Realistic Operational Simulation of Wind Projects

Zuyi Li and Mohammad Shahidehpour, Illinois Institute of Technology, Chicago, IL
Frank Bristol, Acciona Energy NA, Chicago, IL

The profitable operation of a wind project depends on two critical indices: wind energy deliverability and locational marginal prices (LMP). The traditional optimal power flow (OPF) study has been widely used to obtain those indices. However, the traditional OPF study generally provides only the peak load hour results, which ignore temporal constraints of power system components that are considered in day-ahead market operations. This paper proposes the use of a Mixed-Integer-Programming (MIP)-based security-constrained unit commitment (SCUC) software tool for more realistic electricity market simulations. The SCUC-based study provides hourly LMP prospects over one day, one week, and up to one year. Such simulation studies could relate LMPs to the daily/weekly load patterns for a thorough assessment of wind projects. The proposed SCUC approach has been used for the evaluation of several wind projects in various locations in the U.S.

The profitability of a wind project can also be enhanced by hydro-wind coordination, i.e., the coordinated scheduling of wind power units with nearby hydro units to smooth out the volatility of wind power and firm up wind power schedules. Most short-term electricity markets require participating generation companies to submit a day-ahead generating schedule by the market closing time. For a wind generation company, current wind forecasting methods are not yet very accurate and wind generation imbalance charges could be very costly for wind companies that would participate in electricity markets. Wind-hydro coordination can be formulated as a Price-Based Unit Commitment (PBUC) problem by the coordination of wind unit operations and storage capabilities, including a cascaded hydro generating units or a pumped-storage hydro generation unit.

The presentation includes discussions on theses issues and provides several examples to substantiate the discussions with numerical results.

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