Overview

• Highlights of EPIC-1 and EPIC-2 Accomplishments

• Overall EPIC-3 Implementation Status

• EPIC-3 Project Overviews and Accomplishments to Date

• Discussion
Accomplishment: Demonstrated tools and operating capabilities for advanced distribution system automation to support grid modernization and integration of distributed energy resources.

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<th>Primary Strategy and Policy Touchpoints</th>
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<td>Distribution System Modernization, DER Integration</td>
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<td>Distributed Control for Smart Grids</td>
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<td>Demonstration of DER Grid Support Functions</td>
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<td>Smart Distribution Circuit Demonstrations</td>
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Comprehensive final project reports on www.sdge.com/epic
Accomplishment: Demonstrated and evaluated capabilities for data analytics, interoperability of new technologies, emerging standards for communications infrastructure.

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<td>Customer-Focused Services, Distribution System Modernization</td>
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Comprehensive final project reports on www.sdge.com/epic
EPIC-3 Wave 1: In Progress
Mapping to EPIC Framework

Renewables & DER Integration

Customer Service & Enablement

Grid Modernization & Optimization

Cross-Cutting/Foundational

Mobile Battery Storage

• Meter Data to Support System Operations
• Safety Training Simulators

Mobile Battery Storage

• Advanced Applications on Unmanned Aircraft Systems
• Safety Training Simulators

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EPIC-3 Project Life Cycle

Past
- Vetting and submission of application to CPUC (2016-2017)
- Approval of project in application (2017-2018)

Past
- Engage champion Director and form project team (Starting in Q4, 2018)
- Write project plan and add to team as needed

Past
- Site identification and basic fact finding
- Initial benefits assessment and metrics setting

Now
- Contractor and equipment procurement
- Use case definition and test planning

Future
- Perform pre-commercial demonstration
- Perform data analysis; revise benefits analysis; determine value proposition

Future
- Develop findings, conclusions, and recommendation on commercial adoption
- Prepare and submit comprehensive final report

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EPIC-3 In-Flight Projects
Key Focus Issues-1

• AMI for Operations Demonstration (Lead: Amin Salmani)
  • Reliability, resiliency, and improved system operations
• Safety Training Simulator Demonstration (Lead: Mike Colburn)
  • Customer and employee safety
  • Wildfire mitigation and response
• UAS-Related Demonstrations (Lead: Christine Asaro)
  • Asset life and asset management
  • Vegetation management
  • Wildfire mitigation and response
  • Support for power system operations
Mobile Battery Demonstrations (Lead: Chequala Fuller)

Module 1: Port and related applications
- Customer demand management
- Reliability and resiliency
- GHG emissions reduction

Module 2: Application at community resource centers
- Customer support during wildfire and other high-risk events
- Reliability and resiliency

Both Modules:
- Safety and transportability issues (weight, size, toxicity of battery chemistry)
- Simple and safe docking capability
- Costs and benefits: Valuation proposition
Application of AMI Data to Advanced Utility System Operations

1. **Objective**
   - Demonstrate capabilities for leveraging advanced metering infrastructure (AMI) to provide actionable secondary voltage data and analysis to support utility operations.
   - Provide improved operating practices that contribute to better power quality, higher reliability, reduced electrical losses in the power system, increased safety, and reduced cost.

2. **Overview**
   AMI is a rich source of data that could be of significant value in enhancing distribution system operating practices. Capabilities for accessing and applying the data to solving operating problems need to be demonstrated. This project will demonstrate critical capabilities of the AMI system, such as use as a voltage sensor network and as a phase identification tool.

3. **Profile**
   **Timing**
   Launched Q1 2019
   **Primary Customer Benefits**
   
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**Project Type | Value Chain**
Grid Modernization & Optimization | Distribution

**Demonstrating a data-driven paradigm for power system operations**

Real-time Variable Loads  PV & other Distributed Generation  Residential Loads  Energy Storage  EV Charging

AMI Data

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Application of AMI Data to Advanced Utility System Operations

**Module 1**

Leverage existing AMI infrastructure to provide a secondary voltage monitoring network solution (Collaborative funding with NREL).

- Identify network model discrepancies
- Develop AMI data-based insights
- Demonstrate novel visualization tools
- Enable AMI-based controls

**Module 2**

Application of AMI data to automatically identify phasing information within the distribution system.

- Demonstrate use cases to support the following analytical work
- Compare analytical methods and other potential alternatives for phase identification
- Demonstrate analytical algorithms that use SCADA, Geographic Information System (GIS), and AMI data for automated phase identification
- Identify challenges for commercial deployment of the proposed methods
- Make recommendations regarding prospective commercial adoption

*Possible EV Locations*
Example Application of AMI Data to Advanced Utility System Operations

Location of Voltage Exceedances (Duration >10 min.)

Exceedance Type
- > Specified Value
- < Specified Value

Number of Occurrences
- 1
- 2
- 3
- 4
1 Objective
Demonstrate and evaluate training capabilities for field focused design, operations, and asset monitoring and management solutions.

Demonstrate the ability of the latest simulator technologies to train utility industry personnel on safety related issues, such as electric potential zones and wildfire risks.

2 Overview
Safety training is important to every job, and its importance is elevated when dealing with high voltage power equipment used by utilities.

Advanced training simulators can help electric utility crews train and improve worker safety, proficiency, and productivity.

3 Profile
Timing
Launched Q1 2019

Primary Customer Benefits

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Project Type | Value Chain
Grid Modernization & Optimization | Distribution

Project Consists of Two Modules:

• Personal Protective Grounding/Equipotential Zone Work Methods
• Focused Patrol for Distribution Line Outages
Module for Personal Protective Grounding/Equipotential Zone Work Methods Simulator Demonstration

• A key safety element for utility lineworkers
• Effective initial and refresher training is key for competency
• Special attention is required for underground
Module on Personal Protective Grounding/Equipotential Zone Work Methods

- Use virtual reality goggles and other visual and tactile feedback devices in training
  - Available from multiple vendors, at various levels of maturity
  - No vendor is known that has fully developed this particular use case
- Build a physical “test yard”, as the basis for performing the precommercial demonstration

Project approach – test the student before and after the completion of simulator-based training.

The improvement in work performance is a metric on the effectiveness on the training

Compare to conventional training methods
There are many potential causes of faults!

- Animal Contact
- Severe Weather
- Party Balloons
- Customer Problem
- Wire Slap
- Vehicle Contact
- Tree/Vegetation Contact
- Undetermined
- Equipment Failure
- Human Error
- Foreign Object in Lines
- High Winds

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Finding Where the Fault Has Occurred Can be a Challenge!

Often, in rural settings, nobody sees the fault occur, so no initial reports arrive

- Some circuits are over 100 miles long
- Physical access is sometimes a problem
- These things can delay restoration of customers

Need to use all available data to locate faults

- Fault distance data from relays
- Wireless fault indicator targets
- Targets from contemporary SCADA equipment
- Possible use of contingency voltage from AMI
- Apply algorithm to narrow the search
- Assess accuracy compared to conventional “divide and conquer” approach
Unmanned Aircraft Systems (UAS) with Advanced Image Processing for Electric Utility Inspection and Operations

1 Objective
Define, demonstrate, and evaluate concepts for instrumentation and monitoring of power system equipment using enhanced imaging and sensor technologies on UAS.

Determine the potential to increase reliability, safety, and cost efficiency to improve power system operations.

2 Overview
SDG&E has done extensive past work on UAS applications. Analysis of high quality images and data from UAS has been effective in aiding time-sensitive decisions in operations in many applications.

This project seeks to expand capabilities of UAS in asset aging issues and wildfire mitigation.

Supports and increases staff efficiencies of 7 departments including:
- Aviation Services Department
- Electric Distribution Engineering
- Distributed Energy Resources
- Fire Risk Mitigation
- Fire Science and Coordination
- Transmission, Construction & Maintenance
- District Operations & Engineering

3 Profile
Timing
Launched Q1 2019

Primary Customer Benefits

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Project Type | Value Chain
Grid Modernization & Optimization | Distribution

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Example: UAS Application after Public Safety Power Shutoff (PSPS)

- During extreme weather events, to mitigate the risk of a potential ignition source, SDG&E has implemented PSPS.
- Created a red flag UAS operations procedure to include duty day schedule due to the PSPS.
- After the PSPS, UAS crews will support inspecting overhead power lines to check for debris on infrastructure and equipment damage prior to re-energizing lines.
Example:
UAS-Based Corona Camera

- SDG&E is the first company in the US to fly a corona camera on a UAS
- Completed 5 successful test flights on Aug 19 & 20, 2019
Demonstration of Multipurpose Mobile Battery for Port of San Diego and Other Applications--Module 1

1 Objective
Demonstrate a mobile battery system at the Port of San Diego’s cruise ship terminal during the peak cruise ship season and in other applications at other locations during nonpeak season.

Evaluate stacking of various benefits that can be derived from the mobile battery at multiple locations.

2 Overview
Pre-commercial demonstration, showcasing the concept of utilization of a containerized, mobile battery energy storage system for various locations and use cases.

Evaluate the stacking of benefits when rotated between applications, identifying preferred applications and feasibility for commercialization.

3 Profile
Timing
Launched Q1 2019

Primary Customer Benefits

<table>
<thead>
<tr>
<th>Demand Charge ↓</th>
<th>GHG Emissions ↓</th>
<th>Back Up Power</th>
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Project Type | Value Chain
Renewables & DER
Integration/Customer Service & Enablement | Distribution

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Mobile Battery--Use Cases and Prospective Benefits

- Reduce GHG emissions during periods when higher-emission sources required; augment the use of diesel generators
- Offset customer load demand and reduce demand charges
- Reduce frequency and/or duration of customer interruption; optimize the quality of power served to customers
- Reduce line (I²R) losses in the system by placing a power generating source closer to customer load
- Deployment during Public Safety Power Shutoff (PSPS) events and/or other emergency and non-emergency events
- Reduce GHG emissions during periods when higher-emission sources required; augment the use of diesel generators

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EPIC-3 Second Wave
Requires CPUC release of remaining EPIC-3 funds

Module 2 of Mobile Battery Project

• Powering critical loads at Community Resource Centers (CRCs)
• CRCs activated during emergencies
• Reliable power need to support vital activities in the CRCs
• Batteries provide an emission-free alternative to diesel generation
• Batteries can be moved to other applications, when there is no emergency event
Discussion

SDG&E EPIC Website:  www.sdge.com/epic

Thank you for your participation