Proposed SDG&E Program 1: Smart Grid Architecture Pilots

- **Technology or Strategy to be Demonstrated** – Pilot demonstrations of electrical and communication system architecture components, configurations, and standards to evaluate their suitability for inclusion in the SDG&E smart grid architecture. The communication architecture, which will need to be compatible with the electrical architecture, must have standardized device information models (object models) and protocols for the information transfer needed to operate a power system that is becoming increasingly complex.
- **Concern, Problem, or Gap to be Addressed** – SDG&E's smart grid deployment has reached the point at which it is necessary to network the actively controllable ("smart") devices with a monitoring and control system to govern the system operation. This cannot be a random process and it requires commitment to an architecture for both the electric system and the communication and control system that will be overlaid on it.
- **Pre-Commercial Technology or Strategy Aspect** – Utilities have been developing smart grids comprised of autonomous smart devices. An architecture is needed to network the increasingly complex system and deliver the full benefits of coordinated operation of these devices and the electrical circuits in which they are placed, per the overall vision of smart grids.
- **How the Program Avoids Duplication from Other Initiatives** – Each utility will require its own architecture, because the choice of smart grid features (components and system configurations) will differ from one utility to the next.
- **Prioritization: High Priority Program**
  - Autonomous smart devices are proliferating rapidly on the power system. A robust architecture is needed for device networking to support operation of this dynamically changing power system.
  - Provides a structure for continuing power system modernization.
  - Provides an architecture for overlaying information systems on the electrical system.
- **EPIC Primary or Secondary Principles Met**
  - ✔ Increased reliability
  - ✔ Improved power system performance and lower operating costs
  - ✔ Increased safety
  - ✔ Societal benefits

Proposed SDG&E Program 2: Distributed Control for Smart Grids

- **Technology or Strategy to be Demonstrated** – Pilot demonstration of distributed control unit to determine its suitability for inclusion in a hierarchical control infrastructure. The unit would process data coming from smart devices in an individual feeder or larger distributed circuit region and manage the smart devices and the emerging reconfiguring actions of the region in a coordinate manner.
- **Concern, Problem, or Gap to be Addressed** – SDG&E does not yet have a control system infrastructure that is robust enough for the expected increases in power system complexity stemming from grid modernization. This program will pilot a distributed control unit that achieves the needed capabilities to support further advancement of SDG&E's smart grid.
- **Pre-Commercial Technology or Strategy Aspect** – The distributed control system must be capable of processing a much larger amount of data coming from the various new devices and from widely deployed sensors and monitoring nodes that provide intelligence on system status.
- **How the Program Avoids Duplication from Other Initiatives** – Each utility will require its own control system approach, because the choice of smart grid features (components and system configurations) will differ from one utility to the next. The SDG&E control system pilot program will be synchronized to SDG&E's smart grid architecture development, which is a parallel program.
- **Prioritization: High Priority Program**
  - Need a robust and adaptive control systems to manage an increasingly complex smart grid
  - Distributed control unit would be integrated into a hierarchical control system for SDG&E grid modernization
  - Control system algorithms must be able to coordinate and dispatch devices and circuit reconfiguring to respond to contingencies in a fast coordinated manner
- **EPIC Primary or Secondary Principles Met**
  - ✔ Increased reliability and improved management of distributed resources
  - ✔ Improved power system performance and lower operating costs
  - ✔ Increased safety
  - ✔ Societal benefits

Proposed SDG&E Program 3: Smart Distribution Circuit

- **Technology or Strategy to be Demonstrated** – This program seeks to improve outage restoration and regulation on circuits through intelligent and coordinated switching of strategically placed equipment.
- **Concern, Problem, or Gap to be Addressed** – The traditional and typical distribution circuit is managed by distribution operators, field personnel and scheduled or voltage-triggered switching of Load Tap Changers (LTCs), capacitor banks and regulators. While this traditional management scheme has sufficed for operations in the past, a more reliable and efficient distribution circuit is feasible by taking advantage of new communication and control technologies.
- **Pre-Commercial Technology or Strategy Aspect** – With the low-resolution circuit load data and static circuit simulations available today, advanced control cannot be developed properly. This program would aim to upgrade distribution circuit power quality sensing and distribution circuit simulation to implement control algorithms that manage new and existing distribution equipment.
- **How the Program Avoids Duplication from Other Initiatives** – Currently, each utility is in a unique situation. SDG&E is currently working on a few isolated projects to improve distribution circuits, moving from manual operation of devices to remote control. While the aforementioned projects make up the components required for a smart distribution circuit, SDG&E has not yet attempted to optimize the operation and coordination of the various smart components together.
- **Prioritization: High Priority Program**
  - This program focuses on optimizing the choices made for new components in smart grid circuits
  - This program provides a basis for circuit optimization to complement the other planned programs on architecture development and distributed control for the SDG&E smart grid
- **EPIC Primary or Secondary Principles Met**
  - ✔ Increased reliability and more rapid restoration processes
  - ✔ Improved power system performance and lower operating costs
  - ✔ Increased safety
  - ✔ Societal benefits

Proposed SDG&E Program 4: Non-Traditional Uses of Distributed Energy Resources

- **Technology or Strategy to be Demonstrated** – DER can provide additional functions (sometimes called "ancillary services") beyond mere energy supply. The business case (costs and benefits) for commercial use of these functions will be quantified and the interconnection and interoperability requirements will be clarified.
- **Concern, Problem, or Gap to be Addressed** – This program will encompass prototype demonstrations of specific DER functions in specific application situations to get operational data that can be used to assess the business case; to determine in which, if any, application situations the business case may be sufficient to warrant pursuit of commercial use of these functions; and to clarify integration requirements . Pre-commercial prototype testing will be done at SDG&E's integrated test facility and at other sites on the SDG&E system.
- **Pre-Commercial Technology or Strategy Aspect** – The focus will initially be on utility-owned DER. Examples of functions to be addressed are: use of DER as a emergency power source in the utility system, as a peaking power source, as distribution system monitoring nodes, and as a possible component of voltage and power factor regulation solutions. The pilot testing will also assess alternative uses of distributed storage for dealing with renewable resource intermittency, trial use of communication standards (particularly IEC 61850-7-420) to support "plug and play" DER interoperability with the utility operating system, and trial use of planned extensions to IEEE 1547 interconnection standards that address the added functions of DER.
- **How the Program Avoids Duplication from Other Initiatives** – This program is distinct in that it targets pre-commercial pilots of non-traditional DER functions.
- **Prioritization: High Priority Program**
  - This program will leverage the work done in 2011 by SDG&E in its RD&D program, on a functional definition of DER capabilities and a specification for interoperability systems, by moving to a pilot phase.
  - This program is a high priority because the technical capabilities to provide these functionalities exist, but the business case for implementing them has not been examined.
- **EPIC Primary or Secondary Principles Met**
  - ✔ Increased utility system reliability and added value from DER
  - ✔ Improved power system performance and lower operating costs
  - ✔ Increased safety and societal benefits

Proposed SDG&E Program 5: Pilot for Visualization and Situational Awareness System

- **Technology or Strategy to be Demonstrated** – The purpose of this pilot program is to explore how data being collected from sensors and devices of all varieties can be processed, combined, and presented to enhance grid monitoring and situational awareness. In particular, this program will look at how heretofore unexploited and separately processed data can be integrated and presented for strategic use.
- **Concern, Problem, or Gap to be Addressed** –The deployment of a large number of sensors, intelligent devices, meters and other communication nodes within the utility power distribution system is generating a massive amount of highly granular (time series), real-time information on electricity consumption and grid operations also referred to in the utility industry as a "*data tsunami*". If presented inappropriately, this data has the opportunity to overwhelm system operators and make its value in supporting engineering activities less useful. However, if processed and presented appropriately, this data can improve utility system operations.
- **Pre-Commercial Technology or Strategy Aspect** – When transformed and presented in a visual technology framework, this data can be invaluable for utilities to optimize grid operations as well as provide insights in the performance of the overall utility system. It also provides a way to have better insights into customers' energy consumption behavior to serve them more effectively, foster energy conservation and reduce peak demand.
- **How the Program Avoids Duplication from Other Initiatives** – The program will evaluate advanced visualization concepts beyond what is in current use and what others are developing. It will be coordinated with other SDG&E smart grid programs to assure compatibility with the SDG&E system.
- **Prioritization: High Priority Program**
  - This program is high priority in that the ground swell of additional data is already beginning
  - This program provides a needed strategy and defines the system requirements for visualization and situational awareness through demonstrations of prospective concepts to aid in adoption decisions.
- **EPIC Primary or Secondary Principles Met**
  - ✔ Increased reliability and more rapid restoration processes
  - ✔ Improved power system performance and lower operating costs
  - ✔ Increased safety
  - ✔ Improved customer energy efficiency and societal benefits