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California Investor Owned Utilities - Comments on Low Power Modes Test Procedure Discussion Document

Additional submitted attachment is included below.

Low Power Mode

Codes and Standards Enhancement (CASE) Initiative
For PY 2017: Title 20 Standards Development

Response to the California Energy Commission's Request for Public Comment on Low Power Mode Test Procedure Discussion Document
Phase 2 Pre-Rulemaking
Low Power Mode
17-AAEER-12

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TABLE OF CONTENTS

LIST OF TABLES

1. Introduction

The Codes and Standards Enhancement (CASE) initiative presents recommendations to support the California Energy Commission's (Energy Commission) efforts to update California's Appliance Efficiency Regulations (Title 20). This effort was sponsored by Pacific Gas and Electric Company (PG&E), San Diego Gas and Electric (SDG&E), and Southern California Edison (SCE), herein referred to as the Statewide CASE Team. The program goal is to prepare and submit proposals that will result in cost-effective enhancements to improve the energy and water efficiency of various products sold in California. The information presented herein is a response to the Energy Commission's Low Power Mode (LPM) Test Procedure Discussion Document.

The Statewide CASE Team strongly supports the Energy Commission's decision to develop an LPM roadmap to explore energy savings opportunities associated with reducing the energy use of products when they are idle and not actively used. A key first step in the roadmap is to collect the data from a wide range of products that will inform energy use estimates and help identify savings opportunities. To do so, the Energy Commission and stakeholders must develop a data collection procedure that promotes representative and reproducible data collection for a wide range of consumer products. With this procedure, interested parties will be able to collect and contribute the data necessary to evaluate the energy consumption and savings opportunity of products in LPM and allow the Energy Commission to make informed decisions about the ultimate direction of the roadmap, be it creating a formal test procedure and voluntary or mandatory targets for a scope of products, or other actions. This response contains suggestions on terminology, a discussion on the necessary elements of the data collection procedure, responses to the questions posed by the Energy Commission in their Test Procedure Document, and the Statewide CASE Team's plans to support the Energy Commission as they develop their LPM test procedure.

2. Terminology Suggestions

The Statewide CASE Team proposes two clarifications to terminology used in this roadmap to better represent the Energy Commission's roadmap goals and current activity.

2.1 Test Procedure

As discussed above, the first step in the LPM roadmap is to develop a method that stakeholders will use to collect data in a uniform manner. This method will apply to a broad range of products and test conditions so that the Energy Commission can make data-driven decisions about how to focus the roadmap on products that present energy savings opportunities. These decisions include scope, potential targets, and the test procedure for measuring product performance. Because the term "test procedure" is often used to denote a method to confirm compliance with a voluntary or mandatory standard, and because that may indeed be an outcome of this roadmap, the Statewide CASE Team recommends using the term "data collection procedure" to distinguish the current effort from a formal rulemaking.

2.2 Low Power Mode

The term "low power mode" implies two characteristics:

1. It is an operational mode, like sleep or standby, and
2. That mode, by definition, has reduced power compared to active mode.

In its discussion document, however, the Energy Commission proposes testing a product in a generally defined state after some period of inactivity or no user input. This general state does not explicitly define an operational mode, nor does it necessarily result in lower power consumption compared to "on" or "active" modes, depending on how products are designed.

The Statewide CASE Team agrees with the Energy Commission's approach to examine LPM as a state, because it can be applied to data collection across a wide range of products without explicitly defining an operational mode for each one. This broad applicability is appropriate to the roadmap process. Furthermore, this approach does not exclude products that do not power down after a period of inactivity. Gathering data on such products is key to the Energy Commission's goal of identifying energy savings opportunities.[1]

Because the term LPM is potentially misleading, the Statewide CASE Team recommends a different term for the product test condition. Rather than "mode," the Statewide CASE Team recommends "state" to denote that the test condition may be in any number of modes. Rather than "low power," the Statewide CASE Team recommends a term that parlays inactivity of the primary function or lack of user input, such as "idle" or "inactive."

3. Elements of a Data Collection Procedure

Any data collection or test procedure used by the Energy Commission should meet several key criteria, including:

- Repeatability: the test produces the same measurement (within acceptable error) when repeated by the same operator, in the same laboratory, with the same measurement equipment.
- Reproducibility: the test produces the same measurement (within acceptable error) when performed by different operators, in different laboratories, with different measurement equipment.
- Representative: the test conditions and results are reflective of how the product is used in real-world situations.
- Reasonable test burden: the test yields the criteria above at a cost and level of effort that is deemed reasonable by stakeholders.

[1] Products that automatically power down (APD) would be tested at lower power and likely in an operational mode other than active. Products that do not APD may actually be tested in active mode. Some products must remain in active mode, and if the Energy Commission decides to put voluntary or mandatory targets in place, then it might be appropriate to exclude these from the scope.

To produce representative and reproducible results, the Energy Commission's LPM data collection procedure will require several elements, including instructions for:

(1) setting up the product under test, such as how to provision the product and enable LPM functions such as network connections and sensors,

(2) placing the product in its LPM state (either manually or by allowing it to automatically enter the state and potentially auto power down (APD)), and

(3) measuring power.

The Statewide CASE Team finds the existing international test procedure for LPM, International Electrotechnical Commission (IEC) 62301:2011, to be sufficient for requirement number three. That is, once the product under test is prepared with the necessary connections and conditions and placed in its LPM state, IEC 62301:2011 provides well-vetted instructions to measure LPM power. This test procedure has been used internationally to test standby or LPM compliance for voluntary and mandatory measures, such as the European Union standby power regulation, United States (U.S.) Department of Energy vertical product efficiency regulations, and U.S. Environmental Protection Agency ENERGY STAR® specifications.

However, IEC 62301:2011 does not provide product setup instructions (requirement number one above). In fact, no harmonized test procedure includes the setup instructions the Statewide CASE Team deems necessary for a successful LPM roadmap, which include the setup instructions for network connections, sensors, and any other function that can trigger the product's primary function to reactivate from LPM. To date, network connections have received the most attention from researchers, who have examined the elements necessary to test network connections in a representative and reproducible manner (e.g., Nordman 2011). ENERGY STAR includes setup instructions for network connections in many of its specifications, including imaging equipment, small network equipment (SNE), computers, and displays (EPA 2014b, 2014c, 2016, 2017). ENERGY STAR also includes instructions related to motion and light sensors in its TV and display specifications (EPA 2015, 2017).

The second requirement of the data collection procedure, which is to provide instructions to place the product under test in the LPM state, is another gap in existing test procedures. Existing procedures generally define power modes such as sleep, standby, and off. The Energy Commission proposes testing the LPM state in which the product is ready for use, but not actively used. The Statewide CASE Team supports this approach for its potential to apply to a broad range of products and its potential to avoid complicating the test procedure with product-specific mode definitions and test setup language. As the Energy Commission indicates in its Test Procedure Discussion Document, the LPM data collection procedure must provide clear instructions on how to place the product in this state prior to testing.

The Energy Commission's LPM Test Procedure Discussion Document outlines many of the gaps that must be filled by the data collection procedure. The Statewide CASE Team is investigating many of the issues outlined by the Energy Commission and will provide specific findings and recommendations at a later date. In the meantime, the Statewide

CASE Team provides comments to the Energy Commission's LPM Test Procedure Discussion Document in Section 4 below.

4. Test Procedure Discussion Document Responses

In its Test Procedure Discussion Document, the Energy Commission identifies gaps that must be addressed in their LPM test procedure and suggests solutions. The Statewide CASE Team provides responses to the Energy Commission's discussion questions below in Table 1. In summary, the Statewide CASE Team generally agrees that the issues highlighted by the Energy Commission must be addressed in the test procedure and is in the early phases of investigating how to address such issues. Specifically, the Statewide CASE Team is working to develop instructions for provisioning the product under test, including how to place the product in LPM. The Statewide CASE Team will also test the sensitivity of LPM power to test setup conditions related to LPM functions such as network connections and sensors.

Table 1: Responses to Energy Commission Problem Statement & Information Request

Topic	Energy Commission Question	Statewide CASE Team Response
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?	The Statewide CASE Team agrees that the product should run for some period to complete updates and provision itself for use. The Statewide CASE Team is investigating the amount of time that would be long enough so that the product reaches a state of typical operation while minimizing test burden.
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.	The Statewide CASE Team supports an LPM test procedure that is as broadly applicable as possible--that is, one that applies to a wide range of consumer products including electronics, appliances, and lighting. The approach outlined by the Energy Commission moves towards this goal by defining a testing state that can apply to a wide range of products. The Statewide CASE Team is currently testing this approach on electronics and small appliances to understand if it is sufficient or if more details are necessary to place products in the LPM state.

Topic	Energy Commission Question	Statewide CASE Team Response
	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.	The Statewide CASE Team will recommend an approach once it has completed its investigation.
	2.3. How long should X (the time between discontinuation of user interaction and the beginning of the measurement) be?	The Statewide CASE Team is investigating the appropriate amount of time between discontinuing user interaction of the product and starting the LPM power measurement, and whether this differs across product types.
3A. Network Connections, Traffic and Content Levels		
	3.1. To what extent does network and device data communication traffic need to be prescribed?	The product under test should be allowed to communicate during the test as it normally would in real-world use. The Statewide CASE Team therefore agrees that outbound traffic should not be prescribed. The Statewide CASE Team is investigating how much, if any, inbound traffic should be prescribed to maintain the link.
	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.	The Energy Commissions proposal is a reasonable place to start. The Statewide CASE Team plans to test the approach on a wide range of products to identify any necessary modifications.
	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?	As stated above, the product under test should be allowed to communicate during the test as it normally would in real-world use. Therefore, the Statewide CASE Team recommends against prescribing specific outbound network traffic and content, which may prove difficult to do for a broad range of products. The Statewide CASE Team recommends prescribing inbound traffic only if investigation shows this is necessary to maintain a link.

Topic	Energy Commission Question	Statewide CASE Team Response
3B. Network Connections, 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?	The Statewide CASE Team agrees that the instructions are a reasonable starting point and will investigate how these and other conditions impact power draw. Conditions that have significant impact on power should be specified to produce similar results across tests and test labs.
	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?	As the Energy Commission notes, the ENERGY STAR test method for SNE requires Ethernet cables to be 1 to 2 meters long. The new EU network standby test procedure (EN 50643:2018) requires Wide Area Network cables to be 2 ± 0.2 meters and Local Area Network cables 10 ± 0.5 meters. The Statewide CASE Team is investigating the sensitivity of LPM power to the length of the Ethernet cable, and whether cable length should be prescribed in the test procedure.
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.	The functionality provided by edge devices is fundamentally different from that of network devices, however, the way that the products are prepared for testing may be similar. The Statewide CASE Team is investigating how the instructions for the two product types should differ, if at all.
	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?	The Statewide CASE Team is investigating whether other conditions impact LPM power draw.

Topic	Energy Commission Question	Statewide CASE Team Response
	3.8. How far should the device under test be from the network router?	Although the ENERGY STAR test method for SNE does not prescribe the distance between the device under test and the network router, for Wi-Fi connections EN 50643:2018 requires them to be 1 to 5 meters apart and in the same room. For Bluetooth connections, EN 50643:2018 requires the product under test and the connected product to be 0.6 to 1.0 meters apart. The Statewide CASE Team is investigating the sensitivity of LPM power on the distance between the product under test and the network router for Wi-Fi, Bluetooth, and other wireless connections.
iii. SNE-Specific Instructions		
	3.9. Are these setup instructions adequate to ensure reproducible results for testing SNE?	The ENERGY STAR setup instructions for SNE are a reasonable foundation. The Statewide CASE Team is testing those instructions on a range of SNE products to identify any necessary modifications.
	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?	IEC 62301 includes multi-phase products in its scope, which is limited to products with input voltage between 110 and 480 volts AC (Vac). The Energy Commission may wish to harmonize with IEC 62301 to maintain broad scope with this test procedure, even if the subsequent LPM roadmap addresses a smaller subset of SNE, for example single-phase consumer products.
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?	The Statewide CASE Team is unaware of any other types of sensors that are available in products today and have the potential to impact LPM. However, the Statewide CASE Team will report any additional sensors it notes in its investigation to the Energy Commission.

Topic	Energy Commission Question	Statewide CASE Team Response
	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)?	The Statewide CASE Team hypothesizes that voice and gesture recognition sensors and microprocessors must remain activated to process environmental signals and user input during LPM for certain products. The Statewide CASE Team will investigate these technologies, quantify the impact of ambient conditions, and make recommendations on test conditions to the Energy Commission.
	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?	To represent real life conditions, the Statewide CASE Team recommends an instruction that the tester avoid issuing known triggers to the product under test. The Statewide CASE Team plans to investigate the impact of environmental input on LPM power. If varying input impacts power, then the Statewide CASE Team will likely recommend prescribed conditions to measure LPM power in a reproducible manner.
	4.4. What other ambient environment 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?	The methodology appears to be reasonable, and the Statewide CASE Team will test the approach to confirm or identify additional issues to be addressed.

Topic	Energy Commission Question	Statewide CASE Team Response
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?	The methodology appears to be reasonable, and the Statewide CASE Team will test the approach to confirm or identify additional issues to be addressed.
7. Direct Current (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?	The Statewide CASE Team will investigate the sensitivity of LPM power to DC input voltage and measurement approaches to recommend DC powering instructions to the Energy Commission.
	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.	

Topic	Energy Commission Question	Statewide CASE Team Response
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.	The approaches outlined by the Energy Commission seem reasonable, but the Statewide CASE Team will be testing them on a range of products to make sure they are relevant and will recommend any necessary changes.
	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?	The Statewide CASE Team agrees with the proposed definition for off mode and supports the inclusion of off mode in the test procedure. Perhaps even more so than LPM, off mode can be defined for a broad range of products and thus is a good candidate for a horizontal test procedure. Once a product is set up for LPM testing, the off mode test can be conducted with a low level of incremental effort: the time for the off mode test run. The inclusion of off mode in the test procedure will allow the Energy Commission to assess the off mode energy savings potential based on repeatable and reproducible data collected during the roadmap. If the data indicates a significant savings opportunity, then the Energy Commission can plan a course of action to achieve savings.

Topic	Energy Commission Question	Statewide CASE Team Response
	9.2. Are any other instructions beside those in section 9 needed to collect the off mode power measurement?	The Statewide CASE Team will test the completeness of these instructions and recommend any additions as necessary.
	9.3. How might products that do not have hard or soft switches be turned off?	In preliminary work, the Statewide CASE Team has noted some products like computer monitors and Blu-ray players that appear to power down to off mode levels after a period of time. The Statewide CASE Team will continue to collect information on how products turn off in its planned investigation.
	9.4. What proportion of products do not have an off mode?	The Statewide CASE Team does not have an estimate for the proportion of products without an off mode but will collect relevant information as it investigates the issues above.
10. General		
	10.1. Provide inputs on other gaps or issues not identified in the proposed test procedure.	Manufacturers of computing and Internet-of-Things products regularly release software updates that have the potential to impact power draw by changing power management or adding functionality. These updates have the potential to impact measurement repeatability over time: a product measured with an early software version may draw more or less power than it does after undergoing updates. The Statewide CASE Team plans to investigate the impact of software or firmware updates on measurement repeatability. It is likely that the data collection procedure will need instructions that ensure a product is using the same software version whenever it is tested. For example, the product may be tested as-shipped, without performing updates to produce repeatable measurements, and again after updates to produce data that is representative of current usage of that product. The Statewide CASE Team has no additional comments at this time but will provide information from its test procedure investigation once complete.

5. Statewide CASE Team Contributions and Timeline

The Statewide CASE Team plans to make significant contributions to the test procedure development. The Statewide CASE Team's plan, delineating specific activities and the sequence in which they will be undertaken, is presented below. The Statewide CASE Team will adapt these proposed contributions as necessary to fit with the Energy Commission's roadmap activities and process.

Test procedure additions: The Statewide CASE Team plans to (1) evaluate the proposed instructions for provisioning and placing the product under test in LPM and test repeatability and representativeness, (2) evaluate the proposed setup instructions for functions and collect information to answer the questions above and test repeatability and representativeness, (3) engage with other stakeholders to gather consensus on test procedure approach and burden, (4) test the reproducibility of the instructions by coordinating round robin testing of instructions at several test labs, (5) based on round robin results, revise instructions as necessary, and (6) submit test procedure recommendations to the Energy Commission.

6. Conclusion

The Statewide CASE Team strongly supports the Energy Commission's intention to develop an LPM test procedure that yields representative and reproducible results. The Statewide CASE Team is in the early stages of collecting information to help answer questions in the Test Procedure Discussion Document and will continue to update the Energy Commission as it learns more.

7. References

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