Next Generation Distribution Automation Phase III, Intelligent Modern Pole (IMP) Field Demonstration

EPIC Workshop – Fresno California
November 09, 2018

Southern California Edison

Background (Innovation Drivers)

SCE uses approximately **1.5 Million** wood poles in its provision of distribution service to customers. While wood poles have long been the standard, SCE has identified four major challenges that can be addressed using new technology:

Challenge #1 - Fire Prevention and Mitigation

- The utility industry has no reliable standard for detecting wire-down to reduce the risk of ignition.
- Wood poles are susceptible to failure from natural causes, such as wildfires. Removing & replacing damaged poles is very costly, results in disruption of service to customers, does not eliminate the ignition threat, and remains susceptible to repeat events.

Challenge #2 – Pole Loading

- Performing pole loading calculations to ensure adequate pole strength is labor intensive.
- The utility industry has no reliable method to conduct dynamic pole loading.

Background (Innovation Drivers)

Challenge #3 - Asset Management

- Existing wood poles have an average life span of about 40-50 years.

Challenge #4 – Situational Awareness & Storm Damage Assessment

- At this point, physical inspection is the only reliable means for assessing storm damage to utility poles.
- Newer technologies provide a means to conduct a number of assessment and monitoring activities, including earthquake detection.

Objectives

Hybrid Pole Prototype

Top - Composite

Bottom - Steel

Design and Test an Intelligent Modern Pole that would provide a smart approach for Strengthening/Hardening The Grid:

- Detection of fire for quick response;
- Mitigate the possibility of ignition due to downed wire;
- Prevent pole damage due to fires;
- Capability to improve real-time situational awareness
- Provide dynamic load ratings, and improve asset condition monitoring through intelligent sensors; and
- Provide service life extension (~60-70 years) over wood poles (50 years life).

Overview

- The hybrid pole is composed of two materials – steel and fiber glass composite – for a longer service life than standard wood poles.
- The IMP will contain integrated sensors capable of detecting fire, vibration due to earthquakes, impacts, misalignment, strong windstorms, downed-wires, and dynamic pole loading.
  - Sensing improves asset condition monitoring.
  - Sensing also improves storm damage assessment and restoration response times, because the location of fallen or damaged poles would not require physical inspection (automatically identified).
- In testing conducted at SCE's Grid Technology and Modernization-Westminster lab facility, SCE team successfully demonstrated the IMP's ability to pass the following:
  - Fire detection test,
  - Tension detection test,
  - External impact test,
  - Vibration detection test, and
  - Wire-down detection test.
- SCE is ready to begin the next phase of demonstration and testing at its Equipment Demonstration & Evaluation Facility (EDEF) in Westminster, CA.

Scope & Potential Benefits

High-level demonstration scope includes:

- Install two full size IMPs (45ft & 50ft) with all required sensors and the communication system at SCE's Equipment Demonstration & Evaluation Facility (EDEF) in Q1 2019.
- Demonstrate the IMP's ability to pass the following test cases on full-size 45ft and 50ft distribution hybrid pole: fire detection, tension detection, external impact recognition and wire-down detection.
- Complete testing and establish pilot IMP standards for final design, including sensors, communication unit, data aggregator, and construction/installation methods in Q2 2019
- Complete field demonstration in Q4 2019.

Potential benefits include:

- Improved public safety and reliability,
- Enhanced ability to mitigate wildfire risks and damage, and
- Increased pole service life when compared to wood poles

Stakeholder Feedback

Q & A

Cybersecurity for Industrial Control Systems

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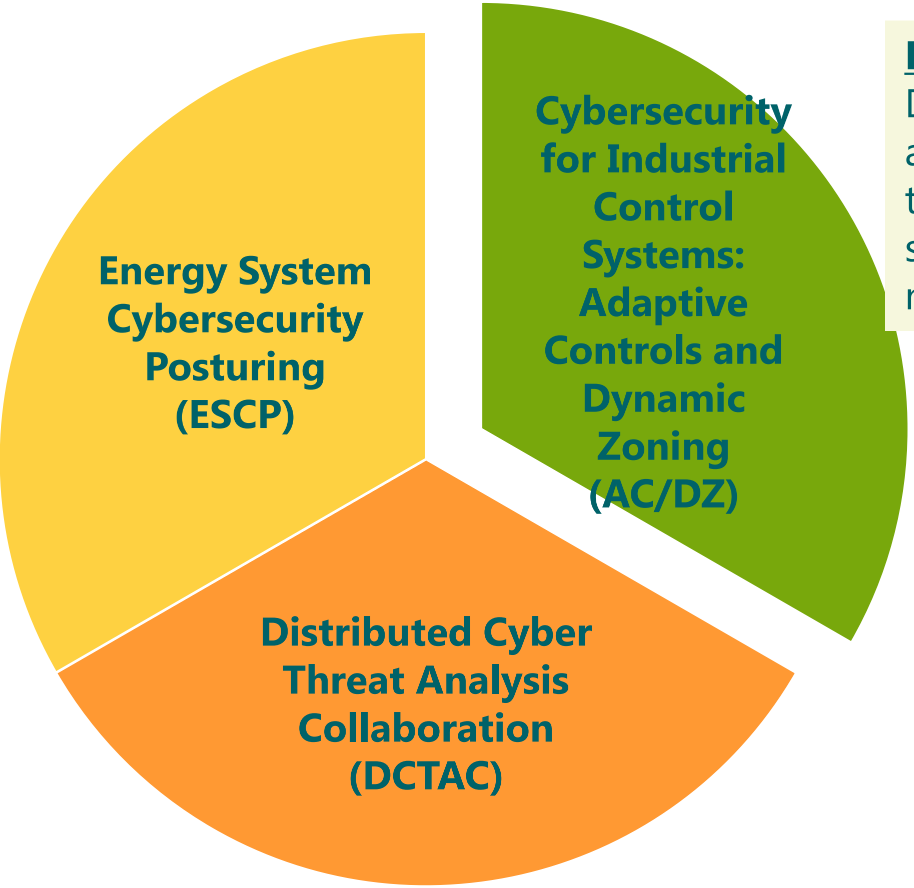
Background (Innovation Drivers)

- Provide overview of one of the three Cybersecurity projects submitted for EPIC III
- All three are intended to complement one another with an ultimate goal of increasing the resiliency of SCE's grid from cyber attack
- These projects will build on the learnings and accomplishments of the California Energy Systems for the 21st Century (CES-21) Program
  - The CES-21 Program is a joint research collaborative project between Pacific Gas and Electric (PG&E), Southern California Edison (SCE), San Diego Gas and Electric (SDG&E) and Lawrence Livermore National Laboratory (LLNL)
- These projects demonstrate and evaluate capabilities that address the following needs:
  - The Ukraine blackout provides insight to what is possible with a grid-focused cyberattack. Control systems of the future must be adaptable and dynamic in the face of an cyber attack
  - In the energy sector today, there is a increased risk of cyber attack and impact due to the lack of real time grid asset information and configurations to support vulnerability and risk analysis
  - Realtime information sharing on grid vulnerabilities between utilities and national analysis centers is needed to reduce cyber attack duration and impact

Overview: EPIC III Cybersecurity Projects

Description:
Provides insight into grid system configuration and what risks exists that are inherently vulnerable to exploitation.



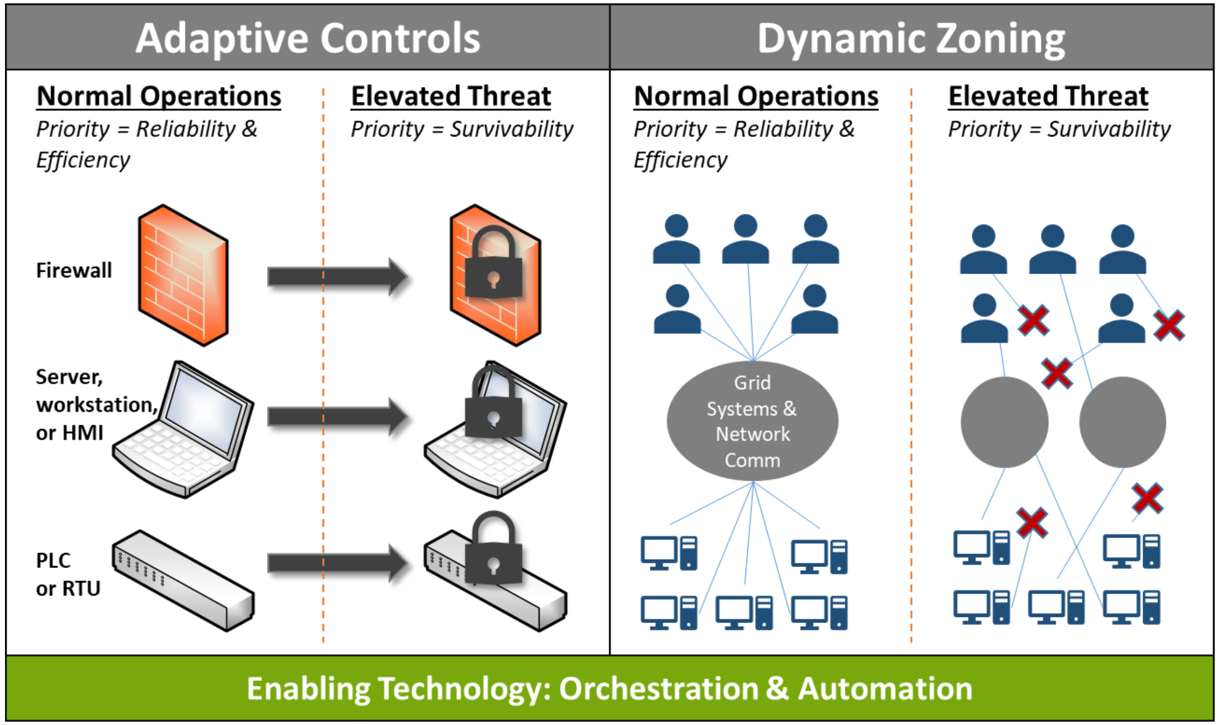
Description:
Demonstrates the ability isolate cyber threats to prohibit spread across grid network.

Description:
Demonstrates the capability to share grid related threat intelligence that may impact other utilities and the national

Objectives

Understand the ability of grid systems to respond to cyber threats at machine speed and prioritize survivability when appropriate by:

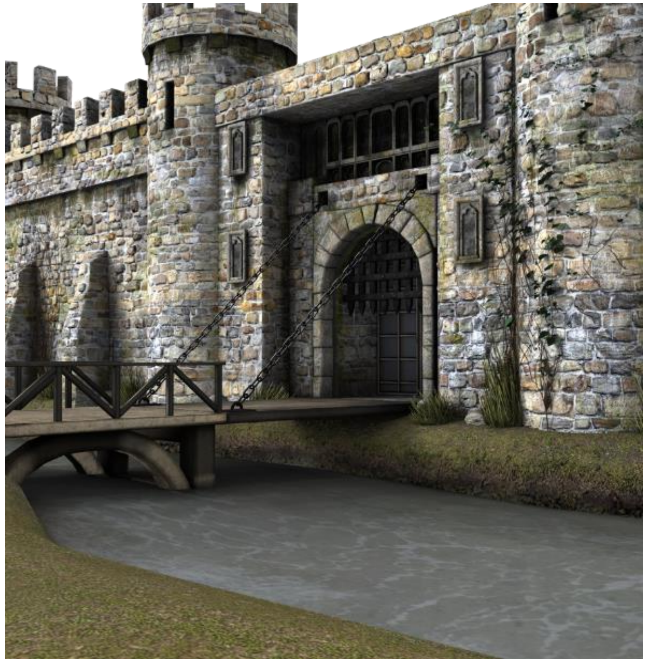
1. Demonstrating how existing technologies can work together for this cause
2. Advancing communication protocols necessary for the technologies to communicate
3. Exercising a progressively complex set of test cases to identify challenges and opportunities



Benefits

Provides greater reliability and increased safety by increasing the ability to respond to advanced cyber attacks by taking machine speed actions that enhance grid protection

- **Adaptive controls** are leveraged in order to contain or thwart a cyberattack
- **Dynamic zoning** allows for isolation of threats to certain segments of the industrial control system (ICS)



CA Energy Systems for the 21 Century

CES-21 Objective: "Machine-to-Machine Automated Threat Response (MMATR)"

Desired Outcomes:

1. Lab Simulation System to model cyberattack scenarios & mitigations.
   - Assess the impact of vulnerabilities at scale.
   - Confirm that remediation actions will not have negative emergent properties when applied at scale.
2. Physical Test Bed to test impacts of high-potential emerging threats
   - Test cyberattack scenarios in a physical environment to evaluate real-world impact to equipment, efficacy of proposed fixes.
3. Research Package to accelerate the third-party productization of next-generation cybersecurity technology.

What is MMATR?

Tools

Automated Response
Threat Monitoring
Secure Communications
Common Operating Model
Test Beds
Machine Learning

Standards

Threat Description
Share Threat Intel
Confidence of Data

Impact Analysis

Prioritization
Scoring
Modeling
Simulation

Machine to **M**achine **A**utomated **T**hreat **R**esponse

CES-21 & EPIC III Cybersecurity Projects

Evolving Capabilities	*Contribution*	*Demonstration*
CES21	Advancements in Grid Security Communications Protocols	**EPIC III Cybersecurity for ICS**
Commercial Technology Landscape	Emerging IT Security Technologies Applied in New Ways to the Grid	

1. **Application of Emerging IT Technologies to the Grid Environment**
2. **Emphasis on Vendor Integration With a Progressively Complex Set of Test Cases**
3. **Emphasis on Demonstration vs. Early Phase Research**

Key Differences
CES21 vs. EPIC III Cyber Projects

Stakeholder Feedback

Q & A

Service and Distribution Centers of the Future

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Background (Innovation Drivers)

- Customer demand for distributed solar generation is high and may reach limits in some areas.
- SCE is committed to electrify its fleet, as well as those of our customers, by allocating at least 5% of its annual vehicle purchase on electric drive vehicles.
    - It is a challenge to satisfy all fleet requirements with electric drives, particularly in heavy-duty and specialized classes.
    - At full scale, charge infrastructure and charge management will be needed to ensure fleets are reliably fueled.
    - Fleet depots, service center or distribution centers, will impose demands on the local grid when fully electrified.
- At large scale, there remain challenges of installing widespread charging infrastructure while managing grid impacts, as well as the localized challenges that can result from high demand for PV distributed generation and concentrated PEV charging.
- The California VGI (Vehicle-Grid Integration) Roadmap needs technical support in implementation to demonstrate the effectiveness of fully integrated and capable V1G and V2G systems.

Objectives

- Deploy electrified trucks, their charging equipment, and employee workplace electric vehicle supply equipment with advanced VGI communications and controls in a selected SCE service center or customer distribution center.
- Evaluate high penetration of distributed solar generation and EV charging grid system impacts in the local area around the fleet service center.
- Design a control environment, including added energy storage and solar generation, to manage the energy impact of the service/distribution center and ensure vehicles are reliably charged and the facility is fully supplied.
- Extend the control environment to receive input from the local distribution system and the generation system to help manage local grid parameters and renewable energy integration.
- Determine the effectiveness of coordinated electric vehicle resources as distributed energy resources under both aggregated (demand response type) and dynamic (distribution operation type) controls.
- Support the California VGI Roadmap and VGI Working Group and demonstrate communication and control protocols and use-cases.

Scope

- Collect data on fleet electrification, facility loads, and local distribution system to select candidate sites and work with stakeholders and customers to make a selection.
- Characterize the current fleet and workforce vehicles and duties.
- Design and implement a vehicle electrification strategy, including acquiring select fleet vehicles, selecting and installing charging infrastructure to support fleet and employee vehicles at the facility.
- Characterize the local grid area and assess current DER penetration and forecast.
- Design communication, metering, and control strategies and protocols.

Scope

- Implement microgrid elements, including storage and PV if designed, control systems, and interface to local and adjacent systems.
- Deploy all equipment and collect operational data.
- Design and conduct control strategies and use cases, including distribution system controls, vehicle to grid generation, DR, and renewable generation integration.
- Assess data and results and produce report.

Potential Benefits

- Evaluate the ability to fully electrify transportation at a service/distribution center, including fleet vehicles and equipment and also employee charging (if an SCE facility) while minimizing grid system impact.
- Demonstrate how to effectively integrate this facility into the local distribution system with manageable impact, and to actively respond to and support the local grid system with integral distributed generators, loads, and control systems.
    - Results could be used to integrate other service centers and local areas.
- Demonstrates the California VGI Roadmap and VGI Working Group communication and control protocols and use cases for Vehicle-Grid Integration and value of V1G and V2G.
    - Evaluate the effectiveness of V1G systems as controllable loads and V2G systems acting as generators.

❖ Possibility of adding testing for submetering of medium and heavy duty vehicles.

Stakeholder Feedback

Q & A