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BEFORE THE PUBLIC UTILITIES COMMISSION OF THE

STATE OF CALIFORNIA

Order Instituting Rulemaking to Consider Smart Grid Technologies Pursuant to Federal Legislation and on the Commission's Own Motion to Actively Guide Policy in California's Development of a Smart Grid System	R.08-12-009 (Filed December 18, 2008)

SOUTHERN CALIFORNIA EDISON COMPANY'S (U 338-E) RESPONSE TO OIR 08-12-009; ORDER INSTITUTING RULEMAKING TO CONSIDER SMART GRID TECHNOLOGIES PURSUANT TO FEDERAL LEGISLATION AND ON THE COMMISSION'S OWN MOTION TO ACTIVELY GUIDE POLICY IN CALIFORNIA'S DEVELOPMENT OF A SMART GRID SYSTEM

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SOUTHERN CALIFORNIA EDISON COMPANY (U 338-E) RESPONSE TO OIR 08-12-009 TO CONSIDER SMART GRID TECHNOLOGIES

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I.

EXECUTIVE SUMMARY

Southern California Edison Company (SCE) appreciates the opportunity to address the Commission concerning California's smart grid future. Federal and state policymakers alike have recognized the need for a smarter, more robust electricity infrastructure if we as a country are to rely on greater amounts of renewable generation, use electricity as a fuel for vehicles, enable consumers to become active participants in the energy supply chain, and ensure the continued reliability and vitality of our nation's energy economy. For example, on January 8, 2009, in discussing his plan for economic renewal and stimulus, President Obama declared that:

> "We'll also do more to retrofit America for a global economy. That means updating the way we get our electricity by starting to build a smart grid that will save us money, protect our power sources from blackout or attack, and deliver clean, alternative forms of energy to every corner of our nation."[1]

SCE seeks to discover, evaluate, and adopt energy and information technologies to implement SCE's smart grid strategy. SCE believes that many aspects of a smarter grid will need to be operational by the year 2020 to enable California's ambitious policy goals, such as AB 32 Green House Gas reductions, Zero Net Energy homes, California Solar Initiative, Advanced Metering Infrastructure, California's Renewables Portfolio Standard, Low Carbon Fuel Standard, and wide-spread consumer adoption of Plug-in Electric Vehicles. By the year 2020, SCE aims to modernize the grid to deliver a cleaner energy supply from renewables and integrated distributed resources, energy-smart consumer devices, and electric vehicles while improving reliability, safety, and cost-effectiveness.

SCE supports a vision for a smart grid that includes, and in selected areas expands upon, elements of national policy as outlined in the Energy Independence and Security Act of 2007 (EISA 2007). SCE welcomes the opportunity to actively participate with the Commission in this endeavor. SCE has been highly successful in driving recent smart grid

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[1] Transcript of Obama speech, Jan. 8, 2009.

advancements, and is regarded as an industry leader in the development and deployment of leading-edge energy and information technologies. For example, SCE's SmartConnect™ program won the U.S. Department of Energy's 2007 award for Smart Grid Implementation and Deployment Leadership. Also, SCE's phasor measurement program was awarded the "2007 T&D Automation Project of the Year" by *Utility Automation & Engineering T&D* magazine. In 2009, SCE won a Power Delivery & Utilization Technology Transfer Award from the Electric Power Research Institute (EPRI), in recognition of SCE successfully advancing the development of Smart Charging technology for Plug-In Hybrid and Electric Vehicles.

SCE envisions a smart grid that leverages advancements in energy technologies, such as transformers utilizing superconducting materials and new energy storage technologies. We foresee an increasingly intelligent and highly automated electric power system -- a system that utilizes advancements in communications, computing, sensing, and control technologies. SCE's overall smart grid strategy encompasses five areas that address a broad set of requirements to better position SCE to meet both current and future power delivery challenges:

- **Renewable and Distributed Energy Resources Integration** – *Integrate* and manage new sources of renewable and distributed energy supply.
- **Grid Control & Asset Optimization** – *Improve* capital efficiency and asset utilization using energy storage, new materials, and better intelligence and technology for optimal system management.
- **Workforce Effectiveness** – *Maximize* workforce safety, productivity, and effectiveness by using enabling tools and technologies.
- **Smart Metering –** *Enable* the grid to automatically adjust to changing loads and supply requirements.
- **Energy-Smart Customer Solutions –** *Empower* customers to become "active" participants in the energy supply chain by, in part, managing their own energy

consumption; and provide customers with the means to use electricity as a fuel for vehicles.

These five areas define our business objectives, and are built on a foundation of new telecommunications networks, software systems and other information technology. The smart grid will be realized through innovations in both energy technology and information technology.

Consistent with the U.S. Department of Energy's and National Energy Technology Laboratory's *Vision for the Modern Grid*,[2] SCE's smart grid will enable the increase of intermittent and renewable resources (such as wind and solar power) and spark greater use of plug-in electric vehicles by increasing system flexibility; reduce greenhouse gas emissions; avoid the economic losses associated with catastrophic failures and wide-area blackouts; foster energy conservation, energy efficiency and demand response capabilities by providing customers with better energy use information and choices; reduce operating costs and improve reliability and safety by providing real-time information for system monitoring and system automation; improve maintenance and operations practices on the electrical grid; and facilitate the development of a "Clean Tech" economy, which is expected to include the creation of new jobs in California.

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[2] http://www.netl.doe.gov/moderngrid/opportunity/vision.html.

The sections below contain SCE's responses to the 32 questions posed by the Commission in its Order Instituting Rulemaking. Some key overall themes are highlighted in SCE's responses:

- In a number of responses, SCE has pointed to areas where this Commission's role in sponsoring workshops can be enormously beneficial. For example, the smart grid offers a number of societal benefits that cannot be easily quantified in dollars. As indicated above, some of these benefits include energy independence, reduced green-house gas emissions, and increased reliability, safety, and security of the system. Workshops would be particularly helpful in solidifying how societal benefits that are not reflected in traditional utility economic analyses of revenue requirements should be calculated, and what regulatory treatment should be proposed.
- Some of the projects needed to implement the smart grid will necessarily run longer than a three-year General Rate Case cycle. The benefits similarly may often not accrue in such a defined time period. SCE believes that Commission-sponsored workshops would be helpful in addressing whether the General Rate Case, as opposed to some other proceeding, is the appropriate forum for Commission evaluation of individual smart grid projects, and whether mechanisms such as a smart grid balancing account may be needed for smart grid research and development activities.
- Adopting smart grid-related technology before it is fully vetted and ready for commercial use may cause significant project cost increases and delays, as well as operational risks. An effective technology adoption plan is essential to managing these risks. A technology adoption plan is a living document that needs to be updated regularly to reflect changes in policy, business needs, and technological advances. Moreover, SCE respectfully believes that legislators and regulators will provide critical guidance in setting policies and related goals, but such guidance

should not extend to the level of actually selecting standards or individual technologies for the utilities to implement. That task should be carried out by the utilities, who will report in detail to this Commission with respect to the smart grid technologies that the utilities examine and use.

- Other regulators and lawmakers are currently seeking to have input into smart grid development, including the California Energy Commission, the California Legislature,[3] Congress, and the U.S. Department of Energy. It is crucial that these various efforts proceed, to as great a degree as possible, on an informed and coordinated basis, so that the risks of duplicative or even contrary standards and policies are minimized.
- While SCE believes it has established a leadership position and made strong efforts to advance smart grid technologies, a significant amount of work remains to be done to reach our vision by the year 2020. SCE respectfully suggests that the Commission:
  - Continue to support utility recovery of its prudent costs and investments and management of its assets and resources.
  - Seek consistency between the utilities where reasonable, while at the same time recognizing the unique aspects of each utility.
  - Ensure that policies and requirements from this proceeding do not impede existing, approved deployment plans. It is critical that utility smart grid efforts that are already underway are not slowed down.

[3] For example, SCE is informed and believes that California State Senator Padilla is sponsoring smart grid legislation (S.B. 17).

II.

PRINCIPLES AND CRITERIA

The United States has arrived at a critical juncture in its energy future. The current stakes for addressing climate change, energy independence and infrastructure security could not be higher. SCE supports a vision for the smart grid that includes, and also expands upon, important elements of national policy as outlined in EISA 2007. To ensure that development and implementation of California's smart grid is successful, SCE respectfully recommends that the Commission adopt a set of criteria that drive the utilities towards a common vision and direction, but also permit flexibility to leverage and otherwise take into account technology innovation, and to address the immediacy of our nation's challenges.

SCE believes that the overarching objective of the Commission is to support the development of a smart grid and to ensure its ultimate flexibility, security, and durability over time while conforming to state and federal policy objectives. To support this objective, SCE respectfully proposes that the Commission develop a defined set of year 2020 smart grid criteria, linked to enabling the various legislative and regulatory policies in place to promote a cleaner environment, adoption of distributed energy sources, reduced consumer consumption and demand, and use of plug-in electric vehicles by 2020, in a manner similar to the way that the Commission adopted six key capability criteria in the AMI proceeding.[4] The Commission could play a very valuable role in facilitating discussion of these key capability criteria through the workshop process. In response to the listed principles included in this proceeding, SCE will comment on the suitability of each principle, and, where appropriate, will also offer proposed modifications.

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[4] *See* R.02-06-001, February 19, 2004 Joint Assigned Commissioner and Administrative Law Judge's Ruling Providing Guidance for the Advanced Metering Infrastructure Business Case Analysis, setting forth minimum functionality criteria for AMI.

A. Question 1

Does the following list include the appropriate principles and criteria to guide the commission's decisions in this proceeding regarding the possible development of a smart grid in California? Explain any modifications you propose.

- Cost effectiveness;
- Interoperability of a smart grid system with non-traditional as well as traditional generation;
- Interoperability of a smart grid with current and future investments in infrastructure, including advanced metering protocols;
- Ability to enable distribution and transmission automation, *e.g.*, be self-healing and adaptive;
- Ability to reduce overall usage (especially peak-usage) because it will be interactive and price responsive; and
- Maintenance of system security and reliability

1. Comments on Commission's Proposed Smart Grid Principles

a) Cost-Effectiveness

SCE supports best-faith efforts to deploy smart grid technologies and components as cost-effectively as possible. However, strict adherence to traditional cost/benefit models may not provide the appropriate level of support for smart grid investment decisions. The smart grid offers a number of societal benefits that simply cannot be readily quantified in dollars. Some of these benefits include energy independence, reduced green-house gas emissions, and increased reliability, safety, and security of the system.

Care should be taken to understand those investments which are foundational in nature, and may result in benefits only after other incremental smart grid capabilities are developed. SCE anticipates that its smart grid development and deployment strategy will center around a comprehensive portfolio of projects. The decision on how to proceed with smart grid deployment requires thoughtful consideration of the associated costs, benefits and deployment timeline. Accordingly, before requiring that the utilities file their respective smart grid applications, SCE suggests that the Commission establish a common analytical framework. This framework should ensure that the applications are prepared in a manner that facilitates comparison and evaluation by the Commission. SCE suggests that the framework be developed through a series of workshops in which the scope and principles of the proceeding are discussed and evaluated.

Moreover, some of the projects needed to implement the smart grid will necessarily run longer than a three-year General Rate Case cycle. The benefits similarly may often not accrue in such a defined time period. SCE believes that a Commission-sponsored workshop would be helpful in addressing whether the General Rate Case, as opposed to some other proceeding, is the appropriate forum for Commission evaluation of individual smart grid projects.

b) Interoperability of a smart grid system with non-traditional as well as traditional generation

Implementation of smart grid technologies at all levels of the utility supply chain will be needed to support California's Renewables Portfolio Standard (RPS) and AB 32 climate change goals. SCE views non-traditional generation as including renewable resources (both centralized bulk power scale and distributed scale), and distributed generation (of any type). Traditional generation sources may be operated more efficiently through a smart grid as well. One example of how this may be accomplished is by improving the balancing of power supply with demand across traditional generation resources, new renewable generation, and distributed generation using advanced sensing and control capabilities achieved through a smart grid. SCE supports the vision of a smart grid configuration that facilitates increasing amounts of non-traditional generation sources, and that enhances the utilization and effectiveness of existing generation capacities wherever it is feasible.

c) Interoperability of a smart grid with current and future investments in infrastructure, including advanced metering protocols

SCE defines "interoperability" as a characteristic that permits seamless communication and exchange of information between diverse, disparate systems. California will need interoperability of key future smart grid technology components to support a robust, flexible, and secure energy infrastructure. SCE's vision for a smart grid has long been premised on the idea of "Interoperability from the generator to the customer, and everywhere in between." This element is key to stimulating vendor competition, fostering innovation, and realizing lower costs. SCE also supports criteria that, where appropriate, call for future smart grid deployments and enhancements to be interoperable with existing capital investments. For example, SCE has invested heavily in substation automation, and believes it is prudent to leverage this existing infrastructure for future smart grid enhancements as much as possible.

d) Ability to enable distribution and transmission automation, *e.g.*, be self-healing and adaptive

As a recognized industry leader in substation and distribution automation, SCE supports automation enhancements to the distribution and transmission networks. However, it is important to note that smart grid technologies that adapt to their operating environments and support self-healing capabilities on the system should not be limited solely to the distribution and transmission systems. For example, SCE has planned to apply advanced metering infrastructure to support and enhance existing distribution automation. We plan to do this by providing aggregated customer usage data. Therefore, SCE proposes modifying the above criterion to read *"Ability to enable and support distribution and transmission automation…"*

e) Ability to reduce overall usage (especially peak-usage) because it will be interactive and price responsive

SCE supports this criterion for smart grid capabilities. SCE is a leader in demand response programs with over 1,550 megawatts of peak load reduction capability.

SCE has also championed the enablement of peak-demand reductions through its approved SmartConnect™ advanced metering program and related dynamic rate and demand response proposals pending with the Commission.

f) Maintenance of system security and reliability

The electric grid is a national security asset. SCE is a leading contributor to the development of a cyber-security framework for a smart grid, and recently completed the first element for a secure advanced metering infrastructure in partnership with ten other utilities nationwide, the U.S. Department of Energy, and Carnegie Mellon University. SCE also seeks to maintain safe and reliable electric service to its customers through the deployment of smart grid technologies and the replacement of aging infrastructure. SCE supports this criterion for the smart grid. The security, reliability, and safety of the system are critical.

2. Proposed Modifications

In addition to the list of smart grid guiding principles and criteria above, SCE proposes including the following items:

a) Enhances the safety and effectiveness of the future workforce that supports the implementation, operation, and maintenance of the smart grid

Significant workforce challenges are expected to become a critical issue for many U.S. industries. The "age bubble," combined with a scarcity of qualified electrical field workers and fewer power-engineering graduates, amplifies this issue for electric utilities. The challenges facing the utility industry are unprecedented given the size and complexity of upgrading our nation's electricity infrastructure. As such, the work practices, field tools, and training programs offered to the next generation of utility workers must accommodate the magnitude of this proposed undertaking. The deployment of advanced technologies and systems across the grid will require a new highly-skilled workforce, and it is SCE's top priority to maintain the safety of these individuals tasked with implementing, operating and maintaining the future smart grid. SCE has taken a proactive approach to addressing this challenge through the development of its "Fieldworker of the Future" concept. SCE recommends the Commission adopt this principle and recognize that the key to smart grid development is the people behind it.

b) Ability to optimize the grid and extend the use of existing assets

SCE expects that advances in energy technologies, such as energy storage and superconducting materials, will enable a more resilient and efficient grid. SCE anticipates the proliferation of sensing, communication and control devices across all levels of SCE's electrical system will enable new operational and maintenance strategies to improve existing asset performance. In the substation, for example, advanced Condition Based Monitoring (CBM) devices can continuously monitor the health of critical assets such as power transformers and circuit breakers. We can use this information to provide just-in-time maintenance practices prior to failure, thereby improving safety and reliability. Another example is found in Dynamic Line Rating for transmission lines and substation transformers. Dynamic Line Rating would allow SCE to increase the power throughput on its transmission system without compromising system stability. SCE believes that significant operational and reliability improvements can be achieved through smart grid technology. The incremental capital investment required to achieve such capabilities is relatively minimal compared to the construction or replacement of infrastructure.

c) Ability to support the transition to electric fuel for transportation

Smart grid technology supports the transition to electricity as a transportation fuel and the utilities' ability to manage the new load associated with plug-in electric vehicles (PEVs). Advanced metering and communications infrastructure, when combined with smart grid connectivity and communication protocols that are currently under development, permit the development of utility rate structures to: (1) incentivize electric transportation growth, (2) capture and document carbon and pollutant emission reductions, (3) collect road taxes, and (4) enable the customer and the utility to manage the recharge process. Smart grid technologies also enable public charge ports and other charging systems, while supporting load management and communications to help simplify complex mobile vehicle-charging scenarios.

III.

EISA QUESTIONS

SCE fully endorses the intent of the 2007 EISA legislation to support the modernization of the Nation's transmission and distribution system. EISA legislation provides a broad set of guiding principles concerning recommended characteristics and capabilities for the envisioned national smart grid. SCE notes that California Senate Bill 17, proposed by State Senator Padilla, also outlines a useful scope for a smart grid. SCE looks forward to working with the Commission, IOUs, and other interested parties to build upon this foundation to develop smart grid criteria that will refine the definition of a "qualified smart grid system" and address additional concerns, such as cost recovery mechanisms for smart grid investment, development of a cost/benefit analytical framework, and other challenges.

According to Title XIII of EISA, it is the policy of the United States to support the modernization of the Nation's electricity transmission and distribution system to maintain a reliable and secure electricity infrastructure. Many of the benefits associated with this modernization (such as improved system safety, reliability and security, development of a green economy/workforce, increased energy independence, and decreased environmental impacts) are societal in nature and potentially difficult to quantify. There does not appear to be proper precedent or consensus from parties on calculation methodologies for these benefits. Absent a common analytical framework that parties can use to determine these benefits, incremental smart grid projects may be difficult to justify in terms of a strict cost-benefit analysis. As indicated in the section titled "Costs and Benefits of a Smart Grid," SCE seeks Commission guidance, via workshops, to develop this framework. Requiring the electric utilities to perform these analyses without a means to adequately demonstrate all of the associated benefits is not reasonable.

It is SCE's hope that, through a series of Commission-led workshops, these issues will be addressed in a manner that helps California develop smart grid requirements that align with federal policy and are flexible enough to support the unique requirements of each utility's electric system.

A. Question 2

Should the Commission require that, prior to undertaking investments in non-advanced grid technologies, an electric utility demonstrate to the Commission that the electric utility considered an investment in a qualified smart grid system, pursuant to PURPA Section 111(d)(16)(A) added by EISA Section 1307(a)?

No. The Commission should not require that, prior to undertaking investments in non-advanced grid technologies, an electric utility demonstrate to the Commission that it considered an investment in a qualified smart grid system. While SCE strongly supports the intent of EISA Section 1307(a), which seeks to promote the deployment of a smart grid electric system, we are concerned that the language of this section, if taken to an extreme, might inadvertently delay ongoing and necessary electric utility capital deployment and infrastructure replacement programs. In other words, even with emerging advancements in energy technologies, telecommunications, and computing technology capabilities, the electric power delivery system over the next ten years will largely continue to consist of longstanding and proven technologies, such as conductors, poles, towers, and transformers. Smart grid investments will often add a layer of "smarts" to the existing assets, but in many cases will not eliminate the need for continued investment in traditional assets.

Adding intelligence and improving the technologies associated with those functions performed by existing assets should prove beneficial from environmental, economic, safety, and reliability perspectives. These additions will constitute the early phases of smart grid deployment. EISA Section 1304 describes the need to conduct and support research, development and demonstration activities to facilitate the creation of a smart grid. Given that the substantial majority of current capital deployment occurs in proven core technologies, requiring that electric utilities formally demonstrate their consideration for smart grid processes and technologies that are not commercially available seems burdensome and unreasonable.

B. Question 3

Should the Commission authorize each electric utility to recover from ratepayers any capital, operating expenditure, or other costs of the electric utility relating to the deployment of a qualified smart grid system, including a reasonable rate of return on the capital expenditures of the electric utility for the deployment of a qualified smart grid system, pursuant to PURPA Section 111(d)(16)(B) added by EISA Section 1307(a)?

Smart grid development and deployment expenses should be recoverable from ratepayers. SCE has already received approval in previous regulatory proceedings, and incorporated into electric utility operations several smart grid projects over the past decade, including the recently-approved $1.6 billion SmartConnect™ program and approximately $260 million in smart grid projects pending before the Commission in our 2009 GRC. Future smart grid developments and deployments will benefit both SCE's ratepayers and society at large. According to the U.S. Department of Energy and National Energy Technology Laboratory *Vision for the Modern Grid*, a smart grid will be more reliable, secure, economic, efficient, safe and environmentally-friendly than current electric systems.[5] Public Utilities Code Sections 399(d), 399.2(c), 399.2.5(b)(4) and others provide utilities a reasonable opportunity to fully recover investments, earn a rate of return, recover operational expenditures, and also attract capital for investment. Existing precedent, potential benefits, and existing state law support utility recovery of its costs and investments.

C. Question 4

Should the Commission authorize any electric utility or other party deploying a qualified smart grid system to recover in a timely manner the remaining book-value costs of any equipment rendered obsolete by the deployment of a qualified smart grid system, based on the remaining depreciable life of the obsolete equipment, pursuant to PURPA Section 111(d)(16)(C) added by EISA Section 1307(a)?

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[5] http://www.netl.doe.gov/moderngrid/opportunity/vision.html.

Yes. The Commission should authorize electric utilities, and other market participants who are subject to Commission authority, to recover the remaining book value costs of assets rendered obsolete by the deployment of a smart grid. Prohibiting recovery of such investments would run counter to existing precedent and state law, and would severely hinder investment in smart grid technologies. Such an impediment would harm California ratepayers, not only by delaying the benefits associated with a smart grid, but also by virtually eliminating the possibility of attracting federal investment reimbursement funding (20 percent) as described in EISA Sections 1304 and 1306, respectively.

SCE is concerned about its customers and the rates they pay for utility service, especially in the current economic environment. Technology obsolescence is an important consideration, because deployment of smart grid technologies may cause certain equipment to become obsolete. Moreover, the smart grid technology itself may have a substantially shorter life-cycle than the equipment it replaced. Recent federal changes to allow faster tax depreciation of qualified smart grid assets help to mitigate the potential rate impacts. However, further analysis is required to better understand the potential impacts of replacing an increasing amount of grid assets (which may have asset lives of several decades) with technologies that have asset lives of perhaps a single decade.

An example of a method for dealing with asset obsolescence in a manner that mitigates the rate impact to customers can be found in the treatment of meters being replaced through SCE's SmartConnect™ program. In SCE's 2009 GRC application, rather than recovering its prudent investment within the 4-5 year period in which the meters will be replaced, SCE proposed that it recover the investment over the previous remaining life of the assets, which was calculated as 19.2 years. This approach, if approved in the GRC, will significantly decrease the impact to ratepayers. The Commission should adopt a similar treatment for obsolete utility investments identified in the future as a result of smart grid advancements.

It is important to note than many of the smart grid investments contemplated in SCE's 2009 GRC, or in the future, are not expected to render existing assets obsolete, and where possible, will "piggyback" on other technology upgrades. One example of a possible piggyback opportunity is found in the current upgrading of digital fault recorders to meet NERC compliance standards. In this process, SCE may be able to add an additional software upgrade to an existing digital fault recorder, improving its capabilities and eliminating the need to deploy a stand-alone phasor measurement unit.

D. Question 5

For purposes of the preceding three questions, how should "qualified smart grid system" be defined? Should any grid that has some or all of the characteristics cited in EISA § 1301 and performs some or all of the functions cited in EISA § 1306(d) be classified as a "qualified smart grid system"?

SCE's vision of the smart grid supports both federal and state policy objectives while also addressing an expansive list of challenges we face concerning SCE's operation and maintenance of the grid. SCE proposes the definition of a "qualified smart grid system" as any system, device, energy or information technology, or supporting infrastructure (e.g., construction materials, cabling, support structures, etc.) necessary to implement smart grid functionalities specified in, but not necessarily limited by, EISA § 1301, EISA § 1306(d), and proposed California Senate Bill 17 (S.B. 17). The proposed S.B. 17 definition of the smart grid is closely aligned with EISA § 1301, and includes the following:

- Increase use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid;
- Dynamically optimize grid operations and resources, with cost-effective full cyber-security;[6] deploy and integrate cost-effective distributed resources and generation, including renewable resources;
- Develop and incorporate cost-effective demand response, demand-side resources, and energy-efficiency resources;

[6] As indicated below, in ascertaining what constitutes "full" cyber-security, it is prudent that security capabilities remain appropriate to the level of exposure and the expected consequence of a security compromise (*i.e.*, the assessed risk).

- Deploy cost-effective smart technologies, including real-time, automated, interactive technologies that optimize the physical operation of appliances and consumer devices for metering, communicating information concerning grid operations and status, and distribution automation;
- Integrate cost-effective smart appliances and consumer devices;
- Deploy and integrate cost-effective advanced electricity storage and peak-shaving technologies, including plug-in electric and hybrid electric vehicles, and thermal-storage air conditioning;
- Provide consumers with timely information and control options; and
- Deploy and integrate cost-effective advanced technology to improve worker safety and productivity (SCE proposed addition).

SCE respectfully recommends that, with the guidance of the Commission, a series of workshops be held to further refine the definition of a "qualified smart grid system," including potential extension of the definition to encompass worker safety and productivity, as referenced below in point 3.

EISA § 1301 provides recommended smart grid characteristics that a "qualified smart grid system" should satisfy. SCE interprets these as broad characteristics of a smart grid technology platform that are needed to enable a host of smart grid capabilities and applications. While the EISA list is fairly comprehensive, SCE would like to provide further clarification and highlight certain omissions that we deem critical to achieving our smart grid vision.

1. EISA § 1301.2 Dynamic optimization of grid operations and resources, with full cyber-security

As indicated above, our system is a national security asset. SCE acknowledges the need to safeguard from cyber-attack the communications and computing systems installed throughout its grid network. SCE is a recognized thought leader and participant in a variety of industry forums and user groups that are working to define and develop national security requirements and standards for a smart grid. SCE is actively collaborating with PG&E and SDG&E in this important area. Here are some examples of organizations that SCE is involved with in the area of security:

- Utility Security Task Force (Utili-SEC);
- EPRI Intelligrid 2009 research project 161.013 (Security Issues for Advanced Metering, Demand Response, and Integration of Distributed Resources);
- AMI Security Acceleration Project (ASAP); and
- ZigBee's Smart Energy Security Standard

SCE has expanded its external technology advisory board to include the director of Computer Emergency Readiness Team (CERT) at Carnegie Mellon University. CERT is a partnership between the Department of Homeland Security and the public and private sectors, and is charged with protecting our nation's Internet infrastructure by coordinating defense against and response to cyber-attacks.

SCE is also currently making modifications to its grid network to comply with recent cyber-security statutes mandated by NERC and FERC, and will continue to support implementation of additional cyber-security standards as necessary.

SCE will continue to use cost-effective security methods and technologies that mitigate real world threats. The SCE security process provides security capabilities that are appropriate to the exposure and the expected consequence of a security compromise (*i.e.*, the assessed risk). SCE recommends that the Commission align with national cyber-security efforts.

2. EISA § 1301.3 Deployment and integration of distributed resources and generation, including renewable resources

SCE supports this criterion. SCE also notes, however, that in addition to distributed resources and distributed generation (including distributed renewable generation), the smart grid must also facilitate the deployment and integration of centralized bulk-power renewable resources. Added infrastructure requirements (at the transmission and distribution level) are implicitly part of this prescribed smart grid characteristic. In order to facilitate increasing amounts of renewable generation resources, additional transmission capacity will be required. Furthermore, a proliferation of distributed energy resources such as distributed generation and Plug-in Electric Vehicles have significant implications to distribution infrastructure. New distribution circuit capacity requirements, system protection strategies, service requirements at the customer premise, and maintenance/repair practices by utility workers will all need to be addressed. Finally, we note that these increased capabilities will be needed to achieve a potentially expanded Renewables Portfolio Standard (RPS) in California and to meet targets in mitigating climate change.

3. Smart Grid Functionalities

EISA § 1301 and § 1306(d), as well as proposed S.B. 17, provide a listing of smart grid functions that are needed to implement the federal smart grid vision. SCE has a more comprehensive view of smart grid functionalities required across the entire energy supply chain to enable California to meet its energy and environmental policy objectives by the year 2020. Most notably, this includes deploying new technology to improve worker safety and productivity.

E. Question 6

How should investments and other costs of a qualified smart grid system be determined for purposes of considering recovery from ratepayers? In particular, should the investment standards in EISA Section 1306(b), excluding investments specified in EISA Section 1306(c), be used to determine investments in qualified smart grid systems that may warrant ratepayer recovery?

As we discuss in the response to Question 5 above, SCE recommends that, under the guidance of the Commission, a series of workshops be held to further refine the definition of a "qualified smart grid system" that is inclusive of and expands upon EISA § 1301 and EISA § 1306(d). This is necessary because California's legislative and regulatory context for a smart grid must be broader and more robust than federal policy to ensure that California utilities are able to achieve ambitious year 2020 policies. These California policies include, among others, greenhouse gas reduction (as outlined in AB 32), Renewables Portfolio Standard, California Solar Initiative, and Zero Net Energy homes. Once the utilities and the Commission develop and agree to the expanded definition of a California "qualified smart grid system," that definition may prove useful as a tool to help identify smart grid investments as eligible for ratepayer recovery.

To answer the second sub-question, items enumerated in EISA Section 1306(b), excluding those specified in EISA Section 1306(c), should **not** "be used to determine investments in qualified smart grid systems that may warrant ratepayer recovery." Section 1306(b) of the EISA serves the purpose of listing smart grid items eligible for federal matching funds, not of delineating all investments which might be included in a "qualified smart grid system."

For example, Section 1306(b) does not include costs related to integrating distributed resources (including renewables or storage), providing timely energy information to consumers, IT systems integration, or computer hardware, although each of these should be included in the definition of a "qualified smart grid system." Furthermore, section 1306(c) specifically excludes costs associated with ongoing operations and maintenance of smart grid and smart grid equipment eligible for special tax treatment. Both of the referenced types of costs, while understandably not eligible for federal matching funds, should certainly be eligible for ratepayer funding.

F. Question 7

Should the Commission implement the standard regarding smart grid information contained in PURPA § 111(d)(17) added by EISA § 1307(a)?

SCE supports the smart grid information guidelines found in PURPA § 111(d)(17) added by EISA § 1307(a). However, SCE would prefer that the utilities not be limited to EISA 1307(a). We believe there are additional opportunities to provide customers with smart grid information that will lead to demand response and conservation benefits, but which are not explicitly mentioned in EISA. SCE would appreciate the opportunity to work with the

Commission and other participants in this proceeding (via workshops and other collaborative efforts) to develop guidelines for additional consumer-oriented smart grid information.

In addition to the guidelines outlined in EISA § 1307(a), SCE intends to consider other smart grid data and information tools for its customers. Examples of this include:

- Peak vs. off-peak usage summaries;
- Tier position information, showing customers' current (and projected) rate tier for a given monthly billing period;
- Average and peak demand data, particularly for commercial customers;
- Demand Response event information and Demand Response event results;
- Forecasting tools (such as a tool to help customers manage their energy budget);
- Rate comparison tools, in light of a customer's typical historic usage; and
- Event alert communications – including electronic messaging concerning system events and conditions.

G. Question 8

Is each California utility complying with the standard for the information that electricity providers must provide to electricity purchasers and other interested persons pursuant to PURPA § 111(d)(17) added by EISA § 1307(a)? If not, which part(s) of the standard is each utility not complying with and what efforts are underway to comply with the standard? If a utility is complying, please provide further details on how the utility complies.

SCE believes that it is either already in compliance or directly on the path to compliance for each of the smart grid information attributes included in PURPA § 111(d)(17). The following response will review SCE's progress to date, and our future plans for each of the guidelines identified in this section. (The guideline language is set off in italics.) In places where SCE indicates that it "will" provide a given service or capability, such language indicates that we plan to implement that service or capability as part of our smart grid efforts.

1. *17 (A) – Standard – All electricity purchasers shall be provided direct access, in written or electronic machine-readable form as appropriate, to information from their electricity provider as provided in sub-paragraph (B):*

Electricity purchasers (*i.e.*, SCE's customers) will have access to their usage information at a service account level via the following information channels:

- Electronic machine-readable form – basically, an internet view and/or downloadable file from the internet;
- Interactive Voice Response (IVR) – a useful alternative for those who don't have access to the internet; and
- Access to usage data directly from smart meter via home area network interface.

SCE believes that in the case of interval data the timeliness of the information is particularly important. We do not wish to provide our customers with stale or out-of-date information which would be of little or no use. Instead, SCE plans to direct customers to the internet or IVR channels for recent and historical interval usage data, and access to real-time usage data from smart meters via a home area network interface, which should provide a more useful and timely set of information for most customers.

2. *Information. — Information provided under this section, to the extent practicable, shall include:*

    - *Prices – Purchasers and other interested persons shall be provided with information on:*
        - *Time-based electricity prices in the wholesale electricity market*
            - SCE currently does not provide time-based wholesale prices to its customers.
        - *Time-based electricity retail prices or rates that are available to the purchasers*

        - Upon request, SCE's customers will be provided with retail price information for each of the different tiers (if applicable) for their given service plan/rate.
        - SCE believes that increased access to current retail prices, as well as to the difference in prices across time-of-use periods and monthly tiers, may affect customer usage patterns, leading to increased energy conservation.
        - Other interested persons, which include non-regulatory parties and non-customers, shall be provided with price information through tariff/rate information available for viewing on SCE's public website, www.sce.com.
- *Usage – Purchasers shall be provided with the number of electricity units, expressed in kWh, purchased by them.*
    - SCE's customers will be provided with usage information on a daily, weekly, and monthly aggregate and interval basis, upon request.
    - SCE is currently providing customers the appropriate monthly usage information, both via their paper bill and through the present "My Account" functionality on www.sce.com.
- *Intervals and projections – Updates of information on prices and usage shall be offered on not less than a daily basis, shall include hourly price and use information, where available, and shall include a day-ahead projection of such price information to the extent available.*
    - SCE is currently developing (as part of the SmartConnect™ program) the capability to provide next-day updates on price and interval usage information to customers via the web or IVR.

- Customers also will receive information that may indicate forthcoming demand response events such as peak time rebate (PTR) or critical peak pricing (CPP) and the pricing implications of such events.

- *Sources – Purchasers and other interested persons shall be provided annually with written information on the sources of the power provided by the utility, to the extent it can be determined, by type of generation, including greenhouse gas emissions associated with each type of generation, for intervals during which information is available on a cost-effective basis.*
  - SCE is already in compliance with the requirement to provide customers with information regarding the source of power provided by the utility, broken out by type of generation.

3. *Access – Purchasers shall be able to access their own information at any time through the internet and on other means of communication elected by that utility for smart grid applications. Other interested persons shall be able to access information not specific to any purchaser through the internet. Information specific to any purchaser shall be provided solely to that purchaser.*

- The utility provides the customer with access to his/her own information at any time via the web, Interactive Voice Response (IVR) or via a smart meter-enabled home area network interface.
- SCE currently provides non-customer specific data to external entities as is required by regulatory policy. SCE would like to suggest working with other utilities on developing and adopting an industry standard for exchanging data with interested persons other than the customer, in order to minimize costs associated with making this data available. SCE will not

provide customer-specific data to any third party entity without obtaining express permission from the customer.

IV.

REQUIREMENTS OF A CALIFORNIA SMART GRID SYSTEM

A number of national and international efforts are underway to develop a definition of the smart grid. As a result, both government and private entities have inundated the U.S. electric utility industry with strategic plans, roadmaps, and vendor product guides that all proclaim to hold the promise of the preeminent smart grid solution. The smart grid framework as prescribed in the EISA 2007 legislation supports most of California's policy objectives.

SCE's vision for the smart grid is both *inclusive* of state, federal, and corporate policy objectives, and *expansive* in the sense that it can accommodate future advancements in energy technologies needed to achieve California's year 2020 objectives. SCE believes the development of California's smart grid requirements should align with federal policy while also permitting prudent flexibility to support California's goals and utility-sponsored innovations. The following responses will address how SCE proposes the requirements for California's smart grid should be shaped, in addition to how a smart grid may support a broad set of California policy objectives.

A. Question 9

What should the characteristics or requirements be for a California smart grid? Should they be the same as those established for a "qualified smart grid system"? (*See* Question 5 above.)

SCE believes California has set ambitious environmental and energy policy goals which define a smart grid that is broader than the EISA requirements. SCE proposes that the modified smart grid characteristics and requirements, as stated in our response to Question 5 above, be established as the "qualified smart grid system" for California. In order to support the implementation of a smart grid on a national scale, SCE believes there is a need for coordinated effort between the utilities, the vendor community, academic and private research entities, and state and federal policymakers. This effort will enable coordination of state and federal policies.

B. Question 10

How can a smart grid system in California help in the following areas?

- **a. Increase energy conservation and energy efficiency;**
- **b. Increase demand response;**
- **c. Increase renewable energy;**
- **d. Reduce greenhouse gas emissions;**
- **e. Improve system reliability and;**
- **f. Lower consumer costs**

It is important to keep in context that California is the nation's leader in most of these areas and as such, several components of a smart grid are already in development within SCE's service territory. For example, SCE has already achieved significant results in energy efficiency, demand response, and renewable energy, and is a recognized national and international leader in these three areas. Plus, SCE is already on a trajectory to significantly increase energy conservation and energy efficiency, enable demand response programs, reduce greenhouse gas emissions, and lower consumer cost through a combination of Edison SmartConnect™, Demand Response, and Energy Efficiency initiatives.[7] Other aspects of a future smart grid are only in their infancy, but their future implementation will significantly enable SCE to meet renewable energy goals, further reduce greenhouse gas emissions, and improve system reliability and safety.

1. Increase renewable energy

California's existing 20% Renewables Portfolio Standard (RPS) is the most ambitious such standard in the U.S., and SCE is already the national leader in renewable power procurement. Nonetheless, there is significant momentum to increase the goals markedly, to a standard of 33% renewables. This unprecedented level appears to be more likely to be attainable with a smarter grid. To attempt to achieve this renewable goal, we

[7] D.08-09-039; A.08-06-001; A.08-07-021.

anticipate the need for bulk and distributed energy storage beyond anything currently feasible, coupled with remarkably intelligent and responsive control systems and optimization of transmission capacity. These conditions cannot be achieved without smart grid capabilities.

The intermittent nature of renewable energy resources will lead to increased challenges in maintaining a reliable grid as use of these resources increases. A robust communication and monitoring system will provide real-time status of wind, solar, and other distributed or customer-owned resources, and increase CAISO's and SCE's effectiveness in handling their variability. Possessing this real-time information will help mitigate energy shortfalls and surpluses, thus assisting in grid stability.

To maximize the integration of these renewable resources, it will be essential to deploy mass and distributed energy storage capabilities, at a level likely well beyond what is currently available in terms of scale, energy density, control systems, and global production capacity. Examples of high-capacity energy storage resources that can theoretically discharge energy very rapidly include compressed air energy storage, sodium sulfur batteries, flywheels, superconducting magnetic energy storage, ultra-capacitors, aggregated plug-in electric vehicles and stationary applications using auto-derivative batteries. Fostering the evolution of these technologies and their ultimate deployment will be a critical aspect of developing the smart grid.

Finally, newer renewable resources will be increasingly larger and further to the edges of our service territory. The improved monitoring and control capabilities of a smart grid will increase transmission capacity to these projects, and mitigate what would otherwise have to be invested to connect them.

2. Reduce greenhouse gas emissions

A discussion of how a smart grid will contribute to the reduction of greenhouse gases is included in our response to Question 30.

3. Improve system reliability

As discussed above, a growing renewable portfolio will increasingly strain grid reliability in the absence of smart grid technologies. The following represent some of the mitigating, and in some cases enhancing, capabilities that will promote reliability and safety:

a) Phasor Monitoring[8]

Use of synchronized, time-stamped phasor measurement data could improve SCE's monitoring and control capabilities, reducing the likelihood of an event causing widespread, and perhaps catastrophic, grid instability. This might allow SCE to avoid service interruptions and other societal costs associated with outages.

b) Centralized Remedial Action Schemes[9]

These schemes assist in maintaining system stability during contingency events, allowing SCE to avoid cascading outages, catastrophic asset failures, and associated collateral damage.

c) Dynamic Line Rating[10]

Dynamic Line Rating might allow SCE to increase throughput during periods of peak demand and provide a contingency analysis application with a wider variety of mitigation options.

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8 Phasor measurement consists of measurements of voltage and current sinusoidal waveforms on transmission lines. The data consists of phase angles, frequency, and electrical parameters (voltage, current, real power and reactive power). This data is used by the utility for monitoring and control purposes.

9 Remedial Action Schemes (RAS) are used to detect abnormal grid conditions involving transmission line or transformer outages in congested transmission corridors, and to mitigate these conditions by taking pre-planned corrective actions. Corrective action can include generation runback or tripping, load shedding, or system configuration changes. Centralized Remedial Action Schemes consolidate the various RASs into a centralized platform, improving the coordination and optimization of the various RASs.

10 Dynamic Line Rating represents power throughput limits that are calculated for transmission lines or transformers based on sensor information collected in the field. Such data could include temperature, line tension, and line sag. Dynamic Line Rating stands in contrast to static ratings which are fixed for all weather, tension and sag conditions. Static line ratings are generally more conservative than Dynamic Line Rating, since static ratings must accommodate most conditions.

d) Distribution and Substation Automation[11]

Automation could allow SCE to identify and isolate faults in less time, reduce the duration of service interruptions, and improve power quality.

e) Condition-Based Monitoring (CBM)

Condition-Based Monitoring could allow SCE to use remote sensor devices to proactively monitor equipment in the field, and make maintenance decisions based on the current conditions of those assets. This is in contrast to "reactive" or "preventive" maintenance strategies that prescribe maintenance based on the calendar, manufacturer recommendations, or actual breakdown.

f) Data beyond SCADA

This data alerts SCE to conditions that could lead to faults, allowing crews to be dispatched prior to faults occurring.

g) Distributed Generation (DG) and Energy Storage resources

These resources allow micro-grid or "islanding" applications to balance premises load with the DG or energy storage unit output. Micro-grids represent smaller grid areas that are designed to operate independently of the rest of the electricity grid. These are generally located in more remote areas with less transmission capacity, or where a long transmission corridor would lead to higher line losses. "Islanding" represents instances where a customer loses electricity supply from SCE, and the premise circuit breaker opens to isolate (or "island") the premise from the grid.

h) Mobile Field Automation

Mobile Field Automation represents a collection of remote field tools, mobile software, and the associated fourth-generation wireless broadband communications

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[11] Distribution and substation automation refers to a collection of programs and processes which provide remote monitoring and control, as well as automation, of various substation and distribution devices such as remote switches, automatic reclosers, remote fault indicators, and programmable capacitor controls.

network infrastructure -- all of which enable field workers to trouble-shoot with increased accuracy and speed, leading to faster service restoration.

V.

STATE OF THE SMART GRID IN CALIFORNIA

SCE's technology landscape is vast, encompassing the entire power delivery supply chain from the generator to the customer. SCE has researched, developed, and implemented smart grid technologies for many years. SCE is a nationally-recognized leader in, among other areas, phasor measurement technology, advanced distribution automation, demand response, advanced metering infrastructure, energy storage, and plug-in electric vehicles. SCE believes that the utility industry has the power to influence and drive technology advancement for positive change. SCE remains committed to integrating new technologies into its power delivery infrastructure to meet the growing needs of customers, address global climate change, and satisfy both current and future state and federal legislative objectives.

The following sections will highlight key systems and technologies that are currently in operation, planned to be in operation, or are in the early planning and development stages with respect to the prescribed smart grid functionalities listed in EISA § 1301. The purpose of this section is to provide a "snapshot" of notable implementations and conceptualized systems within SCE's technology portfolio, and is not intended to be exhaustive.

A. Question 11

What progress has each utility made toward establishing a smart grid? In answering this question, please provide details on progress related to each of the ten characteristics identified in EISA 1301.

1. Increased use of digital information and controls technology to improve reliability, security, and efficiency of the electric grid

SCE has been a leading developer of wide area measurement and control technologies for over 15 years. Since electricity flows across a grid at nearly the speed of light, abnormal conditions can propagate quickly throughout the electric system. SCE's pioneering efforts in the area of Synchronized Phasor Measurement Systems (SPMS) have reached a point where the company can quickly and affordably analyze data from large transmission grids. SCE's system utilizes hardware and software to capture millions of grid stress-point measurements. It then analyzes the data and synthesizes it into a simple visual representation that will enable operators to see where action must be taken to avoid widespread electric system collapse. SCE leads the industry in SPMS technology and recently received the "2007 T&D Automation Project of the Year" awarded by *Utility Automation & Engineering T&D* magazine.

SCE is also an industry leader in both substation and distribution system automation technologies. SCE has equipped over 55% of its 900 substations with automation technology -- 30% of our substations have state-of-the-art microprocessor-based systems that operate over local area networks, and 25% of our substations have remote terminal units and programmable logic controllers. SCE has also equipped approximately 35% of its 4,300 distribution circuits with automation equipment that operates using advanced wireless technology. In addition, SCE has developed and deployed an automated bulk capacitor switching system to offset purchasing expensive must-run generation and increase the power import capability for the Southern California region.

SCE's automation strategy allows for both remote control/monitoring and autonomous control of critical grid components, which helps protect the system during abnormal conditions and maintain reliability. While SCE believes it is an industry leader with its current automation strategies, much work remains to be done to fully integrate both distribution and substation automation into one comprehensive and coordinated system automation approach.

The proliferation of digital devices across the system will also enable smarter maintenance and work practices. SCE currently depends on numerous Intelligent Electronic Devices (IED)[12] to provide information on the condition of Transmission and Distribution assets to utility personnel. SCE calls this information "Data Beyond SCADA." We expect to extend such monitoring capabilities to more assets at all levels of the grid network, creating

[12] Examples include transformer dissolved-gas monitoring, fault indicators, digital fault recorders and relay information.

billions of new equipment-state status points at regular intervals that will need to be processed and synthesized into actionable information.

SCE has performed several use cases that conceptualize new business requirements for advanced diagnostic processing of asset information -- so that we can engage in maintenance of equipment precisely when it's needed, prior to asset failure. In addition, SCE hopes to harness this information to improve how we schedule and dispatch field crews. Using advanced field tools and wireless two-way communications, SCE envisions using mobile field automation to aid in maintenance and repair work while seamlessly communicating job status to the utility back-office for keeping records and responding to customer inquiries in near real-time. This capability will be especially useful in communicating outage restoration status information to our customers.

2. Dynamic optimization of grid operations and resources, with full cyber-security

SCE is in the process of implementing a revolutionary new approach to remedial action scheme (RAS) management for transmission level system protection through its Centralized Remedial Action Scheme (C-RAS) project. The purpose of a RAS is to provide system protection over a wide area, such as a congested transmission corridor (as opposed to a single component). Centralizing all existing and future RASs is necessary for SCE to accommodate all of the new generation resources seeking interconnection and to defer as much as possible massive construction of new transmission facilities. All local RAS data will be transmitted and analyzed by a centralized logic processor facility to make the most optimal decisions to trip generation/load, taking into account multiple factors on the grid.

SCE also leads the way in developing concepts and applications for Phasor Measurement data integration with advanced control systems. In June 2007, SCE was the first utility in the world to successfully implement Synchronized Phasor Measurement System (SPMS) technology as part of a coordinated control algorithm for its Rector Static VAR Compensator (SVC) installation. SVCs help maintain and enhance system stability by controlling voltage with fast-acting, continuously variable power electronics. The SPMS interface provides operational information at approximately 30 scans per second, allowing the SVC to provide excellent voltage regulation. In addition, SCE has completed several use cases pertaining to real-time optimization applications, in order to manage voltage stability and security and to make better use of existing system capacity as part of a broader Smart Grid Command and Control system.

The Smart Grid Command and Control system we envision will continuously examine the system's state, and iteratively simulate grid conditions and calculate contingencies. The system will determine the most optimal set of coordinated control actions to mitigate abnormal system conditions, increase capacity utilization, and improve power quality. In addition, the system will assess the health of critical system assets such as bulk power transformers. If a critical failure occurs that puts the stability of the system at risk, the network would automatically transfer load off the relevant transformer banks through automated reconfiguration of switches and transformer banks to prevent failure and maintain electric service.

3. Deployment and integration of distributed resources and generation, including renewable resources

SCE is the nation's leading purchaser of renewable energy. In 2008, SCE delivered nearly 13 billion kilowatt-hours of power from renewable resources -- more than any other U.S. utility -- accounting for approximately 16 percent of SCE's total power deliveries under California's Renewables Portfolio Standard (RPS) guidelines. On March 7, 2008 SCE broke ground on the first three segments of the nation's largest transmission project devoted primarily to renewable energy -- the 4,500 megawatt Tehachapi Renewable Transmission Project.

Our engineers and researchers are actively pursuing solutions to the growing challenges associated with integrating greater amounts of new intermittent renewable resources with the grid. SCE's Research, Development and Demonstration (RD&D) group was recently awarded a contract by the California Energy Commission's (CEC) Public Interest

Energy Research (PIER) Program to study the feasibility of energy storage for wind interconnection points on the SCE system. SCE is pursuing a Renewable Integration and Advancement program to further address intermittent renewable resource integration challenges.

SCE is also committed to advancing Distributed Energy Resource (DER) research and development, in addition to managing its existing portfolio of interconnections. To date, SCE manages over 4,000 DER projects totaling 270 megawatts. As part of SCE's Circuit of the Future project, internal researchers and scientists developed a "plug-and-play" interface for dispatchable DER as part of a demonstration for future distribution circuit design and functionality. In anticipation of more advanced and widespread deployments of DER by customers and businesses, SCE has completed use cases for facilitating the integration and management of DER using SCE's SmartConnect™ advanced metering and communications infrastructure.

4. Development and incorporation of demand response, demand-side resources, and energy efficiency resources

SCE is a leader in demand response with over 1,550 megawatts of curtailable load, including price-responsive tariffs and programs. SCE's 12,000 largest customers have advanced metering and near real-time communications that enable dynamic pricing, Auto Demand Response (Auto DR), energy curtailment bidding, and interruptible programs. SCE's SmartConnect™ metering will enable all other customers to engage in similar programs, ultimately providing another 1,000 megawatts of demand response. Smart grid enhancements can facilitate additional communications and control capabilities that will help create a demand-responsive customer culture. SCE is also a national leader in energy efficiency programs. Over the past five years, the utility's energy efficiency programs have saved more than five billion kilowatt-hours. Smart grid enhancements can facilitate additional customer awareness of energy saving options, such as investments in energy efficiency.

5. Deployment of "smart" technologies (real-time, automated, interactive technologies that optimize the physical operation of appliances and consumer devices) for metering, communications concerning grid operations and status, and distribution automation

Edison SmartConnect™, SCE's Advanced Metering Infrastructure (AMI) program, will replace over five million of today's electric meters with next-generation electric metering technologies to improve customer service and empower the ratepayer to proactively manage, in part, their energy use. The customer will save money by participating in new programs with time-differentiated rates and demand response options. These devices have the potential to reduce day-to-day utility operation costs by streamlining processes and automating the matching of resources with demand. SCE envisions an advanced metering system that would serve as the information backbone to enable dynamic pricing, demand response, energy conservation, efficient customer service, and rapid outage response.

6. Integration of "smart" appliances and consumer devices

Edison SmartConnect™ will enable the integration of a wide spectrum of smart, programmable, wirelessly communicating consumer devices and appliances using the Home Area Network (HAN) interface. HAN functionality will give customers the option to purchase, connect, and partially manage systems and devices such as the following:

- Home Energy Management Systems;
- Programmable Communicating Thermostats (PCT);
- Smart Appliances (*e.g.,* ZigBee-enabled refrigerators, washers/dryers, pool pumps, etc.);
- Distributed Energy Resources (*e.g.,* home energy storage systems, distributed generation such as rooftop photo-voltaic systems, etc.); and
- Plug-in Electric Vehicles.

7. Deployment and integration of advanced electricity storage and peak-shaving technologies, including plug-in electric and hybrid electric vehicles, and thermal-storage air conditioning

SCE sees tremendous opportunities in using storage technologies to effectively integrate growing amounts of large-scale intermittent resources and distributed renewable resources. SCE leads the way in the development and evaluation of battery storage technology, particularly for use in electric transportation as demonstrated by SCE at our technology labs. We have the nation's largest private electric vehicle fleet, and were the first utility invited to join the U.S. Department of Energy's FreedomCar program. SCE is also involved in partnerships with EPRI, Ford, and GM in further developing Plug-In Electric Vehicles and those vehicles' interoperability with the smart grid.

SCE believes that the next generation of battery storage technology will power plug-in-vehicles and will provide significant value in stationary applications on the distribution grid. SCE is pursuing a program for conducting Research, Development and Demonstration (RD&D) on larger-scale storage technologies. We are currently seeking approval for our Renewable Integration and Advancement Program,[13] which will leverage efforts with the California Energy Commission, Electric Power Research Institute, and the Department of Energy to conduct RD&D on larger-scale storage technologies (such as Catalina Island Battery Integration, Compressed Air Energy Storage, and the Irvine Smart City Project).

8. Provision to consumers of timely information and control options

SCE's SmartConnect™ advanced metering system will provide customers with valuable information regarding both real-time and historical usage patterns, and notifications regarding energy price escalations during peak hours. The system will also give suggested tips for conserving energy, all across a variety of media (*e.g.*, customer web portal, text

[13] Application of Southern California Edison Company (U 338-E) for Approval of Its Renewable Integration and Advancement Program, Application No. 08-03-014 (March 18, 2008).

message, email, in-home display device, etc.). SmartConnect™ will also enable price-responsive control options of appliances and devices in the home through the Home Area Network (HAN) interface.

9. Development of standards for communication and interoperability of appliances and equipment connected to the electric grid, including the infrastructure serving the grid

Please refer to our responses to Questions 12 and 13 for details on SCE's progress with standards development and future standards needs.

10. Identification and lowering of unreasonable or unnecessary barriers to adoption of smart grid technologies, practices, and services

In 2007, SCE embarked on a rigorous company-wide assessment of its operations, processes and initiatives in an effort to determine how the smart grid will potentially impact future operations. SCE's smart grid strategy encompasses five strategic areas (discussed above in our executive summary) that address a broad set of business requirements to better position SCE to meet both current and future power delivery challenges. These areas and their accompanying objectives are closely aligned with California's regulatory commissions and the federal government's smart grid efforts.

In an effort to provide greater integration to SCE's smart grid development efforts, SCE re-aligned multiple organizations spread across the T&D, Information Technology, and Customer Service business units to centralize the technology advancement effort for smart grid. This re-alignment resulted in the formation of SCE's new Advanced Technology organization. The organization includes RD&D and technology-related strategy, policy and standards development for transmission and distribution, energy storage, next generation metering, energy efficiency, demand response, and electric transportation, as well as the related enabling information technology.

VI.

STANDARDS AS PART OF A SMART GRID

New and updated standards across a variety of different functional areas are needed to support the implementation of the SCE smart grid and ensure its ultimate flexibility, security, and durability over time. SCE believes the realization of interoperable smart grid technologies can be achieved by developing standards. Active participation between end-user utilities and the vendor communities responsible for bringing most of the smart grid technologies to market is necessary.

SCE has already demonstrated its belief in and commitment to standards, the standards development process, and the principle of interoperability. We have led and participated in a number of standards development organizations (SDOs) and user groups. SCE established the precedent for supporting the development of standards that foster interoperability and openness in innovation as part of its AMI program. In 2006, Paul De Martini, SCE's Vice-President of Advanced Technologies, asserted in his presentation to FERC on AMI and Demand Response that through interoperability "[i]t is possible to balance the desire to adopt [smart grid] technologies to support well-defined needs and requirements today and allow for flexibility for tomorrow's uses in a secure system."[14] To date, SCE's efforts have included participation in the following standards groups, among others:

- Electric Power Research Institute, Inc. (EPRI) Intelligrid;
- Department of Energy Gridwise Architecture Council;
- International Electrotechnical Commission's (IEC) TC57 and TC8 (IEC 61850, IEC 61968, IEC 61970, etc.);
- UCA International User's Group for OpenSG, UtilityAMI, OpenHAN, UtiliSEC, etc.;
- Society of Automotive Engineers (SAE) J2836 / J2847/ J1772/ J2293;

[14] Paul De Martini presentation at the 2006 FERC Technical Conference on Demand Response and Advanced Metering. Docket No. AD06-2-00, (January 25, 2006).

- ZigBee/ HomePlug Smart Energy Profile; and
- Institute of Electrical and Electronic Engineers (IEEE) 1547 for Interconnecting Distributed Resources.

Existing standards in the smart grid area, while helpful, are presently insufficient and immature. SCE believes we must develop new standards, and coordinate and integrate these new standards with existing ones. SCE supports the National Institute of Standards and Technology (NIST) effort to bring coordination to the development of smart grid standards. SCE suggests that the workshops proposed by this OIR will provide a setting for SCE and others to inform the Commission on the development and adoption of specific national and international smart grid standards.

A. Question 12

Are standards needed as part of a smart grid? If so, in what areas are standards needed to integrate components into the grid, *e.g.*, interoperability standards for distributed generation, distributed storage, plug-in hybrid and electric vehicles, home area networks, in-home displays, energy management systems, etc.?

Yes. The development and adoption of open standards are critical for the implementation of a smart grid. SCE has identified seven areas of standards that must be explored and developed to help drive the implementation of a standardized, interoperable smart grid:

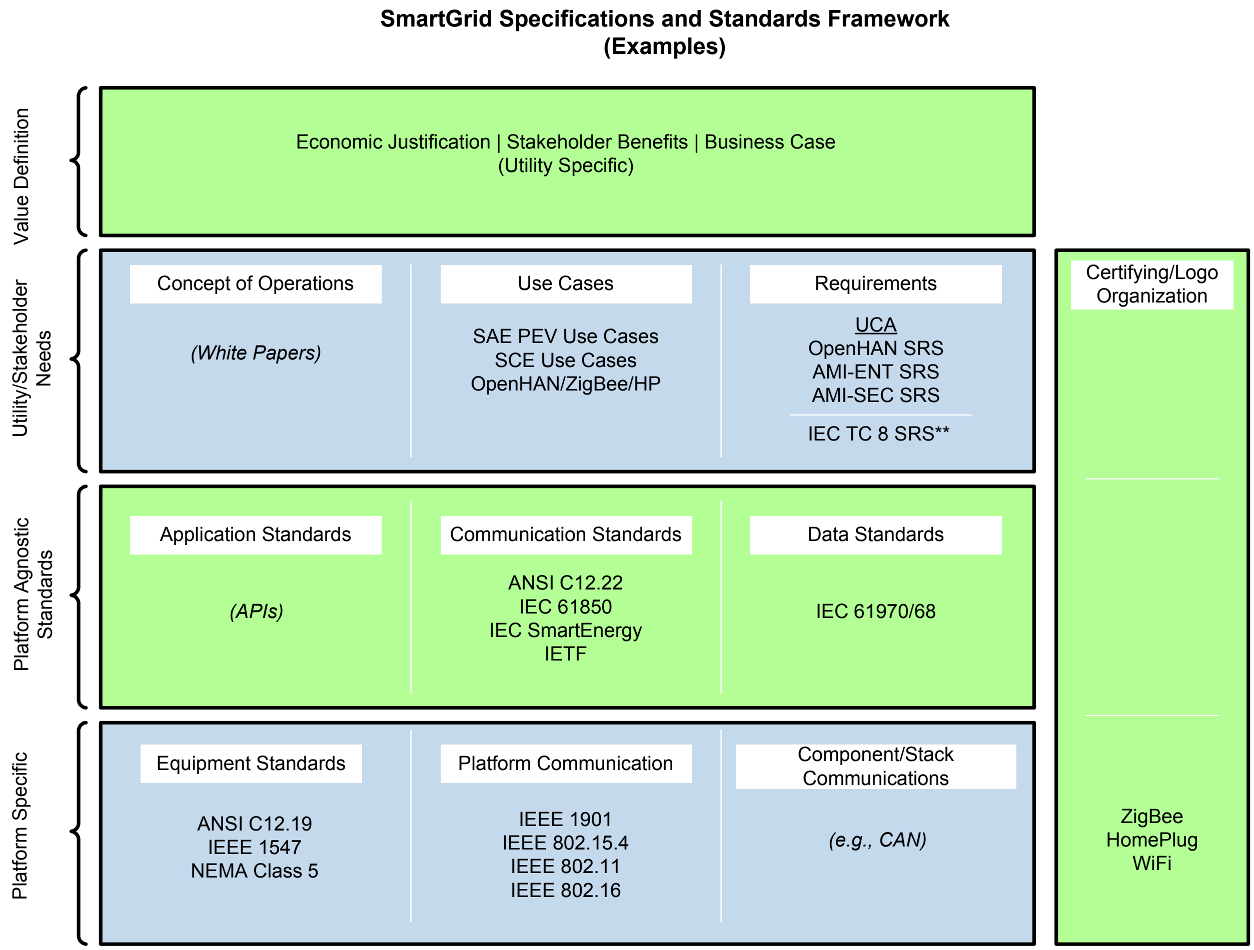
- Advanced Metering Infrastructure (AMI);
- Behind the Meter – Home or Business Area Network (HAN), including Plug-in Electric Vehicles (PEV);
- Distributed Energy Resources (DER) – including distributed renewable generation and energy storage technologies;
- Transmission & Distribution;
- Generation – including large-scale renewable generation;
- Information Technology / Data Management; and

- End-to-End Smart grid Cyber-Security.

Smart grid business functions will reside in one or more of the standards areas above. Each smart grid business function could require multiple individual standards, to ensure common functionality of like equipment and promote interoperability across different equipment and across the grid. Thus, multiple "levels" of standards may be required for any given business function. The types of standards which would fall into these different levels could include some, but not necessarily all, of the following:

- Design Standards/ Reference Designs
- Operating Standards
- Communications Protocols
- Data Standards
- Interconnection Standards
- Measurement/Accuracy Standards
- Application Integration Standards
- Security Standard
- Safety Standards
- Market Rules/Standards
- Business Use Case/Process Standards, etc.

SCE has developed a framework to categorize smart grid standards and specifications types, including those listed above, according their level of specificity. This framework is visually displayed in the figure below, and includes exemplar standards which reside in various sections of that framework. As shown in the figure, we suggest four different levels of standards and standards types. Looking at the figure from top to bottom, the standards included at each level go from abstract and conceptual to greater and greater specificity and detail. For any given smart grid business function, standards for each level will need to be adopted as the function or capability moves from concept towards implementation, and as more specific and recognized standards become available.



B. Question 13

For each type of standard that is needed please answer the following:

a. Who should issue the standards, *e.g.*, NIST, ANSI, IEEE, and/or the Commission?

b. What standard-making processes are already underway?

c. What is or should be the role of the California utilities in the standards-making process?

The following sections will review areas where SCE believes that additional standards work is needed for each of the standards areas identified in Question 12. Within each section, sub-questions 13a, 13b, and 13c will be addressed in terms of potential standards bodies for involvement, standards efforts in progress, and the potential role of SCE, respectively. This list is not exhaustive, but hopefully provides the Commission with some examples of areas where standards development is occurring, and where it is needed, across the smart grid landscape.

1. Advanced Metering Infrastructure (AMI)

In the advanced metering space, the following are examples of areas in need of additional standards development:

- Security for AMI information exchange and command and control events communicated between the utility and metering end points.
- Harmonization between American National Standards Institute (ANSI) C12 and the International Electrotechnical Commission's (IEC) 62056 (Device Language Message Specification / Companion Specification for Energy Metering) metering objects, including incorporation of needed extensions for smart grid uses.

ANSI and IEC should continue to be involved in metering and metering communications standards, including those related to security. SCE is looking to continue its leadership in driving requirements and use cases for AMI security standards through continued involvement in the Advanced Metering Infrastructure Security Task Force (AMI-SEC) users' group and the Electric Power Research Institute, Inc. (EPRI) Intelligrid 2009 research project 161.013 (Security Issues for Advanced Metering, Demand Response, and Integration of Distributed Resources). SCE is also an active participant in the AMI Security Acceleration Project (ASAP) in partnership with EnerNex Corp., Intelguardians, Software Engineering Institute (Carnegie Mellon), Idaho National Lab (INL), and Oak Ridge National Lab (ORNL). This project is supported by both EPRI and the Department of Energy.

2. Behind the Meter – Home or Business Area Network (HAN), including Plug in Electric Vehicles (PEV)

The "behind the meter" standards area includes standards for operation of premise devices, including Plug-in Electric Vehicles (PEV), and their communication with local energy/building management systems and/or a utility enabled Home Area Network (HAN) communications network. Standards development continues to be needed in the following areas, among others:

- Communications platform-independent Smart Energy Profile (SEP) standard, allowing for Smart Energy Profile to be used seamlessly across multiple networking technologies (*e.g.,* wireless, Power Line Carrier, Ethernet).
- Adoption and extension of UtilityAMI HAN (*i.e.*, OpenHAN) specifications.
- Development and extension of Smart Energy Profile for additional uses associated with smart grid capabilities (*e.g.,* distributed generation and energy storage monitoring and control, PEV monitoring and control, etc.).
- Plug-in Electric Vehicle Communications – Standardized messaging and protocols for communications between the utility and PEVs to enable incentive rate structures and demand response programs specifically for electric vehicles.
- PEV Physical connections – Standardized interconnection between a PEV and the utility grid at different voltage levels to ensure charging location interoperability and safety.[15]

The Institute of Electrical and Electronic Engineers (IEEE) has traditionally been active in this arena, setting standards for the IEEE 802.11 (Wi-Fi) and IEEE 802.15.4 ZigBee standards families. SCE, working with multiple other utilities, is leading an effort to develop interoperability of communications messaging between 802.14.5 and Power Line Carrier protocols using Smart Energy Profile. In doing so, SCE continues to support the next generation of Power Line Carrier compatibility and interoperability as defined in IEEE P1901.

With regards to Plug-In Electric Vehicles, team members from SCE's Advanced Technology organization have worked closely with EPRI, other utilities, and

[15] Safety standards may take on even greater importance if PEVs are actually supplying power to the grid as an interconnected Distributed Energy Resource.

multiple auto manufacturers to begin developing vehicle-utility communications and interconnection standards.[16]

3. Distributed Energy Resources (DER)

In the Distributed Energy Resources area, further standards development is needed in the following places:

- Interconnection standards allowing for "ride-through" capabilities, enabling grid support benefits as well as intentional islanding through modification or extension of the IEEE 1547 body of standards.
- Adoption or extension of the International Electrotechnical Commission 61850-7-420 standard for utility/DER communications for monitoring, command and control.
- Harmonization of Home or Business Area Network communication standards with utility command and control systems for DER.

The DER space has witnessed significant progress in recent years with regard to physical interconnection standards development. In response to federal support from the Department of Energy, standards development for integrating DER with electric service providers was placed on a "fast track" development cycle. The resulting standards work by the IEEE 1547 (*Standard for Interconnecting Distributed Resources with Electric Power Systems*) was completed in 2003. The work addresses physical interconnection to the utility, DER unit testing, operating performance, and safety. Subsequent complementary standards aimed at expanding and providing further clarification of IEEE 1547 have been produced or are currently underway. In addition, International Electrotechnical Commission (IEC) Standard 61850-7-420 serves as an example of international standards development pertaining to DER information models for automation and control. SCE is committed to supporting both

[16] We have made these efforts under the guidance of the Society of Automotive Engineers (Society of Automotive Engineers Standards J2836, J2847, J2293, and J1772).

current and future DER standards development and refinement by the IEEE, IEC, and utility sponsored user groups.

4. Transmission and Distribution

The standards landscape in the transmission and distribution domain is extensive. However, additional standards in this domain are needed to support smart grid functions. Examples of where standards development continues to be needed include the following areas:

- Standards pertaining to operating functions for specific Intelligent Electronic Device (IED) classes operating on the transmission and distribution grid.
- Completion and adoption of IEC 62351 security standards for substation and distribution automation information exchange, and command and control events communicated between utility and Intelligent Electronic Devices (IEDs) in the field.
- Extension of IEC 61850 to include distribution devices and distribution automation functions.
- Harmonization between American National Standards Institute standard C12, IEC standard 61850, Smart Energy Profile, and existing distribution automation communication protocols (*e.g.,* Distributed Network Protocol (DNP) 3 and Modbus) for bridging Advanced Metering Infrastructure (AMI) communications with distribution automation.
- Adoption of standards covering overall functionality of Phasor Measurement Unit devices, including data formats and exchange with utility command and control systems such as Energy Management System (EMS) (IEEE C37.118 and 1344).
- EMS standards for communication to Remote Terminal Units (RTUs), integration with data historians, interfaces to outside entities such as the

ISO, and security (compliant with NERC and FERC cyber-security standards).

Recent years have witnessed a proliferation of Intelligent Electronic Devices (IEDs) for both distribution and transmission/substation applications. Although SCE has devised ways to successfully integrate IEDs onto its substation and distribution automation platforms, the processes require significant effort and specialized expertise. Standardized Common Information Model (CIM) extensions for specific distribution IED and asset classes, once fully developed, will potentially facilitate the seamless integration of both existing and new IEDs with distribution automation systems. As SCE begins its effort to implement a Distribution Management System to consolidate, upgrade, and expand upon existing distribution automation capabilities, standards for communication with distribution IEDs and for NERC-compliant security will be critical.

In the future, distribution automation applications will potentially integrate with advanced metering/HAN applications to enable new customer programs and services as well as grid support activities. In order to achieve these capabilities, further harmonization of standards to facilitate the integration of substation automation with distribution automation systems needs to occur. Distribution automation systems will also need to be bridged with AMI/HAN communications and control systems. SCE is committed to supporting both current and future distribution and substation standards development by the IEEE, IEC, and utility-sponsored user groups.

The majority of substation automation applications across North America, including SCE's, utilize the Distributed Network Protocol (DNP3) and Modbus communication protocols. In recent years, much attention has been given to the IEC 61850 international standard development effort for substation architecture and communications. While more prevalent in European markets, widespread implementation of IEC 61850 by North American utilities has not yet occurred. General industry intelligence regarding IEC 61850 points to interoperability and conformance issues when integrating multiple vendor substation automation devices based on varying interpretations of the standard. This will require further reconciliation.

Many IEDs utilized in substation applications also support transmission functions and activities. IEDs such as advanced microprocessor-based relays, phasor measurement units, Flexible Alternating Current Transmission System devices, and transformer dissolved-gas analyzers are now being deployed throughout utility transmission and substation systems. The IEC 61850 standard may potentially facilitate interoperability of communication and control systems throughout the transmission and substation network.[17] Standardized Common Informational Model (CIM) extensions for transmission/substation IEDs will be required to allow us to integrate data collected from the transmission or substation system into a comprehensive utility command and control system. SCE is committed to actively participating in and supporting the advancement of phasor measurement units technology through our membership in the North American Synchro-Phasor Initiative (NASPI) organization. SCE serves on the executive steering group and research coordinating council of this organization.

5. Generation – Inclusive of large scale renewable generation

For generation, most of the focus for smart grid standards development has been and should be associated with distributed energy resources (including energy storage), as discussed above. Large-scale renewable generation should continue to follow existing standards for interconnection into the grid and data exchange with the utilities and CAISO.

6. Information Technology / Data Management

Extensive standards development has been completed for information/data management associated with the electricity grid, notably with the IEC 61970/ 61968 CIM standards. However, additional work is necessary to bring new smart grid technologies into

[17] An example is SCE's planned Centralized Remedial Action Scheme (C-RAS) project, which will centrally manage and control transmission protection services to maintain grid stability.

these and other standards. The following are some examples of needed standards in the Information Technology/Data Management space:

- CIM extensions for smart grid equipment and data types:
  - Including extensions for distribution/substation/transmission automation and monitoring equipment types (FACTS devices, PMUs, advanced relays, thermal monitoring equipment, condition sensors and related messaging, etc.), as well as messages/message structures sent and received by each. This is needed to facilitate data integration with the Energy Management System and other core utility IT systems.
  - Including extensions for HAN devices such as smart thermostats, home/building energy management systems, and plug-in electric vehicles. This is needed to facilitate device management and device communication, and must be harmonized with Smart Energy Profile standards.
- Standard Application Programming Interfaces (APIs) for smart grid equipment and IT systems, so that data can be readily interfaced into existing utility integration frameworks and, as necessary, authorized third party applications.
- Standardized reporting, calculation algorithms, and analytical tools to handle smart grid data collected by the utility. There has been significant general interest in this area, but little consensus or standardization concerning what specific analytics, calculations, and reporting should be developed.

SCE Information Technology architects have been designing SCE IT systems to be compliant with CIM constructs as a standard practice. However, as new technologies and systems are developed for the smart grid, existing CIM standards may not support all new equipment types and functions requiring data exchange. SCE intends to provide input to the various CIM working groups, which work under the umbrella IEC standard, as new or extended standards are required.

With regards to standard Application Programming Interfaces (APIs) for smart grid systems, SCE has been working with AMI hardware and software vendors to advance standardization of application interfaces to integrate smart grid back-office systems with other typical utility IT systems.[18] In addition, SCE has had initial conversations with external companies regarding standardization of APIs for delivery of customer usage data, which (with customer permission) could be used for third party demand response applications, or for third party information display services. It is anticipated that standard APIs would also follow the IEC CIM standard.

7. End to End Smart Grid Cyber-Security

Cyber-security bridges all aspects of the smart grid and must be considered from an end-to-end perspective, as opposed to any individual part of the grid. Security vulnerabilities in one domain or sub-system could leave connected upstream and downstream systems vulnerable as well.

As we mentioned in the response to Question 5, SCE is actively involved in a number of smart grid security standards development efforts and intends to continue its efforts. We hope that one outcome of these efforts is the development of a spectrum of standardized smart grid security solutions -- so that the utility can select the solution that matches calculated risk levels for the types of assets and information involved. SCE has implemented significant cyber-security protections to date, as we work to comply with the NERC cyber-security standards, but we expect that further security standards will be required as additional smart grid automation and information exchange occurs across the entire grid landscape.

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[18] Such systems include customer billing, customer relationship management, asset management and work management.

C. Question 14

What specific standards, if any, should the Commission adopt in this proceeding, and why? What type of standards should the Commission avoid because they risk obsolescence or might lead to unnecessary costs?

SCE recommends that the Commission not adopt specific smart grid standards in this proceeding. Adopting specific standards as "required" for California smart grid implementations at this time is premature, due to the dynamic nature of developing smart grid technologies and the breadth of standards development activities currently underway.

The Commission should instead encourage the utilities to implement open non-proprietary standards-based technologies whenever possible. SCE suggests that the Commission use one or more of the workshops proposed by this OIR as a forum to provide coordination on standards development, and to help ensure that key national and international standards and goals are followed while still meeting California's specific needs and objectives. The Commission should also support the continued participation of SCE and other California utilities in the development, adoption, and coordination of smart grid standards in areas such as, but not necessarily limited to, those highlighted in the response to Question 13. Doing so will result in a body of standards for smart grid capabilities that have been generated through industry collaboration, which utilities can then select from when implementing smart grid projects for their specific business needs and strategies.

Because the current smart grid standards landscape is complex, fractured, and incomplete, SCE looks forward to discussions on this topic with the Commission and the other California utilities in the workshops proposed by this OIR (notably the "Integration/Interoperability" workshop). SCE suggests that consideration of the NIST smart grid standards coordination effort, and how the California utilities might best be able to support and influence that work, be part of the agenda for such a workshop.

D. Question 15

What types of standards should be common across California utility service territories? Do characteristics of each utility's transmission and distribution system (*e.g.,* different mix of overhead versus underground wires) suggest that some types of standards are unnecessary?

By definition, smart grid standards will be common and applicable to each of the California utilities (including municipal utilities). While there are some differences in the layout of electrical systems, many of the relevant standards for the smart grid apply to information exchange, which would probably not differ across the utilities.

That being said, differences in the *application* of individual standards by each utility will result from differences in their business needs, existing infrastructure, and strategic choices. For example, utilities that have invested heavily in substation automation may choose to implement a centralized system for distribution automation, while others with less investment in centralized systems may find that distribution automation employing distributed intelligence is more cost-effective. For this example, both alternatives might be deemed "standard" by ensuring standardized information exchange *at the point of interface* with other systems. This allows for a potentially diverse set of market offerings from the vendor community, all of which could be compliant with key standards. In turn, this gives the utility some reasonable choices in arriving at the best solution that meets applicable standards at the critical "intersection" points between systems.

E. Question 16

What type of standards or protections, if any, are needed to allow secure access by approved market participants or third parties, such as Electric Service Providers or demand response aggregators? Would "guidance" work in lieu of standards?

In general, third parties (whether or not they are associated with demand response programs) should be required to meet the same security and data formatting standards as any of the other entities participating in the CAISO wholesale market (IOU, Merchant Generator, ISO, etc.) in order to have access to utility data and participate in data exchange. Aggregators or Curtailment Service Providers that participate in the market as Aggregated Energy Resources should be held to the same standards and security requirements as Electric Service Providers. More (or less) stringent security standards may be required depending on the nature of the data being accessed. A third party could only access specific SCE customer data from SCE if the customer expressly provides permission.

Guidance, in lieu of required standards, is not preferable to SCE in this case because it leaves the door open to third parties suggesting non-standard mechanisms for security or formats for data exchange. If SCE is required to serve any market participants or third parties, it follows that SCE would likely be required to serve *all* market participants or third parties. In that scenario, any non-standard security arrangements could lead to a significant number of security mechanisms and data exchange formats that would need to be supported by SCE. Each additional non-standard data format would require that SCE and its customers incur significant expense for developing customized integration programs to ensure that the non-standard data can be generated or received by SCE's IT systems. In contrast, under a required standard, the costs and complexities of integration would be significantly reduced.

VII.

COSTS AND BENEFITS OF A SMART GRID

Successful deployment of smart grid technology in California to meet existing environmental and energy policy objectives for the year 2020 will require substantial utility investment. Such smart grid investments will likely be a mix of both incremental investments and replacement investments that enhance and expand existing capabilities, and build new capabilities. The various projects required to deliver these capabilities may be grouped into programs, as was done with AMI, so that complimentary capabilities and associated costs and related benefits are accounted for as building blocks along the overall smart grid deployment plan.

A substantial portion of smart grid benefits are societal in nature and include national and state priorities such as achieving energy independence, reducing greenhouse gas emissions, and increasing grid security, safety, and reliability. These benefits are often difficult to quantify, they may vary widely in their justification of various smart grid technologies, and they are multi-tiered in terms of who benefits from them. Benefits may relate to SCE customers, California residents in general, or society at large. These benefits need to be considered within the context of the complete portfolio of smart grid technologies, which would necessarily be deployed over an extended time horizon.

The Commission should therefore provide the necessary guidance to the utilities by establishing a common smart grid evaluation framework for smart grid investments. Key stakeholders would be best served by the Commission facilitating a series of workshops to establish guidance in determining which investments would qualify as smart grid, what types of benefits should be quantified, and what are the appropriate frameworks for calculating those benefits.

A. Question 17

Given the IOUs' existing transmission and distribution infrastructure and policy programs, to what extent will incremental investments be required in additional smart grid technologies?

The outcome of the research phase (outlined in Question 24) will likely result in both incremental and new investments. The extent to which incremental investments are required for additional smart grid technologies depends on the smart grid goals defined by the Commission, the results from vendor capability assessments of new and existing technologies, cost/benefit trade-off analyses, risk assessment, and deployment sequencing.

B. Question 18

How should the Commission assess the cost-effectiveness and reasonableness of smart grid-related expenditures?

SCE supports best-faith efforts to deploy smart grid technologies and components in as cost-effective a manner as possible. However, strict adherence to traditional cost/benefit models may not provide the appropriate level of support for smart grid investment decisions. A significant percentage of the future smart grid benefits will likely accrue to society and not directly to ratepayers. Some of these benefits may prove difficult to quantify. Some may be quantifiable, but lack proper precedent or consensus from parties on calculation methodologies. The Commission should facilitate the establishment of a common analytical framework that permits the inclusion of certain societal benefits, and yet allows for varying assumptions unique to each specific utility.

As discussed in the response to Question 25, this topic could be discussed in the proposed "Workshop Series: Develop a Consistent Regulatory Framework." We welcome the Commission sponsoring these workshops.

C. Question 19

What types of costs would be associated with deploying a smart grid?

In general, the costs associated with deploying a smart grid are monetary in nature, and will include research and development, business case and regulatory management, program management, engineering, procurement of equipment, technology and materials, construction or systems development, and incremental ongoing costs for operating the smart grid. These costs will include both capital and operations and maintenance expense. The timing and degree of these costs will be driven by the deployment approach articulated in our response to Question 24.

D. Question 20

How should any smart grid upgrades that are approved by the Commission be staged over a reasonable time horizon that mitigates rate impacts?

For smart grid deployment, SCE recommends using a phased approach as described in our response to Question 24 below. SCE recommends exploring this question in detail in a Regulatory Framework workshop, as described in our response to Question 25 below.

E. Question 21

Should smart grid-related costs be borne by ratepayers, shareholders, or third parties?

SCE respectfully submits that smart grid-related costs should be borne by ratepayers in a manner consistent with previous cost recovery proceedings, such as with prior and current rate cases and SCE's SmartConnect™ Deployment Application.

Of course, in addition to other benefits, a deployment recovery mechanism should recognize any relevant operational benefits, in the form of offsets to the deployment costs. The recovery mechanism for deployment costs, as discussed in our response to Question 25, would be explored in the proposed "Workshop Series: Develop a Consistent Regulatory Framework." We welcome the Commission sponsoring these workshops.

F. Question 22

What types of benefits would result from a smart grid? Which benefits can be easily quantified and how? Which benefits are difficult to quantify, and how should they be addressed?

The types of benefits that would result from a smart grid are described, in part, in our response to Question 10. The following benefits have a previously-established methodology within the context of Edison SmartConnect™, Demand Response Filings and Energy

Efficiency filings: Energy Conservation; Energy Efficiency; Demand Response; and Consumer Cost reductions.

Calculating societal benefits requires that the IOUs and the Commission agree on a common framework to evaluate these benefit opportunities. A sample list of Societal Benefits that would result from a smart grid includes:

a. Promotion of the California "Clean Tech" industry through industry clusters (*e.g.,* service aggregation, new products/appliances/services that create efficiencies, etc).
b. Positive impact on California's gross domestic product due to investments in local capital projects, and the associated job creation.
c. Achieving state and federal "Energy Independence" and Renewable objectives.
d. Improvements in employee safety.
e. Avoidance of economic losses associated with reliability events, including catastrophic failures and wide area blackout conditions.
f. Improvement in market operations and efficiencies.
g. Reduction in green house gas emissions.
h. Advancement of national security priorities such as reducing our nation's dependence on foreign oil, fostering the use of electricity as an alternative transportation fuel, and making the electrical system less vulnerable to man-made attacks.

SCE would welcome the opportunity to work with the Commission and other IOUs to craft a framework by which relevant societal benefits could be consistently quantified across the California utilities.

G. Question 23

How should a competitive bidding process for IOU investments in smart grid technology be structured and monitored? Are existing competitive procurement processes sufficient?

Existing IOU procurement processes have proven sufficient for sourcing smart grid technology. SCE has sourced significant smart grid technology over the past decade. We believe that our processes are sufficient, and that the Commission already has the ability to monitor the process and results, as was the case with SCE's SmartConnect™ program.

VIII.

DEPLOYING A SMART GRID IN CALIFORNIA

Smart grid is not a single piece of equipment. Instead, it is an ensemble of equipment, telecommunications, software, and people. Deploying a smart grid requires careful consideration of what capabilities generate the greatest benefit to ratepayers, shareholders and society as a whole. The development of a smart grid is also a never-ending process. The first phase of smart grid in California began in response to the 2001 energy crisis with the deployment of smart metering for large commercial and industrial customers, and now extends to all customers and to the expansion of energy efficiency and demand response.

SCE believes it would be helpful for the Commission to establish a reference point for the development of the next phase of smart grid based on meeting the existing California environmental and energy policy objectives for the year 2020. The Commission should also identify a set of key capabilities that a smart grid should deliver, similar to how the Commission provided guidance for AMI deployment. This sets the guidelines that the utilities should design their smart grid deployment plans to achieve.

A. Question 24

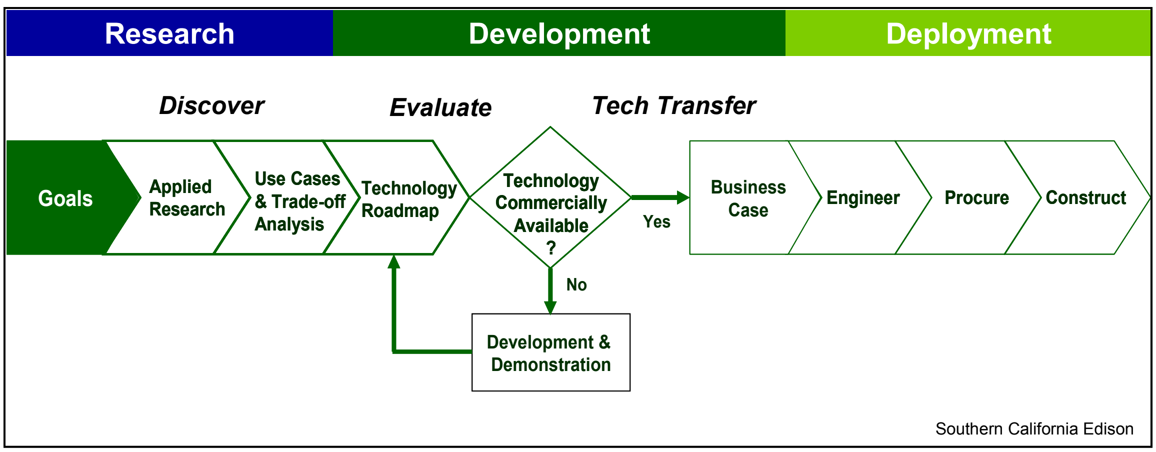
How does the smart grid get deployed? What should a utility do in order to successfully deploy smart grid technology?

As with any endeavor, there are challenges to employing smart grid technology. In SCE's case, substantial investment has been made over the past decade in technology and we are in the midst of a major distribution infrastructure replacement program to replace aging infrastructure.

One challenge is how to gracefully integrate emerging technologies into SCE's infrastructure over the next decade to meet California's energy and environmental policy objectives. Adoption of pre-commercial technology can cause significant project cost increases and delays as well as operational risks. An effective technology adoption plan is essential to manage risks.

Moreover, SCE respectfully believes that legislators and regulators will provide critical guidance in setting policies, but such guidance should not extend to the level of actually picking and choosing individual technologies for the utilities to implement. That task should be carried out by the utilities, who will report in detail to this Commission with respect to the smart grid technologies that the utilities examine and use.

The following depicts the system engineering approach taken by SCE to deploy advanced technologies.



Traditionally, regulators have focused on deployable technology rather than the planning work necessary to design a comprehensive suite of solutions. The Commission should fund the planning steps required (*i.e.*, Establish Goals; Research; and Development) prior to any deployment phase, as depicted in the Figure above.

1. Establish Goals

The establishment of California smart grid criteria to achieve environmental and energy policy goals is crucial for successfully developing and implementing a smart grid. The Commission, in collaboration with the IOUs, should define a reference point and a defined set of smart grid criteria in a manner similar to the way that the Commission established six key capability criteria in the AMI proceeding. This guidance was necessary to help shape the utilities' AMI deployment plans without prescribing a particular solution.

SCE believes the Commission should adopt the year 2020 as the time horizon to reflect the convergence of existing environmental and energy policy objectives that will have a significant impact on the electric grid. This includes California potentially raising the bar on renewable energy mandates from 20% to 33%, adoption of plug-in electric vehicles, the California Solar Initiative and other DER resources, and the California Energy Commission's mandate for Zero Net Energy homes. We also note that the development and refinement of a smart grid is a never-ending process. The first phase of smart grid in California began in response to the 2001 energy crisis with the deployment of smart metering for large commercial and industrial customers, and now extends to all customers and to the expansion of energy efficiency and demand response.

2. Research (Discover)

A utility should analyze smart grid use cases, in order to define smart grid business requirements that will help shape the utility's point of view on what eventual deployment activities it should pursue. The activities include preparing initial business and technical requirements, developing engineering-economic trade-off analysis, conducting technology market assessments, and preparing technology gap analyses. This exploratory period also helps to jumpstart the smart grid industry by ensuring collaboration on the strategic direction of smart grid. Ultimately, the end result should culminate in a strategic technology roadmap that supports the goals established by the Commission. The technology roadmap is a living document that needs to be updated regularly to reflect changes in policy, business needs, and technological advances.

3. Development (Evaluate & Technology Transfer)

To the extent technologies exist in an off-the-shelf form, the IOUs can consider deployment. For immature technologies, it is essential to conduct extensive beta testing (*i.e.*, (pre-production capability testing) to further the development of a viable commercial product. Since the implementation of the smart grid is a significant undertaking, it is prudent to perform technology development and demonstration projects that test the concepts or component parts of the overall smart grid. SCE's current test lab methodologies and results are widely recognized for enabling a variety of vendor capability advancements, such as energy storage technology for both electric vehicles and home energy use. This type of utility-specific development is essential to reduce operation risk in the deployment of new technology in critical operations such as the electric grid. California smart grid R&D activities have been severely limited because of funding. A regulatory imperative should be to adequately fund the phases above, because it sets the strategy, direction and key priorities for future investment decisions.

4. Deployment

SCE envisions that it will likely combine several elements of smart grid technology implementation into multiple programs or singular projects with varying durations. Based on the scope, cost/benefit, and timing for each program or project, SCE expects to seek approval for cost recovery through the appropriate regulatory mechanism, as established through Commission-sponsored workshops.

B. Question 25

What type of regulatory approach should the Commission take to support the development of a cost-effective smart grid?

SCE believes that the Commission should establish an appropriate funding mechanism for early-stage smart grid activities. SCE also welcomes the Commission's sponsorship of workshops to create a common smart grid framework across California, including but not limited to defining the smart grid capability goals that should be achieved by the year 2020, developing methodologies for analyzing and calculating smart grid benefits, and establishing the overall mechanism/process for cost recovery of smart grid projects.

In addition, SCE respectfully suggests that the Commission take the following approach when evaluating smart grid for the IOUs:

- ✓ Continue to support utility recovery of its prudent costs and investments and management of its assets and resources.

- ✓ Seek consistency between the utilities where reasonable, while at the same time recognizing the unique aspects of each utility.
- ✓ Ensure that policies and requirements from this proceeding do not impede existing, approved deployment plans. It is critical that utility smart grid efforts that are already underway are not slowed down. A great deal of work must be accomplished to reach California's 2020 goals, and there is no time to lose.

1. Establish a Funding Mechanism for Pre-Deployment Phases

As discussed in Question 24, there is an upcoming period of activities related to smart grid that will require significant resources. However, there is insufficient funding available for recovering the related costs. The activities that drive the costs are outside the scope of SCE's general rate case. An appropriate regulatory cost treatment is needed, such as a balancing account to record the costs associated with the Establish Goals, Research, and Development phases.

This balancing account treatment is similar to the initial conceptual phase funding that the Commission authorized in the recent AMI proceeding. The research, development, and demonstration costs captured in this account have the potential to obtain fifty percent cost share under EISA Section 1304(b), Smart Grid Technology Research, Development, and Demonstration. Attracting federal cost share will benefit ratepayers by expediting the development of smart grid technologies while reducing the costs associated with such developments.

2. Refine and Expand Commission-Sponsored Workshops

The Commission recommends establishing workshops along the electric supply chain: Transmission, Distribution, Integration/Interoperability, and Consumer Issues. While these workshops are useful in understanding the technical make-up of a smart grid, the Commission should include a broader set of issues. The Commission should also sponsor workshops that facilitate smart grid policy development and a consistent planning and decision-making framework. SCE respectfully proposes to organize a series of workshops that would occur under this Commission's sponsorship:

SCE-Proposed Workshop Series - Develop a Consistent Regulatory Framework, including:

- Smart grid capability criteria to be achieved by 2020;
- Business case framework methodology, including benefits analysis;
- Smart grid cost recovery mechanism/process; and
- EISA compliance.

This series of workshops is designed to establish the smart grid timeline, help clarify the regulatory process across the utilities, and provide the appropriate level of guidance from the Commission to achieve agreed-upon goals (similar to the six key criteria the Commission set forth at the beginning of evaluating AMI).

C. Question 26

What, if any, regulatory barriers to the deployment of a smart grid should the Commission address?

As a recognized industry leader in the development and deployment of smart grid technologies,[19] SCE has developed many innovative programs through its RD&D and advanced technology efforts, including SmartConnect™, Circuit of the Future, Garage of the Future, C-RAS, and synchronized phasor measurement applications. These programs have been developed at a relatively low cost, but are expected to pay significant dividends in the future. A greater level of Commission support for electric utility RD&D and advanced technology programs would significantly accelerate the development and deployment of the smart grid. To achieve success in the timeframes proposed by state and federal energy and environmental policies, adequately funded electric utility programs are critical. State and federal programs alone are insufficient.

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[19] Smart Grid: Enabler of the New Energy Economy, A Report by the Electricity Advisory Committee, December 2008, p. 4.

D. Question 27

If the Commission requires the utilities to develop smart grid deployment plans, what should those plans consist of?

The Commission should evaluate whether a smart grid deployment roadmap answers two fundamental questions:

- **How will smart grid deliver lasting customer value?**
- **Does the deployment roadmap satisfy State energy policy objectives?**

In broad strokes, a deployment roadmap should include a discussion on how the smart grid is cost-effective, including a financial assessment, an evaluation of benefits and revenue requirements, and an assessment of ratepayer impacts. This discussion should include a proposal on the appropriate cost recovery mechanism. The deployment roadmap itself should reflect what was learned during pilot testing and other research and development efforts as described in our response to Question 24. A deployment roadmap should also demonstrate the evolution of capabilities, technologies and investments across the benefit areas described in our response to Question 10.

E. Question 28

What milestones should the Commission use to measure the utilities' progress toward the development of a smart grid?

We believe that the key to measuring the progress of the utilities toward the development of a smart grid is for the Commission to adopt, in collaboration with stakeholders, functional goals that drive toward the year 2020 vision we articulate above. We note that the Commission developed the following six key criteria early in the AMI proceedings:[20]

a. Support dynamic tariffs;

b. Provide customers with access to usage data;

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[20] Testimony Supporting Application for Approval of Advanced Metering Infrastructure Deployment Strategy and Cost Recovery Mechanism, March 30, 2005 – Volume 2 – Technology and Market Assessment, Deployment Strategy and Cost Recovery Proposal, p. 4.

c. Flexibility in data access frequency (without additional hardware costs);

d. Compatible with applications that utilize collected data;

e. Compatible with utility system applications that enhance system operating efficiency and improve service reliability (including outage management); and

f. Capable of interfacing with load control communication technology.

These criteria were applied to each utilities' application and gave not only the guidance necessary to develop robust architectures that met the State's objectives, but also drove the utilities to refine their deployment plans to achieve substantial capabilities within a reasonable time period. The Commission should take a similar but expanded approach with smart grid and provide key criteria to measure the effectiveness of the approach taken by each utility. SCE looks forward to the opportunity to discuss these goals in greater detail in collaborative, Commission-sponsored workshops.

IX.

OTHER QUESTIONS

A. Question 29

How should a smart grid interact with the operation of the transmission system and wholesale market? What is the role of the CAISO relative to a smart grid?

Upon implementation, the SCE smart grid will significantly impact the way that SCE operates its transmission system. Examples of this would include, among others:

- Command and control of FACTS devices to mitigate system disturbances;
- Proactive alerting of potential equipment failures based on the analysis of sensor data by Condition Based Maintenance (CBM) systems;
- Centralized Remedial Action Schemes (C-RAS) for system stability;
- Operator decision support based on automated analysis of phasor data;
- Improved state estimation and contingency analysis from more widespread and near real-time system monitoring; and
- Dynamic Line Rating of transmission lines for transmission capacity optimization.

Many of these uses may involve automated reconfiguration of the transmission system, triggered either by manual SCE operator intervention (potentially prompted by smart grid systems), or triggered automatically based on the analytical outcomes of SCE smart grid information systems. SCE would need to provide immediate updates of any grid configuration changes to CAISO in order to maintain transparency and allow for CAISO oversight.

SCE anticipates that CAISO will continue in its current oversight role with respect to the transmission system. The SCE smart grid will be able to provide additional information to the wholesale market to describe the current state of the transmission system, increasing overall system transparency. The SCE smart grid will also facilitate the integration of demand response, energy storage, and controllable distributed energy resources (distributed generation).

B. Question 30

Will deployment of a smart grid further the State's Assembly Bill 32 greenhouse gas reduction goals? If so, how?

Deployment of a smart grid will facilitate the following four mechanisms that contribute to reduced greenhouse gas (GHG) emissions.

- Increased use of renewable energy;
- Energy conservation;
- Load shifting; and
- Enabling electric transportation.

1. The Smart Grid Will Facilitate Improved Renewable Energy Integration

A key challenge to the development of additional renewable energy resources by California utilities is the ability to integrate these intermittent resources into the California electricity grid. Smart grid technology will more easily enable this integration. Additionally, by fostering other advanced technologies, such as electric transportation infrastructure and energy storage, the smart grid will enable intermittent resources to produce usable power even during off-peak times.

2. The Information Provided via Smart Grid Technology Will Promote Additional Energy Conservation

Based on SCE's SmartConnect™ information, we believe that energy conservation has high potential for creating significant environmental benefits. Based on conservative estimates, SCE expects Edison SmartConnect™ to create an annual reduction of 365,000 metric tons of carbon dioxide or about 1,000 metric tons per day within our service territory.

3. The Demand Response Opportunities Provided by Smart Grid Technology Will Reduce Peak Demand and Enable Increased Use of Lower Emission Base-Load Resources Such as Nuclear, Hydroelectric and Lower Emission Natural Gas Units

The electricity demands of SCE ratepayers are met by a mix of base-load and peak demand generating resources. The generation used to meet the bulk of the base-load demand is composed of emission-free nuclear and hydro-electric generation, and efficient natural gas generating resources. Much of the peak energy demands are met with higher emission gas peaker units. In addition to positively affecting conservation efforts through demand response programs, the smart grid will facilitate reduced greenhouse gas emissions by prompting a move away from peaker units to lower emission base-load generation.

4. The Smart Grid Should Facilitate the Transition to Electric Fuel for Transportation

The increased use of Plug-in Electric Vehicles (PEVs) supports greenhouse gas reduction goals by displacing fossil fuel emissions with electricity from an increasingly renewable utility generation portfolio. Such increased use also replaces internal combustion engines with more efficient electric motors, and should allow the utility and its customers to take advantage of renewable energy that is more readily available during off-peak periods (*e.g.*, wind power) if PEV customers receive incentives to charge at these off-peak times.

C. Question 31

How will deployment of a smart grid system impact the Commission's Planning Reserve Margins? Will a smart grid system impact the amount and type of generation necessary to meet peak demand? Off peak demand?

SCE believes that evaluating the impact of smart grid on Planning Reserve Margins (PRM) is a worthwhile endeavor. NERC, however, has jurisdiction over setting PRM. A potentially fruitful area of research involves the question of whether the smart grid will allow greater access to either Generation supply or firm Load Reduction that qualifies in the ancillary services market. In evaluating PRM using smart grid, we may find that our actual PRM exceeds the known PRM, which would cause us to re-think how we manage grid stability. The use of advanced smart grid technologies such as DER, C-RAS and other state measurement could allow the California Independent System Operator to operate under reduced PRM.

The increase in PRM supply could also exert a downward effect on the price of ancillary services as smart grid allows for greater through-put capacity, distributed generation, energy storage, and demand-side management. For now, it is a theoretical assumption that this increase in supply will create a more efficient market through increased competition in the ancillary services market. To truly evaluate the impact smart grid will have on PRM, it is important to work collaboratively with the regulatory agencies and market participants to understand both the benefits and the risks.

In tackling the challenge of meeting both Peak and Off-Peak demand, the smart grid expands the available generation to types such as variable, micro-storage, and distributed generation. These new generation types can be connected to either the transmission grid or distribution grid using smart grid technologies such as energy storage to reduce their variability.

D. Question 32

What other smart grid-related issues should the Commission address in this proceeding?

Other regulators and lawmakers are currently seeking to have input into smart grid development, including the California Energy Commission, the California Legislature,[21] Congress, and the U.S. Department of Energy. It is crucial that these various efforts proceed, to as great a degree as possible, on an informed and coordinated basis, so that the risks of duplicative or even contrary standards and policies are minimized.

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21 For example, SCE is informed and believes that California State Senator Padilla is sponsoring smart grid legislation (S.B. 17).

The Commission may also consider simplifying the jurisdictional intersections that must be met in order to implement a comprehensive smart grid across California, which includes municipal electric utilities and non-California WECC utilities. If a traditional grid is connected to an adjacent smart grid, the traditional grid might force the smart grid to compensate for the traditional grid's limitations, thereby preventing the full realization of ratepayer and societal smart grid benefits. The Commission should address, and try to reconcile, the various jurisdictional overlaps and gaps that regulate the California infrastructure to achieve a full smart grid implementation.

X.

CONCLUSION

SCE looks forward to working with the Commission, fellow utilities, and other parties to fulfill a year 2020 vision of modernizing the grid to deliver a cleaner energy supply from renewables and integrated distributed resources, energy-smart consumer devices, and electric vehicles while improving reliability, safety, and cost-effectiveness. SCE respectfully requests that this proceeding be structured in accordance with SCE's responses as set forth herein.

Respectfully submitted,

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February 09, 2009

CERTIFICATE OF SERVICE

I hereby certify that, pursuant to the Commission's Rules of Practice and Procedure, I have this day served a true copy of SOUTHERN CALIFORNIA EDISON COMPANY'S (U 338-E) RESPONSE TO OIR 08-12-009; ORDER INSTITUTING RULEMAKING TO CONSIDER SMART GRID TECHNOLOGIES PURSUANT TO FEDERAL LEGISLATION AND ON THE COMMISSION'S OWN MOTION TO ACTIVELY GUIDE POLICY IN CALIFORNIA'S DEVELOPMENT OF A SMART GRID SYSTEM on all parties identified on the attached service list(s). Service was effected by one or more means indicated below:

Transmitting the copies via e-mail to all parties who have provided an e-mail address. First class mail will be used if electronic service cannot be effectuated.

Executed this **9th day of February, 2009**, at Rosemead, California.

/s/ Raquel Ippoliti
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California Public Utilities Commission

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