TIP 281: Impacts Due to Dynamic Transfers

Context

BPA's plays a vital role in wind power development and providing transmission infrastructure in the Pacific Northwest. Dynamic Transfer, or Variable Transfer, is essential to reliably integrate wind, smart grid, Energy Imbalance Markets and other devices that increase variability.

Generally power transfers between Balancing Authorities (BAs) and generating resources are fixed for an hour. In contrast, intermittent resources can change generation unpredictably many times within an hour. In themselves, those changes can affect path flows and result in challenging operational scenarios.

In addition, when BPA generation reserves are low and wind generation changes are large, BPA cannot provide enough balancing resources for the wind. This necessitates the acquisition of balancing resources from other BAs, which in turn will vary in opposition to the wind generation. Utilities are challenged to manage unanticipated flow variations that result from the variation in generation output.

Effective application of dynamic transfer limits is the way to manage the flow variations, maintain grid reliability, and minimize impact to the customer.

Description

This research, focused on four major areas:

1. Factors that influence dynamic transfers,

2. Identification of allowable voltage variation in the transmission system,

3. Approaches to minimize labor intensive dynamic transfer studies and,

4. Understanding how dynamic transfer limits change with respect to system operating conditions.

This project's main goal was to identify drivers and impacts of generation variability on transmission system to effectively manage current and future transmission variability.

Variability of paths flows will increase due to the following:

- Greater penetration of intermittent generation.
- Increased reliance on remote balancing of intermittent resources.
- Increased dynamic transfers.
- Increased adoption of smart grid measures, particularly demand responsive loads.
- Application of FACTS (Flexible AC Transmission Solutions) devices.
- Increased reliance on generation RAS to manage events on the transmission system.
- Expanding use of Energy Imbalance Markets

A thorough understanding of the impact of dynamic transfer on grid operations is critical to ensuring reliable operation and quantifying the true cost to transmission ratepayers. This project was able to resolve the following research questions:

- How much and how frequently power transfers can vary without causing any adverse impacts on bus voltages.
- How the System Operating Limit (SOL) is affected by dynamic transfer.
- Identification of the factors that affect dynamic transfer. And how they differ for different paths.
- How low hydro and high wind affects the system.
- What mitigation measures can be applied.

Benefits

The project developed an understanding of how dynamic transfer affects the reliability and utilization of static transfer; and to realistically account for the costs of Dynamic Transmission Services. This research is essential to the reliable integration of wind, smart grid, Energy Imbalance Markets and other devices that increase variability. It will help develop necessary Dispatcher Standing Orders to integrate wind reliably, understand and mitigate system security issues, and identify additional operating costs.

Further, regulatory requirements intercede: FERC Order 890-B states that a transmission provider is obligated to provide generator imbalance service if it is able to acquire resources to do so.

If the transmission provider is unable to provide or procure generation imbalance services, the transmission provider must facilitate the use of dynamic scheduling to provide these services, while insuring that any dynamic schedule used for these services are utilized without adversely affecting reliability. This research is essential to understand the impacts due to dynamic transfer.

Accomplishments

The project's main goal was to identify drivers and impacts of future variability (due to increased reliance on intermittent resources) so as to successfully manage the effects of transmission variability on transmission system reliability.

The following research objectives were met:

- Identify the factors that influence Dynamic Transfer nomograms.
- Model voltage change propagation to the distribution level to set the allowable voltage variation in the transmission system.
- Develop approach to minimize labor-intensive Dynamic Transfer studies.
- Evaluate how Dynamic Transfer limits change with respect to time and system operating conditions.

The publication of many technical papers based on this project and presentations at industry conferences have resulted in the widespread acceptance of the project's DTC computation methodologies by the west coast transmission industry.

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Project Start Date: January 25, 2013

Project End Date: September 30, 2015

Project Cost

Total Project Cost: $621,742

Deliverables

Final Report, technical papers

Related Projects

TIP 237-Bidirectional Multipath Dynamic Transfer Analysis

Previous project that developed a novel Dynamic Transfer algorithm to compute dynamic transfer limitations respecting certain assumed operating restrictions such as acceptable voltage variation at load buses.

TIP 335: Evaluation of Technical Approaches to Increase Dynamic Transfer

This follow on project evaluates various solutions to further increase dynamic transfer capability (DTC) on the California-Oregon Intertie

Participating Organizations

Maxisys

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Technical Papers

Approach to Implement Variable Transfer Limits in Energy Imbalance Markets; R. Ramanathan
Presented at CIGRE US National Committee
2014 Grid of the Future Symposium

An Analysis of the Impact of Transmission Level Voltage Variation on Distribution Feeder Power Quality; D. Kleinschmidt and R. Ramanathan
Presented at 2014 CIGRÉ Canada Conference, 9/22/2014

Approach to Compute Variable Transfer Limits Using State Estimator Cases; R. Ramanathan, Anand Popat, Brian Tuck

Calculating Variable Transfer Limits for Dynamic Transfers; R. Ramanathan, B. Tuck, S. C. Pai, O. Ciniglio, J. Price, G. Dobson-Mack
Presented at CIGRE US National Committee
2013 Grid of the Future Symposium

Transfer Variability and the need for New Limits on the Grid; S. C. Pai, B. Tuck,R. Ramanathan, O. Ciniglio, J. Price, G. Dobson-Mack
Presented at 2012 CIGRE Canada Conference, 9/24/2012

Real Time Variation of Variable Transfer Limits and the Impact to Transmission Losses; R. Ramanathan, Anand Popat, Brian Tuck

BPA's Experience of Implementing Node Breaker Model for Power System Operation Studies; R. Ramanathan, Brian Tuck

Comparison of VTL Calculations using Linear and Non-linear Method; R. Ramanathan, Anand Popat, Brian Tuck
Presented at CIGRE LUND 2015