

# Strategic Implementation of Protection Upgrades to Support Grid Modernization

Jeff Shiles

Principal Manager, Protection & Automation Engineering  
Southern California Edison

i-PCGRID Workshop

San Francisco, CA

May 26, 2015

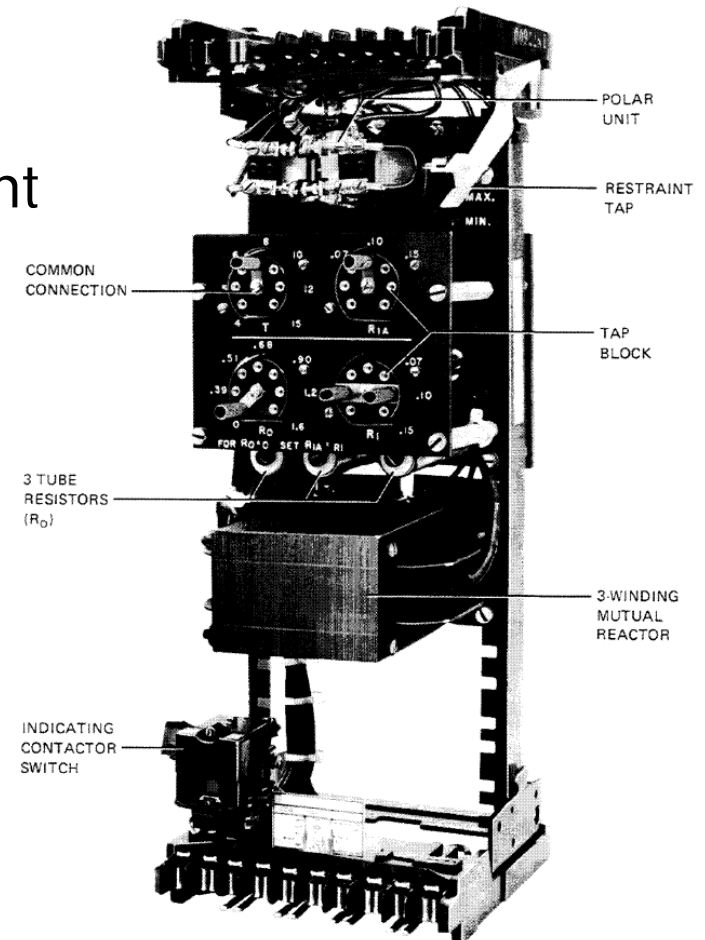
# Overview

- SCE Current Practices
- Industry Trends
- The Case for Investment
- Implementation Challenges
- Investment Opportunities
- Implementation Strategy
- Sample Cases
- Lessons Learned

# SCE Current Practices

## *For 66 kV subtransmission line protection:*

- Line differential protection (primary)
- Inverse-time phase & ground overcurrent protection (backup)
- Predominantly electromechanical relays
- Limited proactive relay replacements
  - \$10 million annual budget
    - 70-80 relays per year
    - All 500 kV & 220 kV
    - *66 kV not yet addressed*



# Industry Trends

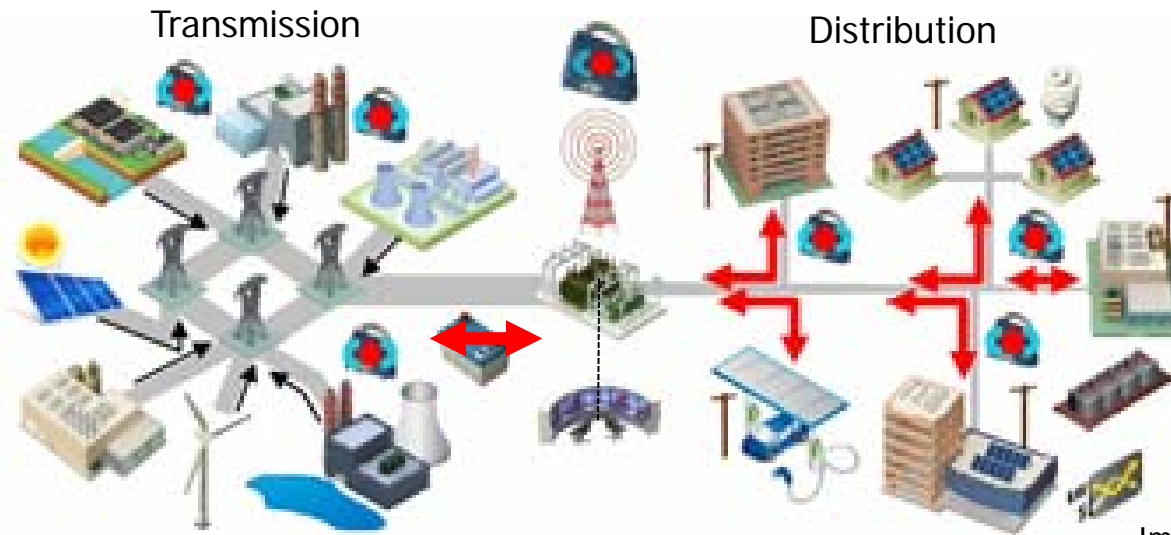
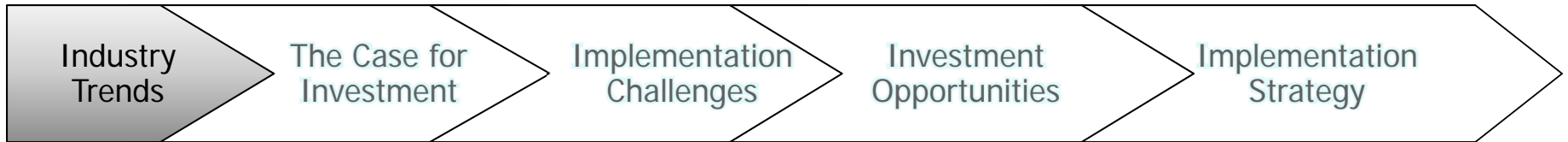


Image: Courtesy of EPRI

- Transmission and distribution now have similarities:
  - Two-way electricity flow
  - Variable Distributed Energy Resources (DERs)
  - Proliferation of Intelligent Electronic Devices (IEDs)

# Industry Trends



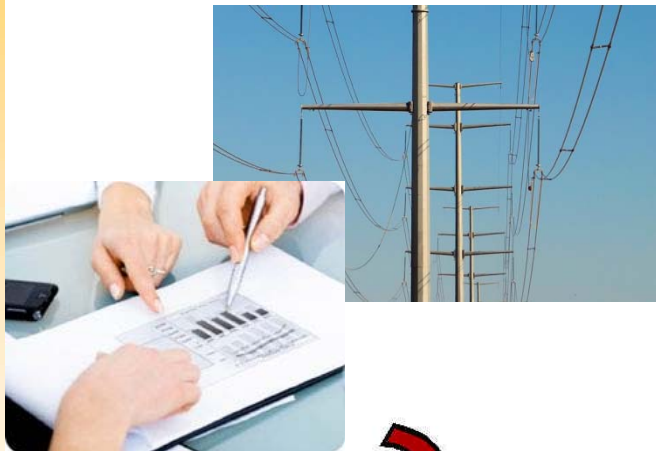
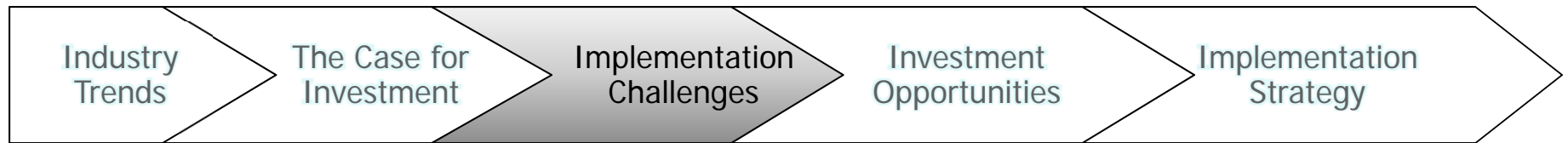
- High penetration of DERs
- PEVs, batteries, microgrids, California energy storage mandate
- Bi-directional power flow on traditionally radial circuits
- Changes in regulatory and business environment
- Need for sustainable protection asset renewal
- Reliability of service
- Public safety improvement and downed wire mitigation

# The Case for Investment



- Traditional design with out-of-date protection fleet that continues to age
- Pilot wire deterioration leading to relay misoperations
- Inability to accommodate bi-directional power flows with traditional overcurrent relays
- Design not optimized for reliability, safety, power quality, or fault protection with high penetration of DERs

# Implementation Challenges



- Executing protection upgrades without a capital budget in Protection & Automation Engineering
- Adding protection upgrades into an already constrained T&D work plan
- Managing investment risk due to uncertainty in technologies, markets, regulation, and future role of the utility



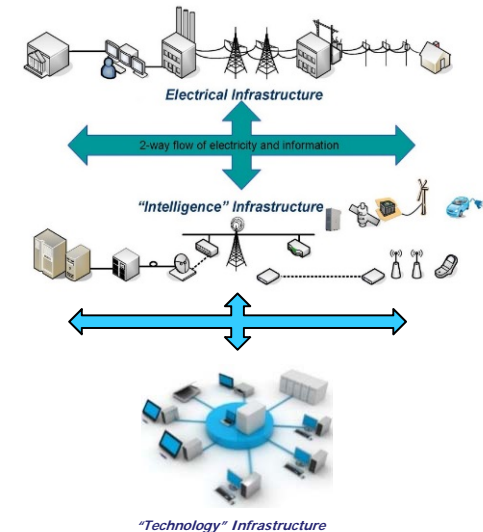
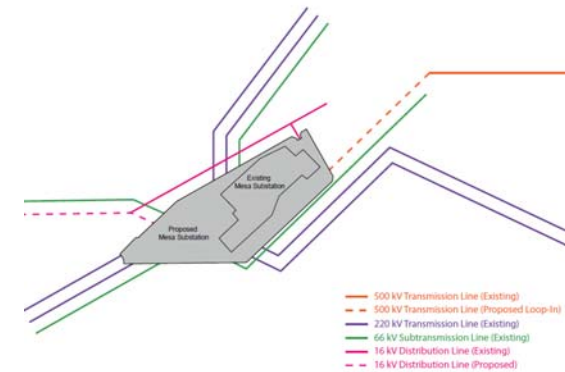
# Investment Opportunities



System expansion plans to serve projected load growth and meet reliability criteria

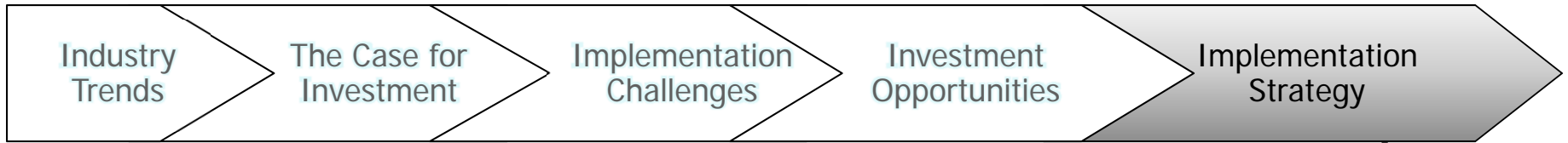
Grid modernization to be safe, reliable, resilient, flexible, affordable, and seamlessly integrate DER

Risk-informed planning framework (PRISM) for developing new projects & programs to mitigate key operational risks to the grid



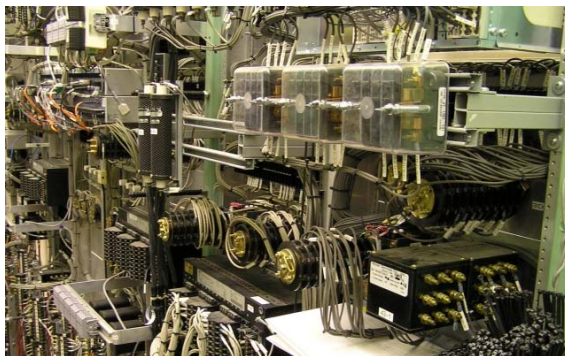


# Implementation Strategy



Define a “no regrets” set of enhanced protection & control capabilities and standards

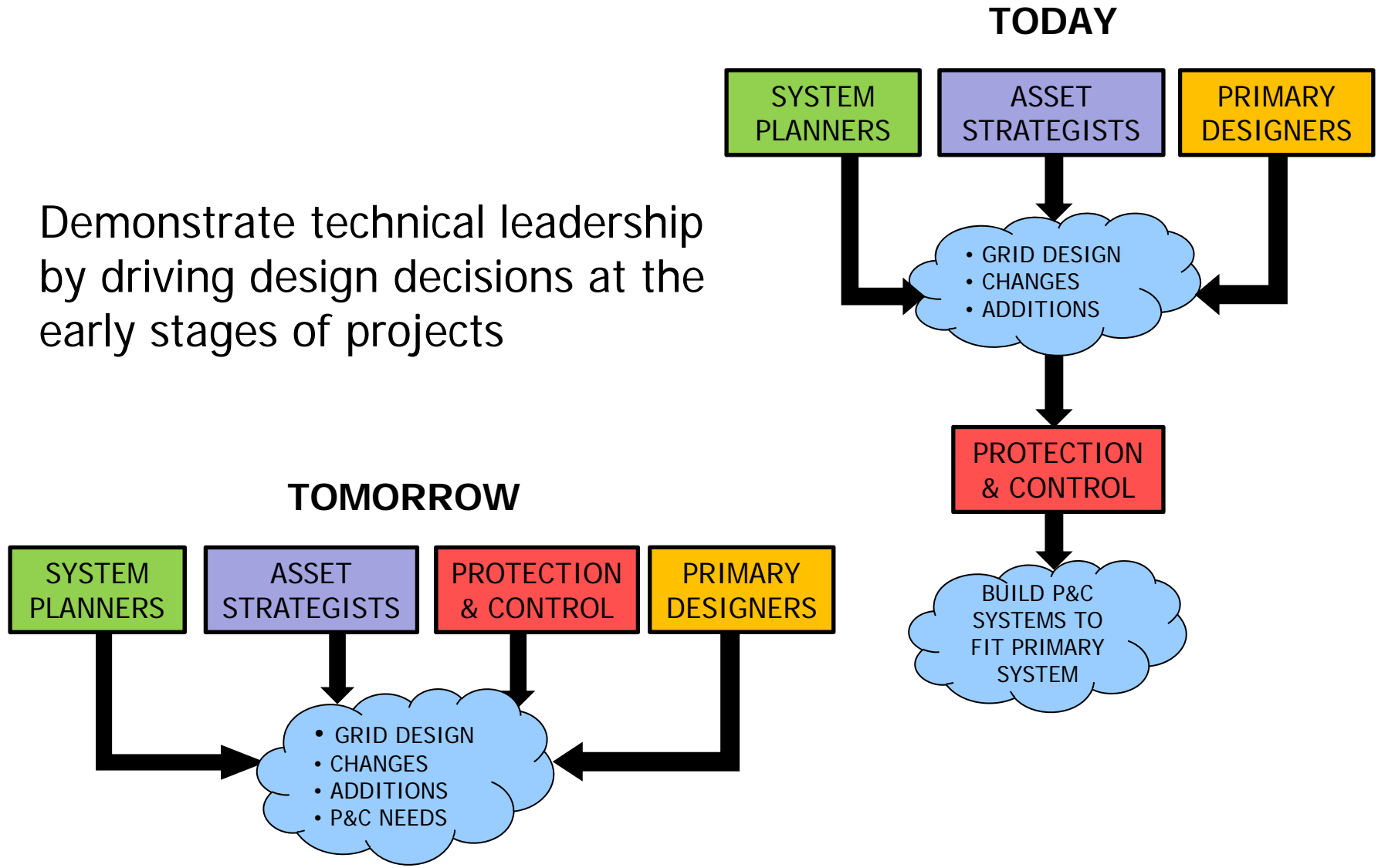
Incorporate new protection standards into existing capital projects across the company *regardless of who sponsors the work*



Develop a robust risk-informed relay replacement program to fill gaps not covered by other capital projects

# Implementation Strategy

- Demonstrate technical leadership by driving design decisions at the early stages of projects



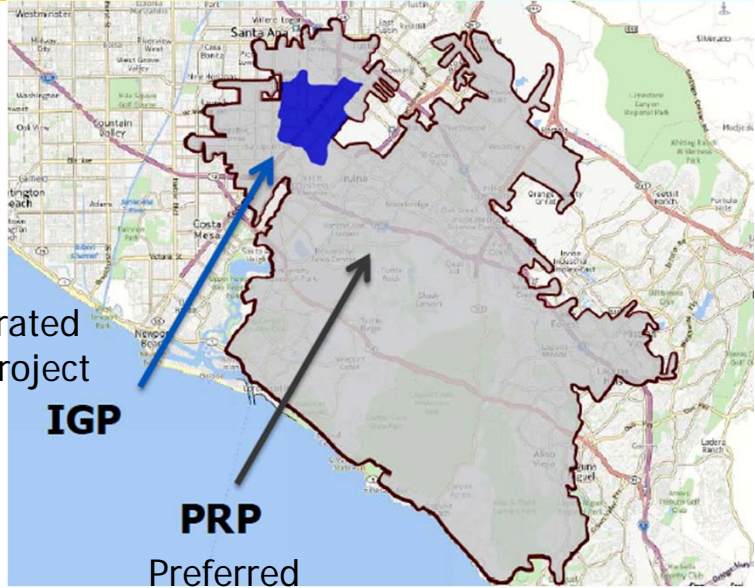
# Sample Case – Mesa Substation Rebuild Project

- Original scope:
  - Rebuild the existing Mesa 220/66/16 kV Substation to 500/220/66/16 kV
- *Added protection upgrade scope:*
  - Replace 14 relays on 66 kV line terminals at Mesa
  - Replace 53 relays on 66 kV line terminals at 16 satellite substations throughout the Mesa 66 kV system
  - Modern microprocessor relays for both primary & backup protection



# Sample Case – Johanna Substation Expansion Project

- Original scope:
  - Add a new 220/66 kV transformer bank at Johanna Substation
- *Added protection upgrade scope:*
  - Replace 27 relays on 66 kV line terminals at Johanna
  - Replace 16 relays on 66 kV line terminals at 4 satellite substations throughout the Johanna 66 kV system
  - Modern microprocessor relays for both primary & backup protection



Integrated  
Grid Project  
**IGP**

**PRP**  
Preferred  
Resources Pilot

# Sample Case – Risk-Informed Relay Replacement Program

(work in progress)



## Objective

Develop and maintain a risk-informed strategic plan for T&D that drives regulatory, financial, and work planning activities

- Develop profile of relay fleet
- Assess relay performance and associated risks
- Develop relay replacement strategies to mitigate risks
- Build business cases for input into T&D capital prioritization

## Lessons Learned

- Leverage corporate strategy to justify investments in system protection & control
- Revise protection & control standards - don't plan or justify relay upgrades project-by-project
- Explain need for enhanced relaying capabilities to the organization in layperson's terms
- Incorporate relay upgrades in project scope at the initiation stage before execution begins
- Create strong partnerships with system planners, primary facility designers, and asset strategists

# Questions?

