SOUTHERN CALIFORNIA EDISON
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Introducing SCE's Grid Management System

The twenty-first century electric energy infrastructure will require enhanced situational awareness, automation, reliability, and safety and the ability to seamlessly integrate distributed energy resources (DERs). At SCE, we are pursuing a next-generation Grid Management System (GMS) as the overarching solution to addressing these changes and to anticipate future demands on the system.

Recognizing that no one can predict all of the changes coming to our industry, nor can they be implemented all at once, the GMS is based on an architecture and guiding principles that allow us to proactively support changing requirements. This will minimize disruption to existing operations, consumer commitments and regulatory requirements while allowing incremental deployments and transition from legacy systems.

Developing and implementing the GMS will require a new way of thinking about how we procure, integrate and operate the new technologies. We intend to share the details of our strategy and architecture with our peer utilities and the vendor community to accelerate the industry's ability to support a new vision for how power system infrastructure is built, maintained and operated.

SCE Grid Modernization Strategy

- ***Leverage existing projects*** *to validate new technology and business concepts*
- ***Capture traceable business requirements***
- ***Develop a comprehensive architecture*** *around which to build and evolve the GMS*
- *Ensure that the system* ***can be procured and integrated incrementally***
- ***Engage and share concepts and artifacts*** *with other utilities to develop common industry requirements*
- ***Engage vendors early*** *to communicate requirements so they can integrate into product roadmaps*

GMS Capabilities

Our previous approach has been to minimize change; rigid processes and management structures, compartmentalized by specific functions, operate and support a stable distribution network. In the future, agility and flexibility will be required. Adaptive technologies must meet the challenges of a two-way distribution network and anticipate further disruptions to current ways of operating.

The GMS will provide an integrated set of engineering, planning and operational functions as well as advanced analysis capabilities. The advanced analysis capabilities will enable management of the distribution network in conjunction with decisions made by customers and third parties, within the limits provided by the grid-connected equipment, and in the environment the grid is operating in at the time.

The GMS will provide direct support for:

- Responding to growth of customer-controllable DERs that can respond to demand response signals
- Managing to the growing complexity of the California energy market, including prices communicated directly to end-consumer DER equipment
- Running the distribution and transmission infrastructure closer to its capacity margin
- Responding to dynamic two-way power flow in the distribution grid
- Increasing reliability and power quality for customers
- Supporting customer micro-grids that can be islanded -- leaving or joining the grid based on customer decisions
- Forecasting the total load by location from:
    - the available power from DG,
    - the amount of energy available in storage,
    - the available demand response based on market conditions, weather, equipment status, customer decisions, and other factors
- Providing operators with transmission-like contingency options that reduce the impacts to customers due to shifting grid conditions
- Managing the grid based on multi-objective optimization, including customer values, grid capacity, economics, equipment life cycle, reliability, and lowest impact to the environment

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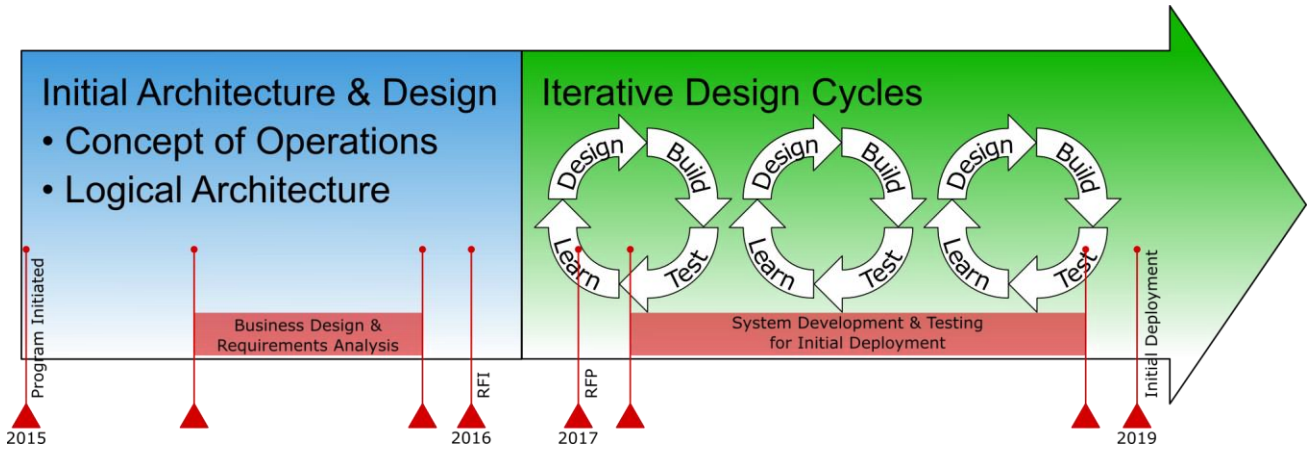
Development Status and Next Steps

As of February 5, 2016, SCE has completed the conceptual architecture and system decomposition of the GMS and seeks to engage and partner with other utilities and vendors on design details. SCE plans to engage in a series of industry activities and events to capture the best thinking the industry has to offer as well as to send clear signals to the supplier community on capabilities, requirements and timelines. Key success factors include the formulation of detailed System Requirements and associated Use Cases so as to inform, shape, and align the commercial product roadmaps with common utility objectives.

The broad schedule for the GMS development effort is shown in the figure below. To build and test the system, we will be using an iterative design cycle approach in which we repeatedly cycle through high level and low level design phases to address new functions to be implemented against the architecture and refine our approach as we incrementally procure and implement. This process will repeat through subsequent system releases.

This approach is necessary in order to be able to adapt to rapid technology changes during and following the course of the project, so that the final system will be able to continually reflect evolving policy, business and technology. An iterative design approach also reflects the need to be able to learn from the incremental implementation of system components. During these design cycles we will incorporate findings from other utility implementations, learn from implementation challenges and performance metrics, and incorporate vendor innovation.



Reference Documents

SCE has created some guiding documents that serve as the foundation for the execution of later phases of the program. We have published two key documents that communicate SCE's specific goals and expectations from the GMS and are also broadly applicable to the industry.

Concept of Operations[1]

The Concept of Operations (ConOps) defines the overall scope, capabilities, and high level technical expectations for SCE's next generation distribution control system and describes the shift from how SCE operates the system now to how we intend to operate it in the future through deployment of the technologies that comprise the Grid Management System. This document is intended for a wide audience within a utility organization including distribution engineering, R&D, customer service, IT, and OT.

Architecture Definition Document[2]

The Architecture Definition document provides a qualitative view of GMS in order to communicate the architects' intent to other stakeholders. This document contains systems engineering content and is intended for technical audiences.

SCE looks forward to a successful collaboration with industry on the GMS project. Please direct any questions or feedback to John.H.Bubb@sce.com .

[1] www.edison.com/home/innovation/smart-grids.html

[2] www.edison.com/home/innovation/smart-grids.html