28, 2013.

lamps, including directional [10] LED lamps. 79 FR 32027. In addition, for directional LED lamps, DOE suggested measuring total lumen output from the lamp rather than beam lumens [11] because other directional lamp technologies currently measure and report total lumen output on the FTC Lighting Facts label.

Regarding directional lamps, the Joint Comment argued that DOE should provide procedures for beam intensity measurement of LED directional lamps, as this would help determine if a lamp is distributing light effectively. It recommended that DOE reference the ENERGY STAR Program Requirements Product Specification for Lamps (Light Bulbs) Version 1.0 (*see supra* note 9) which specifies that the center-beam candle power and beam angle be tested for directional lamps. (Joint Comment, No. 34 at p. 2) In addition, Lighting Design Inc. provided comment that DOE should, at minimum, require reporting of center-beam candlepower and beam angle for directional lamps. More preferably, Lighting Design argued, complete photometric data such as lumen output through angles 0° to 180° and the number of planes consistent with the distribution (*e.g.,* one plane for axially symmetric distribution), should be required for directional lamps as this helps consumers, designers, and engineers more accurately compare lighting products.

Lighting Design also suggested that DOE define and provide naming conventions for the beam spread of directional lamps because manufacturer labeling is inconsistent. It argued that consumers, designers, and engineers need comprehensive definitions to compare the performance of directional lamps. (Lighting Design Inc., No. 24 at p. 1)

Because only total lumen output is needed for the ongoing GSL standards rulemaking and for the FTC Lighting Facts label, DOE is not proposing to include additional measurements for center-beam candlepower, beam angle, or any other detailed photometric measurements in this test procedure. Therefore, DOE maintains its proposal from the June 2014 SNOPR to measure the total lumen output for LED lamps, whether they are directional or omnidirectional. Measuring the total lumen output for LED lamps will enable industry and consumers to compare general service lamp products across different technologies. DOE also recognizes concerns about the naming conventions for the beam spread of directional lamps. However, developing comprehensive definitions for directional lamps is outside the scope of this rulemaking.

b. Lamp Efficacy Metric

As discussed in section I, this proposed test procedure will support any potential future energy conservation standards for general service LED lamps, which may include efficacy as a metric for setting standards. Accordingly, in the June 2014 SNOPR, DOE proposed that the efficacy of an LED lamp be calculated by dividing measured initial lamp lumen output in lumens by the measured lamp input power in watts, in units of lumens per watt. Providing a calculation for efficacy of an LED lamp does not increase testing burden because the test procedure already includes metrics for input power and lumen output. Both OSI and NEMA agreed with the DOE proposal for the efficacy calculation. (OSI, No. 32 at p. 3; NEMA, No. 30 at p. 3) However, the California Investor Owned Utilities (hereafter referred to as CA IOUs) recommended that DOE reference section 11.0 of IES LM–79–2008, which defines efficacy. (CA IOUs, No. 35 at p. 1)

While section 11.0 of IES LM–79–2008 does provide an efficacy definition and calculation, DOE proposes to continue to reference its own definition and calculation. This approach increases clarity as it specifies the calculation using the naming conventions for measured parameters established by DOE. Therefore, in this SNOPR, DOE retains the proposal that efficacy of an LED lamp be calculated by dividing measured initial lamp lumen output in lumens by the measured lamp input power in watts, in units of lumens per watt.

c. Measuring Correlated Color Temperature

In the June 2014 SNOPR, DOE proposed that the CCT of an LED lamp be calculated as specified in section 12.4 of IES LM–79–2008. *Id.* The CCT is determined by measuring the relative spectral distribution, calculating the chromaticity coordinates, and then matching the chromaticity coordinates to a particular CCT of the Planckian radiator. The setup for measuring the relative spectral distribution, which is required to calculate the CCT of the LED lamp, would be as specified in section 12.0 of IES LM–79–2008. That section describes the test method to calculate CCT using a sphere-spectroradiometer system and a spectroradiometer or colorimeter system. Furthermore, DOE also proposed in the June 2014 SNOPR to require all photometric measurements (including CCT) be carried out in an integrating sphere, and that goniophotometer systems must not be used. Therefore, DOE proposed that the instrumentation used for CCT measurements be as described in section 12.0 of IES LM–79–2008 with the exclusion of section 12.2 of IES LM–79–2008. *Id.*

DOE received comments from OSI, the Republic of Korea, and NEMA recommending reporting nominal CCT based on the tolerance specified in Table 1 of ANSI C78.377. (OSI, No. 32 at p. 4; Republic of Korea, No. 37 at p. 2; NEMA, No. 30 at p. 4) More specifically, the Republic of Korea recommended that DOE be consistent with international industry standard IEC/PAS 62612, which references ANSI C78.377 and states that nominal CCT values shall be reported. (Republic of Korea, No. 37 at p. 2) Nominal CCT values are defined by a region of the chromaticity diagram and any lamp that falls in a certain region is assigned a single CCT value. However, nominal CCT values do not address all regions of the chromaticity diagram. Although manufacturers in the marketplace may choose to design lamps that fall within regions defined by nominal CCT, DOE's goal is to establish one test method that applies to all LED lamps. Therefore, DOE is not proposing to follow a nominal CCT methodology, and is maintaining its proposal in the June 2014 SNOPR regarding the method to calculate the CCT of an LED lamp.

d. Measuring Color Rendering Index

In the June 2014 SNOPR, DOE proposed to add a requirement that the CRI of an LED lamp be determined as specified in section 12.4 of IES LM–79–2008, and to require all photometric measurements (including CRI) be carried out in an integrating sphere. *Id.* Therefore, the setup for measuring the relative spectral distribution, which is required to calculate the CRI of the LED lamp, would be as specified in section 12.0 of IES LM–79–2008 with the exclusion of section 12.2 of IES LM–79–2008, as goniophotometer systems would not be used. Section 12.4 of IES LM–79–2008 also specifies that CRI be calculated according to the method defined in the International Commission

[10] Directional lamps are designed to provide more intense light to a particular region or solid angle. Light provided outside that region is less useful to the consumer, as directional lamps are typically used to provide contrasting illumination relative to the background or ambient light.

[11] Please refer to the NOPR Test Procedures for Light-Emitting Diode Lamps (Docket No. EERE–2011–BT–TP–0071) for a detailed explanation of why DOE is not proposing to measure beam lumens for directional LED lamps (77 FR 21043; April 9, 2012).

on Illumination (CIE) 13.3–1995.[12] DOE proposed that the test procedure for LED lamps include measurement methods for CRI in order to support the upcoming general service lamps energy conservation standard rulemaking. *Id.*

DOE received many comments regarding its proposal for measuring CRI. Lighting Designs supported the DOE proposal to include requirements for measuring the CRI of an LED lamp, and additionally commented that DOE should consider adding a metric for R9.[13] Lighting Designs argued that combined, CRI and R9 data are sufficient metrics to enable consumers to assess and select a lamp product. (Lighting Design Inc., No. 23 at p. 1) Soraa provided similar comments, suggesting that R9 through R14 (*see supra* note 13) be included along with CRI in the test measurements for LED lamps. Pennsylvania State University and Jon Walker suggested that DOE not include CRI measurements in the LED lamps test procedure, and in addition to Soraa, advised that DOE adhere to the technical manual (TM) for the IES Color Metric Task Group once the industry standard comes available. (Soraa, No. 28 at p. 2; Pennsylvania State University, No. 29 at p. 2; Jon Walker, No. 25 at p. 1)

NEMA and OSI also suggested that DOE not include CRI measurements in the LED lamps test procedure. (NEMA, No. 30 at p. 3; OSI, No. 32 at p. 3) Both NEMA and OSI argued that CRI is not a necessary metric for this test procedure. (NEMA, No. 30 at p. 3; OSI, No. 32 at p. 3) NEMA further indicated that CRI should not be included in the LED lamps test procedure because this metric is not required to support the FTC labeling provisions. (NEMA, No. 30 at p. 3) In contrast, Pennsylvania State University argued that DOE should not include measurements for CRI because standards for this color rendition metric have not been updated since CIE 13.2–1974. Pennsylvania State University also commented that the limitations of CRI are well documented in academia and CIE 127–2007 provides evidence that CRI can fail to characterize visual impressions for LED lamps. (Pennsylvania State University, No. 29 at p. 2)

There are currently no industry standards that define or provide instructions for color quality metrics other than the CRI of LED lamps. After conducting thorough research of existing test procedures for all lighting products and industry literature regarding LED lamp color metrics, DOE has tentatively concluded that there is no industry consensus for how to characterize the color quality of LED lamps other than CRI. Therefore, DOE is not proposing to use metrics such as R9 through R14 to describe the color quality of LED lamps. Although industry may be working to develop new and revised standards to better define color metrics and establish test procedures for measuring this quality, the timeframe for their development is unknown. DOE reviewed the efforts of other working groups, as suggested by interested parties, but was unable to find any U.S. or international standard that provides a test procedure for measuring color quality other than the CRI procedures provided in CIE 13.3–1995. As discussed in section I, this proposed test procedure will support any potential future standards for general service LED lamps. Accordingly, in this SNOPR, DOE will not propose color quality metrics of an LED lamp other than CRI be measured in this test procedure. DOE requests comment on any industry standards or test methods that are available for measuring other color quality metrics.

C. June 2014 and Lifetime SNOPR Proposals

The methodology proposed in the June 2014 SNOPR and lifetime SNOPR to calculate time to failure for integrated LED lamps consisted of four main steps: (1) Measuring the initial lumen output; (2) operating the lamp for a period of time (the test duration); (3) measuring the lumen output at the end of the test duration; and (4) projecting time to failure using an equation adapted from the underlying exponential decay function in ENERGY STAR's most recent specification for integrated LED lamps, Program Requirements Product Specification for Lamps (Light Bulbs) Version 1.0. The June 2014 SNOPR equation projected time to failure using the test duration and the lumen maintenance at the end of the test duration as inputs, and limited time to failure claims to no more than four times the test duration. There was no minimum test duration requirement. 79 FR 32035.

DOE received many comments regarding its June 2014 SNOPR proposal for time to failure measurement and projection. DOE received comment from the Republic of Korea suggesting that DOE align its lifetime test procedure for LED lamps with that of ENERGY STAR Program Requirements Product Specification for Lamps (Light Bulbs) Version 1.0. (Republic of Korea, No. 37 at p. 2) NEMA recommended that DOE be consistent with industry standards IES–LM–80–2008 and IES–TM–21–2011, which provide measurement and projection procedures of lumen maintenance for the LED source component. (NEMA, No. 30 at p. 3) However, other commenters, including Soraa, OSI, OSRAM Opto Semiconductors, and Rensselaer Polytechnic Institute (hereafter referred to as RPI) argued that DOE should better align its lifetime test procedure with new industry standards IES LM–84–14 and IES TM–28–14 for lumen maintenance measurement and projection of time to failure of LED lamps. (Soraa, No. 28 at p. 2–3: OSI, No. 32 at p. 2–3: OSRAM Opto Semiconductors, No. 33 at pp. 1, 3–4: RPI, No. 36 at p. 1) Alternatively, Cree argued that DOE procedures for lumen maintenance should be consistent with those outlined IES–LM–80–2008 and IES–TM–21–2011, or IES LM–84–14 and IES TM–28–14. (Cree, No. 31 at p. 1)

DOE understands that industry standards represent the consensus position of industry experts, and appreciates both Cree and NEMA's proposal to reference industry standards IES LM–80–2008 and IES TM–21–2011. However, these industry standards provide lifetime measurements and projection procedures for the LED source component and not the whole LED lamp. In the June 2014 SNOPR, DOE noted that other components may cause lamp failure before the LED source falls below 70 percent of its initial light output, and therefore, it is undesirable for the lifetime of LED lamps to be approximated by the lumen maintenance of the LED source. 79 FR 32030. DOE reaffirms this position in this SNOPR. At the time of the June 2014 SNOPR publication, no industry standards were available that addressed the measurement of lumen maintenance and projection of time to failure for the complete LED lamp. However, as indicated by several comments, since the June 2014 SNOPR publication, both IES LM–84–14, and IES TM–28–14, were completed and provide a recommended method for testing lumen maintenance and projecting the time to failure of LED lamps, light engines, and luminaires.

DOE has reviewed IES LM–84–14 and IES TM–28–14 and proposes to modify its method for determining lifetime to align, where possible, with these industry standards. The revised lifetime test method proposal is described in

[12] ''Method of Measuring and Specifying Colour Rendering Properties of Light Sources.'' Approved by CIE in 1995.

[13] R Value (R1 through R14) refers to the 14 test color samples used in comparing the color rendering of two light sources. R1 through R8 are the test color samples used to determine CRI, while R9 is one of six saturated test colors not used in calculating CRI.

section III.D.3. In particular, the lifetime projection method in IES TM–28–14 will lead to more accurate lifetime projections than the June 2014 and lifetime SNOPR proposals and ENERGY STAR Program Requirements Product Specification for Lamps (Light Bulbs) Version 1.0 [14] (*see supra* note 9). IES TM–28–14 specifies a method that projects time to failure using multiple lumen maintenance measurements collected over a period of time, rather than a single measurement at the end of the test duration. Although DOE now proposes this change, DOE did receive comments on specific aspects of the June 2014 and lifetime SNOPR proposals. These comments are discussed in further detail in the following sections.

1. Definition of Lifetime and Time to Failure of Integrated Light-Emitting Diode Lamps

In the lifetime SNOPR, DOE proposed that the definition of lifetime should be revised to better align with the EPCA definition of lifetime in 42 U.S.C. 6291(30)(P). This statutory definition states that lifetime means the length of operating time of a statistically large group of lamps between first use and failure of 50 percent of the group in accordance with test procedures described in the IES Lighting Handbook-Reference Volume. In addition, DOE proposed revising the name of the metric from ''lifetime,'' to ''lifetime of an integrated light-emitting diode lamp.'' DOE proposed defining the lifetime of an integrated light-emitting diode lamp to be as follows: ''the length of operating time between first use and failure of 50 percent of the sample units.'' This revision also clarified that the metric ''lifetime of an integrated light-emitting diode lamp'' is a metric calculated for all sample units collectively. 79 FR 36243.

To support the definition of lifetime as applied to LED lamps, in the lifetime SNOPR DOE also proposed to define time to failure for LED lamps. The revised definition of lifetime refers to the ''failure'' of a lamp. Because LED lamps typically exhibit gradual degradation of light output over a long period of time rather than a sudden loss of light output, lumen maintenance of 70 percent is generally accepted as a criterion of reaching the end of useful LED lamp lifetime. 79 FR 36244. Therefore, DOE proposed to treat the point in time where an individual LED lamp reaches 70 percent lumen maintenance as the point of ''failure.'' In order to calculate the lifetime of an integrated LED lamp for a particular basic model, the manufacturer must determine the length of time between first use and failure for each unit in the sample. Therefore, DOE also proposed to define time to failure, in section 2.2 of appendix BB to subpart B of 10 CFR part 430, as ''the time elapsed between first use and the point at which the lamp reaches 70 percent lumen maintenance as measured in section 4.5 of appendix BB of this subpart.'' These revisions also clarified that the metric ''time to failure'' would be measured for an individual lamp. DOE also proposed that the lifetime of an integrated LED lamp is calculated by determining the median time to failure of the sample. The median time to failure of the sample is calculated as the arithmetic mean of the time to failure of the two middle sample units when the numbers are sorted in value order. DOE requested comment on these proposed definitions and calculations of lifetime and time to failure of integrated LED lamps.

OSRAM Opto Semiconductors and the Joint Comment agreed with DOE's proposal to define time to failure as the point at which the lamp reaches 70 percent lumen maintenance. (Joint Comment, No. 34 at p. 2; OSRAM Opto Semiconductors, No. 33 at p. 4) However, DOE received comments from the Joint Comment, CA IOUs, and NEMA requesting that DOE revise its definition and calculation for lifetime of LED lamps from mean time to failure of the *middle* two samples to the mean time to failure of *all* tested samples. (Joint Comment, No. 34 at p. 2; CA IOUs, No. 35 at p. 3; NEMA, No. 30 at p. 5) The CA IOUs further commented that this definition and calculation for lifetime would allow the first 40 percent of the LED lamp sample to fail during testing and still allow for a lumen maintenance projection based on the surviving 60 percent of the sample. For this reason, according to the CA IOUs, DOE should consider calculating the lifetime of an LED lamp as the mean time to failure of all tested samples, rather than the mean time to failure of the middle two samples. The CA IOUs also commented that they understand DOE's efforts to propose a definition of lifetime that is consistent with the definition of other similar lighting products. However, they argued that other lighting products measure the sample set to the point of catastrophic failure rather than using projected lumen maintenance. For this reason, the CA IOUs suggested that it may not be appropriate to define rated life for LED lamps the same way it is defined for other technologies. (CA IOUs, No. 35 at p. 2) RPI also urged that DOE's test procedure for LED lamps require the percentage of test samples that undergo catastrophic failure, and the time period within which these failures occur, be reported and included as factors when calculating the projected lumen maintenance of the product. (RPI, No. 36 at p. 1)

DOE understands the concerns regarding the proposed definition and calculation for lifetime of LED lamps. However, in order to be consistent with the statutory definition of lifetime in 42 U.S.C. 6291(30)(P), DOE is maintaining its proposal from the lifetime SNOPR to define the lifetime of an integrated light-emitting diode lamp as ''the length of operating time between first use and failure of 50 percent of the sample units (as defined in 10 CFR 429.56(a)(1)), in accordance with the test procedures described in section 4.5 of appendix BB to subpart B of part 430 of this chapter.'' Further, DOE is only proposing measurements necessary for generating a lifetime value as defined by EPCA, and as a result is not proposing reporting the percentage of lamps that experience catastrophic failure or the time at which these failures occur.

2. Test Duration

In the June 2014 SNOPR, DOE proposed that initial lumen output is the measured amount of light that a lamp provides at the beginning of its life, after it is initially energized and stabilized using the stabilization procedures. 79 FR 32033. DOE also proposed that the period of time starting immediately after the initial lumen output measurement and ending when the final lumen output measurement is recorded is referred to as the ''test duration'' or time ''t.'' In the June 2014 SNOPR, DOE discussed that the test duration does not include any time when the lamp is not energized. If lamps are turned off (possibly for transport to another testing area or during a power outage), DOE proposed that the time spent in the off-state not be included in the test duration. DOE did not specify a minimum test duration or measurement interval, so manufacturers could customize the test duration based on the expected lifetime of the LED lamp. 79 FR 32034.

Both the CA IOUs and the Joint Comment argued that DOE should include a minimum test duration to help guard against early failure of LED lamps. (CA IOUs, No. 35 at p. 3; Joint Comment, No. 34 at p. 2) The Joint Comment also offered a suggestion that

[14] The ENERGY STAR specification for Lamps will be revised to reference the DOE LED lamp test procedure after publication of the LED lamp test procedure final rule.

minimum test duration be set at 4,000 hours. The CA IOUs expressed concern that historically test laboratories conducting lumen maintenance testing have disregarded lamps experiencing early failure. Therefore they suggested that DOE specify that the proposed lifetime test procedure is for a population of LED lamps, and not a lumen maintenance projection exercise based on the subset of lamps that have survived. (CA IOUs, No. 35 at p. 3) DOE agrees that early catastrophic failure of LED lamps is problematic. However, to render the test procedure applicable to LED lamps of all lifetimes (including lifetimes that could be less than the 4,000 hour minimum test duration recommended in the Joint Comment), DOE does not propose minimum test duration requirements for LED lamps in this SNOPR. The proposed method for lifetime testing is discussed in more detail in section III.D.3. DOE has included a proposal in section III.D.3.g detailing the required procedures if an LED lamp fails prematurely during lumen maintenance testing.

3. Test Duration Operating Conditions

The June 2014 SNOPR discussed that, while operating an LED lamp, lumen output can vary with changes in ambient temperature, air flow, vibration, and shock. However, because lamps may need to be operated for an extended period of time for the purpose of lifetime testing, DOE proposed less stringent requirements when measurements are not being taken (*e.g.,* ambient temperature and air flow) to reduce test burden. To determine ambient temperature requirements, DOE reviewed industry standard IES LM–65–10 ''Approved Method Life Testing of Compact Fluorescent Lamps.'' Section 4.3 of IES LM–65–10 requires that ambient temperature be controlled between 15 and 40 °C. Although industry standard IES LM–65–10 is intended for compact fluorescent lamps, DOE proposed that this ambient temperature range is appropriate for the operation of LED lamps. Therefore, DOE proposed that ambient temperature be maintained between 15 and 40 °C. DOE also proposed that LED lamp testing racks be open and designed with adequate lamp spacing and minimal structural components to maintain ambient temperature conditions. Furthermore, similar to the requirements in section 4.2 of IES LM–65–10, DOE proposed minimizing airflow surrounding the LED lamp testing racks and that the lamps not be subjected to excessive vibration or shock. These requirements would minimize the impact of airflow and the physical environment while minimizing test burden. 79 FR 32034.

Several stakeholders commented that DOE should tighten its proposal for ambient temperature requirements. Both the CA IOUs and the Joint Comment recommended tightening the ambient temperature requirements during lumen maintenance testing to 25 °C with a tolerance of ± 5 °C. (CA IOUs, No. 35 at p. 3; Joint Comment, No. 34 at p. 2) The CA IOUs argued that the lower end of DOE's proposed range (15 °C) is significantly cooler than room temperature, and therefore, not an accurate representation of the operating conditions of most LED lamps. Additionally, it argued that the wide range between 15 and 40 °C could result in wildly different lamp performance measurements. (CA IOUs, No. 35 at p. 3) Similarly, RPI also recommended that DOE consider testing LED lamps at the higher end of the proposed temperature range in more tightly controlled tolerances, specifically at 30 °C with a tolerance of ± 5 °C. (RPI, No. 36 at p. 1) NEMA commented that DOE should continue to reference IES LM–65–10, and not reference IES LM–84–14 because industry has not yet had time to gain familiarity with the new IES LM–84–14 standard. NEMA further commented that DOE should simplify the temperature range in IES LM–65–10 by setting the ambient temperature to ''15 °C or above.'' (NEMA, No. 30 at p. 2)

DOE agrees that the ambient temperature tolerance of between 15 and 40 °C is large, but notes that in the June 2014 SNOPR, DOE based this range on Section 4.3 of IES LM–65–10. As previously mentioned, for this SNOPR, DOE has developed a test procedure that references the industry standards IES LM–84–14 and IES TM–28–14. Therefore, DOE no longer proposes the ambient temperature conditions provided in Section 4.3 of IES LM–65–10. This SNOPR instead proposes to adopt section 4.4 of IES LM–84–14, which indicates that during lumen maintenance testing the ambient temperature shall be maintained at 25 °C ± 5 °C. These requirements are discussed in more detail in section III.D.1. Regarding industry familiarity with IES LM–84–14, DOE expects that the compliance date of the test procedure final rule (see section III.L) will provide adequate time for gaining familiarity and conducting the adopted test procedure for LED lamps.

4. Stress Testing

The Joint Comment, CA IOUs, and RPI recommended that DOE should not only consider test procedures for lumen maintenance, but also for the possibility of catastrophic failure as measured through stress testing. (Joint Comment, No. 34 at p. 2; CA IOUs, No. 35 at p. 4; RPI, No. 36 at p. 2) The CA IOUs argued that DOE should consider utilizing an additional elevated temperature test, and/or other stress tests, because heat buildup and other factors such as rapid cycling will likely have a significant impact on component failure of integrated LED lamps. Furthermore, the CA IOUs indicated that stress-test procedures are already included in the ENERGY STAR Program Requirements Product Specification for Lamps (Light Bulbs) Version 1.0 (*see supra* note 9), and therefore would not represent additional testing burden to manufacturers. (CA IOUs, No. 35 at p. 4) RPI also recommended that DOE require on-off cycling at realistic operating intervals (*e.g.,* a minimum of two-hours on and two-hours off), claiming that this could potentially damage subcomponents within the LED lamp. RPI argued that this cycling method would allow lamp components to experience maximum temperature differences and undergo stresses similar to what they would experience in real-life applications. (RPI, No. 36 at p. 2)

Industry has stated that unlike other lighting technologies, the lifetime of LED lamps is minimally affected by power cycling.[15] DOE research of existing literature and industry test procedures indicates none are available that use rapid-cycle stress testing to predict the failure of the complete LED lamp. In this SNOPR, DOE proposes to retain the testing conditions that LED lamps operate without rapid-cycle stress testing. DOE requests comment on whether standardized test methods exist that use rapid-cycle stress testing to predict the failure of integrated LED lamps.

The Joint Comment also requested that if DOE does not include procedures for stress testing of LED lamps that DOE not preclude the U.S. Environmental Protection Agency (EPA) from requiring stress testing for the purposes of the ENERGY STAR program. (Joint Comment, No. 34 at p. 2) While DOE understands the issue raised in the Joint Comment, DOE is not addressing procedures for stress testing of LED lamps in the context of the present rulemaking.

[15] NEMA Comments on ENERGY STAR Program Requirements Product Specification for Lamps (Light Bulbs) Version 1.0, Draft 2 *http://energystar.gov/products/specs/sites/products/files/NEMA.pdf.*

5. Color Maintenance

In addition to including lumen maintenance in DOE's lifetime test procedure, Soraa also requested that DOE measure and report color maintenance of LED lamps using the procedures described in IES LM–84–14. (Soraa, No. 28 at p. 2) Color maintenance is the difference or ''shift'' in chromaticity as measured initially compared to that over an elapsed operating time, and color shift and other degradation mechanisms can affect the useful lifetime of LED lamps. While color maintenance measurement procedures are provided in IES LM–84–14, no method for projection is provided. Furthermore, color maintenance is not well understood or well-studied, and is not commonly used for traditional incandescent lamps and CFLs.[16] After conducting thorough research of existing test procedures for all lighting products and industry literature regarding LED lamp lifetime, DOE has tentatively concluded that there is no industry consensus for how to characterize lifetime of LED lamps in terms of performance metrics other than lumen maintenance. Therefore, DOE is not proposing to use metrics such as color maintenance to determine the lifetime of LED lamps.

D. Proposed Approach for Lifetime Measurements

As discussed in section III.C.1, DOE previously had proposed to define the time to failure of an LED lamp as the time required to reach a lumen maintenance of 70 percent (L_{70}). 79 FR 36243. Lumen maintenance is the measure of lumen output after an elapsed operating time, expressed as a percentage of the initial lumen output. In this SNOPR, DOE proposes a new test procedure for measuring and projecting the lifetime of LED lamps that addresses many of the stakeholder concerns (discussed in the preceding sections) regarding the June 2014 and lifetime SNOPR proposals. This new proposal is largely based on the IES LM–84–14 and IES TM–28–14 industry standards, and provides a simple, straightforward, and flexible test procedure.

IES LM–84–14 provides a method for lumen maintenance measurement of integrated LED lamps that specifies the operational and environmental conditions during testing such as operating cycle, ambient temperature, airflow, and orientation. IES TM–28–14 provides methods for projecting the lumen maintenance of integrated LED lamps depending on the available data and test duration. These requirements, and any modifications proposed by DOE, are further discussed in the sections III.D.1 through III.D.4. DOE requests comment on the proposed incorporation of IES LM–84–14 and IES TM–28–14 for measuring and projecting the lumen maintenance of LED lamps.

1. Test Conditions

DOE proposes that the operating conditions for lamp operation between lumen output measurements be as specified in section 4.0 of IES LM–84–14, with some modifications. Lumen output of LED lamps can vary with changes in ambient temperature and air movement around the LED lamp. However, to reduce test burden, DOE proposes that the operating conditions (*e.g.,* ambient temperature) required during the test duration while measurements are not being taken would be less stringent than those required when taking photometric measurements. The test conditions outlined in IES LM–84–14 ensure reliable, repeatable, and consistent test results without significant test burden. These conditions are discussed in further detail below.

DOE proposes to include section 4.1 of IES LM–84–14, which specifies that LED lamps should be checked and cleaned prior to lumen output measurement and maintenance testing, and further states that unusual environmental conditions, such as thermal interference from heating, ventilation and air conditioning systems or solar loading, are to be reduced to levels reasonably expected to minimize influence. DOE also proposes to include section 4.2 of IES LM–84–14, which states the lamp should be mounted in accordance with manufacturer specifications. In addition, DOE proposes to include section 4.4 of IES LM–84–14, which specifies that photometric measurements should be taken at an ambient temperature of 25 ± 5 °C. A tolerance of 5 °C for the ambient temperature during lumen maintenance testing is practical, limits the impact of ambient temperature, and is not burdensome. Section 4.4 of IES LM–84–14 also indicates that the temperature variation of the operating environment shall be monitored with a sufficient number of and appropriately located temperature measurement points, and that the sensors used for measurements must be shielded from direct optical radiation from the lamp or any other source to reduce the impact of radiated heat on the ambient temperature measurement. Section 4.4 of IES LM–84–14 further states that if the ambient temperature falls outside the allowed range, the lumen maintenance test shall be terminated. This setup for measuring and controlling ambient temperature would result in appropriate testing conditions as the lamp would be tested at room temperature and in an environment that is used most commonly for testing lamp technologies.

DOE proposes that the requirement for vibration and air movement around the LED lamp be as specified in sections 4.3 and 4.6 of IES LM–84–14, which require that the LED lamps not be subjected to excessive vibration or shock during operation or handling, and that the air flow surrounding the LED lamp be minimized. This is a requirement in relevant industry standards for the test setup of other lamp types such as GSFLs, and would ensure consistent LED lamp measurements. DOE also proposes that humidity of the environment around the LED lamp shall be maintained to less than 65 percent relative humidity during the lumen maintenance test as specified in section 4.5 of IES LM–84–14.

DOE requests comment on the proposal to reference section 4.0 of IES LM–84–14 for specifying the ambient conditions for lumen maintenance testing of LED lamps.

2. Test Setup

In this SNOPR, DOE proposes test setup requirements for determining lifetime. Power supply, test rack wiring, electrical settings, and operating orientation are discussed in sections III.D.2.a through III.D.2.d.

a. Power Supply

DOE proposes that line voltage waveshape and input voltage of AC power supplies be as specified in sections 5.2 and 5.4 of IES LM–84–14, respectively. Section 5.2 specifies that an AC power supply shall have a sinusoidal voltage waveshape at the input frequency required by the LED lamp such that the RMS summation of the harmonic components does not exceed 3.0 percent of the fundamental frequency while operating the LED lamp. Section 5.4 requires, in part, that the voltage of an AC power supply (RMS voltage) applied to the LED lamp shall be less than or equal to 2.0 percent of the rated RMS voltage. Lastly, DOE proposes to not reference section 5.3 of IES LM–84–14, which provides line impedance guidelines, because the procedures are listed as optional by IES and lack specific line impedance

[16] U.S. Department of Energy, ''*LED Luminaire Lifetime: Recommendation for Testing and Reporting,*'' June 2011. *http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/led_luminaire-lifetime-guide_june2011.pdf*

restrictions. DOE invites comments on the proposal to reference section 5.2 of IES LM–84–14 requirements for AC power supplies, and on the requirement that input voltage be monitored and regulated to less than or equal to 2.0 percent of the rated RMS voltage as specified in section 5.4 of IES LM–84–14. DOE also invites comments on the proposal to not reference the line impedance guidelines provided in section 5.3 of IES LM–84–14.

b. Test Rack Wiring

DOE proposes that section 5.5 of IES LM–84–14 be incorporated by reference to specify test rack wiring requirements during lumen maintenance testing of LED lamps. This section specifies that that wiring of test racks should be in accordance with national, state or provincial, and local electrical codes, and in accordance with any manufacturer operation and condition recommendations for the LED lamp. This section also requires that an inspection of electric contacts including the lamp socket contacts be performed each time the LED lamps are installed in the test rack. DOE invites comments on the proposal to adopt section 5.5 of IES LM–84–14, which provides test rack wiring requirements during lumen maintenance testing of LED lamps.

c. Electrical Settings

DOE proposes requiring lumen maintenance testing of LED lamps at the rated voltage as specified in section 5.1 of IES LM–84–14. For lamps with multiple operating voltages, DOE proposes the electrical settings requirements provided in section III.C.3.d of the June 2014 SNOPR. 79 FR 32025–6. For LED lamps with multiple modes of operation, DOE proposes incorporating section 7.0 of IES LM–79–2008, which specifies that dimmable LED lamps should be tested at maximum input power. When multiple modes (such as multiple CCTs and CRIs) occur at the maximum input power, DOE proposes that the manufacturer can select any of these modes for testing. For certification, DOE proposes that all measurements (lumen output, input power, efficacy, CCT, CRI, power factor, lifetime, and standby mode power) be conducted at the same mode of operation.

d. Operating Orientation

DOE proposes to include section 4.7 of IES LM–84–14, which specifies that the operating orientation of the lamp be the same as during photometric measurement. Lamp operating orientation during photometric measurement is discussed in section III.B.2.

3. Test Method

DOE proposes that the lumen maintenance test procedure for LED lamps be as specified in section 7.0 of IES LM–84–14 and section 4.2 of IES TM–28–14. The test methods outlined in IES LM–84–14 and IES TM–28–14 ensures reliable, repeatable, and consistent test results without significant test burden. The lumen maintenance test method is discussed in further detail in sections III.D.3.a through III.D.3.g. DOE requests comment on the lumen maintenance test procedure.

a. Initial Lumen Output Measurements

DOE proposes to reference section 7.6 of IES LM–84–14, which states that an initial lumen output measurement is required prior to starting the maintenance test. Initial lumen output is the measured amount of light that an LED lamp provides at the beginning of its life after it is initially energized and stabilized using the stabilization procedures proposed in section III.C.4.b of the June 2014 SNOPR. 79 FR 32027. The methodology, test conditions, and setup requirements described in the June 2014 SNOPR (with the modifications described in section III.B above) would be used when measuring initial lumen output for the lifetime test procedure. Manufacturers testing an LED lamp for lifetime would be required to use the same value of initial lumen output as used in the lamp efficacy calculation.

b. Interval Lumen Output Measurements

DOE also proposes to reference section 7.6 of IES LM–84–14 to indicate that additional lumen output measurements (known as interval lumen output measurements) are made after the initial lumen output measurement and continue at regular intervals. Interval lumen output is measured after the lamp is energized and stabilized using the stabilization procedures in section III.C.4.b of the June 2014 SNOPR. 79 FR 32027. The methodology, test conditions, and setup requirements described in the June 2014 SNOPR (with the modifications described in section III.B above) would be required when measuring interval lumen output for the lifetime test procedure. Further instructions specifying the timing of the collection of interval lumen output measurements are discussed in section III.D.4.a.

c. Test Duration

During lumen maintenance testing, the LED lamps must operate for an extended period of time, referred to as the ''elapsed operating time.'' The entirety of elapsed operating time starting immediately after the initial lumen output measurement and ending with the recording of the final interval lumen output measurement is then referred to as the ''test duration.'' The test duration does not include any time when the lamp is not energized. If lamps are turned off (possibly for transport to another testing area or during a power outage), DOE proposes that the time spent in the off state not be included in the test duration. Similar to the June 2014 SNOPR, DOE does not specify minimum test duration requirements, so manufacturers can customize the test duration based on the expected lifetime of the LED lamp. However, DOE understands that the test duration has a significant impact on the reliability of the lumen maintenance prediction and proposes maximum time to failure claims that increase as the test duration increases. These lumen maintenance calculation requirements are discussed further in section III.D.4.

d. Lamp Handling and Tracking

Section 7.2 of IES–LM–84–14 specifies that when handling, transporting, or storing LED lamps, care should be taken to prevent any damage or contamination that may affect the test results. These handling requirements are practical, prevent lamp damage that could affect the measured results, and would not be burdensome to manufacturers.

DOE also proposes that the requirements for LED lamp marking and tracking during lumen maintenance testing be as specified in section 7.3 of IES–LM–84–14. Section 7.3 of IES–LM–84–14 specifies that each LED lamp shall be tracked during the maintenance test and identified by marking applied directly to the LED lamps or by labels that can be attached during transport, operation and evaluation or to the test rack position occupied by the LED lamp. The chosen identification method should also consider the effect of exposure to light and heat, as this may alter or compromise the marking or label. Section 7.3 of IES–LM–84–14 also offers several possible marking methods and materials, including durable bar coding, ceramic ink marking, high-temperature markers, or any other method that endures or can be periodically renewed for the duration of the test. These requirements ensure that the LED lamp can be tracked and

identified correctly throughout lumen maintenance testing. DOE requests comment on the lamp handling and tracking proposal.

e. Operating Cycle

Lifetime test procedures for other lamp types sometimes require ''cycling,'' which means turning the lamp on and off at specific intervals over the test period. However, industry has stated that unlike other lighting technologies, the lifetime of LED lamps is minimally affected by power cycling (*see supra* note 15). Thus, in this SNOPR, DOE proposes that cycling of the LED lamp not be required during lumen maintenance testing.

f. Time Recording

Accurately recording of the elapsed operating time is critical for the lumen maintenance test procedure. Therefore, DOE proposes to adopt section 7.5 of IES LM–84–14, which states that elapsed time recording devices shall be connected to the particular test positions and accumulate time only when the LED lamps are operating. The LED lamp is operating only when the lamp is energized. If lamps are turned off (possibly for transport to another testing area or during a power outage), DOE proposes that the time spent in the off state not be included in the recorded elapsed operating time. Section 7.5 of IES LM–84–14 also indicates that video monitoring, current monitoring, or other means can be used to determine elapsed operating time. All equipment used for measuring elapsed operating time would be calibrated and have a total minimum temporal resolution of ±0.5 percent. These requirements are achievable with minimal testing burden and provide reasonable stringency that is achievable via commercially available time recording instrumentation. DOE requests comment on the time recording proposal.

g. Lamp Failure

Finally, DOE also proposes that LED lamps be checked regularly for failure as specified in section 7.8 of IES–LM–84–14, which requires that checking for LED lamp operation either by visual observation or automatic monitoring be done at a minimum at the start of lumen maintenance testing and during every interval measurement. Section 7.8 of IES LM–84–14 further specifies that each non-operational LED lamp shall be investigated to make certain that it is actually a failure, and that it is not caused by improper functioning of the test equipment or electrical connections. DOE proposes that if lumen maintenance of the LED lamps is measured at or below 0.7 or an LED lamp fails resulting in complete loss of light output, time to failure has been reached and therefore it must not be projected using the procedures described in the following section III.D.4. Instead, the time to failure is equal to the last elapsed time measurement for which the recorded lumen output measurement is greater than or equal to 70 percent of initial lumen output. DOE requests comment on this proposal.

4. Projection Method

In this SNOPR, DOE proposes a new lumen maintenance projection procedure that addresses many of the stakeholder concerns discussed in section III.C regarding the June 2014 and lifetime SNOPR proposals. This proposal is largely based on the IES TM–28–14 industry standard and provides a simple, straightforward, and flexible calculation based on the recorded trend in lumen maintenance of an LED lamp. However, DOE is proposing certain modifications, discussed below, so that the projection method better meets DOE's needs.

a. Interval Lumen Output Measurement Collection Instructions

In this SNOPR, DOE proposes that all interval lumen output measurements meet the requirements specified in section 4.2, 4.2.1, and 4.2.2 of IES TM–28–14. For test durations greater than or equal to 6,000 hours, DOE proposes that section 4.2.1 of IES TM–28–14 be followed. Section 4.2.1 of IES TM–28–14 specifies that lumen maintenance data used for direct extrapolation must be collected initially and at least once every 1,000 hours thereafter. For test durations greater than or equal to 3,000 hours and less than 6,000 hours, DOE proposes section 4.2.2 of IES TM–28–14 be followed, except that lumen maintenance data of LED packages and modules would not be collected. Section 4.2.2 of IES TM–28–14 specifies that lumen maintenance data used for combined extrapolation must be collected initially after 1,000 hours, and at least once every 500 hours thereafter.

Lumen maintenance data collected at intervals greater than those specified above must not be used as this may compromise the accuracy of the projection results. In addition, section 4.2 of IES TM–28–14 indicates that lumen maintenance data shall be collected within a ±48 hour window of each measurement point, *e.g.,* for 1000-hour intervals, between 952 hours and 1048 hours, between 1952 and 2048 hours, etc. This ±48 hour data collection window is also applicable to other intervals smaller than 1,000 hours. Furthermore, section 4.2 specifies that lumen maintenance data used for the projection calculation shall be equally dispersed in time (to within ±48 hours), and that no two consecutive data collection intervals after the initial 1,000 hours shall differ by more than 96 hours in length. Therefore, data may be used in the projection calculation if they are collected every 1,000 hours (±48 hours), every 500 hours (±48 hours), etc., but not every 1,000 hours and occasionally at 500 hours, as this will give excessive statistical weight to certain data points. DOE requests comment on adopting the proposed lumen maintenance data collection requirements specified in section 4.2 of IES TM–28–14.

b. Projection Calculation

Section 5.0 of IES TM–28–14 provides guidance for how to determine time to failure for an integrated LED lamp. For short test durations (less than 3,000 hours), IES TM–28–14 does not provide a projection method so time to failure is determined using actual test data. For test durations of 3,000 hours or greater, IES TM–28–14 provides two different methods for projecting time to failure, depending on test duration. The first is a direct extrapolation method for projecting time to failure based on lumen maintenance data of a whole LED lamp. The second is a combined extrapolation method based on both whole LED lamp and LED source lumen maintenance data. DOE discusses these provisions of IES TM–28–14 in more detail in this section.

IES TM–28–14 does not provide a lumen maintenance projection method if IES LM–84–14 testing has been completed for a total elapsed operating time of less than 3,000 hours. IES TM–28–14 indicates that the prediction may be unreliable since the spread of prediction estimates increases significantly for data sets that do not meet the minimum test duration requirements for the either the direct or combined extrapolation methods. On the basis of the limited dataset potentially yielding unreliable projections, DOE proposes no projection of time to failure for test durations less than 3,000 hours. Instead, time to failure would equal the test duration.

For test durations of at least 6,000 hours, the IES TM–28–14 procedures recommend use of a direct extrapolation method. The direct extrapolation method uses an exponential least squares curve-fit to extrapolate lumen maintenance measurements of the complete integrated LED lamp to the time point where lumen maintenance

decreases to 70 percent of its initial lumen output.

The direct extrapolation method described in section 5.1 of IES TM–28–14 for projecting time to failure based on lumen maintenance data of a whole LED lamp is similar to DOE's June 2014 SNOPR proposal. 79 FR 32035. However, where DOE's June 2014 SNOPR projected time to failure based on the underlying exponential decay function in ENERGY STAR's Program Requirements Product Specification for Lamps (Light Bulbs) Version 1.0, IES TM–28–14 projects time to failure based on the data obtained for each individual LED lamp. Thus, DOE proposes to incorporate the direct extrapolation method provided in section 5.1 of IES TM–28–14, as this should result in more accurate projections.

While DOE proposes referencing the direct extrapolation method specified in section 5.1 of IES TM–28–14 for projecting time to failure of LED lamp lumen maintenance data (tested as described in sections III.D.1 through III.D.3), this SNOPR also proposes the following modification for consistency with DOE's reporting requirements. Measured lumen maintenance data of all the LED lamp samples must not be averaged, and the averaging procedures specified in section 5.1.2 of IES TM–28–14 shall not be used. DOE proposes that the projection calculation be completed for each individual LED lamp and the projected time to failure values be used to calculate the lifetime of the sample using the procedures proposed in section III.G.3.

If at least 3,000 hours but less than 6,000 hours of whole-lamp lumen maintenance data is available, IES TM–28–14 recommends a combined extrapolation method. This method uses IES TM–21–2011 to project the data collected from IES LM–80–2008, which measures lumen maintenance of the LED source component. This method then corrects for additional lumen maintenance losses in the complete integrated LED lamp, if they are observed during whole-lamp testing.

DOE proposes not to reference the combined extrapolation method described in section 5.2 of IES TM–28–14 for when at least 3,000 hours, but less than 6,000 hours, of whole-lamp lumen maintenance test data are available. The requirement to use lumen maintenance data of the LED source component would require disassembly of the lamp, which could necessitate irreversible modifications to the lamp and introduce potential for error and variation in the measurements. Furthermore, failure of an integrated LED lamp is often determined by components other than the LED source, as many stakeholders described in comments to the NOPR test procedure. 79 FR 32030.

In place of the combined extrapolation method for test durations of at least 3,000 hours but less than 6,000 hours, DOE proposes to use the direct extrapolation method specified in section 5.1 of IES TM–28–14 but to lower the maximum allowed time to failure claim. Section 5.1.5 of IES TM–28–14 provides instruction for how to limit time to failure claims depending on sample size. Because DOE requires a sample size of a least ten LED lamps, the projected time to failure, as specified in Table 1 in section 5.1.5 of IES TM–28–14, would be limited to no more than six times the test duration for test durations greater than or equal to 6,000 hours. However, to account for the increased uncertainty in lowering the threshold for the direct extrapolation method to 3,000 hours, DOE proposes to reduce the maximum time to failure claims based on the test duration. For this test duration range, DOE proposes a maximum projection limit that scales linearly from one times the test duration (the effective limit for test durations less than 3,000 hours) to approximately six times the test duration (the limit for test durations greater than or equal to 6,000 hours).

In summary, DOE proposes to determine time to failure using the following procedures:

(1) If the test duration is less than 3,000 hours:

No projection of lumen maintenance data is permitted, and the time to failure claim equals the test duration or the recorded time at which the lamp reaches 70 percent lumen maintenance, whichever is of lesser value. See section III.D.3.g for more details on how lamp failure is recorded during lumen maintenance testing.

(2) If the test duration is greater than or equal to 3,000 and less than 6,000 hours:

The direct extrapolation method specified in section 5.1 of IES TM–28–14 may be utilized. The maximum time to failure claim is determined by multiplying the test duration by the limiting multiplier calculated in the following equation:

$$Limiting\ multiplier = \frac{1}{600} * test\ duration - 4$$

Where:

Test duration is expressed in hours

This equation is a linear function that equals one when the test duration is equal to 3,000 hours and six at 6,000 hours. As an example, if an LED lamp is tested for 4,500 hours, the maximum time to failure that could be reported based on this approach is only 15,750 hours (3.5 times the test duration of 4,500 hours). The limiting multiplier increases as the test duration increases until the test duration equals or exceeds 6,000 hours where it is set and remains at a value of six.

(3) If the test duration is greater than or equal to 6,000 hours:

The direct extrapolation method specified in section 5.1 of IES TM–28–14 may be utilized. The projected time to failure is limited to no more than six times the test duration.

DOE requests comment on referencing the direct extrapolation method specified in section 5.1 of IES TM–28–14 for projecting time to failure of LED lamps. DOE also seeks comment on the proposed modifications to project time to failure of each individual lamp (no averaging lumen maintenance values), lowering the test duration threshold to 3,000 hours for the direct extrapolation method, and the procedures for limiting the maximum time to failure claim.

E. Proposed Approach for Standby Mode Power

As explained in the June 2014 SNOPR, EPCA section 325(gg)(2)(A) directs DOE to establish test procedures to include standby mode, ''taking into consideration the most current versions of Standards 62301 and 62087 of the International Electrotechnical Commission. . . .'' (42 U.S.C. 6295(gg)(2)(A)) IEC Standard 62087 applies only to audio, video, and related equipment, but not to lighting equipment. As IEC Standard 62087 does not apply to this rulemaking, in the June 2014 SNOPR, DOE proposed procedures consistent with those outlined in IEC Standard 62301, which applies generally to household electrical

appliances. 79 FR 32035. However, to develop a test method that would be familiar to LED lamp manufacturers and maintain consistent requirements to the active mode test procedure, DOE referenced language and methodologies presented in IES LM–79–2008 for test conditions and test setup requirements.

In the June 2014 SNOPR, DOE noted that a standby mode power measurement is an input power measurement made while the LED lamp is connected to the main power source, but is not generating light (an active mode feature). DOE proposed in the June 2014 SNOPR that all test condition and test setup requirements used for active mode measurements (*e.g.,* input power) (see sections III.B.1 and III.B.2) also would apply to standby mode power measurements. Once the test conditions and setup have been implemented, the LED lamp would be stabilized in accordance with the requirements given for active mode measurements in the June 2014 SNOPR. After the lamp has stabilized, the technician would send a signal to the LED lamp instructing it to provide zero light output. The technician would then measure standby power in accordance with section 5 of IEC 62301. *Id.*

NEMA commented that requiring lumen output measurements to determine stability of standby mode operation is not necessary, and that electrical stabilization in the standby mode should be sufficient. (NEMA, No. 30 at p. 4) For standby mode, DOE is proposing to measure the power consumed, not the light output (light output is zero in standby mode by definition). Therefore, DOE agrees that requiring lumen output measurements to determine stability of standby mode operation is not necessary. Thus, DOE is revising the procedures for purposes of standby mode power measurement, and proposes that, once test conditions and setup have been implemented, the stabilization procedures in section III.C.4.b of the June 2014 SNOPR are required for input power only, not lumen output. 79 FR 32027. DOE requests comment on the proposal to determine stabilization for standby mode measurements using power measurements only.

NEMA also recommended that DOE revise its proposal in the June 2014 SNOPR to state that standby mode power measurements may be taken before or after active mode operation. NEMA reasoned that if stabilization of the light output of the lamp was not a necessary element of the stabilization procedure for standby mode measurements, that the sequence of standby and active mode measurements would not affect the measured values. (NEMA, No. 30 at p. 4) DOE agrees that the sequence of standby mode and certain active mode measurements should not affect the measured values. However, DOE does propose that standby mode measurements be completed before initiating lumen maintenance testing for determining time to failure. Therefore, DOE proposes to clarify that standby mode measurements may be taken before or after active mode measurements of lumen output, input power, CCT, CRI, power factor, and lamp efficacy, but must be taken before the active mode measurement of and calculation of time to failure.

F. Proposed Approach for Power Factor

DOE proposes to include a power factor measurement requirement, because power quality can impact energy consumption. Power factor is a dimensionless ratio of real power to apparent power, where real power is the measured input power of the LED lamp and apparent power is equal to the product of measured input current and input voltage. Power factor is not described directly in IES LM–79–08, but the instrumentation for measuring the values necessary for calculating power factor is specified.

DOE proposes to calculate power factor in this SNOPR by dividing input power by the product of input current and input voltage. Input power would be measured as proposed in the June 2014 SNOPR. 79 FR 32028. Following seasoning and stabilization, input current and input voltage to the LED lamp would be measured using the instrumentation specified in section 8.0 of IES LM–79–08. Input current and input voltage would be measured using the same test conditions and test setup as for lumen output, lamp efficacy, CCT, and CRI as proposed in the June 2014 SNOPR (79 FR 32023–26) and sections III.B.1 and III.B.2 of this SNOPR. DOE requests comment on the method of measuring and calculating power factor.

G. Basic Model, Minimum Sample Size, and Determination of Represented Values

1. Basic Model

In the June 2014 SNOPR, DOE proposed to revise the term ''basic model'' in 10 CFR 430.2 for LED lamps as follows: ''With respect to integrated light-emitting diode lamps: Lamps that have essentially identical light output and electrical characteristics—including lumens per watt (lm/W), color rendering index (CRI), correlated color temperature (CCT), and lifetime.'' 79 FR 32036. In their written comments, both OSI and NEMA agree with the revision to the definition of ''basic model.'' (OSI, No. 32 at p. 3; NEMA, No. 30 at p. 3) However, the Republic of Korea commented on DOE's definition that requires that manufacturers test the entire basic model, and that this may become burdensome particularly for lifetime testing. Therefore, it recommended that DOE align the basic model definition with that of the ENERGY STAR Program Requirements Product Specification for Lamps (Light Bulbs) Version 1.0, which requires a lifetime test only on representative model regardless of color temperature. (Republic of Korea, No. 37 at p. 2)

Upon further review, DOE determined that a revised definition of basic model specific to integrated LED lamps is not currently necessary for the general service lamp energy conservation rulemaking (see public docket EERE–2013–BT–STD–0051) and that LED lamps with different CCT, CRI, or lifetime could be categorized as the same basic model. All products included in a basic model must comply with the certified values, and products in the same basic model must also have the same light output and electrical characteristics (including lumens per watt) when represented in manufacturer literature. DOE requests comment on this revised proposal.

2. Minimum Sample Size

The June 2014 SNOPR proposed testing a minimum of ten LED lamps to determine the input power, lumen output, efficacy, CCT, CRI, lifetime, and standby mode power. DOE also proposed that all LED lamps within the sample, including those that fail prematurely, be included in the reported results for input power, lumen output, efficacy, CCT, CRI, lifetime, and standby mode power. LED lamp failure should not be exempt from reporting, because this would potentially mislead consumers. Furthermore, DOE proposed that sample units be randomly selected from production units. 79 FR 32036.

DOE determined that a minimum of ten LED lamps was appropriate, based on collected photometric test data from two sources: the first data set was provided by ENERGY STAR, and the second from a collaborative effort between Pacific Gas and Electric Company (hereafter referred to as PG&E), California Lighting Technology Center (hereafter referred to as CLTC), and the Collaborative Labeling and Appliance Standards Program (hereafter referred to as CLASP). These test data, combined, represent ten samples of 47 different LED lamp products each.

Statistical analysis of the LED lamp test data indicated that a minimum sample size of ten lamps is appropriate to estimate the average input power, initial lumen output, efficacy, CCT, and CRI given the variation present in the data set. Standby mode power is assumed to vary to the same degree as input power during active mode. In addition, 37 LED lamps from the data set were tested for lumen output after 3,000 hours of operation. DOE used this data to help determine the sample size required for estimating the lifetime of the LED lamp. Analysis of the test data revealed that a minimum sample size of ten should also be sufficient to estimate lumen output for the LED lamp after an elapsed operating time. In addition, requiring a minimum sample size of ten LED lamps aligns with ENERGY STAR's sampling procedure. *Id.*

Regarding the minimum sample size proposal, the Joint Comment and NEMA agreed with DOE's proposal to adopt a minimum sample size of ten LED lamps for input power, lumen output, CCT, CRI, lifetime, and standby mode. (Joint Comment, No. 34 at p. 1; NEMA, No. 30 at p. 3) In contrast, OSI and OSRAM Opto Semiconductors commented that in the industry standard IES TM–28–14, sample size affects the confidence level for lumen output maintenance projection. They, therefore, recommend that DOE adopt the sample size and associated projection time length in IES TM–28–14. (OSI, No. 32 at p. 3; OSRAM Opto Semiconductors, No. 33 at p. 4)

DOE maintains its proposal to require a sample size of at least ten LED lamps. As specified in section III.D.4.a, DOE proposes referencing Table 1 in section 5.1.5 of IES TM–28–14, which states that the projected time to failure is limited to no more than six times the test duration for sample sizes greater than or equal to ten. However, to account for the increased uncertainty in lowering the threshold for the direct extrapolation method to 3,000 hours, DOE proposes to reduce the maximum time to failure claims for test durations less than 6,000 hours, as discussed in section III.E.4.b. Therefore, DOE retains the proposal that a minimum of ten LED lamps must be tested to determine the input power, lumen output, efficacy, CCT, CRI, lifetime, and standby mode power. DOE also proposes that a minimum of ten LED lamps must be tested to determine power factor.

Regarding inclusion of all 10 lamps in the reported results, NEMA commented that DOE should follow the current practice of the ENERGY STAR lamps specification v1.1 and allow for early failure for one of ten samples. That is, one of the ten samples could be excluded from calculation of lumen maintenance and any projected values. NEMA cited reduced regulatory burden as a benefit to harmonizing DOE's test procedure with ENERGY STAR. (NEMA, No. 39 at p. 1) DOE's view has not changed from the June 2014 SNOPR and is that LED lamp failure should not be exempt from reporting, because this would potentially mislead consumers, particularly with respect to lamp lifetime. DOE will work with ENERGY STAR to harmonize its test procedure with that proposed here, including sampling and sample size.

3. Determination of Represented Values

In the June 2014 SNOPR, DOE proposed calculations to determine represented values for CCT, lumen output, lifetime, CRI, and efficacy using a lower confidence limit (LCL) equation, and input power and standby mode power using an upper confidence limit (UCL) equation. 79 FR 32037. LED lamp test data provided by ENERGY STAR as well as PG&E, CLASP, and CLTC were used to derive the confidence level and sample mean divisor for each metric. Descriptions of each of the LCL and UCL calculations are provided below.

DOE proposed in the June 2014 SNOPR that the CCT of the units be averaged and that average be rounded as specified in the June 2014 SNOPR. 79 FR 32038. The average CCT would be calculated using the following equation:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

where, $\bar{x}$ is the sample mean; n is the number of units; and x_i is the i^{th} unit.

DOE proposed in the June 2014 SNOPR that the represented value of lumen output be equal to or less than the lower of the average lumen output of the sample set and the 99 percent LCL of the sample mean divided by 0.97. Additionally, DOE proposed that the represented value of CRI be equal to the lower of the average CRI of the sample set and the 99 percent LCL of the sample mean divided by 0.99, and that the represented value of efficacy be equal to the lower of the average efficacy of the sample set and the 99 percent LCL of the sample mean divided by 0.98. DOE proposed the following equation to calculate LCL for lumen output, CRI, and efficacy:

$$LCL = \bar{x} - t_{0.99}\left(\frac{s}{\sqrt{n}}\right)$$

where, $\bar{x}$ is the sample mean; s is the sample standard deviation; n is the number of samples; and $t_{0.99}$ is the t statistic for a 99 percent one-tailed confidence interval with n-1 degrees of freedom.

DOE also proposed in the June 2014 SNOPR that the represented value of input power and standby mode power be equal to or greater than the greater of the average lumen output of the sample set and the 99 percent UCL of the sample mean divided by 1.01. DOE proposed the following equation to calculate UCL:

$$UCL = \bar{x} + t_{0.99}\left(\frac{s}{\sqrt{n}}\right)$$

where, $\bar{x}$ is the sample mean; s is the sample standard deviation; n is the number of samples; and $t_{0.99}$ is the t statistic for a 99 percent one-tailed confidence interval with n-1 degrees of freedom.

Additionally in the lifetime SNOPR, DOE proposed that the definition of lifetime should be revised to better align with the EPCA definition of lifetime in 42 U.S.C. 6291(30)(P). 79 FR 36243. Therefore, as described in section III.C.1, DOE added that the lifetime of an integrated LED lamp is calculated by determining the median time to failure of the sample (calculated as the arithmetic mean of the time to failure of the two middle sample units when the numbers are sorted in value order). All comments received for DOE's proposed definition of lifetime are summarized and addressed in section III.C.1.

Cree, OSI, and NEMA commented that DOE should use a 95 percent confidence limit instead of 99 percent confidence limit for all represented values. (OSI, No. 32 at p. 4; Cree, No. 31 at p. 1; NEMA, No. 30 at p. 5) Additionally, NEMA recommended that DOE modify the Certification, Compliance, and Enforcement (hereafter referring to as CC&E) requirements at 10 CFR 429 to set tolerances based on expected measurement and product variation as set forth in NEMA LSD 63–2012. NEMA also contended that DOE's use of the LCL equation together with a divisor is statistically invalid. It suggested that DOE's equation eliminates the statistical confidence level associated with the estimated quantity and therefore no longer accounts for uncertainties related to both lamp manufacturing and testing. However, if DOE retains the LCL and divisor statistical representation, NEMA requested that DOE then use the recommendations presented in NEMA LSD 63–2012 and refer to its comments in previous rulemakings to properly set the value of the divisor. NEMA also suggested a formula to calculate the divisor for efficacy reporting, and expressed concerns regarding any future minimum lamp efficacy performance

requirements set by DOE. It argued that maximum technology levels need to be considered if DOE retains the LCL and divisor statistical representation. NEMA suggested that DOE keep minimum efficacy performance requirements for LED lamps between 9 and 13 percent below maximum technology levels, or accept NEMA's recommendation for compliance tolerances. (NEMA, No. 30 at p. 6)

DOE is maintaining its proposal to use a 99 percent LCL. However, DOE proposes to revise the divisor value to be computed using the maximum rather than average standard deviation of the collected LED lamp test data. The new divisor values for each metric are provided below:

Metric	LCL or UCL divisor value
Lumen Output	0.96
Input Power	1.02
Efficacy	0.96
CRI	0.98

Furthermore, DOE disagrees with NEMA's assertion, and continues to find that the LCL equation and divisor adequately address variation in lamp manufacturing and testing. DOE used the same methodology recommended by NEMA in LSD–63–2012 in the June 2014 SNOPR. However, DOE calculated a different standard deviation based on data provided by ENERGY STAR as well as PG&E, CLASP, and CLTC. DOE found the variation in test data for a single lamp model to be less than that provided by NEMA in LSD–63–2012. As described in the June 2014 SNOPR, certification testing is permitted to take place at one test laboratory and the sample set is unlikely to include inter-lab variability. Therefore, DOE does not include an inter-lab variability parameter in its calculation of the divisor when establishing rating requirements that are based on certification testing for which the manufacturer chooses the lab to conduct such testing. DOE will establish efficacy requirements within the GSL energy conservation standards rulemaking.[17]

Finally, DOE also proposes in this SNOPR to include represented value instructions for representations of power factor. Power factor is calculated using electrical measurements, including measurement of input power. DOE expects power factor to exhibit the same variability as input power, and bases the represented value calculation on that proposed for input power. Consumers prefer smaller values of input power, while larger values of power factor are preferred. Therefore, DOE inverted the input power represented value requirements from a UCL and divisor to an LCL and divisor. Input power uses a UCL of 99 percent and a divisor of 1.02, therefore, DOE proposes the corresponding LCL of 99 percent and divisor of 0.98 for the represented value of power factor.

DOE requests comment on the proposal for represented value calculation and specifically the revised divisors and new power factor represented value calculation in this SNOPR.

H. Rounding Requirements

In the June 2014 SNOPR, DOE proposed rounding requirements for lumen output, input power, efficacy, CCT, CRI, estimated annual energy cost, lifetime, and standby mode power. DOE received comments on some of these proposals and these comments are discussed in the following sections. DOE also discusses a new proposal regarding rounding requirements for power factor.

1. Lumen Output

In the June 2014 SNOPR, DOE proposed that the lumen output of all units be averaged and the value be rounded to three significant figures. 79 FR 32037. Based on a review of commercially available LED lamp products as well as testing equipment measurement capabilities, DOE determined that three significant figures is an achievable level of accuracy for LED lamps. NEMA commented that rounding to three significant figures does not provide a similar level of specificity for lumen outputs of all sizes as claimed by DOE, indicating that for small light sources, the resolution of photometric measurement is not sufficient for three-digit accuracy. Both OSI and NEMA recommended using Table 8–1 of LSD 63–2012 for reporting rounded values of lumen output. (OSI, No. 32 at p. 4; NEMA, No. 30 at pp. 4–5)

DOE agrees that rounding requirements should reflect realistic expectations of accuracy and repeatability. Based on a review of commercially available LED lamp products as well as testing equipment measurement capabilities, DOE maintains its determination in the June 2014 SNOPR that three significant figures is an achievable level of accuracy for LED lamps. Therefore, for this SNOPR, DOE continues to propose rounding of three significant figures [18] for lumen outputs of all sizes.

2. Correlated Color Temperature

In the June 2014 SNOPR, DOE proposed to round CCT values for individual units to the tens place and round the certified CCT values for the sample to the hundreds place. 79 FR 32038. DOE received comments from OSI, the Republic of Korea, and NEMA, recommending reporting nominal CCT based on the tolerance specified in Table 1 of ANSI C78.377. (OSI, No. 32 at p. 4; Republic of Korea, No. 37 at p. 2; NEMA, No. 30 at p. 4) However, as indicated in section III.B.3.c, DOE is not proposing to follow a nominal CCT methodology and therefore continues to propose rounding to the nearest tens digit for measurements of individual lamp units, and that certified CCT values for the sample be rounded to the hundreds place.

3. Lifetime

In the June 2014 SNOPR, DOE proposed that lifetime of LED lamps be rounded to the nearest whole hour. 79 FR 32038. NEMA commented that rounding to the nearest hour is not meaningful, and suggested that two significant digits is sufficient for lifetime rounding. (NEMA, No. 30 at p. 5) However, DOE maintains that rounding to the nearest whole hour is consistent with the unit of time used for lifetime metrics for other lamp technologies, and is a level of accuracy a laboratory is capable of measuring with a standard time-keeping device. Therefore, in this SNOPR, DOE retains the proposal that lifetime of LED lamps be rounded to the nearest whole hour.

4. Power Factor

DOE proposes that power factor be rounded to the nearest hundredths place, consistent with common usage in industry literature. DOE requests comment on this rounding proposal for power factor.

I. Interaction with ENERGY STAR

In the June 2014 SNOPR, to reduce test burden, DOE proposed allowing measurements collected for the ENERGY STAR Program Requirements Product Specification for Lamps (Light Bulbs) Version 1.0 to be used for calculating represented values of lumen output, input power, lamp efficacy, CCT, CRI, and lifetime. Both Cree and NEMA agreed with the allowance of using measurements collected for ENERGY STAR program requirements.

[17] Documents for the GSL rulemaking are available at *http://www.regulations.gov/#!docketDetail;D=EERE-2013-BT-STD-0051.*

[18] If the number 3,563 is rounded to three significant digits it becomes 3,560—with the 3, 5, and 6 being the significant digits.

(Cree, No. 31 at p. 1; NEMA, No. 30 at p. 4) However, the Republic of Korea suggested that DOE align all test procedures for LED lamps with those presented in the ENERGY STAR Program Requirements Product Specification for Lamps (Light Bulbs) Version 1.0. It indicated that having different test methods is burdensome for manufacturers and creates confusion. (Republic of Korea, No. 37 at p. 2)

In this SNOPR, DOE proposes a new test procedure for lifetime that is largely based on the recent published IES LM–84–14 and IES TM–28–14 industry standards and provides a simple, straightforward, and flexible test procedure to account for potential future changes in the lifetime of LED products.

DOE notes that the proposal in this SNOPR projects time to failure based on data obtained for each individual LED lamp rather than assuming the same relationship between test duration and lumen maintenance applies to every LED lamp. Because DOE has revised its approach for lifetime measurement and projection, there is no longer significant similarity between the DOE and ENERGY STAR lifetime test procedures. DOE will work with ENERGY STAR to revise the test procedures for lifetime accordingly.

Measurements collected for the ENERGY STAR Program Requirements Product Specification for Lamps (Light Bulbs) Version 1.0 can be used for calculating represented values of energy efficiency or consumption metrics covered by the DOE test procedure as long as those measurements were collected in accordance with the DOE test procedure. Manufacturers must make representations in accordance with the DOE test procedure and represented value determination method beginning 180 days after publication of the final rule in the **Federal Register**.

J. Laboratory Accreditation

Regarding the National Voluntary Laboratory Accreditation Program (NVLAP) accreditation, in the June 2014 SNOPR DOE proposed to require lumen output, input power, lamp efficacy, CCT, CRI, lifetime, and standby mode power (if applicable) testing be conducted by test laboratories accredited by NVLAP or an accrediting organization recognized by the International Laboratory Accreditation Cooperation (ILAC). 79 FR 32039. NVLAP is a member of ILAC, so test data collected by any laboratory accredited by an accrediting body recognized by ILAC would be acceptable. Soraa, OSI, NEMA, and ILAC agreed with the proposal in the June 2014 SNOPR. (Soraa, No. 28 at p. 3; OSI, No. 32 at p. 4; NEMA, No. 30 at p. 4; ILAC, No. 26 at p. 1) Therefore, DOE maintains its proposal to require accreditation by NVLAP or an entity recognized by ILAC. DOE also proposes to state directly that accreditation by and Accreditation Body that is a signatory member to the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement (MRA) is an acceptable means of laboratory accreditation. In addition, DOE proposes to require that testing for power factor be conducted by test laboratories accredited by NVLAP or an entity recognized by ILAC.

K. Certification

DOE is proposing certification requirements for LED lamps in this SNOPR. Manufacturers will not have to certify values to DOE unless standards are promulgated for LED lamps as part of the rulemaking for general service lamps. However, DOE is providing certification requirements and the ability to certify by CCMS to enable FTC to allow manufacturers to submit data through DOE's Compliance Certification Management System (CCMS) related to FTC labeling requirements. Where the proposal is discussed in mandatory terms, the certification requirements would not be required for DOE purposes until compliance with standards is required.

DOE recognizes that testing of LED lamp lifetime requires considerably more time than testing of other LED lamp metrics. DOE proposes to allow new basic models of LED lamps to be distributed prior to completion of the full testing for lifetime. Similar to treatment of GSFLs and incandescent reflector lamps in 10 CFR 429.12(e)(2), DOE proposes that prior to distribution of the new basic model of LED lamp, manufacturers must submit an initial certification report. If testing for time to failure is not complete, manufacturers may include estimated values for lifetime and life. If reporting estimated values, the certification report must state the description of the prediction method and the prediction method must be generally representative of the methods specified in appendix BB. Manufacturers are also required to maintain records per 10 CFR 429.71 of the development of all estimated values and any associated initial test data. If reporting estimated values for lifetime and life, the certification report must indicate that the values are estimated until testing for time to failure is complete. If, prior to completion of testing, a manufacturer ceases to distribute in commerce a basic model, the manufacturer must submit a full certification report and provide all of the information listed in 10 CFR 429.12(b), including the product-specific information required by 10 CFR 429.56(b)(2), as part of its notification to DOE that the model has been discontinued.

DOE requests comment on the proposed certification report requirements.

L. Effective and Compliance Date

If adopted, the effective date for this test procedure would be 30 days after publication of the test procedure final rule in the **Federal Register**. Pursuant to EPCA, manufacturers of covered products must use the applicable test procedure as the basis for determining that their products comply with the applicable energy conservation standards adopted pursuant to EPCA and for making representations about the efficiency of those products. (42 U.S.C. 6293(c); 42 U.S.C. 6295(s)) For those energy efficiency or consumption metrics covered by the DOE test procedure, manufacturers must make representations in accordance with the DOE test procedure and represented value determination method beginning 180 days after publication of the final rule in the **Federal Register**.

M. Description of Standards Incorporated by Reference

In this SNOPR, DOE proposes to incorporate by reference the test standard published by ANSI and IES, titled ''Nomenclature and Definitions for Illuminating Engineering,'' ANSI/IES RP–16–2010. ANSI/IES RP–16–2010 is an industry accepted standard that specifies definitions related to lighting and is applicable to products sold in North America. The definition of integrated LED lamp proposed in this SNOPR references ANSI/IES RP–16–2010. ANSI/IES RP–16–2010 is readily available on IES's Web site at *http://www.ies.org/*.

DOE also proposes to incorporate by reference the test standard published by IES, titled ''Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products,'' IES LM–79–2008. IES LM–79–2008 is an industry accepted standard that specifies test methods for determination of lumen output, input power, lamp efficacy, CCT, and CRI and is applicable to LED lamp products sold in North America. The test procedure for lumen output, input power, lamp efficacy, CCT, and CRI proposed in this SNOPR references IES LM–79–2008. IES

LM–79–2008 is readily available on IES's Web site at *http://www.ies.org/*.

DOE also proposes to incorporate by reference the test standard published by IES, titled ''Approved Method: Measuring Luminous Flux and Color Maintenance of LED Lamps, Light Engines, and Luminaires,'' IES LM–84–2014. IES LM–84–2014 is an industry accepted standard that specifies test methods for determination of lumen maintenance and is applicable to LED lamp products sold in North America. The test procedure for lifetime proposed in this SNOPR references IES LM–84–2014. IES LM–84–2014 is readily available on IES's Web site at *http://www.ies.org/*.

DOE also proposes to incorporate by reference the test standard published by IES, titled ''Projecting Long-Term Luminous Flux Maintenance of LED Lamps and Luminaires,'' IES TM–28–14. IES TM–28–14 is an industry accepted standard that specifies test methods for projection of lumen maintenance and is applicable to LED lamp products sold in North America. The test procedure for lifetime proposed in this SNOPR references IES TM–28–14. IES TM–28–14 is readily available on IES's Web site at *http://www.ies.org/*.

N. Ceiling Fan Light Kits using LED Lamps

DOE proposed to harmonize the lamp testing procedures for lamps, including LEDs, used in ceiling fan lights kits in a notice published on October 31, 2014. 79 FR 64688 (Docket EERE–2013–BT–TP–0050). The comments received as part of that docket were generally supportive of this approach and are discussed as part of that rulemaking docket. Since the test procedure for LED lamps is still being considered as part of this rulemaking, DOE is proposing to revise the appropriate cross-reference (relative to the proposals at 79 FR 64688 (October 31, 2014)) in the ceiling fan light kit test procedure appendix as part of this rulemaking. DOE requests comments on this approach and adopting the cross reference for LED lamps used in CFLKs as part of this rulemaking.

IV. Procedural Issues and Regulatory Review

A. Review Under Executive Order 12866

The Office of Management and Budget (OMB) has determined that test procedure rulemakings do not constitute ''significant regulatory actions'' under section 3(f) of Executive Order 12866, Regulatory Planning and Review, 58 FR 51735 (Oct. 4, 1993). Accordingly, this action was not subject to review under the Executive Order by the Office of Information and Regulatory Affairs (OIRA) in OMB.

B. Review under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) requires preparation of an initial regulatory flexibility analysis (IRFA) for any rule that by law must be proposed for public comment, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. As required by Executive Order 13272, ''Proper Consideration of Small Entities in Agency Rulemaking,'' 67 FR 53461 (August 16, 2002), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the DOE rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel's Web site: *http://energy.gov/gc/office-general-counsel*.

DOE reviewed the test procedures considered in this SNOPR under the provisions of the Regulatory Flexibility Act (RFA) and the policies and procedures published on February 19, 2003. As discussed in more detail in the following sections, DOE found that because the proposed test procedures have not previously been required of manufacturers, all manufacturers, including small manufacturers, may potentially experience a financial burden associated with this new testing requirement. While examining this issue, DOE determined that it could not certify that the proposed rule, if promulgated, would not have a significant impact on a substantial number of small entities. Therefore, DOE has prepared an IRFA for this rulemaking. The IRFA describes the potential impacts on small businesses associated with LED lamp testing requirements. DOE has transmitted a copy of this IRFA to the Chief Counsel for Advocacy of the Small Business Administration (SBA) for review.

1. Estimated Small Business Burden

SBA has set a size threshold for electric lamp manufacturers to describe those entities that are classified as ''small businesses'' for the purposes of the RFA. DOE used the SBA's small business size standards to determine whether any small manufacturers of LED lamps would be subject to the requirements of the rule. 65 FR 30836, 30849 (May 15, 2000), as amended at 65 FR 53533, 53545 (Sept. 5, 2000) and codified at 13 CFR part 121. The size standards are listed by North American Industry Classification System (NAICS) code and industry description and are available at *www.sba.gov/sites/default/files/Size_Standards_Table.pdf*. LED lamp manufacturing is classified under NAICS 335110, ''Electric Lamp Bulb and Part Manufacturing.'' The SBA sets a threshold of 1,000 employees or fewer for an entity to be considered a small business for this category.

For the June 2014 SNOPR, DOE examined the number of small businesses that will potentially be affected by the LED lamps test procedure. This evaluation revealed that the test procedure requirements proposed in the June 2014 SNOPR will apply to about 41 small business manufacturers of LED lamps. DOE compiled this list of manufacturers by reviewing the DOE LED Lighting Facts label list of partner manufacturers,[19] the SBA database, ENERGY STAR's list of qualified products,[20] and performing a general search for LED manufacturers. DOE determined which companies manufacture LED lamps by reviewing company Web sites, the SBA Web site when applicable, calling companies directly, and/or reviewing the Hoovers Inc. company profile database. Through this process, DOE identified 41 small businesses that manufacture LED lamps, each offering about 23 different basic models.[21] NEMA suggested that DOE contact Jim Brodrick, Program Manager of DOE's solid-state lighting (SSL) program, to review the estimate for total number of small businesses that will likely be affected by implementing this test procedure. (NEMA, No. 30 at p. 4) DOE has incorporated feedback from DOE's SSL program, and maintains its estimate for the number of small businesses that would be affected by the proposed rulemaking.

In the June 2014 SNOPR, DOE estimated that the labor costs associated with conducting the input power, lumen output, CCT, CRI, and standby mode power testing is $31.68 per hour. 79 FR 32041. Calculating efficacy of an LED lamp was determined not to result in any incremental testing burden beyond the cost of carrying out lumen output and input power testing. DOE also expected standby mode power testing to require a negligible incremental amount of time in addition to the time required for the other

[19] DOE LED Lighting Facts Partner List, *http://www.lightingfacts.com/Partners/Manufacturer*.

[20] ENERGY STAR Qualified Lamps Product List, *http://downloads.energystar.gov/bi/qplist/Lamps_Qualified_Product_List.xls?dee3-e997*.

[21] The median revenue for these small businesses can be found in the June 2014 SNOPR. 79 FR 32040.

metrics. In total, DOE estimated that using the June 2014 SNOPR test method to determine light output, input power, CCT, CRI, and standby mode power would result in an estimated incremental labor burden of $29,140 for each manufacturer.

The June 2014 SNOPR also estimated that lifetime testing would also contribute to overall cost burden. The initial setup including the cost to custom build test racks capable of holding 23 different LED lamp models, each tested in sample sets of ten lamps (a total of 230 LED lamps) would be $25,800. 79 FR 32041. The labor cost for lifetime testing was also determined to contribute to overall burden. DOE estimated that the combination of monitoring the lamps during the test duration, measuring lumen maintenance, and calculating lifetime at the end of the test duration would require approximately four hours per lamp by an electrical engineering technician. DOE estimated that using this test method to determine lifetime would result in testing-related labor costs of $29,140 for each manufacturer. 79 FR 32041.

Because NVLAP [22] imposes a variety of fees during the accreditation process, including fixed administrative fees, variable assessment fees, and proficiency testing fees, DOE also provided cost estimates for light output, input power, CCT, CRI, lifetime, and standby mode power (if applicable) testing to be NVLAP-accredited or accredited by an organization recognized by NVLAP. Assuming testing instrumentation is already available, in the June 2014 SNOPR, DOE estimated the first year NVLAP accreditation cost would be $15,320, initial setup cost would be $25,800, and the labor costs to carry out testing would be approximately $58,280 for each manufacturer producing 23 basic models. 79 FR 32042. Therefore, in the first year, for manufacturers without testing racks or NVLAP accreditation who choose to test in house, DOE estimated a total cost burden of $99,400, or about $432 per LED lamp tested. Alternatively, if a manufacturer opts to send lamps to a third-party test facility, DOE estimated testing of lumen output, input power, CCT, CRI, lifetime, and standby mode power to cost $500 per lamp. In total, DOE estimated in the June 2014 SNOPR that the LED lamp test procedure would result in expected third-party testing costs of $115,000 for each manufacturer for 23 basic models. 79 FR 32042.

Both OSI and NEMA commented that most established manufacturers participate in the ENERGY STAR program, and therefore manufacturers already incur the testing costs. (OSI, No. 32 at p. 4; NEMA, No. 30 at p. 4) In contrast, Soraa commented that it estimates its testing costs at approximately $50,000 per year for each model of LED lamp, not including internal costs. (Soraa, No. 28 at p. 3)

Regarding Soraa's cost estimate, DOE reviewed its cost estimates for the proposals in this SNOPR and determined that the majority of the assumptions involved are still appropriate. DOE tentatively concluded that calculation of power factor represented no incremental burden over the estimate in the June 2014 SNOPR, because the calculation is simple and the measurements needed would already be available using the input power test setup. However, for the lifetime test procedure described in section III.D of this SNOPR, a lumen output measurement is required to be recorded for multiple time intervals at a minimum of every 1,000 hours of elapsed operating time. This represents an increase in the number of required measurements in the lifetime test procedure compared to the previous proposal. Therefore, DOE estimates that the combination of monitoring the lamps during the test duration, measuring lumen maintenance at multiple time intervals, and calculating lifetime at the end of the test duration would increase the labor hour requirements from approximately four hours to eight hours per lamp. With this updated assumption DOE estimates that using the test method proposed in this SNOPR to determine lifetime would result in testing-related labor costs of $58,280 for each manufacturer.

Therefore, in the first year, for manufacturers without testing racks or NVLAP accreditation who choose to test in-house, DOE estimated a maximum total cost burden of $128,540, or about $559 per LED lamp tested. DOE expects the setup cost to be a onetime cost to manufacturers. Further, the labor costs to perform testing would likely be smaller than $87,430 after the first year because only new products or redesigned products would need to be tested. DOE estimates that the cost to send lamps to a third-party test facility would be $600 per lamp due to the additional required measurements in the lifetime test procedure. In total, the LED lamp test procedure would result in expected third-party testing costs of $138,000 for each manufacturer who produces 23 basic models. DOE notes this is not an annual cost.

Regarding OSI and NEMA's comment, DOE agrees that the cost estimates described in this section are much larger than the actual cost increase most manufacturers will experience. DOE notes that the majority of manufacturers are already testing for lumen output, input power, CCT, and CRI, as these metrics are well established and required within the industry standard IES LM–79–2008. The IES LM–79–2008 standard is also the recommended standard for testing LED lamps for the FTC Lighting Facts label as well as the ENERGY STAR program. Most manufacturers of LED lamps already participate in the ENERGY STAR program, which includes requirements for lifetime, input power, lumen output, CCT, and CRI. While DOE's proposed test procedure differs from ENERGY STAR in some respects, DOE expects the incremental difference in testing costs under the two test procedures to be significantly less than full cost of testing under the proposed DOE test procedure. This is because most manufacturers already own the requisite test equipment (*e.g.,* test racks) and already have labor expenditures corresponding to carrying out testing for ENERGY STAR. DOE and ENERGY STAR testing costs would not be additive, because ENERGY STAR references DOE test procedures where they exist and revises its specification to reference new DOE test procedures when they are finalized.[23] Based on these revisions, manufacturers would not need to complete separate testing for the ENERGY STAR and DOE programs.

DOE invites all interested parties to provide comments, including specific data and rationale if they recommend DOE revise its cost estimate. As part of any comments submitted on the potential small business impacts, it would be helpful if impacted entities were to describe any cost estimates as compared to their current business (*e.g.,* a general comparison to the annual revenues and how this proposal would impact their business for an example manufacturer), including any suggested alternatives DOE should consider to potentially mitigate burden.

[22] As discussed in section III.J, laboratories can be accredited by any accreditation body that is a signatory member to the ILAC MRA. DOE based its estimate of the costs associated with accreditation on the NVLAP accreditation body.

[23] ENERGY STAR published a second draft of its Lamps Version 2.0 specification on April 10, 2015 and included the following note on page 2: ''In an effort to provide partners with continuity and honor the Agency's intention to harmonize with applicable DOE Test Procedures, this Draft proposes to allow for use of the final test procedure for LED Lamps once it is published by DOE, where applicable.''

2. Duplication, Overlap, and Conflict With Other Rules and Regulations

DOE is not aware of any rules or regulations that duplicate, overlap, or conflict with this proposed rule.

3. Significant Alternatives to the Proposed Rule

DOE tentatively determined that there are no better alternatives to the proposed test procedure, including test procedures that incorporate industry test standards, other than the proposed methods. IES LM–79–2008, the test procedure referenced in this SNOPR for the proposed approach for determining lumen output, input power, lamp efficacy, CCT, CRI, and power factor, is the most commonly used industry standard that provides instructions for the electrical and photometric measurement of LED lamps. This SNOPR also references IES LM–84–14 and IES–TM–28–14, which represent new industry guidance for measuring and projecting lumen maintenance. While the ENERGY STAR Program Requirements Product Specification for Lamps (Light Bulbs) Version 1.1 presents a separate method for testing the lifetime of LED lamps, proposing a lifetime test procedure based on IES LM–84–14 and IES–TM–28–14 will align with current industry consensus on this subject. The lifetime test procedure proposed in this SNOPR will produce more accurate lifetime estimates than the method currently used for ENERGY STAR certification because this SNOPR projects time to failure based on data obtained for each individual LED lamp.

C. Review Under the Paperwork Reduction Act of 1995

DOE established regulations for the certification and recordkeeping requirements for certain covered consumer products and commercial equipment. 76 FR 12422 (March 7, 2011). The collection-of-information requirement for the certification and recordkeeping was subject to review and approval by OMB under the Paperwork Reduction Act (PRA). This requirement was approved by OMB under OMB Control Number 1910–1400.

DOE requested OMB approval of an extension of this information collection for three years, specifically including the collection of information proposed in the present rulemaking, and estimated that the annual number of burden hours under this extension is 30 hours per company. In response to DOE's request, OMB approved DOE's information collection requirements covered under OMB control number 1910–1400 through November 30, 2017. 80 FR 5099 (January 30. 2015).

Notwithstanding any other provision of the law, no person is required to respond to, nor must any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the PRA, unless that collection of information displays a currently valid OMB Control Number.

D. Review Under the National Environmental Policy Act of 1969

In this proposed rule, DOE is proposing a test procedure for LED lamps that will be used to support the upcoming general service lamps energy conservation standard rulemaking as well as FTC's Lighting Facts labeling program. DOE has determined that this rule falls into a class of actions that are categorically excluded from review under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq.*) and DOE's implementing regulations at 10 CFR part 1021. Specifically, this proposed rule would adopt existing industry test procedures for LED lamps, so it would not affect the amount, quality or distribution of energy usage, and, therefore, would not result in any environmental impacts. Thus, this rulemaking is covered by Categorical Exclusion A5 under 10 CFR part 1021, subpart D. Accordingly, neither an environmental assessment nor an environmental impact statement is required.

E. Review Under Executive Order 13132

Executive Order 13132, ''Federalism,'' 64 FR 43255 (August 4, 1999) imposes certain requirements on agencies formulating and implementing policies or regulations that preempt State law or that have Federalism implications. The Executive Order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and to carefully assess the necessity for such actions. The Executive Order also requires agencies to have an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have Federalism implications. On March 14, 2000, DOE published a statement of policy describing the intergovernmental consultation process it will follow in the development of such regulations. 65 FR 13735. DOE has examined this proposed rule and has determined that it would not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the products that are the subject of today's proposed rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6297(d)) No further action is required by Executive Order 13132.

F. Review Under Executive Order 12988

Regarding the review of existing regulations and the promulgation of new regulations, section 3(a) of Executive Order 12988, ''Civil Justice Reform,'' 61 FR 4729 (Feb. 7, 1996), imposes on Federal agencies the general duty to adhere to the following requirements: (1) Eliminate drafting errors and ambiguity; (2) write regulations to minimize litigation; (3) provide a clear legal standard for affected conduct rather than a general standard; and (4) promote simplification and burden reduction. Section 3(b) of Executive Order 12988 specifically requires that Executive agencies make every reasonable effort to ensure that the regulation: (1) Clearly specifies the preemptive effect, if any; (2) clearly specifies any effect on existing Federal law or regulation; (3) provides a clear legal standard for affected conduct while promoting simplification and burden reduction; (4) specifies the retroactive effect, if any; (5) adequately defines key terms; and (6) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. Section 3(c) of Executive Order 12988 requires Executive agencies to review regulations in light of applicable standards in sections 3(a) and 3(b) to determine whether they are met or it is unreasonable to meet one or more of them. DOE has completed the required review and determined that, to the extent permitted by law, the proposed rule meets the relevant standards of Executive Order 12988.

G. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA) requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. Public Law 104–4, sec. 201 (codified at 2 U.S.C. 1531). For a proposed regulatory action likely to result in a rule that may cause the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector of $100 million or more in any one year (adjusted annually for

inflation), section 202 of UMRA requires a Federal agency to publish a written statement that estimates the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a), (b)) The UMRA also requires a Federal agency to develop an effective process to permit timely input by elected officers of State, local, and Tribal governments on a proposed ''significant intergovernmental mandate,'' and requires an agency plan for giving notice and opportunity for timely input to potentially affected small governments before establishing any requirements that might significantly or uniquely affect small governments. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR 12820; also available at *http://energy.gov/gc/office-general-counsel.* DOE examined this proposed rule according to UMRA and its statement of policy and determined that the rule contains neither an intergovernmental mandate nor a mandate that may result in the expenditure of $100 million or more in any year, so these requirements do not apply.

H. Review Under the Treasury and General Government Appropriations Act, 1999

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. 105–277) requires Federal agencies to issue a Family Policymaking Assessment for any rule that may affect family well-being. This rule would not have any impact on the autonomy or integrity of the family as an institution. Accordingly, DOE has concluded that it is not necessary to prepare a Family Policymaking Assessment.

I. Review Under Executive Order 12630

DOE has determined, under Executive Order 12630, ''Governmental Actions and Interference with Constitutionally Protected Property Rights'' 53 FR 8859 (March 18, 1988) that this regulation would not result in any takings that might require compensation under the Fifth Amendment to the U.S. Constitution.

J. Review Under Treasury and General Government Appropriations Act, 2001

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516 note) provides for agencies to review most disseminations of information to the public under guidelines established by each agency pursuant to general guidelines issued by OMB. OMB's guidelines were published at 67 FR 8452 (Feb. 22, 2002), and DOE's guidelines were published at 67 FR 62446 (Oct. 7, 2002). DOE has reviewed the proposed rule under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

K. Review Under Executive Order 13211

Executive Order 13211, ''Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use,'' 66 FR 28355 (May 22, 2001), requires Federal agencies to prepare and submit to OMB a Statement of Energy Effects for any proposed significant energy action. A ''significant energy action'' is defined as any action by an agency that promulgated or is expected to lead to promulgation of a final rule, and that: (1) Is a significant regulatory action under Executive Order 12866, or any successor order; and (2) is likely to have a significant adverse effect on the supply, distribution, or use of energy; or (3) is designated by the Administrator of OIRA as a significant energy action. For any proposed significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use should the proposal be implemented, and of reasonable alternatives to the action and their expected benefits on energy supply, distribution, and use.

This proposed regulatory action to establish a test procedure for measuring the lumen output, input power, lamp efficacy, CCT, CRI, power factor, lifetime, and standby mode power of LED lamps is not a significant regulatory action under Executive Order 12866. Moreover, it would not have a significant adverse effect on the supply, distribution, or use of energy, nor has it been designated as a significant energy action by the Administrator of OIRA. Therefore, it is not a significant energy action, and, accordingly, DOE has not prepared a Statement of Energy Effects.

L. Review Under Section 32 of the Federal Energy Administration Act of 1974

Under section 301 of the Department of Energy Organization Act (Pub. L. 95–91; 42 U.S.C. 7101), DOE must comply with section 32 of the Federal Energy Administration Act of 1974, as amended by the Federal Energy Administration Authorization Act of 1977. (15 U.S.C. 788; FEAA) Section 32 essentially provides in relevant part that, where a proposed rule authorizes or requires use of commercial standards, the notice of proposed rulemaking must inform the public of the use and background of such standards. In addition, section 32(c) requires DOE to consult with the Attorney General and the Chairman of the FTC concerning the impact of the commercial or industry standards on competition.

The proposed rule incorporates test methods contained in the following commercial standards: ANSI/IES RP–16–2010, ''Nomenclature and Definitions for Illuminating Engineering;'' IES LM–79–2008, ''Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products;'' IES LM–84–14, ''Approved Method: Measuring Luminous Flux and Color Maintenance of LED Lamps, Light Engines, and Luminaires;'' and IES TM–28–14, ''Projecting Long-Term Luminous Flux Maintenance of LED Lamps and Luminaires.'' The Department has evaluated these standards and is unable to conclude whether they fully comply with the requirements of section 32(b) of the FEAA, (*i.e.,* that they were developed in a manner that fully provides for public participation, comment, and review). DOE will consult with the Attorney General and the Chairman of the FTC concerning the impact of these test procedures on competition prior to prescribing a final rule.

V. Public Participation

A. Submission of Comments

DOE will accept comments, data, and information regarding this proposed rule no later than the date provided in the **DATES** section at the beginning of this proposed rule. Interested parties may submit comments using any of the methods described in the **ADDRESSES** section at the beginning of this notice.

Submitting comments via regulations.gov. The regulations.gov Web page will require you to provide your name and contact information. Your contact information will be viewable to DOE Building Technologies staff only. Your contact information will not be publicly viewable except for your first and last names, organization name (if any), and submitter representative name (if any). If your comment is not processed properly because of technical difficulties, DOE will use this information to contact you. If DOE cannot read your comment due to technical difficulties and cannot contact you for clarification, DOE may not be able to consider your comment.

However, your contact information will be publicly viewable if you include it in the comment or in any documents attached to your comment. Any information that you do not want to be

publicly viewable should not be included in your comment, nor in any document attached to your comment. Persons viewing comments will see only first and last names, organization names, correspondence containing comments, and any documents submitted with the comments.

Do not submit to regulations.gov information for which disclosure is restricted by statute, such as trade secrets and commercial or financial information (hereafter referred to as confidential business information or CBI). Comments submitted through regulations.gov cannot be claimed as CBI. Comments received through the Web site will waive any CBI claims for the information submitted. For information on submitting CBI, see the Confidential Business Information section.

DOE processes submissions made through regulations.gov before posting. Normally, comments will be posted within a few days of being submitted. However, if large volumes of comments are being processed simultaneously, your comment may not be viewable for up to several weeks. Please keep the comment tracking number that regulations.gov provides after you have successfully uploaded your comment.

Submitting comments via email, hand delivery, or mail. Comments and documents submitted via email, hand delivery, or mail also will be posted to regulations.gov. If you do not want your personal contact information to be publicly viewable, do not include it in your comment or any accompanying documents. Instead, provide your contact information on a cover letter. Include your first and last names, email address, telephone number, and optional mailing address. The cover letter will not be publicly viewable as long as it does not include any comments.

Include contact information each time you submit comments, data, documents, and other information to DOE. If you submit via mail or hand delivery, please provide all items on a CD, if feasible. It is not necessary to submit printed copies. No facsimiles (faxes) will be accepted.

Comments, data, and other information submitted to DOE electronically should be provided in PDF (preferred), Microsoft Word or Excel, WordPerfect, or text (ASCII) file format. Provide documents that are written in English, free of any defects or viruses, and not secured. Documents should not contain special characters or any form of encryption and, if possible, they should carry the electronic signature of the author.

Campaign form letters. Please submit campaign form letters by the originating organization in batches of between 50 and 500 form letters per PDF, or as one form letter with a list of supporters' names compiled into one or more PDFs. This reduces comment processing and posting time.

Confidential business information. According to 10 CFR 1004.11, any person submitting information that he or she believes to be confidential and exempt by law from public disclosure should submit via email, postal mail, or hand delivery two well-marked copies: one copy of the document marked confidential including all the information believed to be confidential, and one copy of the document marked non-confidential with the information believed to be confidential deleted. Submit these documents via email or on a CD, if feasible. DOE will make its own determination about the confidential status of the information and treat it according to its determination.

Factors of interest to DOE when evaluating requests to treat submitted information as confidential include: (1) A description of the items; (2) whether and why such items are customarily treated as confidential within the industry; (3) whether the information is generally known by or available from other sources; (4) whether the information has previously been made available to others without obligation concerning its confidentiality; (5) an explanation of the competitive injury to the submitting person which would result from public disclosure; (6) when such information might lose its confidential character due to the passage of time; and (7) why disclosure of the information would be contrary to the public interest.

It is DOE's policy that all comments may be included in the public docket, without change and as received, including any personal information provided in the comments (except information deemed to be exempt from public disclosure).

B. Issues on Which DOE Seeks Comment

Although DOE welcomes comments on any aspect of this proposal, DOE is particularly interested in receiving comments and views of interested parties concerning the following issues:

1. Whether industry standards or test methods are available for measuring color quality metrics other than CRI. The proposed incorporation of IES LM–84–14 and IES TM–28–14 for measuring and projecting the lumen maintenance of LED lamps.

2. The proposal of referencing section 4.0 of IES LM–84–14 for specifying the ambient conditions for lumen maintenance testing of LED lamps.

3. The lumen maintenance test procedure.

4. The proposal to adopt the section 5.2 of IES LM–84–14 requirements for AC power supplies, and on the requirement that input voltage be monitored and regulated to within less than or equal to 2.0 percent of the rated RMS voltage as specified in section 5.4 of IES LM–84–14. DOE also invites comments on the proposal to exclude the line impedance guidelines provided in section 5.3 of IES LM–84–14.

5. The proposal to adopt section 5.5 of IES LM–84–14, which provides test rack wiring requirements during lumen maintenance testing of LED lamps.

6. Referencing the lamp handling and tracking proposal specified in sections 7.2 and 7.3 of IES–LM–84–14.

7. The proposal to adopt the time recording procedures in section 7.5 of IES–LM–84–14.

8. The proposal that, for the case in which lumen maintenance testing results in complete loss of light output, the time to failure is equal to the last elapsed operating time measurement for which the recorded lumen output measurement is greater than or equal to 70 percent.

9. The proposal that all lumen maintenance data shall be collected at least once every 1,000 hours, as well as the adoption of the data collection requirements specified in section 4.2 of IES TM–28–14.

10. The proposal to reference the direct extrapolation method specified in section 5.1 of IES TM–28–14 for projecting time to failure of LED lamps, as well as the proposed modifications to project time to failure of each individual lamp (no averaging lumen maintenance values), the proposal to lower the test duration threshold to 3,000 hours, and the proposed procedures for limiting the maximum time to failure claim.

11. The proposal to determine stabilization for standby mode measurements using power measurements only.

12. The proposed measurement and calculation of power factor of LED lamps.

13. The proposal to revise the basic model definition in 10 CFR 430.2 with respect to LED lamps as follows: ''With respect to integrated light-emitting diode lamps: Lamps that have identical lumens per watt (lm/W).''

14. The proposed represented value calculation and specifically the revised divisors for lumen output, input power, efficacy, and CRI, and the new power factor represented value calculation proposed in this SNOPR.

15. The proposed rounding requirements for power factor.

16. The analysis of initial setup and labor costs as well as the average annual burden for conducting testing of LED lamps.

VI. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of this proposed rule.

List of Subjects

10 CFR Part 429

Confidential business information, Energy conservation, Household appliances, Imports, Reporting and recordkeeping requirements.

10 CFR Part 430

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Imports, Incorporation by reference, Intergovernmental relations, Small businesses.

Issued in Washington, DC on June 25, 2015.

Kathleen B. Hogan,

Deputy Assistant Secretary for Energy Efficiency, Energy Efficiency and Renewable Energy.

For the reasons stated in the preamble, DOE is proposing to amend parts 429 and 430 of Chapter II, Subchapter D, of Title 10, of the Code of Federal Regulations, as set forth below:

PART 429—CERTIFICATION, COMPLIANCE, AND ENFORCEMENT FOR CONSUMER PRODUCTS AND COMMERCIAL AND INDUSTRIAL EQUIPMENT

■ 1. The authority citation for part 429 continues to read as follows:

Authority: 42 U.S. C. 6291–6317.

■ 2. Section 429.12(f) is revised to read as follows:

§ 429.12 General requirements applicable to certification reports.

* * * * *

(f) *Discontinued model filing.* When production of a basic model has ceased and it is no longer being sold or offered for sale by the manufacturer or private labeler, the manufacturer must report this discontinued status to DOE as part of the next annual certification report following such cessation. For each basic model, the report shall include the information specified in paragraphs (b)(1) through (7) of this section, except that for integrated light-emitting diode lamps, the manufacturer must submit a full certification report, including all of the information required by paragraph (b) of this section and the product-specific information required by § 429.56(b)(2).

* * * * *

■ 3. Section 429.33 is amended by revising paragraphs (a)(2)(ii), (a)(3)(iv), and (a)(3)(vi) [proposed at 79 FR 64688 (October 31, 2014)] to read as follows:

§ 429.33 Ceiling fan light kits.

(a) * * *

(2) * * *

(ii) For ceiling fan light kits with medium screw base sockets that are packaged with integrated light-emitting diode lamps, the represented values of each basic model of lamp packaged with the ceiling fan light kit shall be determined in accordance with § 429.56.

* * * * *

(3) * * *

(iv) For ceiling fan light kits packaged with integrated LED lamps, the represented values of each basic model of lamp shall be determined in accordance with § 429.56.

* * * * *

(vi) For ceiling fan light kits packaged with other SSL lamps (not integrated LED lamps), the represented values of each basic model of lamp shall be determined in accordance with § 429.56.

* * * * *

■ 4. Section 429.56 is added to read as follows:

§ 429.56 Integrated light-emitting diode lamps.

(a) *Determination of represented value.* Manufacturers must determine the represented value, which includes the certified rating, for each basic model of integrated light-emitting diode lamps by testing, in conjunction with the sampling provisions in this section.

(1) *Units to be tested.*

(i) The general requirements of § 429.11(a) are applicable except that the sample must be comprised of production units; and

(ii) For each basic model of integrated light-emitting diode lamp, the minimum number of units tested shall be no less than 10 and the same sample comprised of the same units must be used for testing all metrics. If more than 10 units are tested as part of the sample, the total number of units must be a multiple of two. For each basic model, a sample of sufficient size shall be randomly selected and tested to ensure that:

(A) Represented values of initial lumen output, lamp efficacy, color rendering index (CRI), power factor, or other measure of energy consumption of a basic model for which consumers would favor higher values must be less than or equal to the lower of:

(*1*) The mean of the sample, where:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

and, $\bar{x}$ is the sample mean; n is the number of units; and x_i is the i^{th} unit; or,

(*2*) The lower 99 percent confidence limit (LCL) of the true mean divided by 0.96; or the lower 99 percent confidence limit (LCL) of the true mean divided by 0.98 for CRI and power factor, where:

$$LCL = \bar{x} - t_{0.99}\left(\frac{s}{\sqrt{n}}\right)$$

and, $\bar{x}$ is the sample mean; s is the sample standard deviation; n is the number of samples; and $t_{0.99}$ is the t statistic for a 99 percent one-tailed confidence interval with n–1 degrees of freedom (from appendix A to this subpart).

(B) Represented values of input power, standby mode power or other measure of energy consumption of a basic model for which consumers would favor lower values must be greater than or equal to the higher of:

(*1*) The mean of the sample, where:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

and, $\bar{x}$ is the sample mean; n is the number of units; and x_i is the i^{th} unit; or,

(*2*) The upper 99 percent confidence limit (UCL) of the true mean divided by 1.02, where:

$$UCL = \bar{x} + t_{0.99}\left(\frac{s}{\sqrt{n}}\right)$$

and, $\bar{x}$ is the sample mean; s is the sample standard deviation; n is the number of samples; and $t_{0.99}$ is the t statistic for a 99 percent one-tailed confidence interval with n–1 degrees of freedom (from appendix A to this subpart);

(C) Represented values of correlated color temperature (CCT) of a basic model must be equal to the mean of the sample, where:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

and, $\bar{x}$ is the sample mean; n is the number of units; and x_i is the ith unit.

(D) The lifetime of an integrated light-emitting diode lamp is calculated by determining the median time to failure of the sample (calculated as the arithmetic mean of the time to failure of the two middle sample units when the numbers are sorted in value order) rounded to the nearest hour. Represented values of lifetime cannot exceed the calculated lifetime of an integrated light-emitting diode lamp.

(2) The represented value of life (in years) of an integrated light-emitting

diode lamp must be calculated by dividing the lifetime of an integrated light-emitting diode lamp by the estimated annual operating hours as specified in 16 CFR 305.15(b)(3)(iii).

(3) The represented value of estimated annual energy cost for an integrated light-emitting diode lamp, expressed in dollars per year, must be the product of the input power in kilowatts, an electricity cost rate as specified in 16 CFR 305.15(b)(1)(ii), and an estimated average annual use as specified in 16 CFR 305.15(b)(1)(ii).

(b) *Certification reports.* (1) The requirements of § 429.12 are applicable to integrated light-emitting diode lamps;

(2) Values reported in certification reports are represented values. Lifetime and life are estimated values until testing is complete. When reporting estimated values, the certification report must specifically describe the prediction method, which must be generally representative of the methods specified in appendix BB. Manufacturers are required to maintain records per 10 CFR 429.71 of the development of all estimated values and any associated initial test data. Pursuant to § 429.12(b)(13), a certification report shall include the following public product-specific information: The testing laboratory's NVLAP identification number or other NVLAP-approved accreditation identification, the date of first manufacture, initial lumen output, input power, lamp efficacy, CCT, power factor, lifetime (and whether value is estimated), and life (and whether value is estimated). For lamps with multiple modes of operation (such as variable CCT or CRI), the certification report must also list which mode was selected for testing and include detail such that another laboratory could operate the lamp in the same mode.

(c) *Rounding requirements.*

(1) Round input power to the nearest tenth of a watt.

(2) Round lumen output to three significant digits.

(3) Round lamp efficacy to the nearest tenth of a lumen per watt.

(4) Round correlated color temperature to the nearest 100 Kelvin.

(5) Round color rendering index to the nearest whole number.

(6) Round power factor to the nearest hundredths place.

(7) Round lifetime to the nearest whole hour.

(8) Round standby mode power to the nearest tenth of a watt.

PART 430—ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

■ 5. The authority citation for part 430 continues to read as follows:

Authority: 42 U.S.C. 6291–6309; 28 U.S.C. 2461 note.

■ 6. Section 430.2 is amended by adding in alphabetical order the definitions of ''Integrated light-emitting diode lamp'' and ''Lifetime of an integrated light-emitting diode lamp'' to read as follows:

§ 430.2 Definitions.

* * * * *

Integrated light-emitting diode lamp means an integrated LED lamp as defined in ANSI/IES RP–16 (incorporated by reference; see § 430.3).

* * * * *

Lifetime of an integrated light-emitting diode lamp means the length of operating time between first use and failure of 50 percent of the sample units (as defined in § 429.56(a)(1)), in accordance with the test procedures described in section 4 of appendix BB to subpart B of part 430 of this chapter.

* * * * *

■ 7. Section 430.3 is amended by:

■ a. Adding paragraphs (o)(8) through (11); and

■ b. Removing ''and X'' in paragraph (p)(4) and adding in its place, ''X, and BB''.

The additions read as follows:

§ 430.3 Materials incorporated by reference.

* * * * *

(o) * * *

(8) IES LM–79–08 (''IES LM–79''), Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products, approved December 31, 2007; IBR approved for appendix BB to subpart B of this part.

(9) IES LM–84–14 (''IES LM–84''), Approved Method: Measuring Luminous Flux and Color Maintenance of LED Lamps, Light Engines, and Luminaires, approved March 31, 2014; IBR approved for appendix BB to subpart B of this part.

(10) ANSI/IES RP–16–2010, Nomenclature and Definitions for Illuminating Engineering, published July 1, 2010; IBR approved for § 430.2.

(11) IES TM–28–14 (''IES TM–28''), Projecting Long-Term Luminous Flux Maintenance of LED Lamps and Luminaires, approved May 20, 2014; IBR approved for appendix BB to subpart B of this part.

* * * * *

■ 8. Section 430.23 is amended by:

■ a. Revising paragraphs (x)(1)(ii) and (x)(2)(iv) [proposed at 79 FR 64688 (October 31, 2014)]; and

■ b. Adding paragraph (dd).

These revisions and addition read as follows:

§ 430.23 Test procedures for the measurement of energy and water consumption.

* * * * *

(x) * * *

(1) * * *

(ii) For a ceiling fan light kit with medium screw base sockets that is packaged with integrated LED lamps, measure lamp efficacy in accordance with paragraph (dd) of this section.

* * * * *

(2) * * *

(iv) For a ceiling fan light kit packaged with integrated LED lamps, measure lamp efficacy in accordance with paragraph (dd) of this section.

* * * * *

(dd) *Integrated light-emitting diode lamp.* (1) The input power of an integrated light-emitting diode lamp must be measured in accordance with section 2.7 of appendix BB of this subpart. Individual unit input power must be rounded to the nearest tenth of a watt.

(2) The lumen output of an integrated light-emitting diode lamp must be measured in accordance with section 3 of appendix BB of this subpart. Individual unit lumen output must be rounded to three significant digits.

(3) The lamp efficacy of an integrated light-emitting diode lamp must be calculated in accordance with section 3 of appendix BB of this subpart. Individual unit lamp efficacy must be rounded to the nearest tenth of a lumen per watt.

(4) The correlated color temperature of an integrated light-emitting diode lamp must be measured in accordance with section 3 of appendix BB of this subpart. Individual unit correlated color temperature must be rounded to the nearest 10 Kelvin.

(5) The color rendering index of an integrated light-emitting diode lamp must be measured in accordance with section 3 of appendix BB of this subpart. Individual unit color rendering index must be rounded to the nearest whole number.

(6) The time to failure of an integrated light-emitting diode lamp must be measured in accordance with section 4 of appendix BB of this subpart. Individual unit time to failure must be rounded to the nearest hour.

(7) The power factor of an integrated light-emitting diode lamp must be measured in accordance with section 4

of appendix BB of this subpart. Individual unit power factor must be rounded to the nearest tenths place.

(8) The standby mode power must be measured in accordance with section 5 of appendix BB of this subpart. Individual unit standby mode power must be rounded to the nearest tenth of a watt.

■ 9. Section 430.25 is revised to read as follows:

§ 430.25 Laboratory Accreditation Program.

The testing for general service fluorescent lamps, general service incandescent lamps (with the exception of lifetime testing), incandescent reflector lamps, medium base compact fluorescent lamps, fluorescent lamp ballasts, and integrated light-emitting diode lamps must be conducted by test laboratories accredited by an Accreditation Body that is a signatory member to the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement (MRA). A manufacturer's or importer's own laboratory, if accredited, may conduct the applicable testing.

■ 10. Appendix BB to subpart B of part 430 is added to read as follows:

Appendix BB to Subpart B of Part 430—Uniform Test Method for Measuring the Input Power, Lumen Output, Lamp Efficacy, Correlated Color Temperature (CCT), Color Rendering Index (CRI), Power Factor, Time to Failure, and Standby Mode Power of Integrated Light-Emitting Diode (LED) Lamps

Note: After [Date 180 Days after Publication of Final Rule in the **Federal Register**], any representations made with respect to the energy use or efficiency of integrated light-emitting diode lamps must be made in accordance with the results of testing pursuant to this appendix.

1. *Scope:* This appendix specifies how to measure input power, lumen output, lamp efficacy, CCT, CRI, power factor, time to failure, and standby mode power for integrated LED lamps.

2. *Definitions*

2.1. The definitions specified in section 1.3 of IES LM–79 except section 1.3(f) (incorporated by reference; see § 430.3) apply.

2.2. *Initial lumen output* means the measured lumen output after the lamp is initially energized and stabilized using the stabilization procedures in section 3 of this appendix.

2.3. *Interval lumen output* means the measured lumen output at constant intervals after the initial lumen output measurement in accordance with section 3 of this appendix.

2.4. *Lamp efficacy* means the ratio of measured initial lumen output in lumens to the measured lamp input power in watts, in units of lumens per watt.

2.5. *Rated input voltage* means the voltage(s) marked on the lamp as the intended operating voltage. If not marked on the lamp, assume 120 V.

2.6. *Test duration* means the operating time of the LED lamp after the initial lumen output measurement and before, during, and including the final lumen output measurement, in units of hours.

2.7. *Time to failure* means the time elapsed between first use and the point at which the lamp reaches 70 percent lumen maintenance as measured in section 4 of this appendix.

3. *Active Mode Test Method for Determining Lumen Output, Input Power, CCT, CRI, Power Factor, and Lamp Efficacy*

In cases where there is a conflict, the language of the test procedure in this appendix takes precedence over IES LM–79 (incorporated by reference; see § 430.3).

3.1. *Test Conditions and Setup*

3.1.1. Establish the ambient conditions, power supply, electrical settings, and instrumentation in accordance with the specifications in sections 2.0, 3.0, 7.0, and 8.0 of IES LM–79 (incorporated by reference; see § 430.3), respectively. The ambient temperature must be maintained at 25 °C ± 1 °C.

3.1.2. Position an equal number of integrated LED lamps in the base up and base down orientations throughout testing; if the position is restricted by the manufacturer, test units in the manufacturer-specified position.

3.1.3. Operate the integrated LED lamp at the rated voltage throughout testing. For an integrated LED lamp with multiple rated voltages including 120 volts, operate the lamp at 120 volts. If an integrated LED lamp with multiple rated voltages is not rated for 120 volts, operate the lamp at the highest rated input voltage. Additional tests may be conducted at other rated voltages.

3.1.4. Operate the lamp at the maximum input power. If multiple modes occur at the same maximum input power (such as variable CCT or CRI), the manufacturer can select any of these modes for testing; however, all measurements described in sections 3 and 4 of this appendix must be taken at the same selected mode. The manufacturer must indicate in the test report which mode was selected for testing and include detail such that another laboratory could operate the lamp in the same mode.

3.2. *Test Method, Measurements, and Calculations*

3.2.1. The test conditions and setup described in section 3.1 of this appendix apply to this section 3.2.

3.2.2. Stabilize the integrated LED lamp prior to measurement as specified in section 5.0 of IES LM–79 (incorporated by reference; see § 430.3). Calculate the stabilization variation as [(maximum − minimum)/minimum] of at least three readings of the input power and lumen output over a period of 30 minutes, taken 15 minutes apart.

3.2.3. Measure the input power in watts as specified in section 8.0 of IES LM–79 (incorporated by reference; see § 430.3).

3.2.4. Measure the input voltage in volts as specified in section 8.0 of IES LM–79 (incorporated by reference; see § 430.3).

3.2.5. Measure the input current in amps as specified in section 8.0 of IES LM–79 (incorporated by reference; see § 430.3).

3.2.6. Measure lumen output as specified in section 9.1 and 9.2 of IES LM–79 (incorporated by reference; see § 430.3). Do not use goniophotometers.

3.2.7. Determine CCT according to the method specified in section 12.0 of IES LM–79 (incorporated by reference; see § 430.3) with the exclusion of section 12.2 and 12.5 of IES LM–79. Do not use goniophotometers.

3.2.8. Determine CRI according to the method specified in section 12.0 of IES LM–79 (incorporated by reference; see § 430.3) with the exclusion of section 12.2 and 12.5 of IES LM–79. Do not use goniophotometers.

3.2.9. Determine lamp efficacy by dividing measured initial lumen output by the measured input power.

3.2.10. Determine power factor by dividing measured input power by the product of the measured input voltage and measured input current.

4. *Active Mode Test Method to Measure Time to Failure*

In cases where there is a conflict, the language of the test procedure in this appendix takes precedence over IES LM–84 (incorporated by reference; see § 430.3) and IES TM–28 (incorporated by reference; see § 430.3).

4.1. *Lamp Handling, Tracking, and Time Recording*

4.1.1. Handle, transport, and store the integrated LED lamp as described in section 7.2 of IES LM–84 (incorporated by reference; see § 430.3).

4.1.2. Mark and track the integrated LED lamp as specified in section 7.3 of IES LM–84 (incorporated by reference; see § 430.3).

4.1.3. Measure elapsed operating time only when the LED lamps are operating. Calibrate all equipment used for measuring elapsed operating time to have a total minimum temporal resolution with a tolerance of 0.5%, as described in section 7.5 of IES LM–84 (incorporated by reference; see § 430.3).

4.1.4. Check the integrated LED lamps regularly for failure either by visual observation or automatic monitoring, at a minimum, at the start of time to failure testing and during every interval measurement.

4.2. *Measure Initial Lumen Output.* Measure the initial lumen output according to section 3 of this appendix.

4.3. *Test Duration.* Operate the integrated LED lamp for a period of time (the test duration) after the initial lumen output measurement and before, during, and including the final lumen output measurement.

4.3.1. There is no minimum test duration requirement for the integrated LED lamp. The test duration is selected by the manufacturer. See section 4.6 of this appendix for instruction on the maximum time to failure.

4.3.2. The test duration only includes time when the integrated LED lamp is energized and operating.

4.4. *Operating Conditions and Setup Between Lumen Output Measurements*

4.4.1. Electrical settings must be as described in section 5.1 of IES LM–84 (incorporated by reference; see § 430.3).

4.4.2. Ambient temperature conditions must be as described in section 4.4 of IES LM–84 (incorporated by reference; see § 430.3). Maintain the ambient temperature at 25 °C ± 5 °C.

4.4.3. Humidity in the testing environment must be as described in section 4.5 of IES LM–84 (incorporated by reference; see § 430.3).

4.4.4. Air movement around each lamp must be as described in section 4.6 of IES LM–84 (incorporated by reference; see § 430.3).

4.4.5. Position an equal number of integrated LED lamps in the base up and base down orientations throughout testing; if the manufacturer restricts the position, test the units in the manufacturer-specified position.

4.4.6. Operate the lamp at the rated input voltage as described in section 3.1.3 of this appendix for the entire test duration.

4.4.7. Line voltage waveshape must be as described in section 5.2 of IES LM–84 (incorporated by reference; see § 430.3).

4.4.8. Monitor and regulate rated input voltage as described in section 5.4 of IES LM–84 (incorporated by reference; see § 430.3).

4.4.9. Operate LED lamps as specified in section 7.4 of IES LM–84 (incorporated by reference; see § 430.3).

4.5. Measure Interval Lumen Output. Measure interval lumen output according to section 2.7 of this appendix.

4.5.1. Record interval lumen output and elapsed operating time as described in section 4.2 of IES TM–28 (incorporated by reference; see § 430.3).

4.5.1.1. For test duration values greater than or equal to 3,000 hours and less than 6,000 hours, measure lumen maintenance of the integrated LED lamp at an interval in accordance with section 4.2.2 of IES TM–28 (incorporated by reference; see § 430.3).

4.5.1.2. For test duration values greater than or equal to 6,000 hours, measure lumen maintenance at an interval in accordance with section 4.2.1 of IES TM–28 (incorporated by reference; see § 430.3).

4.6. *Calculate Lumen Maintenance and Time to Failure*

4.6.1. Calculate the lumen maintenance of the lamp at each interval by dividing the interval lumen output ''x_t'' by the initial lumen output ''x_0''. Measure initial and interval lumen output in accordance with sections 4.2 and 4.5 of this appendix, respectively.

4.6.2. For lumen maintenance values less than 0.7, including lamp failures that result in complete loss of light output, time to failure is equal to the previously recorded lumen output measurement at a shorter test duration where the lumen maintenance is greater than or equal to 70 percent.

4.6.3. For lumen maintenance values equal to 0.7, time to failure is equal to the test duration.

4.6.4. For lumen maintenance values greater than 0.7, use the following method:

4.6.4.1. For test duration values less than 3,000 hours, do not project time to failure. Time to failure equals the test duration.

4.6.4.2. For test duration values greater than or equal to 3,000 hours but less than 6,000 hours, time to failure is equal to the lesser of the projected time to failure calculated according to section 4.6.4.2.1 of this appendix or the test duration multiplied by the limiting multiplier calculated in section 4.6.4.2.1.

4.6.4.2.1. Project time to failure using the projection method described in section 5.1.4 of IES TM–28 (incorporated by reference; see § 430.3). Project time to failure for each individual LED lamp. Data used for the time to failure projection method must be as specified in section 5.1.3 of IES TM–28 (incorporated by reference; see § 430.3).

4.6.4.2.2. Calculate the limiting multiplier from the following equation:

Limiting multiplier = 1/600 * test duration − 4

4.6.4.3. For test duration values greater than 6,000 hours, time to failure is equal to the lesser of the projected time to failure calculated according to section 4.6.4.3.1 or the test duration multiplied by six.

4.6.4.3.1. Project time to failure using the projection method described in section 5.1.4 of IES TM–28 (incorporated by reference; see § 430.3). Project time to failure for each individual LED lamp. Data used for the time to failure projection method must be as specified in section 5.1.3 of IES TM–28 (incorporated by reference; see § 430.3).

5. *Standby Mode Test Method for Determining Standby Mode Power*

Measure standby mode power consumption for integrated LED lamps capable of operating in standby mode. The standby mode test method in this section 5 may be completed before or after the active mode test method for determining lumen output, input power, CCT, CRI, power factor, and lamp efficacy in section 3 of this appendix. The standby mode test method in this section 5 must be completed before the active mode test method for determining time to failure in section 4 of this appendix. In cases where there is a conflict, the language of the test procedure in this appendix takes precedence over IES LM–79 (incorporated by reference; see § 430.3) and IEC 62301 (incorporated by reference; see § 430.3).

5.1. *Test Conditions and Setup*

5.1.1. Establish the ambient conditions, power supply, electrical settings, and instrumentation in accordance with the specifications in sections 2.0, 3.0, 7.0, and 8.0 of IES LM–79 (incorporated by reference; see § 430.3), respectively. Maintain the ambient temperature at 25 °C ± 1 °C.

5.1.2. Position an equal number of integrated LED lamps in the base up and base down orientations throughout testing.

5.1.3. Operate the integrated LED lamp at the rated voltage throughout testing. For an integrated LED lamp with multiple rated voltages, operate the integrated LED lamp at 120 volts. If an integrated LED lamp with multiple rated voltages is not rated for 120 volts, operate the integrated LED lamp at the highest rated input voltage.

5.2. *Test Method, Measurements, and Calculations*

5.2.1. The test conditions and setup described in section 3.1 of this appendix apply to this section 5.1.3.

5.2.2. Stabilize the integrated LED lamp prior to measurement as specified in section 5.0 of IES LM–79 (incorporated by reference; see § 430.3). Calculate the stabilization variation as [(maximum − minimum)/minimum] of at least three readings of the input power over a period of 30 minutes, taken 15 minutes apart.

5.2.3. Configure the integrated LED in standby mode by sending a signal to the integrated LED lamp instructing it to have zero light output.

5.2.4. Measure the standby mode power in watts as specified in section 5 of IEC 62301 (incorporated by reference; see § 430.3).

[FR Doc. 2015–16477 Filed 7–8–15; 8:45 am]

BILLING CODE 6450–01–P