



TIP 268: Verification & Validation of Transient Stability Models & Results

Context

Transient stability is an important consideration for North American power grids, including the WECC. In light of some major system disturbances in the past two decades, efforts have gone into improving the representation of dynamic devices such as generators and loads in planning cases by using field measurements; but veracity of a simulation study depends equally on the solution processes of the simulation software being used.

Transient stability simulations form a vital part of planning studies. A transient stability simulation assesses the short-term (several to 30 seconds) angular stability of the power system following a major disturbance. The studies are used to determine transmission operating limits and for expansion planning purposes, amongst several other important applications. Inaccurate models have the potential to allow serious disturbances and instabilities in the system to go undetected, possibly leading to blackouts. However, no standard methods or tools have been created so far to validate these models. This work is aimed to overcome these limitations, with a special emphasis on the BPA system.

Description

The major technology development efforts in this work will be the creation of an automated analysis tool to perform transient stability software verification, development of a wide-area visualization tool for to analyze wide-area data and simulated transient stability data as well as detect model error, and finally the creation of a model validation tool to compare study simulations with PMU measurements during disturbances. Visualization techniques, which have proved to be remarkably useful in wide-area power system analyses, have not yet been used widely in validation efforts, but are envisioned to be a useful tool in achieving the objectives of this project. Major project tasks include the following:

- Develop an automatic analysis tool to verify transient stability software packages from GE, PowerWorld and Powertech Labs.
- Develop a wide-area visualization tool to analyze wide-area data and detect model errors
- Validate transient stability models and software against PMU measurements

Why It Matters

A key operational challenge identified in the Transmission Technology Roadmap is the absence of verified planning models for different operating conditions. Validating dynamic models and dynamic data in existing planning models, using field measurements such as PMU disturbance data, will enable BPA to develop better transient stability models and simulations. Verifying the software packages will ensure that the planning studies will reflect actual system behavior consistently between software programs. Implementation of wind-generation models in different software packages is an ongoing effort; this project will seek to verify the consistency of these implementations with each other.

The immediate benefits to BPA would be improved transient stability simulations, planning and better operational decisions. This will lead to an optimized grid performance. The economic benefits of optimal grid performance can be monumental, potentially saving both BPA and its customers substantial money. Better operational strategies will enable more reliable power service, thus benefiting electricity consumers at large. More accurate planning studies will also facilitate better expansion planning decisions, thus influencing major dollar decisions for BPA. Accurate model representation will not only prevent the operation of the system at unreliable levels on the one hand, but also avoid the economic repercussions of underutilizing the grid.

Goals and Objectives

The overall objective of this work is to further BPA's cause in optimizing their transmission grid by facilitating better transient stability studies and consequent operational enhancements. This will be attained by increasing confidence in the dynamic simulation studies of the BPA system through an integrated software-verification and model-validation approach.

- Develop automated mechanisms to verify and compare commercial-grade transient stability simulation packages -- used by BPA for their system analyses -- with each other.
- Validate power system dynamic models using BPA-furnished PMU data, as an extension to the software verification process as well as a means to improve the representation of dynamic models in planning studies.

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Project Start Date: November 1, 2012

Project End Date: April 15, 2015

Reports & References (Optional)

Links (Optional)

Funding

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BPA FY2014 Budget:	\$152,931

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UI Project (Illinois Department of Commerce & Economic Opportunity, Illinois Center for Smarter Electric Grid)

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