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Electric Grid

Title

Application of Advanced Wide Area Early Warning Systems with Adaptive Protection

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ELECTRIC GRID RESEARCH

Project Summary

Application of Advanced Wide-Area Early Warning Systems with Adaptive Protection

Context

Blackouts on power systems of North America and several other systems throughout the world have shown how critical a reliable power system is to modern societies, and the enormous economic and societal damage a blackout can cause. It has been noted that, during the cascading phenomena which lead to blackouts, some protection systems operate in an unanticipated fashion and such operations are often an important contributing factor in the sequence of events leading to cascading outages. This condition might be metaphorically thought of as an “autoimmune syndrome.”

A recent PIER research effort using historical data on a model of the California grid has shown that wide area synchrophasor measurements can be used to improve the “intelligence” of protective systems, resulting in a reduction in the number of false trips and the associated exacerbations of grid disturbances. The very positive results obtained to date have resulted in the need for the next step of a large scale demonstration of the concepts.

Goals and Objectives

The overall goal of the project is to conduct a demonstration on the California grid of the use of synchrophasors to reduce false trips of protection systems under conditions of stress such as during grid disturbances.

Specific project objectives are to develop and conduct a demonstration in three areas:

- a) Security-Dependability Adaptive Voting System
An adaptive protection system that will alter relay characteristics to adjust the security-dependability balance in response to changing power system conditions to reduce the likelihood of cascading outages in a stressed power system, as determined by real-time synchrophasor measurements.
- b) Alarms for Power Swing Encroachment on Relay Characteristics

The use of synchrophasor measurements in monitoring and reporting on encroachment on the operating zones of relays by non-fault events leading to inappropriate relay trips and a cascading process.

- c) Visualization
A protection information tool to assist operators in the interpretation of synchrophasor data.

Description

This is a 3-year, multi-phased project by a team of both universities and California utilities. In Phase 1, algorithms for the adaptive relay system and for alarming on encroaching zones will be refined and finalized. A prototype Protection Information Tool will be developed at the participating universities. In Phase 2, laboratory testing by universities will be followed by laboratory testing by the participating utilities. In Phase 3, the demonstration will consist of system installation at key substations, archiving of all data, and subsequent analysis of results. While the system would be operating in real time under real grid conditions, the system output will not operate the actual relays.

Development of the Protection Information Tool will be conducted in parallel with algorithm development, and will be evaluated and improved through interviews and focus groups of grid operators, protection engineers and other utility personnel.

Why It Matters

Cascading blackouts, while rare, are extremely costly to virtually all stakeholders in the electric power system. For example, the blackout of August 14, 2003 on the East Coast affected 50 million people at a cost to society of between \$7 to \$10 billion, and operation of protective systems was determined to be a significant factor contributing to the cascade. This research can lead to a more reliable electric system by reducing the frequency and scale of cascading power system blackouts.

{More details}



ELECTRIC GRID RESEARCH

Project Summary

Application of Advanced Wide-Area Early Warning Systems with Adaptive Protection (Pg 2)

Participating Organizations

Principal Investigator:

California Institute for Energy and Environment

Research Participants:

Mississippi State University
Pacific Gas and Electric Co.
Southern California Edison Co.
Virginia Polytechnic Institute

Research Advisors:

Quanta Technologies
San Diego Gas and Electric Co.

Project Start Date: October 1, 2009

Project End Date: September 30, 2012

DOE Solicitation No: DE-FOA-0000035

Reports

Final Report: *Application of Advanced Wide-Area Early Warning Systems with Adaptive Protection* (Not yet available)

Funding



Funds for this project came from a \$1,180,875 award by the United States Department of Energy with an additional \$321,039 cost sharing from the research participants and a \$200,000 California Energy Commission (CEC) grant through the Public Interest Energy Research (PIER) program. Authorized expenditures are currently limited to the first project year.

For More Information, Contact

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