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In the matter of:	)	Docket No. 17-AAER-12
	)	
Phase 2 Appliance Efficiency Roadmaps	)	Request for Public Comment on
	)	Low Power Mode Test Procedure
	)	Discussion Document
	)	RE: Phase 2 Appliance Efficiency
_____	)	Roadmaps

Request for Public Comment on Low Power Mode Test Procedure Discussion Document

California Energy Commission staff requests information from interested parties as it considers establishing test procedures for low power mode (LPM) of consumer electronics and appliances. Interested parties must submit comments to the Docket Unit by:

Tuesday, August 7, 2018
5:00 p.m. (PDT)
(Instructions below)

Background

The Energy Commission is in the early stages of establishing an energy savings roadmap for consumer electronics and appliances in their standby, idle, or in general LPM. To do so, the Energy Commission is considering collecting data to characterize LPM power draw for a wide variety of products using a common test procedure. Although an international test procedure for standby power exists, supplemental instructions, especially related to how the product is set up, are necessary for robust and repeatable testing.

The Energy Commission, therefore, seeks further information from stakeholders to develop a consensus LPM test procedure, which will allow subsequent collection of the required data on the performance and energy use of products in LPM.

<u>Existing Test Protocols</u>

The International Electrotechnical Commission (IEC) 62301, as an established international test procedure for LPMs, provides sufficient instructions for making

measurements once the product under test is set up; however, it lacks setup instructions that apply to a broad scope of products and their relevant secondary functions. These instructions are necessary to ensure that products are tested in a consistent and repeatable manner, and cover important operating conditions.

Several international standards, including the European Union's Ecodesign standby power requirements and broadband code of conduct, as well as ENERGY STAR® test methods, have setup conditions that are applicable to these efforts. In some situations, however, new or modified instructions may be required to create more consistent and replicable outcomes.

Discussion Document

Attachment A to this notice outlines a proposed test procedure discussion document for all electrical devices. Attachment B to this notice contains a list of questions and issues on which the Energy Commission seeks feedback. The Commission will consider all information received when developing its draft test procedure for LPM. Stakeholders will have additional opportunities to comment on the draft test procedure before it is finalized.

Public Comment

Written comments and/or proposals should be submitted to the Dockets Unit by **5:00 p.m. on August 7, 2018**.

Please note that your written comments, attachments, and any associated contact information (e.g., your address, phone number, email address) contained in the comment become part of the viewable public record. This information may become available via Google, Yahoo, and any other search engines.

The Energy Commission encourages use of its electronic commenting system. Visit the website at http://www.energy.ca.gov/appliances/2017-AAER-06-13/17-AAER-12.html.

This link will take you to the page for adding comments to this docket. Please enter your contact information, any organization name, and a comment title describing the subject of your comments. You may include comments in the box titled "Comment Text" or attach a file in a downloadable, **searchable format** in Microsoft® Word (.doc, .docx) or Adobe® Acrobat® (.pdf). Maximum file size is 10 MB.

Written comments may also be submitted by emailing them (include the docket number 17-AAER-12 and "Phase 2 Pre-Rulemaking Low Power Mode & Power Factor" in the subject line) to the Docket Unit at:

docket@energy.ca.gov

If you prefer, you may send a paper copy of your comments to:

California Energy Commission
Docket Unit, MS-4
Re: Docket No. 17-AAER-12
1516 Ninth Street
Sacramento, CA 95814-5512

Public Adviser and Other Commission Contacts

The Energy Commission's Public Adviser's Office provides the public assistance in participating in Energy Commission proceedings. If you want information on how to participate in this forum, please contact the Public Adviser, Alana Mathews, at PublicAdviser@energy.ca.gov or (916) 654-4489, or toll free at (800) 822-6228.

If you have a disability and require assistance to participate, please contact Poneh Jones at poneh.jones@energy.ca.gov or (916) 654-4425 at least five days in advance.

Media inquiries should be sent to the Media and Public Communications Office at mediaoffice@energy.ca.gov or (916) 654-4989.

If you have questions on the subject matter of this meeting, please contact Soheila Pasha at Soheila.Pasha@energy.ca.gov or (916) 657-1002.

Availability of Documents

Documents related to the Energy Commission's Low Power Mode and Power Factor roadmaps will be available online at https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=17-AAER-12.

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ATTACHMENT A
Test Procedure Discussion Draft

The proposed low power mode (LPM) test procedure for all electrical devices is outlined in the following sections. Note that sections 1-3 and 10 apply to both small network equipment (SNE) and edge devices while sections 4-9 apply to edge devices only.

For the context of this document, the term edge devices is in reference to devices that provide energy services to users as described in IEA 4E Standby Annex paper[1]. Edge devices include appliances and consumer electronics that have network connections.

1. Provisioning the Product

Upon first use, some products may require software updates or other provisioning. The test procedure should allow enough time for the product to carry out these activities.

2. Testing State

The Energy Commission is formulating guidance on how to put the product under test into one LPM state for testing. For individual products, the testing state is usually a defined mode. For this horizontal effort, however, defining a mode for the testing may be burdensome because each product may require its own mode definition. To make this test procedure broadly applicable to a wide range of product types, the Commission is considering an approach where LPM is not defined as a specific mode, but rather a particular state that is reached when the user has not interacted with the product for a defined amount of time. This is similar to the U.S. Environmental Protection Agency's (EPA) approach in the ENERGY STAR imaging equipment test method. To put products into that state, the Commission is considering the following instructions:

- After putting the product into an active mode, discontinue the primary function of the product and then cease interaction with the product.
- After X minutes without user interaction or other conditions that would cause the product to power up, including environmental or internal conditions, measure LPM power according to IEC 62301.
- If the product has the ability to manually enter LPM, place the product into LPM manually and conduct a second LPM power measurement using IEC 62301.

3. Network Connections

The test procedure will require setup instructions for testing SNE as well as edge devices with network functionality.

A. Traffic Content and Levels:

The Energy Commission assumes that in LPM, SNE and edge devices maintain a network connection, and potentially communicate with other devices on a network.

[1] https://standby.iea-4e.org/files/otherfiles/0000/0104/Network_Standby_Report_Final.pdf

Thus, test conditions should ensure that the link is maintained and the product is able to run routine communications.

The Energy Commission is aware of some approaches to maintain the link. In its SNE test method, ENERGY STAR requires power measurements of SNE in a variety of states and corresponding data rate: 1) idle state: 0 kb/s; 2) low data rate state: 1 kb/s (0.5 kb/s in each direction).[2] The data packets are sent evenly up and down in a variety of frame sizes at random intervals over user datagram protocol (UDP). The European Union's broadband code of conduct describes a state in which the product under test is ready to detect network activity, but not processing or transmitting a significant amount of traffic.

The minimal traffic conditions that maintain the link, or the idle and low data rate states used by ENERGY STAR may be too restrictive to capture the behavior of products in LPM. For example, a product may report air temperature to a cloud service periodically. Therefore, the Energy Commission proposes that during the test, the product should be allowed to communicate as it would under normal operating conditions. Although it may be necessary to prescribe a small amount of incoming traffic to make sure the product doesn't wake up with inapplicable traffic, the Commission does not see the need to prescribe outbound traffic for testing SNE and edge devices.

B. Configuration Requirements

A variety of network connection set up instructions exist for edge devices, most prevalently in ENERGY STAR test methods for electronic products. These instructions provide minimal configuration requirements. The ENERGY STAR test method for SNE, on the other hand, provides detailed instructions on setting up products for testing. The Energy Commission is considering the use of some of these instructions for testing SNE and edge devices and seeks input on which instructions are applicable, and what gaps remain.

i. Wired Connections

Each wired network technology present in the product under test must be tested one at a time. Wireless network connections are required to be disconnected for these tests.

The ENERGY STAR SNE test procedure[3] has specific product configuration requirements for wired network connections:

[2] ENERGY STAR also requires a test at the highest data rate supported by the link, which is out of scope for LPM.
[3] ENERGY STAR® Program Requirements for Small Network Equipment (Rev Oct-2014) https://www.energystar.gov/sites/default/files/FINAL%20Version%201.0%20SNE%20Program%20Requirements%20%28Rev%20Oct-2014%29_0.pdf.

1) *Peripheral Devices: Non-Ethernet wired ports (e.g., HPNA, MoCA, USB) analog connections shall not be connected, unless a secondary device and cable are shipped with the product (e.g., an external disk with a USB connection).*

2) *Network Link Maintenance: The product's wide area network (WAN) port shall be connected to a live source. Network links shall be continuously maintained, with the exception of brief lapses when transitioning between link speeds.*

3) *Ethernet Port Connection Rate: Ethernet ports shall be connected at the maximum supported link rate unless otherwise specified in this test procedure.*

4) *Ethernet Cabling: All Ethernet cables used for testing shall meet ANSI/EIA/TIA - 568 Category 5e (Cat5e) specifications and shall be between 1 and 2 meters in length.*

5) *Efficient Networking Protocols:*

    i. *If the UUT supports IEEE 802.3az protocol, all connected devices must support IEEE 802.3az,*

    ii. *If the UUT supports Link Layer Discovery Protocol (LLDP) for 802.3az, all connected devices must support LLDP for 802.3az.*

ii. Wireless Connections

Each wireless network technology present in the product under test must be tested one at a time. Wired network connections will be disconnected for these tests.

The ENERGY STAR SNE test procedure has specific product configuration requirements for wireless network connections:

1) *SSID: As-shipped, or assigned a random value as required by the product;*

2) *Network Encryption: As-shipped, or 128-bit WPA2 as required by the product;*

3) *Network Key: As shipped, or assigned a random value as required by the product;*

4) *Network Channel: A supported channel shall be selected and maintained for the duration of testing;*

5) *Interference Mitigation: Interference robustness or other interference mitigation technology shall be as-shipped or set to "ON" if configuration required by UUT.*

6) *Wireless Link Precedence:*

   i. *Single instantaneous frequency band support: The first supported wireless standard and frequency band starting from the top of Table 4 shall be used for Access Point testing. Only one band shall be active during the test.*

Table 4: Wireless Link Precedence – Single Instantaneous Frequency Band Support

Wireless Band	*Frequency*
IEEE 802.11ac	*5 GHz (Maximum supported channel bandwidth)*
IEEE 802.11n	*5 GHz (Maximum supported channel bandwidth)*
IEEE 802.11n	*2.4 GHz (20MHz channel bandwidth)*
IEEE 802.11g	*2.4 GHz*
IEEE 802.11b	*2.4 GHz*
IEEE 802.11a	*5 GHz*

   ii. *Simultaneous instantaneous frequency band support: The first supported pair of wireless standards and frequency bands starting from the top of Table 5 shall be used for access point testing.*

Table 5: Wireless Link Precedence – Simultaneous Instantaneous Frequency Band Support

Wireless Band 1	*Frequency 1*	*Wireless Band 2*	*Frequency 2*
IEEE 802.11n	*2.4 GHz (20 MHz channel bandwidth)*	*IEEE 802.11ac*	*5 GHz (Maximum supported channel bandwidth)*
IEEE 802.11n	*2.4 GHz (20 MHz channel bandwidth)*	*IEEE 802.11n*	*5 GHz (Maximum supported channel bandwidth)*
IEEE 802.11g	*2.4 GHz*	*IEEE 802.11n*	*5 GHz (Maximum supported channel bandwidth)*

IEEE 802.11g	*2.4 GHz*	*IEEE 802.11a*	*5 GHz*
IEEE 802.11b	*2.4 GHz*	*IEEE 802.11a*	*5 GHz*

iii. Alternative configurations: If a device cannot support any configuration listed in either Table 4 (for support of a single instantaneous frequency band) or Table 5 (for support of multiple instantaneous frequency bands), the test client shall provide a configuration. The configuration shall be recorded in the test report.

Some of these instructions may be a starting point for configuration instructions for wireless network connections in edge devices.

iii. SNE-Specific Instructions

The Energy Commission recognizes that network equipment differs from edge devices, particularly in how they operate. Although edge devices often have the opportunity to essentially become unavailable to the user, network equipment must always be available to move network traffic. Consequently, "standby," "sleep," and other modes used to denote a low power state rarely apply to network equipment. Rather, network equipment can scale its power draw to network traffic and enter idle state(s) when minimal traffic is present, such efficient idle state is tested for EU Ecodesign compliance. Similar to the network-connected edge devices, the Commission is considering LPM for SNE to be a state with minimal inbound network traffic, and therefore includes it in the LPM roadmap.

Given the differences between edge devices and network equipment, the Energy Commission is considering separate setup instructions and testing requirements for these two product types. For SNE, the Commission is considering the setup conditions in the ENERGY STAR SNE Test Method, Section 6. Additional guidance for SNE, such as connecting to a wide area network (WAN) or the number of Ethernet ports to connect to the local area network (LAN), is also necessary. The Commission proposes using the set up instructions provided in the ENERGY STAR SNE Test Method's section 7.2.B-D, but with the network traffic conditions described in Section 3A above. The applicable instructions from the ENERGY STAR Test Method include:

- For wired WAN connections: connect one Ethernet port. Ensure that Ethernet ports are connected at their highest supported link rate.
- For wired LAN connections: test with half the ports in use.
- For wireless LAN connections: ensure only one Ethernet port is connected to the unit under test (UUT). Establish a single client device in the test client. The wireless local area network type must be consistent with the priority specified in Section 6.3 and shall be configured for the highest supported link rate.

Once SNE is set up with the traffic conditions described in Section 3A, it shall be tested according to IEC 62301, similarly to edge devices.

4. Sensors

Examples of sensors that may impact LPM power include: occupancy/motion, vacancy, gesture, sound, voice recognition, ambient light, temperature, humidity, and touch. These sensors monitor the surroundings and, if triggered by their environment, can signal the product to resume its active mode or otherwise exit LPM. To ensure that sensors are tested in an environment that represents typical operating conditions, the Energy Commission is investigating whether or not additional conditions are required beyond those contained in IEC 62301 (ambient temperature from 18 °C to 28 °C, and relative humidity from 10 percent to 80 percent).

Such additional conditions, for example for light and sound, may be necessary. Possibilities include:

- Ambient light: Ambient light shall be from 300 Lux to 400 Lux[4].
- Ambient audio noise: Ambient audio noise shall be from 40 dbA to 50 dbA[5].

Some sensors, such as voice or gesture recognition sensors, monitor for specific input such as a spoken phrase or a wave motion. Using smart technology, these sensors pick out a particular pattern from environments filled with higher levels of motion and noise, and filter out false triggers. For these types of sensors, the Energy Commission has identified the following instructions:

- Take precautions to provide environmental conditions that prevent sensor(s) from signaling the product to exit LPM.
- For example, if the product has voice recognition, ensure that nobody in the vicinity speaks a trigger phrase during the test. If the product has gesture recognition, ensure that there are no gestures made for the product to exit LPM during the test. If the product has a motion sensor, ensure that no object(s) moves near the product during the test.

5. Charging, Wired

Some products are shipped with peripherals that can be charged with a wired strategy such as USB power delivery (e.g., game console controllers). If a product is packaged with an additional product that it charges, it should be tested together. This requirement indicates the power management capability of the port(s) on the product under test to gauge whether or not charging port(s) power down when charging is complete. The following setup instructions are considered for wired charging functionality:

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[4] General illumination levels: http://energy.ca.gov/2015publications/CEC-400-2015-037/CEC-400-2015-037-CMF.pdf.

[5] Typical sound levels measured in the environment: http://www.cpuc.ca.gov/environment/info/aspen/cresseygallo/fmnd/5-12_noise.pdf.

- If the product under test has charging port(s) and ships with a peripheral intended for that charging, attach the fully charged peripheral product (such as a game console controller) to the charging port during the test.
- Wait X minutes for the charging device to determine that the attached peripheral is fully charged.

6. Charging, Wireless

Similar to wired charging, some products may ship with a peripheral that charges wirelessly, and the Energy Commission wishes to test the power management of the wireless charging equipment. Consumer Technology Association (CTA) is developing a test procedure for wireless charging, which the Energy Commission will review and consider once finalized. In the meantime, the Commission is considering the following setup instructions for wireless charging functionality:

- If the product under test has wireless charging capability and ships with a peripheral intended for that charging, place the fully charged peripheral in position to be charged.

7. DC Powering

If a DC-powered product is shipped with an AC-DC converter that connects to the main AC, then the Energy Commission proposes for the device to be supplied with AC power for the test.

However, for DC-powered products shipped without an AC-DC converter, and are not powered with rechargeable batteries that are subject to the battery charger system (BCS) regulation, test conditions should be specified by the test procedure. Some examples for the conditions that need to be specified are: 1) the DC voltage supplied to the product; and 2) guidance on how and where the power measurement is made.

Regarding the first issue, the U.S. Department of Energy (DOE) battery charger test procedure provides guidance on the DC voltage to be provided to the product. For details refer to Section 3.1.4(c) of DOE's test procedure, 10 C.F.R. Section 430.23(aa) (Appendix Y to Subpart B of part 430)[6].

The Energy Commission is also aware of instructions regarding the second issue, how to make the power measurement, in the ENERGY STAR Displays test method. This method instructs DC-powered products to be installed and powered as directed by the manufacturer using a port with the full specifications recommended for the product. The power measurement is made between the DC source (either a regulated DC power source or host machine for devices receiving power and data) and the cable shipped with the product, including the losses introduced by the shipped cable. If no cable is shipped with the product, any cable between 2 and 6 feet long may be used in its place.

[6] https://www.ecfr.gov/cgi-bin/text-idx?SID=cdc20a5aec263f02e9b115cfec14a985&mc=true&node=ap10.3.430_127.y&rgn=div9.

8. Systems

The Energy Commission is aware of some smart home products that need a data connection (wired or wirelessly) to another product in order to provide their function. The wireless speakers of a whole-home audio system, for example, may need to have a data connection with a system hub to play content. In many situations, each product in the system is powered separately. In this case, the Commission is considering instructions to test the products with the data connection established, measuring power of each product individually.

Another possibility is that an end product not only needs a data connection to a proprietary device, but also receives its power from that same device. In this situation, the Energy Commission is considering two options for testing the end device:

- First measure the power of the hub alone, then the hub with the edge device connected. To calculate power for the edge device, subtract the two measurements.
- Connect the hub to the edge device, measuring power between the hub and edge device with a short cable spliced to the power meter (wired connections only).

9. Off Mode

The Energy Commission is including off mode as part of this roadmap, and therefore in the test procedure. The off mode test can be performed immediately after the LPM test, without altering set up conditions. The Commission proposes the following definition for off mode:

- Off mode is an operating state that may only be exited with a power command (such as from a switch, a remote control, or a network signal).

To test this mode, the Energy Commission is considering the following instructions:

- After LPM test is complete, turn the product off via a hard switch, soft switch, or other process (must be recorded). Do not alter the product's set up in any other way. Measure off mode power according to IEC 62301.

10. General

The Energy Commission welcomes input on other gaps or issues not identified in the discussion above.

ATTACHMENT B
List of Questions for the Low Power Mode Test Procedure
Problem Statement & Information Request

Prior to developing a draft test procedure, the Energy Commission seeks technical information and feedback from interested stakeholders on a range of identified gaps, such as those related to setting up network connections, sensors, and power delivery. For many of these issues, the Commission proposes a solution and asking for feedback. For other issues where information is lacking, the Commission seeks technical guidance. The Commission also seeks input on other gaps for which instructions will need to be developed.

The numbering order of the questions below includes its corresponding section in the test procedure discussion document in Attachment A.

1. Provisioning the Product

1.1. Should the product be allowed to run for a specific amount of time, for example 24 hours, to allow the product to update and provision software before taking the LPM measurements? If so, what is the appropriate amount of time?

2. Testing State

2.1. Is the approach outlined in section 2 of the test procedure an effective way to define the testing state for a broad range of products? If not, explain why.

2.2. Explain other approaches that would be preferable/superior to the approach described in section 2 for testing state that is applicable to a broad range of products.

2.3. How long should X (the time between discontinuation of user interaction and the beginning of the measurement) be?

3. Network Connections

A. Traffic content and levels:

3.1. To what extent does network and device data communication traffic need to be prescribed?

3.2. Is the Energy Commission's proposed approach in section 3A of the test procedure appropriate? What is an appropriate limit on the inbound traffic? Explain what modifications or additions need to be made.

3.3. Alternatively, is it better to prescribe specific network conditions, such as which network services are present, similar to the ENERGY STAR's approach? If so, what modifications, if any, need to be made to the ENERGY STAR's network conditions?

B. Configuration requirements

i. Wired Connections

3.4. Are the instructions described in section 3.B.i of the test procedure complete and appropriate? What other configurations or conditions need to be specified?

3.5. Does Ethernet cable's length significantly impact power draw in LPM, and should it be specified for the testing? If so, what is an appropriate length for the Ethernet cable used for the testing?

ii. Wireless Connections

3.6. Do edge devices require different instructions from network devices? If so, specify which parts of the instructions should be different and how they should be.

3.7. What other test conditions besides those described in section 3.B.ii will impact LPM power draw? What additional test instructions are necessary to account for these impacts?

3.8. How far should the device under test be from the network router?

iii. SNE-Specific Instructions

3.9. Are these setup instructions adequate to ensure reproducible results for testing SNE?

3.10. If not, what instructions should be added or modified?

3.11. Should 3-phase input power requirements be added to the setup instructions?

NOTE: Questions 4 through 9 apply to edge devices only. The test procedure will require setup instructions for some secondary functions, in addition to network functionality, that are present in the product under test, particularly those that significantly impact power draw.

4. Sensors

4.1. Which sensors besides those listed in section 4 of the test procedure (occupancy/motion, gesture, sound, voice recognition, ambient light, temperature, humidity, touch) need to be addressed in the test procedure?

4.2. Which sensors (for example, gesture recognition) must process environmental conditions to identify particular patterns (for example, a wave gesture)? How sensitive is power draw to ambient inputs (such as, sound for a voice recognition sensor or movement for a gesture sensor)?

4.3. What is the appropriate instruction to ensure that sensors do not cause the product to exit LPM during the test and also represent real life situations? No environmental input or no specific trigger?

4.4. What other ambient environmental inputs should be specified? For example, what type and level of background ambient noise should be used?

5. Charging, wired

5.1. Is the methodology described in section 5 of the test procedure a reasonable approach to evaluate the wired charging function to minimize its power impact when it is not being used?

6. Charging, wireless

6.1. Is the methodology described in section 6 of the test procedure a reasonable approach to evaluate wireless charging function to minimize its power impact when it is not being used?

7. DC Powering

7.1. What is the appropriate input voltage to supply during testing, particularly for products that specify a range of acceptable DC input voltages?

7.2. How should the measurement be made? Are the instructions in the ENERGY STAR display test procedure appropriate? Explain how the procedure should be modified, if the ENERGY STAR instructions are not adequate.

8. Systems

8.1. Would the approach described in section 8 of the test procedure for systems that are powered separately from their system hub adequately represent system's power draw? If not, explain how to capture the actual power of products that need to connect to other products, wired or wirelessly, in order to transfer data.

8.2. Does the test procedure described in section 8 for systems that are powered from their system hub apply to all products? Explain if and how this approach should be modified to be applicable for new technologies.

8.3. Are the test procedures described in section 8 reasonable approaches? Provide reasons and explain what needs to change.

9. Off Mode

9.1. Is the definition in section 9 an appropriate definition for the off mode? If not, what is an appropriate definition?

9.2. Are any other instructions beside those in section 9 needed to collect the off mode power measurement?

9.3. How might products that do not have hard or soft switches be turned off?

9.4. What proportion of products do not have an off mode?

10. General

10.1. Provide inputs on other gaps or issues not identified in the proposed test procedure.