2012 Smart Grid Program
Peer Review Meeting

Irvine Smart Grid Demonstration (ISGD)

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Southern California Edison (SCE)

6/8/2012

ISGD

Objective

SCE's Irvine Smart Grid Demonstration (ISGD) will demonstrate an integrated, scalable Smart Grid system that includes many of the interlocking pieces of an end-to-end Smart Grid system, from the transmission and distribution systems to consumer applications such as smart appliances and plug-in electric vehicles.

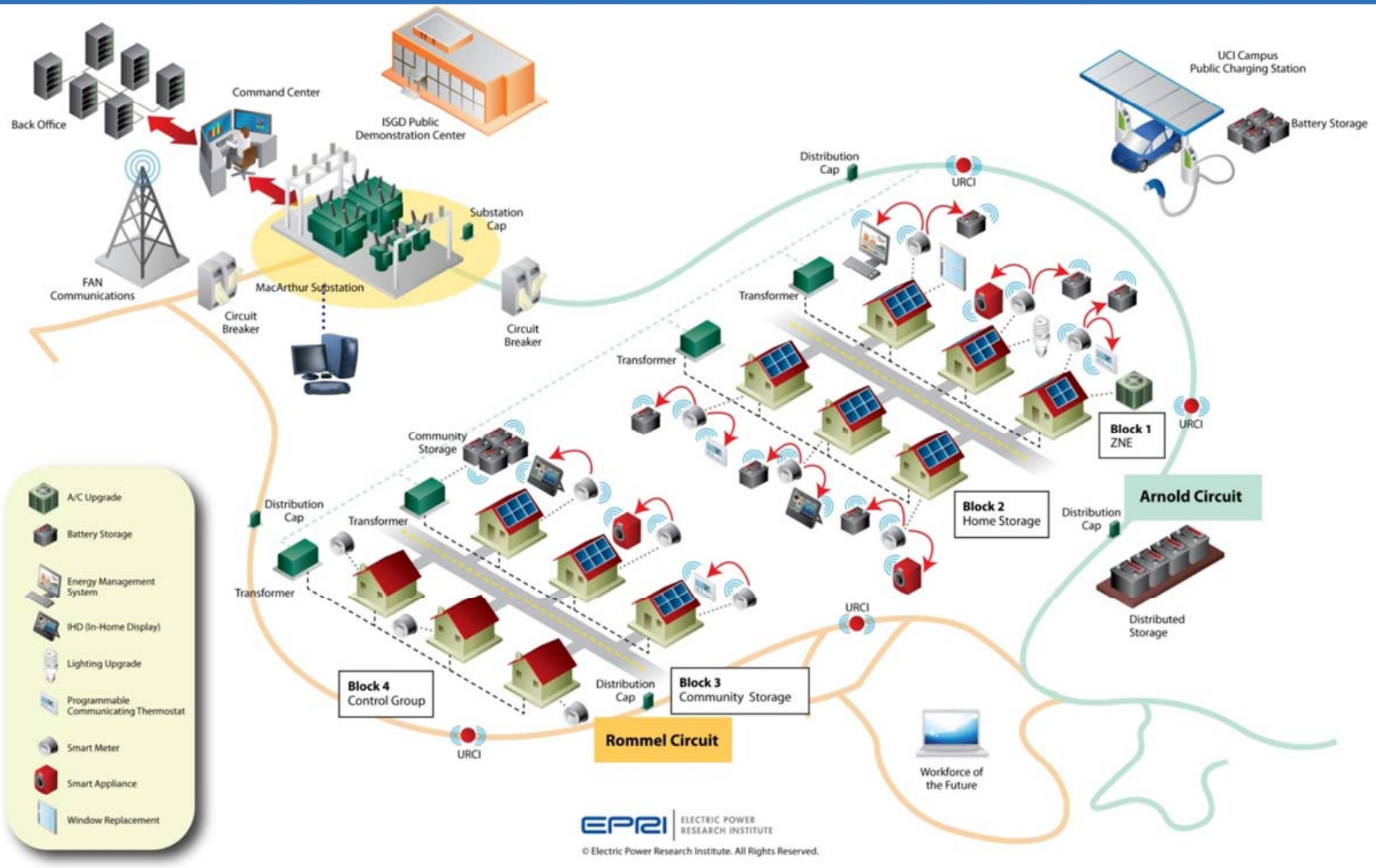
Life-cycle Funding ($K)

FY2010 – FY2015
$39,612

Technical Scope

1. Energy Smart Customer Devices
2. Year 2020 Distribution System
3. Interoperability & Cyber Security
4. Workforce of the Future

ISGD


Back Office
Command Center
ISGD Public Demonstration Center
UCI Campus Public Charging Station
Battery Storage
Substation Cap
FAN Communications
MacArthur Substation
Circuit Breaker
Circuit Breaker
Distribution Cap
URCI
Transformer
Transformer
Community Storage
Block 1 ZNE
URCI
Block 2 Home Storage
Distribution Cap
Arnold Circuit
Distributed Storage
Distribution Cap
Transformer
Transformer
URCI
Block 4 Control Group
Distribution Cap
Block 3 Community Storage
URCI
Rommel Circuit
Workforce of the Future
A/C Upgrade
Battery Storage
Energy Management System
IHD (In-Home Display)
Lighting Upgrade
Programmable Communicating Thermostat
Smart Meter
Smart Appliance
Window Replacement
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Needs and Challenges

	RD&D Needs	Technical Challenges
Energy Smart Customer Devices	• Impact of multiple Zero Net Energy technologies (grid and residential load) • PEV load management using energy storage and distributed solar	• Identifying device vendors • Integrating communications solutions • Obtaining customer participation
Year 2020 Distribution System	• Use energy storage to manage constrained distribution circuits • Advanced Volt/VAR control • Self-healing distribution circuits	• Placement of energy storage system • Designing Volt/VAR control architecture • Building low latency wireless comms. • Lack of standard universal distribution protection settings
Interoperability & Cyber Security	• Facilitate interoperability of project components within a standards-based, secure environment	• Integrating new and legacy systems • Common Cyber Security implementation scope • Application of IEC 61850 to field devices
Workforce of the Future	• Identify training and educational needs for Smart Grid implementation	• N/A

Technical Approach

Energy Smart Customer Devices

- Deploy aggressive EE measures, smart appliances and on-site solar generation and energy storage systems in a group of single family homes
- Introduce DR programs for appliance-specific loads (e.g., PEV)
- Install 20 PEV charging stations (EVSE)
- Integrate EVSEs with on-site solar generation and energy storage

Year 2020 Distribution System

Distribution Constraint Management

- Deploy a large energy storage system downstream of the distribution voltage circuit breaker; demonstrate circuit load relief using the energy storage

Volt/VAR Control

- Pilot an Advanced Volt/VAR Control (AVVC) algorithm to reduce average voltage and associated energy use
- Demonstrate an Integrated Volt/VAR Control system using real-time load flow

Self-healing Circuits

- Loop two distribution circuits
- Install 4 URCIs to enable circuit segmentation

Deep Situational Awareness

- Use a large energy storage system and other DER to change distribution level load; measure these changes using phasor measurement technology

Technical Approach (continued)

Interoperability & Cyber Security

Secure Energy Network (SENet)

- Develop and demonstrate end-to-end secure communications between SCE back office, field networks, and smart energy devices in the home
- Implement robust cyber security systems and provide a unified architecture for intra- and inter-utility telecommunication

Substation Automation System (SA-3)

- Conform to the IEC 61850 global standard

Workforce of the Future

- Identify training, curriculum development, and organizational impacts needed to produce the next generation utility worker

Technical Accomplishments

	2012*	2013 - 2015
Energy Smart Customer Devices	• Completed the homeowner agreement process (*Jan*) • Completed initial meter installations (*Feb*) • Perform data collection and control related communications testing (*Oct*) • Install solar car shade (Dec)	• Install and integrate ZNE devices (May '13) • Install Battery Energy Storage System (BESS) (Mar '13) • Integrate and test BESS (May '13) • Begin M&V activities (Jul '13)
Year 2020 Distribution System	**Distribution Constraint Management** • Complete site preparation for Large Energy Storage System (*Nov*)	• Complete site installation of Large Energy Storage System (*Sep '13*)
	Advanced Volt/VAR Control • Finalized algorithm specification (Mar) • AVVC Finalized architecture (Mar)	• Begin AVVC demonstration (Jul '13) • Begin IVVC demonstration (Jul '13)
	Self-healing Distribution Circuits • Conducted radio field test (Jan) • Simulate protection logic using final device assembly (Aug)	• Install field devices (Apr '13) • Begin data collection (Jun '13)
	Deep Situational Awareness • Select data points to be monitored (Dec)	• Develop complete data acquisition and point monitoring system with decision making criteria (Jun '13)

* Accomplishments during 2010 and 2011 consisted of finishing contract negotiations with the DOE and major project partners.

Technical Accomplishments (continued)

	2012*	2013 - 2015
Interoperability & Cyber Security	**Secure Energy Network (SENet)** • Completed Preliminary Design Review (May) • Complete Critical Design Review (Sep) **Substation Automation System (SA-3)** • Complete HMI-3, SEMT and substation gateway development and testing (Jul) • Complete system fabrication and factory acceptance testing (Nov)	• Complete acceptance testing (Jun ’13) • Integrate cyber security solution (Jun ’13) • Begin demonstration (Jun ’13) • Demonstrate SA-3 system interoperability (Feb ’13) • Commission SA-3 pilot at MacArthur substation (Jun ’13) • Begin M&V activities (Jul ’13)
Workforce of the Future	• Develop technical training for field personnel (Dec)	• Develop curriculum based on power system engineering needs (Sep ’15)

* Accomplishments during 2010 and 2011 consisted of finishing contract negotiations with the DOE and major project partners.

Significance and Impact

	Scalability and Adaptability Considerations	Types of Benefits
Energy Smart Customer Devices	• Utility role “behind the meter” • Rate design and regulatory environment (e.g., time-of-use rates, decoupling, net energy metering) • Requires advanced load control and smart metering capabilities	• Lower energy use • Peak load reduction • GHG reduction
Year 2020 Distribution System	• Utility-specific technology roadmap (including field communications) • May require a Energy, Distribution and Operations Management System capable of looped circuit topology, secure substation gateways, and phasor measurement technology	• Peak load reduction • GHG reduction • Voltage reduction • Fewer and shorter outages
Interoperability & Cyber Security	• Legacy system design compatibility • Optimizing IEC 61850 implementation • Requires IEC 61850 based HMI, substation engineering modeling tool and gateway	• Security compliance • Enables other benefits • Accelerate standards
Workforce of the Future	• Trade school and Universities with related programs • Relevant to utilities with Smart Grid technologies	• Qualified utility personnel

Interactions & Collaborations

Internal Organizations

Advanced Technology	Project management
Major Projects Organization	Field level project management
Substation Engineering	Substation automation design
Tariff Programs & Services	Load management programs
Edison Material Supply / Law	Contract negotiations
Design & Engineering Services	Energy efficiency
Information Technology & Business Integration	Interoperability and cyber security
Customer Communications Organization	Homeowner support

External Organizations

General Electric	SSI, smart appliances, 4G radios, DMS and ALCS
University of California, Irvine	Simulation modeling; host site
University of Southern California - ISI	Stress test cyber security
Space-Time Insights	Advanced visualization
Electric Power Research Institute	Assistance with measurement and verification
DC Systems, Inc	IEC 61850 compatible HMI-3
GNC -	IEC 61850-based substation Engineering Modeling Tool
Subnet Solutions	IEC 6185-based substation gateway

Contact Information

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