

Western Water and Power Solution Bulletin

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Power System Stability Improvements

Improving generator controller and power system performance through improved data analysis.

What Is The Problem?

Turbine-driven “synchronous” generators are the heart of the interconnected power system in the U.S., and they supply over 95 percent of the nation’s electricity. Dynamic computer models that simulate these generators and their controllers (voltage regulators, power system stabilizers, and speed governors) are used to predict and plan for abnormal occurrences within the power system. Modeling the generator being used with up-to-date controllers and other correct parameters is crucial—in the same way that modeling the behavior of a 747 airplane will not be much help if you are flying a 737 airplane. Inadequate models can lead to unforeseen system behavior, which may lead to significant problems such as regional blackouts.

Traditionally, severe, sudden, short-circuit tests are performed on synchronous generators to get the information needed to develop these models. These tests are costly, time consuming, and potentially dangerous. These tests require the generator to be disconnected from the power system and to have specialized control and monitoring circuitry connected. New methods are needed to retrieve this information while the generator is still operating normally. Moreover, severe tests only show extremes, so we need to improve the quality of generator parameter data under smaller disturbances.

What Is The Solution?

Reclamation’s Hydropower Technical Services staff has developed computer software to identify generator/controller characteristics, dynamic parameters, their effects on the power system, and any unusual operations. The software is used in concert with normal routine test results (with the generator connected normally to the power system) to develop the required simulation model parameters. This new model identification capability, based on data acquired during either staged tests or via continuous monitoring, improves the understanding of the impact of generator controllers on power system stability in a more efficient way while adding the ability to monitor the impact of long-term power system operation on powerplant equipment life. Individual generator governors and voltage regulators can be better integrated with regional automatic generation control systems and voltage controllers when improved parameter data are incorporated into generator/controller simulation models.

These model identification methods provide more accurate data for the prevention of power system problems such as blackouts. Moreover, they can save several days of test preparation and set up and reduce the possibility of a failure during testing. Reducing the number of testing days gets the generating units back in normal production faster.

Who Can Benefit?

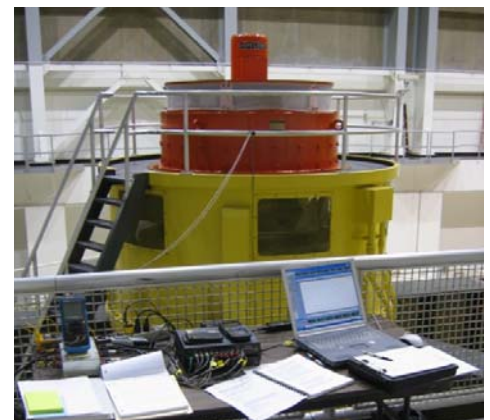
Powerplant managers and regional power system managers will benefit from improved generator/controller simulation models. Improved power management and the reduced potential for problems such as blackouts will benefit all consumers.

Where Have We Applied This Solution?

We have used these new methods at Reclamation’s Crystal, Glen Canyon, Shasta, and Parker Powerplants. We improved generator/controller simulation models by using parameters that were established through these applications. Reclamation test procedures and model parameter development procedures have been modified to incorporate the new techniques, and publications in technical journals are pending.

Future Development Plans

These methods for establishing generator/controller parameters for improving simulation models will be refined continuously as technologies advance and experience is gained. They are planned for implementation at all large Reclamation powerplants during the next sequence of routine tests in 2012 – 2016.



Generator testing and monitoring at Crystal Powerplant

More Information

Reclamation staff may request copies of internal and draft reports related to this research (see below), and links to publicly available documents will be added to this bulletin as they become available. Members of the public and non-Federal agencies may contact J. Agee for additional information.

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Collaborators

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