IMPACT OF WIND FARMS AGGREGATION ON LARGE SYSTEM SCHEDULING COST UNDER FREQUENCY LINKED DEVIATION SETTLEMENT MECHANISM

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Overview

Large penetration of intermittent and volatile wind power generation significantly impacts system frequency and generation adequacy which not only affect smooth functioning of the grid but also imposes additional cost to the system. For the economic operation of power system analyzing the cost of intermittency is important. Well ahead of the hours of actual operation short term operation planning of the system including commitment of generating units is done based on the forecasts of uncertain wind generations. This is supported by economic dispatch decisions at real time with actual wind generation. However actual wind generation is usually different from their estimates. For secure operation of the grid demand should match the supply while power flow in the network is within secure limits. This is challenging with high variability and uncertainty that comes with increased wind energy penetrations. Though, in a large interconnected system where several wind farms diversified at different locations are connected, aggregation of wind generation outputs would be less uncertain. This can help in economicaly efficient system scheduling solutions. This paper represents the economic analysis of scheduling and dispatch decisions of an Indian system (Tamilnadu grid) considering uncertain wind and impact of special correlations between generations of several geographically diversified wind sites. The work also considers frequency linked deviation settlement mechanism used in the Indian system. The results represents that aggregation of uncorrelated or less correlated wind farms in a larger system helps to improve system performance with less frequency deviations and provides economicaly efficient solutions for system scheduling.

The paper is organized as follows: After the introduction the second section gives a brief overview about the Indian power system and frequency linked deviation settlement mechanism. The third section gives a clear problem statement, description with necessary modeling. In the next section considered case study, simulations and results with analysis are discussed. Based on which conclusive remarks derived from the research are given in last section.

Methods

This paper contributes by mathematical modeling of the system scheduling problem with frequency deviations due to demand supply mismatch considering DCOPF, for the practical Indian system. Data handling, coding and simulations are done on commercially available softwares such as MATLAB and GAMS with their interfacing.

Results

1. Comparative analysis of the impact of different correlations of generation outputs of various wind sites on total system short term operation cost.
2. Comparative analysis of the impact of different correlations of generation outputs of various wind sites on system frequency deviations.

Conclusions

This paper analysis cost of uncertainty of wind generation on overall operational cost of the system. The effect of the wind farms aggregation of diversified locations on overall uncertainty, for a large scale power system is modeled and analyzed for Indian system, considering frequency deviations. For different values of correlation between uncertain characteristics of generation outputs from wind farms, a comparative analysis is done optimal cost for system scheduling and system frequency.

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