



TIP 289: Wide-Area Damping Control Proof-of-Concept Demonstration

Context

Recent efforts by the Bonneville Power Administration (BPA) have identified control schemes that can mitigate inter-area power oscillations through increased damping. There are two main motivations for mitigating power system oscillations. First, if damping is insufficient, oscillations may grow and cause a series of cascading outages. Avoiding large outages provides a significant financial incentive. Second, power flows down major transmission paths are often limited by small signal stability. Additional damping will enable greater power flows, and thus greater revenue. Greater power flows down existing transmission paths also provides a potential transmission deferral benefit, along with potential reduced congestion pricing for wholesale electricity consumers.

The supervisory controller is responsible for monitoring system damping, assessing the performance of local control nodes, periodically updating parameters (e.g., local control gains), and disabling the system if improper operation is detected. The design of a supervisory control system is essential for safe and robust operation. Not only must a wide-area-damping controller improve system damping, it should also cause no harm over a range of operating conditions.

Description

The most promising actuation schemes are real power injection via Pacific DC Intertie (PDCI) modulation; energy storage devices; and a thyristor braking system. This effort will focus on these actuation approaches.

The plan is to design a supervisory control system for wide-area damping and then perform the necessary modeling, analysis, and simulation to verify that it meets system requirements. The experiments and proof-of-concept demonstrations are aimed at increasing the technology readiness level of wide-area damping

Thyristor braking may be used independently to modulate real power absorption, or in combination with PDCI modulation or energy storage devices. To organize efforts, thyristor braking will be evaluated in conjunction with energy storage. Depending on the results of the evaluation, actuation will consist of one of the following:

- Exclusively energy storage
- Energy storage coupled with thyristor braking
- Exclusively thyristor braking

In addition to damping-control devices at BPA and selected New Mexico areas, a Pacific DC Intertie (PDCI)

modulation control scheme will be prototyped upon BPA approval.

Further, the assessment of sensors and communications is critical to establish the feasibility of full-scale wide area damping control systems. Included is an evaluation of the phasor measurement unit (PMU) data network and updated PMU specifications to enable damping control applications.

Why It Matters

This project will provide the following benefits:

1. Increased revenue: Power flow on certain transmission lines, e.g., the California-Oregon Intertie (COI), is small-signal stability-limited. Increasing these power flows corresponds to additional revenue.
2. Increase stability margins: This work will develop control methods that will increase system stability margins.
3. Opportunity to capitalize on the upgraded phasor measurement units (PMU) data network, PMU data and possible inter-area-damping capability.

Goals and Objectives

The research goals of this effort are to significantly increase the technology readiness level of oscillation damping equipment by performing a proof-of-concept demonstration. These areas require further investigation prior to full-scale implementation:

1. Increase the technology readiness level of wide-area damping control. After this effort, the next logical step will be a full-scale (i.e., full-power) demonstration project.
2. Provide new guidelines or standards for PMU frequency measurement for damping control applications.
3. Provide assessment of existing PMU communications network for damping control applications.
4. Assess the Phasor Measurement Unit (PMU) data network for latency and reliability.
5. Upgrade capabilities of the BPA Energy Storage Test Facility.
6. Investigate supervisory control algorithms to guarantee failsafe operation.

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Project Start Date: October 1, 2012

Project End Date: September 30, 2015

Reports & References (Optional)

Links (Optional)

Participating Organizations

DOE
Sandia National Laboratories

Funding

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BPA Share:	\$935,000
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BPA FY2014 Budget:	\$500,000

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