POWER

FACULTY

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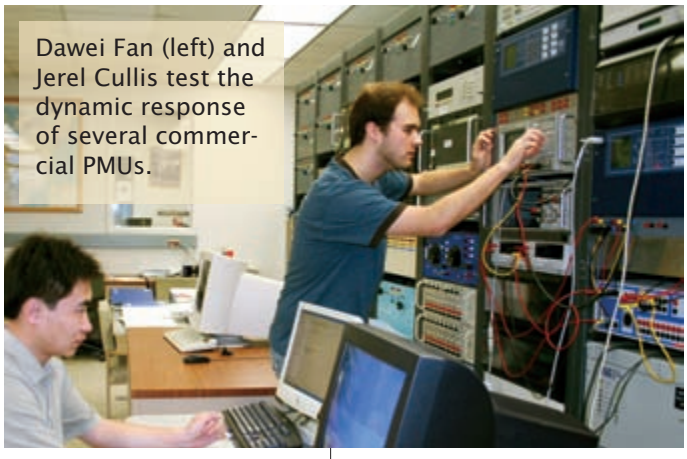
Improving California's power system

Higher energy costs and recent blackouts in North America and other systems around the world have spawned an increased emphasis on protection systems. Wide area measurement concepts and devices developed at Virginia Tech are being applied worldwide to reduce catastrophic failures of the power grids, limit the regions affected by such events, and to increase the speed of restoration after such an event.

In one project, researchers are using real-time wide area measurements of the California power system to determine optimum protection policies and settings for critically located relaying systems. The goal of the three-year development and demonstration project is to improve protection system supervision by making it adaptive to the prevailing state of the system.



Dawei Fan (left) and Jerel Cullis test the dynamic response of several commercial PMUs.

Towards this goal, the team is developing techniques for adaptive adjustment of dependability and security, potential load encroachment alarm systems, and more-intelligent out-of-step relaying functions.

The team will determine key locations on the California grid where an insecure relaying operation during stressed system conditions would be detrimental to the viability of the power system. The team will also develop a method for using real-time wide area measurement data and the existing protection system data to determine which of the relay characteristics are in danger of being encroached upon during a catastrophic event. Appropriate countermeasures will be developed for those vulnerabilities.

Finally, the team will develop a technique to use wide-area measurements to improve out-of-step decision-making at key locations where out-of-step blocking and tripping functions are used. Out-of-step relays are traditionally set based on transient stability studies performed for assumed base case and contingency conditions. However, in practice, the power system and the actual complex sequence of events differ from the study cases, and the protection settings in use are not appropriate to the changed system conditions.

DEVICE CHARACTERIZATION

The increased demand, availability, and applications of wide area measurement devices have created the need for proper testing and standardization. Virginia Tech power engineering researchers are collaborating with the National Institute of Standards and Testing (NIST) to develop procedures and testing devices that will allow researchers, users, and manufacturers to document, evaluate and compare the dynamic response of the different wide area measurement devices on the market. In addition to the NIST work, graduate students from Virginia Tech and Otto-Von-Guericke University in Germany have collaborated on efforts to test industrial prototypes of wide area measurement devices.

Designing the distribution system of the future

Virginia Tech, Southern California Edison and KEMA, Inc. are working to extend the use of synchronized measurements beyond conventional transmission system applications to enhance distribution system reliability in a project sponsored by the U.S. Department of Energy. The team seeks to improve fault localization, prediction, isolation, and service restoration capabilities. Moreover, system security will be enhanced through the use of distributed intelligence to execute system islanding and service restoration. The team is also investigating the use of synchronized measurement of single phase and harmonic components for the detection of incipient faults in distribution protection.

PMUs go global

Virginia Tech's wide area measurement technologies are gaining popularity worldwide, with researchers making presentations last year in Taiwan, China, India, Sweden and France. ECE teams are working with the Power Grid in India and the National System Operation Center in Brazil to aid in developing optimal wide area measurement systems based on the phasor measurement technology (PMU) developed at Virginia Tech. The Indian PMU system is being designed to improve power system monitoring and to control their rapidly growing system. The Brazilian system seeks to monitor and control their system to take full advantage of hydro generation and reduce the effect of regional weather on energy generation. ECE researchers are working to determine the optimal placement and deployment schedule to obtain the greatest benefit from the measurement system at every stage of implementation.

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