SDG&E RDSI Project Overview

SDG&E Borrego Springs
Microgrid Demonstration Project

DOE Peer Review
November 3, 2010
SDG&E Borrego Springs Microgrid Project Summary

Utilize advanced technologies to integrate and manage distributed resources within the Smart Grid

<table>
<thead>
<tr>
<th>Budget:</th>
<th>$15.2M ($4.1M SDG&amp;E, $7.5M DOE, $2.8M CEC, and $0.8M partners)</th>
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</table>
| Benefits: | • Reduce the peak load of feeders and enhance system reliability  
       • Accommodate various generation and storage configurations |
| 2010 Goal: | Successfully resolve DOE audit, negotiate contracts for remaining partners, and engage/inform Borrego Springs community |
Department of Energy

Project Overview
Project Benefits

• Allow more power to be delivered through existing infrastructure and reduce the need to build more in the future

• Increase in the reliability and security of the grid by adding elements that make the grid more stable and reconfigurable.

• Allow Utility to utilize and control customer-owned resources

• Optimize the design of circuit operations for microgrid capabilities given DG, demand response, automated response, and other advanced tools
Project Objectives

• Achieve > 15% reduction in feeder peak load

• Demonstrate capability of Volt-Amps-Reactive (VAr) management

• Develop a strategy and demonstrate:
  – Integration of AMI into Microgrid operations
  – Self-healing networks through the integration of Feeder Automation System Technologies (FAST)
  – Integration of an Outage Management System/Distribution Management System (OMS/DMS) into Microgrid operations
  – Intentionally island customers in response to system problems
  – Information/tools addressing the impact of multiple DER technologies
Project strategies

• Design and demonstrate a smart grid that incorporates sophisticated sensors, communications, and controls in the following ways:
  – Intelligently incorporate solar power generators on homes and businesses into the electrical delivery system.
  – Enable coordinated Demand Response (DR) programs whereby heavy electrical use during peak demand periods can be moderated to prevent electrical supply emergencies.
  – Integrate and control multiple distributed generation and electrical energy storage devices to operate the grid in a more cost-effective and reliable manner, benefiting customers and electrical rates.

• This project will proactively identify and apply leading-edge technologies to improve the security and reliability of electricity supply and to lower costs to consumers.
Microgrid Project Overview

Phase 1:
- Establishment of Baselines and Key Developments
  - Pilot Network Analysis and Base-lining
  - Key Developments
  - Integration of Existing DG & VAR
  - Integration of OMS for Microgrid
  - Integration of FAST
  - Integration of Storage
  - Stage 1 Distributed Systems Integration Testing
  - Stage 2 DSI Testing
  - Stage 3 DSI Testing
  - Stage 4 DSI Testing
  - Stage 5 DSI Testing

Phase 2:
- Integration of Technologies and Distributed Systems Integration Testing

Phase 3:
- Optimization and Analysis

Final Report and Documentation
Implementation Plan for Large Scale Deployment
Cost/Benefit Analysis for Large Scale Deployment
Project Status
# Phase I: Establishment of Baselines & Key Developments

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<th>Task</th>
<th>Description</th>
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**Site Selection – Borrego Springs, CA**

**Key Strengths:**

- High concentration of customer-owned solar generation
- Potential to realize advanced reliability enhancements
- Opportunity to demonstrate self-sufficient circuit
- Extendable to service territory
Borrego Substation Conceptual Circuit Illustration

Legend
- Existing
- MicroGrid
- SCADA Automated Switches

Borrego Substation
- C170
- C171
- C172
- SCADA

MG Area
- Diesel Generator
- AES

HAN Device (ADM)
- AMI Meter
- Thermostat
- PHEV
- Water Heater
- Pool Pump

Gridpoint Connect
- Solar
- Storage

Residential Customer
- HAN

Commercial Customer
- PDLM

Industrial Customer
- PDLM

Residential Customer
- HAN
**Phase II – Integration of Technologies and Operational Testing**

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Distributed Energy Resource (DER)

Utility-owned distributed generation will simulate customer-owned renewable generation

- Identified DER requirements
  - two 1.8 MW Tier 1 Caterpillar 3516DITA diesel generators owned by SDG&E
  - 200 hours per generator per year
- Filed application with Air Pollution Control District of San Diego County (APCD) for a Stationary Source Permit
  - Negotiating contract to retrofit generators with advanced emissions control to meet required Tier 4 standards
- Filed application with County of San Diego for Variance from County Noise Ordinance
  - To likely require a wall to be built to help reduce noise
- Developed requirements for remote control capabilities
  - Negotiating contract to retrofit generators with advanced controls
Advanced Energy Storage (AES)

Advanced Energy Storage will supplement Distributed Energy Resources

- Identified AES System requirements in conjunction with EPRI & Sandia
  - 1.0 MW Power Output
  - 6.0 MW-Hr of Energy
  - Potential future applications
- Developed RFP and issued to nine (9) vendors
- Received six (6) proposals
- Conducted best & final review with two (2) vendors
- Negotiating Terms and Conditions with preferred vendor
- Conducting RFI to assess state of battery technology
  - 25-50kW, 1-3 hours of storage (120/240v single phase)
  - 100-300kW, 3 hours of storage (120/208v or 277/480v 3-phase)
Automated switching technology will improve reliability by enabling circuit operations without human intervention

- Identified objectives of FAST
  - Programmed switch operation on Cir 170 (including tie switches) will automatically isolate faulted segments and restore service
  - All operations will be done based on real-time loads
- Borrego circuits modified for FAST Installation
Microgrid Controller & OMS/DMS

Microgrid Controller technology will integrate with the Distribution Management System while balancing the distributed energy resources and energy demand in the Microgrid control area

- Modeled use cases & business processes
  - Presented Use Cases at Microgrid Symposium in Vancouver, BC
  - Shared Use Cases with Xanthus Consulting for work on IEC 61850
- Mapped detailed requirements to functional requirements
- Received approval from Information Security
- Investigating vendor options for Design/Build
- OMS/DMS system testing
- Discussions with other RDSI projects
- Literature review
Microgrid Controller

**Distributed Energy Resources**
- Utility-scale Energy Storage
- Rooftop PV Solar
- Micro-turbines
- Building Energy Storage
- Community Energy Storage
- Distributed Generation
- Home Energy Manager
- PEVs
- Ground PV Solar Array

**Grid Resources**
- Capacitor Banks
- Voltage Regulators
- Automated Switches
- Power Electronics
- Communications

**Microgrid**
- Master Controller

**Information**
- Electricity Pricing
- DER status
- Demand Response Programs
- Network status
- Community Objectives
- Load and Resource Profiles

**SCADA System**

National Energy Technology Laboratory
Price-Driven Load Management

Leveraging Advanced Metering Infrastructure (AMI) and Home Area Network (HAN) devices, we will be able to influence/manage customer loads. Pricing signals will alter customer usage, Demand Response will be used during “Reliability Events”.

- Completed contracts with Gridpoint
- Collaborating with internal SDG&E departments to develop plan to present “one-face” to customers
- Developing customer participation plan
- Developing Timeline for Customer Communications
- AMI rollout complete
### Phase III – Data Collection and Analysis

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- **Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1**: Dates
- **Pending**: Indicates tasks pending as of 11/3/2010.
California Energy Commission

Project Overview
Smart Grid Project (CEC)

Participants:
SDG&E, Horizon Energy Group (HEG), Xanthus, GridPoint

**Project Goals**

- Integrate *utility* and *customer-based* energy resources, including carbon and non-carbon-based energy sources

- Enhance the management of intermittent renewable resources, including the impact of resources from *sustainable communities*

- Identify and evaluate the key technical and operational issues with designing, implementing, and managing an integrated energy portfolio of utility and non-utility interconnected resources

- Improve power reliability and quality via utility asset optimization
Smart Grid Project (CEC)

**Project Objectives**

- Assess the ability to achieve at least a fifteen percent reduction in feeder peak load through the integration of multiple, integrated DER on a SDG&E feeder
- Demonstrate capability of Volt-Amps-Reactive (VAr) electric power management
- Develop a strategy and demonstration of information integration focused on both security and overall system architecture.
- Develop a strategy and demonstrate the integration of AMI into smart grid operations;
- Demonstrate the capability to use automated distribution control to intentionally island customers in response to system problems
- Develop information/tools addressing the impact of multiple DER technologies including:
  - control algorithms for autonomous DER operations/automation that address multiple DER interactions and stability issues
  - coordination and interoperability of multiple DER technologies with multiple applications/customers.
- Demonstrate Programmable and Controllable Thermostats to achieve Demand Response goals within the smart grid.
Issues and Challenges

- Contract Management
- Security – Cyber and Physical
- Network Communications Infrastructure
- Internal/External Communications
- Customer Participation
- Regulatory and Tariff Impacts
- Permitting
- Synchronization with other SDG&E projects (AMI, OMS/DMS)
- Development of Microgrid Controller
Q & A