TIP 362: Assessment of Maturity and Technology Readiness of Power Flow Control Solutions for Congestion Management Problems

Context

Power flow controls (PFC) are known solution to congestion management and relieving transmission constraints. However, BPA's experience with the technology has been mixed. While BPA has been one of the leaders in deployment of fixed series capacitors, the experience with controlled devices was not positive. Slatt Thyristor controlled series capacitor (TCSC) TCSC has experienced numerous thyristor control and cooling system failures, making the device a reliability risk and resulting in device breaker bypass. At the same time, there are several other successful TCSC installations around the world.

Project Description

The project had two Phases:

Phase I was an overview of technology maturity and operating experiences to determine which technologies match BPA-specific needs.

Specifically, we considered the following technologies:

- Thyristor-controlled series capacitors (TCSC)
- Controlled phase-shifters
- Controlled series reactors
- Smart wire technologies
- Back to back HVDC projects

The project activities in this phase included:

- A contract with a consultant to assist with the interviews and to prepare the final report
- Interviews of operating entities, site visits
- Interviews equipment manufacturers
- Review of technical reports and papers

The primary Phase I deliverable was a technical report covering the topics descried above.

After the technology maturity assessment, we recommended power flow control technologies that were sufficiently established and suitable for BPA needs.

Phase II focused on the most relevant technologies and working with manufacturers to develop methodologies to size and rate power flow control devices.

BPA installation required several devices in parallel on the same circuit (to achieve required MVA capacity), and several devices on multiple lines in the same transmission path. The project reviewed technical requirements for such complex installations in terms of equipment ratings and required control capabilities.

We also developed requirements for equipment control, protection and monitoring.

Benefits

This project expands the portfolio of technology solutions that can be used by BPA transmission planners in developing system reinforcement plans.

Ultimately, these power flow solutions can defer or even eliminate the need for new line builds, resulting in significant cost savings to BPA

Accomplishments

This project developed an understanding of the maturity and technology readiness of various power flow control technologies, so that BPA transmission planning can make risk-informed decision on using these controllers as potential solutions for congestion management problems.

Results of this project informs BPA planners on which power flow control technologies can be considered as viable transmission reinforcement alternatives

Deliverables

Task 1: A technical document summarizing the metrics used to evaluate various power flow control solutions.

Task 2: A technical report summarizing maturity of power flow control technologies in applications similar to BPA needs.

Task 3: A technical report summarizing methodology for sizing and rating power flow control technologies, including examples relevant to BPA needs.

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Project Start Date: April, 2017

Project End Date: September, 2018

Related Projects

BPA had an exploratory Technology Innovation project on power flow control principles.

Participating

Electric Power Research Institute (EPRI)

For More Information Contact:

Technology Innovation Office:
TechnologyInnovation@bpa.gov

Technical Contacts:

Dmitry Kosterev, Transmission Planning
dnkosterev@bpa.gov

Anita Heredia, Transmission Long Term Planning Engineering
alheredia@bpa.gov

Conclusions:

The project developed and implemented a systematic approach to identify options and determine the location, rating and controls requirement for PFC devices. It is valid for screening options and preliminary analysis of alternatives.

PFC devices in this study are available to potentially help resolve power flow issues on BPA's Transmission system, but require more internal detailed studies by Transmission Planning to fully vet that these PFC devices are feasible.

Information from this project was used in the August 2018 presentation of the EPRI P39.12—Reactive Power Management and Voltage Control: Project Set Overview