Technology Innovation Project *Project Brief*

TIP 245: Control of Power Flow Control Devices for Optimal Usage and Enhancement of Transmission Capacity

Context

Flexible AC Transmission Systems (FACTS) control devices, by virtue of their thyristor-based technology, might allow better use of existing transmission by enhancing transfer capability, improving voltage profiles, and redistributing power flows according to the availability of transmission capacity, i.e., pushing power from heavily loaded lines to lines less loaded, a necessity for accommodating maximum variable input. They offer quick adjustment settings with a continuous range, ideal for variable energy inputs to rapidly boost supply, but also accommodate needed reductions to prevent overload, a significant feature with highly variable supplies such as wind. Their major strengths are speed and system flexibility, with fast response and decentralized application potentially adding significant system reliability. The ultimate goal is to avoid new line construction.

Description

This project investigates the effectiveness of power flow control instrumentation such as FACTS devices with regards to congestion management and maximizing use of the existing transmission system. This technology might provide a more flexible system and help push more power through existing lines. Schemes will be derived to determine optimal settings of the power flow control devices, taking into account the varying power injections from intermittent and variable generation resources such as wind and solar. Attempts will be made to determine the minimum number of variables needed to provide computational accuracy and verifiable conclusions.

Why It Matters

This study can provide conclusive insight on the effectiveness of power flow control devices and their ability to push more power through the existing transmission system. With increasing power consumption and the addition of variable generation resources, such as wind generation, that are distant from load centers, it becomes important to make optimal use of existing assets. The transmission system must enable integration of renewable generation by becoming flexible and adjustable rather than being a static, unaccommodating obstacle.

Another indirect benefit to BPA is establishing a close relationship with Carnegie Mellon University and its growing power systems program. This would open the door for students to work as BPA summer interns, contributing to their research efforts and making a strong connection to potential future employees. A cost of this project entails providing support for the students and faculty involved. Should project results conclude that the potential of power flow control devices is significant and BPA decides to implement the solutions provided, additional labor and equipment costs might result. But it could significantly reduce future investments in new transmission construction. Costs for carrying out the research are clearly quantifiable and are provided in the project budget. Costs for the installation of power flow control devices and full implementation of the proposed control concept ultimately depend on the determined effectiveness of these power flow control devices.

Goals and Objectives

1. System setup to test congestion management and power transfer from renewable generation resources to loads.
2. Development of a decentralized control method including simulation testing.
3. Quantification of power transfer increase using power flow control devices.

Deliverables

1. White Paper, approximately10 pages, documenting test system used, justification for objective function and description of method used for sensitivity analysis.
2. Interim Report, approximately 15 pages. Description of decentralized control methodology including simulation results comparing achieved results with results of Optimal Power Flow.
3. Final Report, approximately 50 pages. Detailed report on project tasks carried out, results of system studies and conclusions on effectiveness of power flow control devices in the proposed application.
4. Simulation code software including detailed comments.
5. Presentation of accomplished work including explanation of simulation code.

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Project Start Date: December 2011

Project End Date: September 2012

Funding

Total Project Cost:	$142,864
BPA Share:	$ 72,682
External Share:	$ 70,182
BPA FY2012 Budget:	$ 72,682

Participating Organizations

Carnegie Mellon University

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