Technology Innovation Project

Project Brief

TIP 311: Power Flow Control Reactor Demonstration on a 115kV Line

Context

As the power system becomes more dynamic and the future less certain, BPA must look for ways to make the power system more flexible. One way to do this is with devices which actively control power flow. Such devices can optimize the use of existing infrastructure and can offer a richer set of options for managing extreme situations. There are several emerging technologies in this area that are close but not yet commercially available. These new technologies must be successfully demonstrated in the power system under controlled situations before being relied upon to solve real power system challenges.

Description

This project is a continuation of a previous Technology Innovation project TIP 282 which examined several candidate power flow control technologies. The technology chosen for development and demonstration is the single-phase Continuously Variable Series Reactor (CVSR) currently under development by the Advanced Research Projects Agency – Energy (ARPA-E), a cost-share partner on this project.

The project is being implemented in two phases. BPA will perform work in both phases.

In Phase 1, Oak Ridge National Laboratory (ORNL), in conjunction with SPX Transformer Solutions, Inc. (SPX) will design, build and complete initial testing of a prototype single-phase, variable impedance power flow control device for the electric grid. BPA will select a suitable 115kV site to install and test the devices, will provide design specifications to SPX, and will write a testing and instrumentation plan.

In Phase 2, BPA, working directly with SPX, will be responsible for the installation, commissioning tests and demonstration of three prototype units at the designated test site on the BPA system. At the conclusion of the 1-year demonstration phase, BPA will analyze the data collected and determine whether the devices performed as anticipated, and whether this approach to controlling power flow is technically and financially viable.

In addition, both BPA and the University of Tennessee, Knoxville (UTK) will perform modeling and analysis studies of the power system to investigate the benefits of the CVSRs under a variety of operational scenarios to quantify the value for the transmission system.

Why It Matters

The project advances technology that has the potential to provide a very cost effective and desirable competitor to existing options such as phase shifting transformers. Typical estimates for 115 kV connected, 150 MVA phase shifting transformers range from $3.5-4m. The prototype CVSR is estimated to cost $3m for a 115kV connected, 300 MVA device, with further cost reductions expected. It is also expected that the CVSR will be simpler to operate and have lower maintenance requirements.

Potential benefits of this technology include: the ability to shift current from limited facilities to under-utilized ones, thereby reducing congestion; provide an option for planners to consider when looking for alternatives to construction of a new line; and improve operational flexibility and make outage windows more available.

If successful, at the conclusion of the project BPA will have a fully functional dynamic 3-phase series reactor that can be re-deployed on the BPA system.

Goals and Objectives

The objective of this project is to plan, install and test 3 single-phase CVSRs at a BPA substation in 2015-17.

The goals are to demonstrate the ability of the prototype to control power flow in a safe, reliable, and cost-effective manner and work with ARPA-E as a cost share partner to jointly develop and test this new technology.

Long-term: drive successful commercialization of the technology by early manufacturers, enabling adoption at BPA and utilities nationwide.

Deliverables

The deliverables on this project include the following:

1. Designs (BPA and SPX)
2. Test Plan (BPA)
3. Three CVSR devices (SPX)
4. DC control system (ORNL/UTK)
5. Modeling studies (UTK)
6. Commissioning tests and demonstration (BPA)
7. Final Report and evaluation of results (ALL)

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Project Start Date: May 2014

Project End Date: March 2016

Reports & References

Related Technology Innovation Project

TIP 282-Transmission Power Flow Controls for Bulk Grid Optimization

Links

Funding

Total Project Cost:	$2,730,000
BPA Share:	$1,415,000
BPA FY2016:	$ 463,000

For More Information Contact:

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Participating Organizations

US Department of Energy/ARPA-E
Oak Ridge National Laboratory (ORNL)
SPX Transformer Solutions, Inc. (SPX)
University of Tennessee, Knoxville (UTK)