EPRI | ELECTRIC POWER RESEARCH INSTITUTE

AEP AMERICAN ELECTRIC POWER

Transmission Efficiency Initiative: Host Demonstration Project

Switching or Cycling Equipment Not Needed for Current Operation

- Evaluate options to reduce losses in the transmission system by switching out equipment not needed for current operation.
- Monitor before and after energy losses and document the results.
- Benefits include reduced losses and reduced carbon footprint without significant investment.

Project Scope

As part of EPRI's Transmission Efficiency Initiative, American Electric Power is evaluating a possible demonstration of the application of innovative operational strategies to reduce losses in the transmission network, without significant capital expenditure or equipment purchase, in a relatively short implementation time frame, and without sacrificing system reliability.

The underlying concept is switching or cycling out-of-service equipment that is not needed for current operation. This measure could include the following equipment:

- Shunt reactors not in use
- Flexible ac transmission systems devices
- Equipment on hot standby that is rarely used
- High-loss transmission circuits

Losses in power electronic-based controllers (that is, flexible ac transmission systems) are mainly due to conduction and switching losses in the semiconductors. There are also losses in the snubber circuits, the output filters, and the auxiliary equipment.

American Electric Power has several power electronic devices installed in its systems, including static volt-ampere-reactive compensators, static synchronous compensators, high-voltage dc devices, and one unified power flow controller. Thus, there is a potential of improving system efficiency through optimal utilization of these controllers. Another option to improve efficiency is to disconnect high-loss transmission circuits. In principle, a lossy asset could be switched out of service when operating conditions permit.

Determining the switches required to achieve minimum-loss operation can be done repetitively as the power system progresses through the daily load cycle. An algorithm that optimally provides the application of ongoing switches of each component to reduce losses while keeping operational security margins could be implemented. This situation would be a burden to operators if they were required to adjust settings manually throughout each day as load and generation changed. The options would be the following:

- Automate the process so that the settings and switch conditions for minimum transmission-system losses would be repetitively adjusted without requiring the close involvement of the operator. This option is more onerous, as each of the involved facilities should require the capability of being remotely adjusted or switched.
- Fix the settings for a seasonal full-load condition. The highest losses occur at the highest loads, so fixed settings would be a compromising way to operate. However, this may not apply to the option of switching lossy lines.

In addition to documenting the lessons learned during the implementation of these operation strategies, the project will quantify the impact on lifecycle carbon footprint and system losses.

Expected Benefits

One or more of the following benefits will be realized through the implementation of this project:

- Lower real and reactive losses
- Lower CO_2 emissions and fuel savings

Approach for Measurement and Verification

A key objective of EPRI's Transmission Efficiency Initiative is to verify and validate the "actual" benefits realized by the application of the technology using a consistent measurement and verification (M&V) methodology that will be developed as part of EPRI's transmission efficiency research portfolio.

The detailed methodology of M&V will be developed during the course of the project using the following general approach:

- Demand, energy, and CO_2 savings will be determined based on transmission load flow analysis for the studied system before and after the implementation of operational strategies.
- Switching equipment will be monitored to determine on/off cycle and power consumed over a one-year period and compared to the calculations. This will lead to an industry-accepted methodology for projecting savings from advanced operating strategies.

Project Schedule

The schedule of the project tasks is as follows:

1. Conduct an inventory of facilities and equipment that can be switched out at strategic times to reduce system losses. This includes a detailed evaluation of the equipment characteristics to determine the associated losses.
2. Conduct an analytical study to accomplish the following:
   - Evaluate the possibility of switching out equipment at specific conditions without jeopardizing system reliability.
   - Evaluate the effectiveness of switching each single component or facility by comparing the system losses that it achieves with the reference base case.
   - Determine the need to deploy a centralized control to remotely control and switch the identified components.
3. Conduct a detailed engineering study to define switching cycle procedure and prepare rules and protocols for operators.
4. Implement the operating strategies and measure the relevant variables for 12 months.
5. Evaluate and document savings, lessons learned, and implementation considerations.
6. Final project report, December 2011.

April 2010

Electric Power Research Institute
3420 Hillview Avenue, Palo Alto, California 94304-1338 • PO Box 10412, Palo Alto, California 94303-0813 USA
800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com