Sandia National Laboratories

CONTROL SYSTEM FOR ACTIVE DAMPING OF INTER-AREA OSCILLATIONS

Sandia's control system increases damping of inter-area oscillations to enhance power grid reliability.

New control system leads to higher power transfers

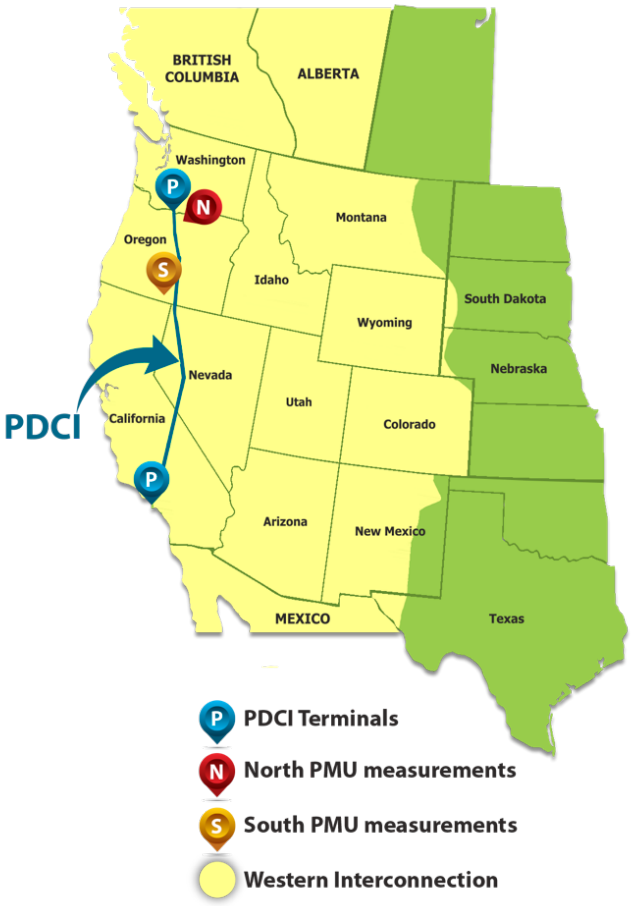
Inter-area oscillations can develop on power grids with large generation and load complexes separated by long transmission lines. Poorly damped inter-area oscillations can have devastating effects, such as extensive blackouts like those experienced on the West Coast in August 1996. To prevent these effects, operators run the grid well below transmission capacity on long lines, which is not economical. Sandia has developed a control system for damping inter-area oscillations to improve power grid reliability and enable higher power flows.

How It Works

Sandia's control system uses real-time measurements from over 1,000 Phasor Measurement Units (PMUs) as feedback information to modulate real power flow over a high voltage direct current (HVDC) transmission line. The PMUs, installed across North America through investments by the Department of Energy, provide high speed, accurate insight into grid dynamics and stress.

2017 R&D 100 WINNER

The control system has an integrated supervisory system that determines damping performance, maintains fail-safe operation of the controller, and ensures the controller does no harm to the grid. Extensive testing of Sandia's control system on the Pacific DC Intertie (PDCI), an HVDC transmission line, has proven that it effectively dampens critical



inter-area oscillations without reducing the damping of peripheral oscillations.

The Control System also demonstrated fast response times (≈100 ms) from the acquisition of PMU measurement data to the time it takes for the PDCI commanded power to reach the grid.

Sandia's Control System can be easily integrated into current grid systems and would improve the damping of worrisome inter-area oscillations. It would also reduce and/or postpone the need for new transmission capacity, increase revenue by enabling higher power flows, and facilitate a higher penetration of renewable energy on the grid.

Sandia's control system is the first successful grid demonstration of feedback control, making it a game changer in efforts to transform the existing grid into the future smart grid.

Actual system prototype demonstrated in an operational environment.

TRL:7

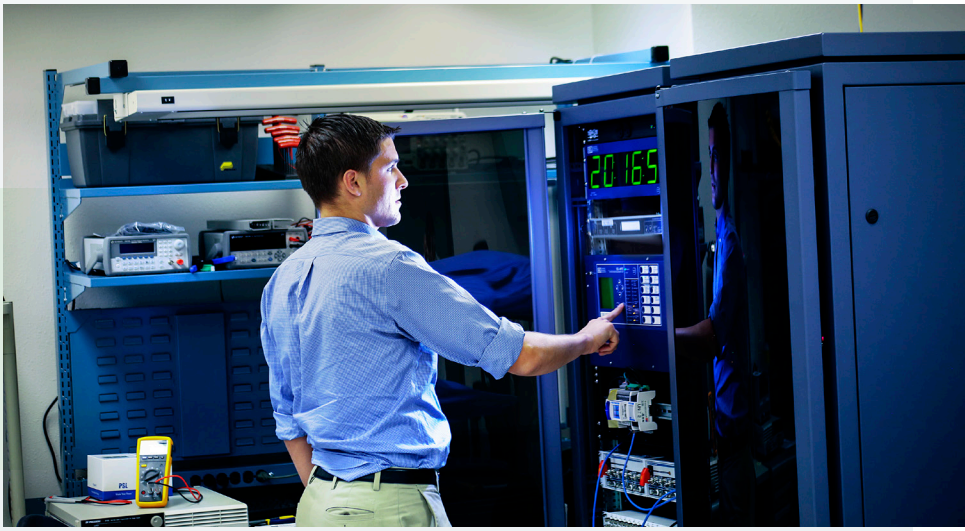
Technological Benefits

- Improves grid reliability and efficiency
- Enables higher power flows on stability-constrained transmission lines
- Utilizes existing PMUs and HVDC transmission lines
- Incorporates a supervisory system to ensure robust, reliable, and safe performance

Commercialization Path

Sandia is looking for partners to implement the control system on their energy delivery systems. Target customers include:

- Electric utilities
- Suppliers of power grid measurement and control systems



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