



**ELECTRIC GRID RESEARCH**  
**Project Summary**

## Adaptive Relaying Technology Development & Measurements

### Context

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. Other contributing factors to catastrophic failures are unexpected power system configurations which have not been foreseen when protection systems were initially configured, errors in setting and calibration of relays, or undiscovered design flaws in the protection systems.

The increasing availability of time-synchronized phasor measurement data can enable improved protection system supervision by allowing these systems to adapt to the prevailing system state. By using real-time wide area measurements, it is possible to determine optimum protection policies and settings for critically located relaying systems.

### Goals and Objectives

The overall goal is to improve several specific types of protection systems through the use of wide area phasor measurements. The protection functions chosen are all of the type in which the time delay involved in remote phasor measurements is not an obstacle.

The specific objectives of this project are to:

- Develop and evaluate the operational performance of 4 protection system enhancement tools to meet California Independent System Operator (CAISO) specifications,
- Initiate the transfer of prototypes to a CAISO vendor for implementation as production-grade operating tools
- Develop and conduct first-ever demonstration of 3 of the enhancement tools using wide area measurements for CAISO

### Description

Four tools will be developed, simulated, and evaluated using a model of the California grid. A technical advisory committee is composed of engineers from the major California utilities, Bonneville Power Administration, the California Independent System

Operator, Department of Energy, and others.

The areas to be studied include:

- Methods for supervising back-up zones (Zone 3 relays) utilizing phasor measurements from non local sites so that back-up protection is not allowed to operate when it is not appropriate.
- Supervisory control techniques that implement an intelligent load shedding when significant loss of generation or load takes place, but that does not require the establishment of islands and does not result in frequency decay.
- Use of wide area measurement systems to automatically adjust the settings of generator protecting loss-of-field relays as the grid characteristics evolve over time. Determine the proper method for setting these relays and verify of the appropriateness of the developed logic by further simulations.
- Methodology to design a robust damping controller for grid oscillations using remote phasor measurements. Develop the methodology to extend the results to FACTS devices and generator excitation systems as the control mechanism.

### Why It Matters

Cascading blackouts, while rare, are extremely costly to virtually all stakeholders in the electric power system. The blackout of August 14, 2003 on the East Coast affected 50 million people and operation of protective systems was determined to be a significant factor contributing to the cascade. Each of the areas in this study has been implicated as a contributing factor in one or more cascading blackouts. The potential of automated adaptive control is a more reliable electric system with a reduction in the frequency and scale of cascading power system blackouts.

{More details}



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## Adaptive Relaying Technology Development & Measurements (Pg 2)

### Participating Organizations

#### Principal Investigator:

Virginia Polytechnic Institute

#### Advisory Team Representation:

Pacific Gas and Electric;  
Southern California Edison;  
California Independent System Operator;  
Bonneville Power Administration;  
U.S. Department of Energy;  
Pacific Northwest National Laboratory  
Georgia Tech;  
Schweitzer Engineering Laboratories;  
General Electric;  
Elequant;  
Infrasource, Inc.;

**Project Start Date:** October 15, 2008

**Project End Date:** October 13, 2011

**CIEE Contract No.:** TRP-08 -06

**CEC Contract No.:** 500-037-07

### Reports

Final Report: *Advanced Protection Systems using Wide Area Measurements* (Not yet available)

### Funding



Funds for this project came from a \$180,000 award by the CIEE under a research contract 500-07-037 awarded to CIEE by the California Energy Commission (CEC) through the Public Interest Energy Research program (PIER)

### For More Information, Contact

Dr. Merwin Brown,  
CIEE Electric Grid Research Program Director  
(916) 551-1871  
[merwin.brown@uc-ciee.org](mailto:merwin.brown@uc-ciee.org)