ELECTRIC GRID RESEARCH PROGRAM

Project Summary

Probabilistic Transmission Congestion Forecasting

Context

Due to the restructuring of the power markets in the Western region after 1999, including California, much greater amounts of power transfers now take place across the entire region. In recent years, transmission investment had lagged behind the growth of electricity demand and the increasing amount of power transfers. As a result, transmission congestion has increased significantly causing very high congestion costs. Because there are many factors that combine to determine how electricity flows on an interconnected power grid, the uncertainties of these factors compound the uncertainty and the difficulty of forecasting transmission congestion for any particular transmission path. In order to improve the reliability and efficiency of the electricity delivery system in California, it is important to forecast transmission congestion for various transmission paths, both for the short term (e.g., next 24 hours) and for the long term (e.g., next 10 to 20 years).

Goals and Objectives

The goal of this research was the development of transmission planning and forecasting tools that recognize uncertainties created by independent market participants, especially renewable resources, and distributed generation, and by consumer participation, particularly demand response, in order to evolve a comprehensive congestion planning methodology.

The objectives of this project were to develop new probabilistic methods for forecasting both short term and long-term transmission congestion in California, and to use the findings as a building block to develop a comprehensive congestion planning process for California.

Description

The method utilized for this project combined the use of analytical functions with regression methods to provide accurate models of the uncertainties, including the effect of correlation. It used a Monte Carlo simulation method to accurately model the physical relationships between generation dispatch, load demand, and the configuration of the transmission grid in order to mathematically predict the key operating constraints of line loading along critical transmission paths in the WECC system, with focus on the impact of such congestion on the California power grid and consumers. The mathematical models and the time frames of the simulation differed between the short term (24 hours) and the long term (10-20 years), and therefore two computer models were developed to address the two time frames. With these computer programs, each Monte Carlo simulation computed the power flow under one particular scenario about the uncertainties. Thousands of Monte Carlo simulations were conducted in order to gain confidence about the variability of the forecasted results of transmission congestion.

At the conclusion of the research, a workshop was held to publicize and review results.

Key Results/Conclusions

This project developed probabilistic models and, most importantly, specified how to accurately model the key input assumptions in order to derive valid confidence levels of the forecasted congestion variables. It demonstrated the methodology using the equivalent model of the WECC system, with focus on the impact of such congestion on the California power grid and consumers. Two computer models were developed to separately address the short term and long term time frames.

For long term probabilistic forecasting, results were highly dependent on load forecasts and future resource projections, but probabilistic forecasting gives significant information regarding incremental improvements and timing of future transmission upgrade requirements.

Short term simulations also showed a strong dependence on load forecasts and on generation dispatch. High variability in daily wind patterns will increase congestion and the uncertainty of forecasts.

Why It Matters

Improved forecasting of transmission congestion in both the short term and the long term can increase the reliability, efficiency and long term of the California electricity system. Improvements in congestion management will help achieve the State's goals for CO_2 reduction and to provide reliable and low cost electricity with minimum environmental impacts.

{More details}

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Participating Organizations

Principal Investigator:

Electric Power Research Institute

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Research Partners:

California Independent System Operator

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Reports

Final Report: *Probablistic Transmission Congestion Forecasting*

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