Resilient Energy Systems
Mission Campaign

SIGNAL-BASED FAST-TRIPPING PROTECTION SCHEMES FOR ELECTRIC DISTRIBUTION SYSTEM RESILIENCE

This project improves the resilience of the electric power distribution system by developing faster and more accurate fault-detection protection schemes. Using signal-based algorithms with very high frequency sampling sensors on the grid, the novel protection schemes will locate and isolate disturbances and faults on the grid.

THE CHALLENGE

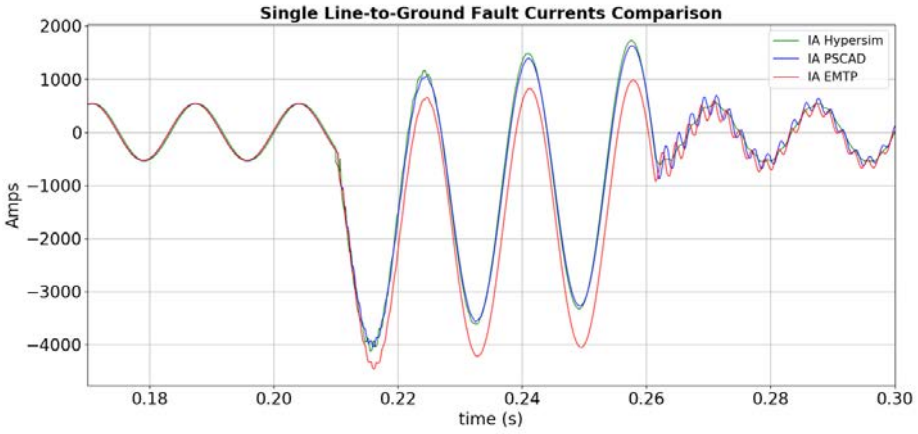
This research seeks to develop methods to detect faults in the electrical power grid dramatically faster than today's protection systems. Accurately detecting and quickly removing faults is imperative for system resilience, national security, and to minimize impacts to defense-critical infrastructure. Modernized protection schemes will improve grid stability during disturbances.

This project will take a holistic perspective to address the challenges of distribution system protection with inverter-based distributed energy resources by developing and demonstrating highly reconfigurable fast-tripping protection schemes without communication. Ultimately this transforms the paradigm for how power system protection is currently accomplished and provides improved reliability and stability to make the energy system more resilient to cyberattacks.

EXPECTED RESULTS

Completion of this project will result in major impacts, including:

- Improved system stability as faults will be removed before generation is impacted.
- Maintained system security during loss of communication.
- Reduced risk of cybersecurity attacks without communication to protective relays.
- Improved energy system resilience, specifically at the distribution level.
- Ability to detect faults in systems with high penetrations of renewable inverter-based systems with low short circuit current.
- Detection of high impedance faults.



APPROACH

The project will improve grid resilience by developing new signal-based protection schemes that quickly detect faults locally without communication. This approach is novel to conventional protection schemes. The successful completion of this project includes signal-based fast-tripping schemes that improve grid resilience.

EXPECTED IMPACT OF THIS RESEARCH

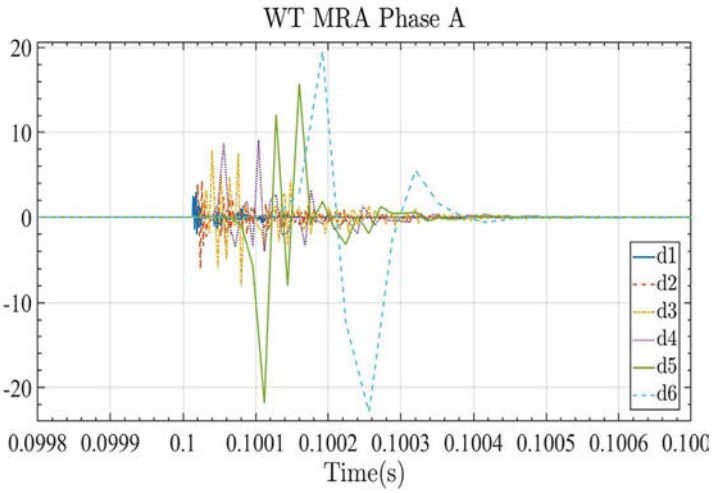
The research will develop a more resilient real-time response to detect, locate, and isolate faults in the electrical system significantly faster. Additionally, there will be reduced cyber risks in the electric grid protection system by not requiring communication. This will decrease potential damage to power systems by detecting faults very

quickly before the fault current has increased. Successful implementation of this project will provide the basis for potential future investment by industry, utility, and government partners.

RESILIENT ENERGY SYSTEMS

Sandia's investment in this project is part of the Resilient Energy Systems portfolio of projects, coordinated R&D that addresses the resiliency of the nation's energy systems and other critical infrastructures to threats.

This project is part of the second thrust, *Materials, Device, and Cyber Innovation,* and the objective is to develop new power system protective relays to improve resilience.



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