SCE's Transactive Energy Demonstration Project

GWAC Workshop

Bob Yinger

December 10-11, 2013

Southern California Edison (SCE) is committed to safely providing reliable and affordable electricity to our customers

- One of the largest utilities in America
- Committed to providing safe, reliable and affordable electric service to nearly 14 million people in central, coastal and southern California
- Award-winning energy efficiency and demand response programs
- Industry leader for 125 years

SCE's Transactive Energy Work

- Irvine Smart Grid Demo – test and field demonstrate building blocks for TE project
- Caltech modeling work – build distribution models to test TE system design
- EPIC-funded demonstration project – take what is learned and implement in TE field demonstration starting in 2014

ISGD UPDATE

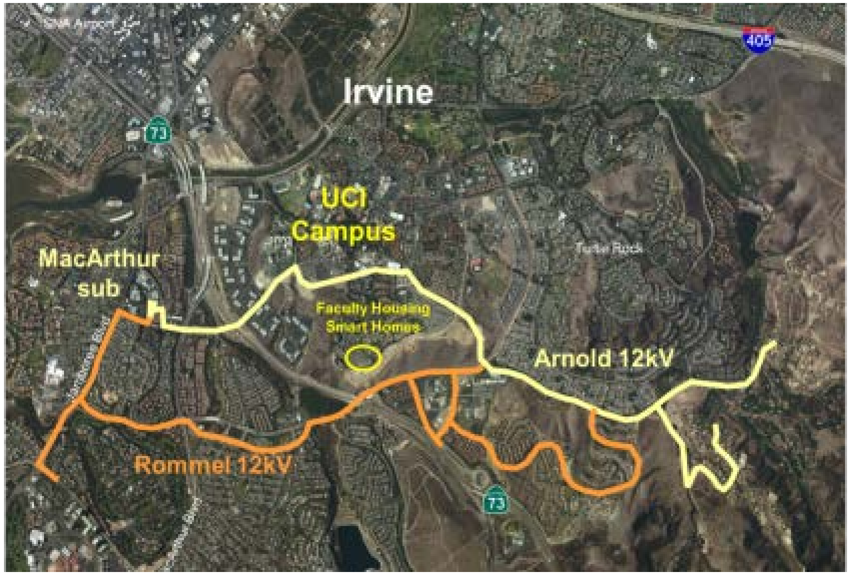
Objectives

The ISGD project will evaluate a variety of Smart Grid technologies to demonstrate the following:

- Interconnectivity and interoperability of those technologies
- End-to-end cybersecurity
- Capability of technologies to shift consumption load to off-peak hours
- Improved reliability through looped circuit topology
- Optimizing circuit voltage and using renewables and energy storage
- Recommend job training for nationwide implementation of Smart Grid technologies

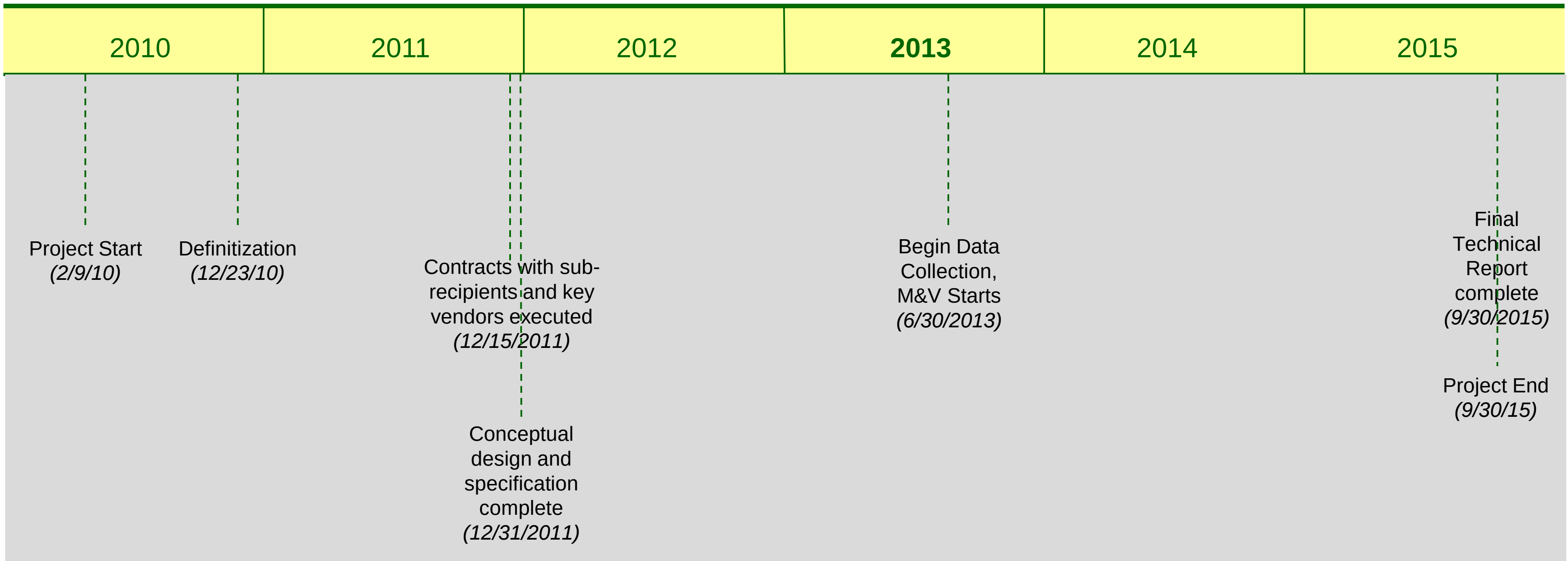
Project Location

ISGD will be deployed in Irvine, California at the University of California, Irvine and at the MacArthur substation in Newport Beach, California. The location is a site typical of some heavily populated areas of Southern California in climate, topography, environmental concerns, and other public policy issues.



ISGD Timeline

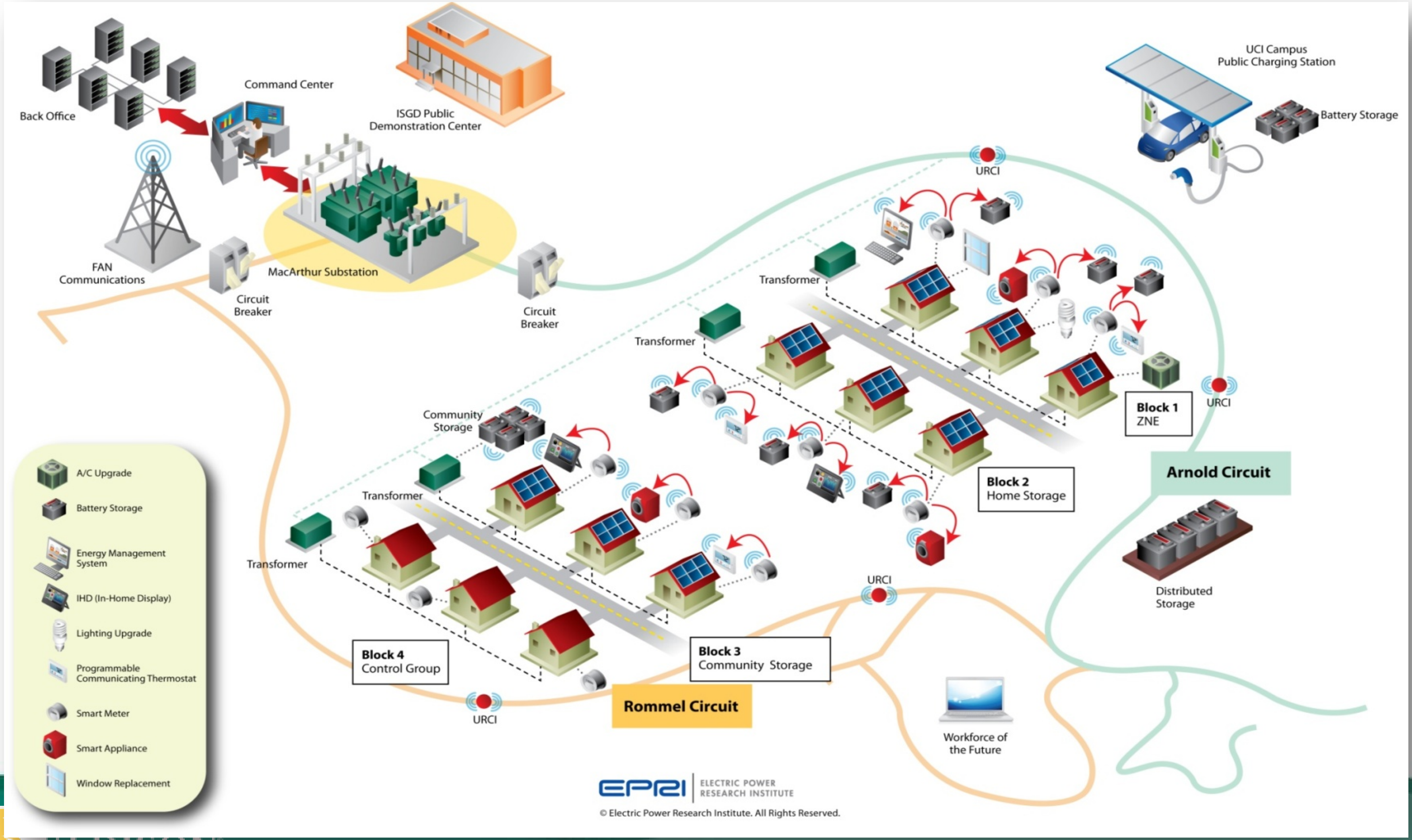
Overall Project Timing



ISGD Scope

- **Sub-Project 1** – Zero Net Energy (ZNE) Homes through Smart Grid Technologies
- **Sub-Project 2** – Solar Shade-enabled Plug-in Electric Vehicle (PEV) Charging
- **Sub-Project 3** – Distribution Circuit Constraint Management with Energy Storage
- **Sub-Project 4** – Advanced Volt/VAR Control (AVVC)
- **Sub-Project 5** – Self-Healing Distribution Circuits
- **Sub-Project 6** – Deep Grid Situational Awareness
- **Sub-Project 7** – Interoperability and Cyber Security
    - Secure Energy Network (SENet)
    - SA3 – IEC 61850 Substation Automation System
- **Sub-Project 8** – Workforce of the Future

TE Building Blocks:
Irvine Smart Grid Demonstration Project



Work to Date in Homes

Smart Appliances

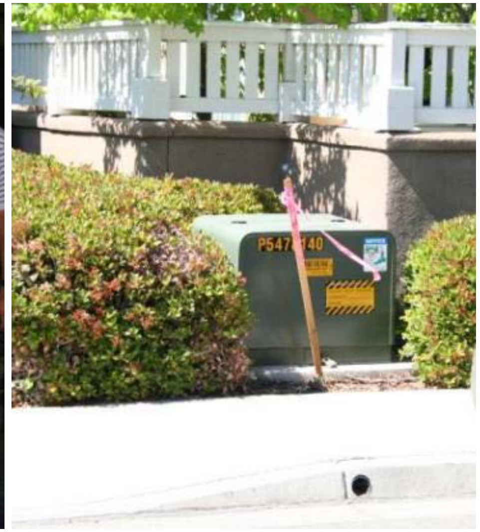
Electric Vehicle Supply Equipment (EVSE)*

Residential Energy Storage Unit (RESU)

Home Data Monitoring System

Home Area Network (HAN) devices

CES Installation



CALTECH UPDATE

Statement of Caltech Distribution Market Work

As Is/To Be

- Define Current State
  - DER
  - DG
  - EE
  - PEV
  - Storage
- Identify Pilot Structures
  - AEP-Ohio
  - Pacific Northwest
  - Microgrids
- Market Concept
  - Interface with CAISO
  - Incentives
  - Cost Allocation

Q2 2013

Adoption Model

- Define SCE Service Area Characteristics
  - Circuit
  - Customers
- Refine Solar PV Model
- Validate Model
- Develop Additional Adoption Models
  - PEV
  - Storage
  - DR

Q3 2013

Simulation & Analysis

- Develop Assumptions
  - Telecomm
  - Controls
  - Cybersecurity
  - Adoption
  - Customer Behavior
  - Regulatory
- Identify Costs
- Identify Benefits

Q4 2013

High Level Project Plan

- Project Scope
- Technology Deployed
- Project Location
- Project Participants
- Identify Milestones and Deliverables
- Develop High-Level Project Plan for Demonstration Project

Q1 2014

Analysis to Drive Decisions

- Analyze adoption scenarios for system impacts under existing rate structure
  - How does significant distributed solar impact revenue
  - When does significant distributed solar adoption occur (what solar panel price/install cost, what areas, what customer segments)
- Analyze adoption scenarios within each customer segment (e.g. low income, high demand, urban, coastal)
  - What cost-shifting occurs to which customer segments
- Analyze for different adoption scenarios the infrastructure stress
  - Circuit loading by generic circuit type mapped to entire SCE grid
- Analyze adoption scenarios on specific technology solutions
  - Impacts of distributed resources on Conservation Voltage Reduction, Demand Response, and Energy Efficiency programs

Residential Model

GridLAB-D Home Requirements

- Home Design (e.g. ft^2, stories, ceiling height)
- R-values (roof, floor, wall, doors)
- Windows (type, number)
- Thermostat (setpoints and schedule)
- Cooling/Heating Design (AC, efficiency)
- Thermal Model (solar radiation, mass heat coefficient)
- Water Heater
- Plug Loads (appliances and schedule)
- Lights (interior, exterior schedules)

Home Design, Thermal Model, Insulation

- Determined by County Assessor Information (ft^2, year built)

Device and Light Loads

- Annual Demand, Square Footage, and PRIZM Segment (zip + 4)

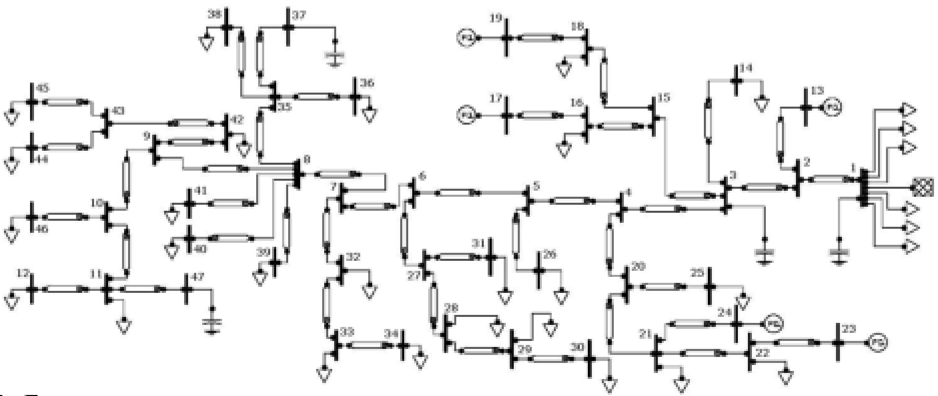
CASE STUDY INFORMATION TEMPLATE

Architecture

- Hierarchical
  - Distributed control to speed local actions
  - Central control to set and oversee central control strategy

Need for distributed control in DER integration and TE interactions

- Scalability
  - Communications
  - Computation
  - Dynamic topology
  - Available measurements



- Economic incentive variations
- Reliability (hierarchal system design)
- Security & trust engineering

Extents

- ISGD demo includes 4 blocks of homes and distribution circuits near UC Irvine
- Contemplated TE field demonstration will include:
  - Single community/ distribution substation area
  - High solar PV penetration with favorable solar resource
  - High adoption of PEV, DR, EE and home automation
  - Community interest in smart grid technologies

Transactions

- Expected to be price signals sent to customers that would interact with their automation systems to control load, generation and storage

Transacting Parties

- Expected to be commercial and residential customers
- Either manually or through automation systems

Temporal Variability

- Timing of intervals will be determined as an output of the Caltech work

Interoperability

- SCE encourages the use of existing standard where ever possible (e.g. SEP 2.0, IEC 61850)
- Since TE is a new area of development, new standards may have to be developed

Value Discovery Mechanisms

- Expected to be a market mechanism
- Details should come from Caltech work

Value Assignment

- To be determined as part of the Caltech work

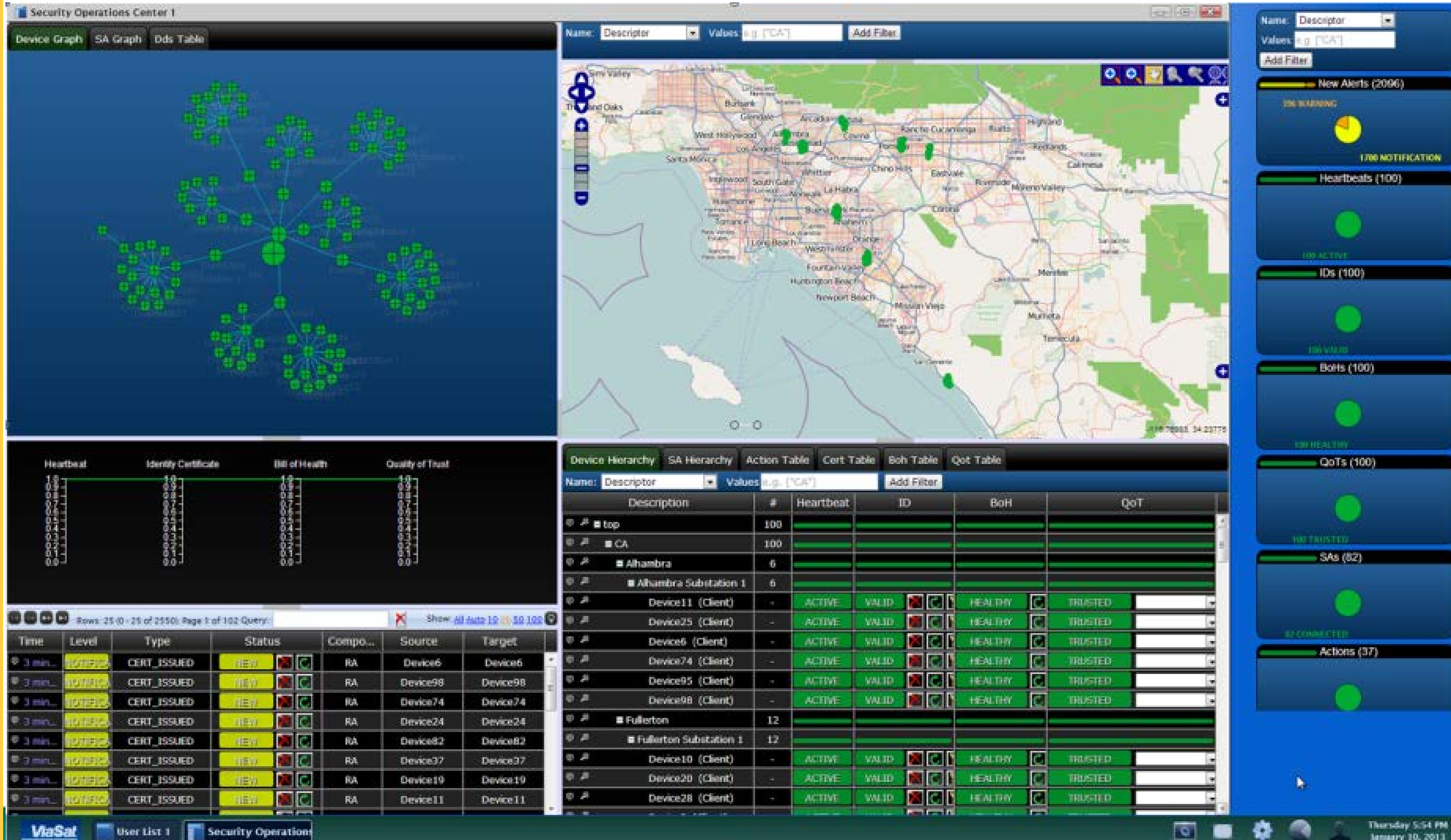
Alignment of Objectives

- To be determined as part of the Caltech work

Stability Assurance

- SCE contemplates the use of Centralized Cyber Security System to prevent outside influences on the market
- Need to avoid market manipulation and market power issues
- Specific control system stability can not yet be evaluated because of the early design phase of the project

Cybersecurity and Distributed Control



Participating Agencies and Organizations

- ISGD project – UC Irvine, General Electric, Space-Time Insight, SunPower, USC, EPRI
- Caltech
- Demonstration project - TBD

Bob Yinger, P.E.

Consulting Engineer

Advanced Technology

714-379-7913

robert.yinger@sce.com

SOUTHERN CALIFORNIA EDISON®
An EDISON INTERNATIONAL® Company