Integrated Test Facility

A Sempra Energy utility®

RESEARCH & TESTING FOR SMART GRID AND CYBERSECURITY EFFORTS

Did you know?

The Smart Grid system is reliable, ready for the next century and able to incorporate renewables, plug-in electric vehicles, and other new emerging technologies safely and efficiently.

Cybersecurity is pivotal to system safety and reliability, and to protecting customer information.

Foundational/Communications Lab

This lab helps advance the Smart Grid Communications System and assists in developing comprehensive solutions while integrating with some of SDG&E's other systems. Existing and emerging technologies are tested to validate equipment and processes before they're deployed in the field.

Transmission Communication Reliability Improvement – Modernize and replace the existing and aging communications infrastructure currently supporting today's substation relay and controls equipment. In doing so, SDG&E® will be one of the top five electric utilities within North America to fully migrate a network communications system into their substations.

Power Systems Lab

In this state-of-the-art lab, engineers use real-time simulation to conduct advanced modeling studies on the electric grid as well as to test/evaluate new technology. Advanced modeling gives us a glimpse into the future and gives us a better understanding of how our transmission, substation and distribution systems can work together to improve reliability.

Borrego Springs Microgrid – One of the nation's largest microgrids that can operate solely on renewable energy using advanced technologies including local power generation, energy storage and automated switching.

Advanced modes of operation such as black start and islanding functionality were tested for a remote microgrid.

Distributed Energy Resource Management System – Our solution for managing distributed energy resources such as batteries and microgrids. The system allows the operator to remotely monitor, optimize and dispatch resources in real time. Or, operations can be scheduled for future use, which contributes to increased reliability on the distribution system.

Falling Conductors – The problems with detection and downed conductors have plagued the electric utility industry for decades. This project was so successful that it resulted in a patent for SDG&E. The affected circuit section is de-energized while the conductor is still falling, eliminating the risk of an arcing ground fault or live circuits on the ground.

Voltage Optimization – The process of optimally managing voltage levels and reactive power to achieve a more efficient grid. This project looked at reducing system losses, peak demand or energy consumption, or a combination of the three. This project optimized three situations – legacy devices, legacy plus Supervisory Control and Data Acquisition (SCADA) and Intelligent Electronic Devices.

Distributed Energy Resources Lab

Simulating electricity that's produced (generation) and electricity that's used (load), this lab tests equipment like inverters, energy storage systems and their impact on the electric grid.

Plug-In Electric Vehicles – Analyze the impact of plug-in electric vehicle (PEV) charging on SDG&E's distribution grid. Through this project, an integrated approach to PEV charging incorporating renewables, battery storage and smart charging served as a showcase of potential strategies for PEVs appearing on the distribution grid. Two PEV battery charging simulators were designed using commercially available power supplies and inverter systems to replicate PEV charging patterns.

Distributed Energy Storage Systems – Evaluate and verify the impact of Distributed Energy Storage Systems with other Distributed Energy Resources (DERs). The testing helped our Research & Development team determine the requirements of interconnection, interoperability and communication. It also helped with requirements for control and dispatch in support of specific grid support functions.

Integrating DERs for Volt/Var Optimization – Evaluate the interactions between one or more Distributed Energy Resources Systems with the smart inverter volt function capabilities. It was connected to a simulated power circuit using the Real Time Digital Simulator. The voltage on that circuit was modified at different rates and amplitudes and the smart inverter was activated to mitigate for line losses, reduced energy consumption and optimized voltage levels.

Smart Garage Lab

This lab supports the advancement of intelligent plug-in electric vehicle charging systems as well as several test setups including the Photovoltaic Inverter Test Bed. Vehicle charging station characteristics and impacts to the electric distribution grid are also evaluated.

Advanced Energy Management System – A conceptual design for integrating various resources was built to examine a proof-of-concept design for an innovative home area energy management system. The test bed was used to verify automation aspects of the energy management system and to monitor and manage load demand, renewable production and backup supply (energy storage) for outages.

In addition to offsetting a customer's residential load consumption with the help of energy storage from electric vehicles and home storage, the hybrid controller was designed to provide these features:

- Incorporate time-of-use pricing to limit PEV charging and load consumption from each house.
- Ability to power the house by taking advantage of the PEV and battery in case of power outages.
- Perform load shifting to balance production if the resident has a PV system.

Power Your Drive℠ **–** SDG&E's Clean Transportation group used the Smart Garage to evaluate EV charging, including Vehicle-2-Grid capabilities of automakers. The equipment and facilities helped validate charger-metering capabilities for several EV charging companies. A bank of four EV chargers helped us refine and develop the Vehicle-Grid Integration proposal that is SDG&E's Power Your Drive program. The program aims to install over 3,000 EV chargers at over 300 workplaces and multi-family locations in our service area.

Home Area Network Lab

In this lab, technologies such as in-home displays, programmable communicating thermostats, and internet gateways which all connect to SDG&E's smart meters are tested. SDG&E collaborates with other companies to test plug-load controllers and smart appliances with two-way communication features. All devices go through a series of tests to make sure they're compatible with our smart meters.

Entryway™ **–** A system that allows us to connect HAN devices to smart meters remotely. This technology is already used but Entryway™ takes things a step further to allow customers to add their own devices.

Vendor Compatibility Testing – This process is used to allow third parties to validate their devices with our smart meters.

Pricing Test – In conjunction with the Entrywa™y system, pricing signals are tested and sent through the meters to the HAN devices.

Thermostat Testing – Testing of smart thermostats with demand-response capabilities and connections to smart meters.

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Information Security Lab

This lab has three primary uses – testing, evaluation and research. When new SDG&E hardware and software is purchased, the lab's engineers conduct real-world cybersecurity attacks against the equipment to identify potential risks and recommend solutions to remediate those risks. The team also evaluates new vendor security solutions to determine if the technology could be a fit for a future deployment.

California Energy Systems of the 21st Century – Large multi-year research and development project which leverages a variety of equipment for a number of specific tasks related to developing a "machine-to-machine automated threat response system."

Time Resilient System – Leveraged lab equipment, Global Positioning Satellite (GPS) clocks, and radio frequency cage to transmit spoofed GPS signals.

In November 2016, SDG&E and Southwest Research Institute (SwRI) received an R&D 100 Award from R&D Magazine for inventing a new technology that safeguards GPS-dependent systems from potential cyber threats. R&D Magazine recognized the discovery as one of the 100 most significant innovations of 2016. SDG&E and SwRI invented the new technology, called the Time REsilient System (TRES), to protect GPS-dependent networks and applications used in energy infrastructure from potential cyber attacks and other threats.

For more information about our Integrated Test Facility, please visit ***sdge.com/smartgrid***.

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