TIP 242: Impact of Power Electronic Loads on Grid Stability

Context

Power electronic loads – electronic drives, battery chargers, consumer electronics – are rapidly increasing as a percentage of total system load. The potential emergence of electric vehicles is expected to only further increase this load burden. Many major transmission paths in the Western Interconnection are stability limited. Previous research has shown that power electronic loads have a very unfavorable characteristic with respect to the grid. They behave as constant power loads with respect to voltage and frequency. Therefore, as system voltage drops, these loads will attempt to produce the same power by increasing current draw, a very undesirable outcome for system stability. But, since they are discontinuous, they can oscillate rapidly from very low to very high voltage, a nightmare for planners. Their degrading effects on system frequency response spurs the need for use of larger generator reserves. Studies indicate that these loads will affect synchronous stability, oscillation damping and frequency peaks.

Description

This project will evaluate the impact of power electronic loads on power system stability – specifically, dynamic voltage stability, damping of power oscillations, and frequency controls. It will investigate a wide spectrum of power electronic loads, including Variable Frequency Drives, consumer electronics, LED lighting, and Electric Vehicle Chargers. Project studies will help simulate, test and evaluate designs that can make these electronic loads amenable to electrical power grid stability. The data derived will provide technical input for larger DOE and NERC efforts to address the effects of increasing penetration of power electronic loads on power system stability, raising awareness of the these conditions among equipment manufacturers, and support the development of the grid-friendly end-use standards.

Why It Matters

1. Better understanding of reliability risks in the Pacific Northwest associated with the increasing penetration of power electronic loads, and specifically vehicle battery chargers.
2. Understanding the conventional transmission investments needed to mitigate such risks.
3. Understanding what can be done on the demand side to mitigate such risks.
4. Developing a portfolio of solutions (technical and regulatory) to address the emerging issue in a cost-effective manner.

Goals and Objectives

1. Facilitate technology transfer from BPA to DOE.
2. Continued technical support to DOE in their effort to make end-uses grid friendly.
3. Conduct studies, simulations, testing and evaluation of grid-friendly solutions.
4. Evaluate the impact of new electronic loads on the Pacific Northwest grid.

Deliverables

1. System impact study report (Stage Gate 1).
2. Test reports for power electronic end-uses (Stage Gate 2).
3. Simulation models of power electronic end-uses and their controls (Stage Gate 3).
4. Feasibility report of modifying power electronic characteristics.
5. Report evaluating the applicability of the grid-friendly power electronic devices.
6. Presentation materials for DOE, NERC and manufacturing organizations.

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Project Start Date: Oct 1, 2011

Project End Date: Sept 30, 2015

Funding

Total Project Cost:	$297,500
BPA Share:	$297,500
External Share:	None
BPA FY2012 Budget:	$ 86,500

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