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An Innovative Short-Term Large Wind Ramp Forecasting System

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Abstract:

Grid operators often make critical decisions on how to most reliably and economically balance load and generation on time frames from a few minutes to six hours ahead. Rapid changes in wind power production (i.e. wind ramps) within this time frame can pose a significant problem for grid management and extreme events may pose a risk for system stability. The ability to anticipate such events has the potential to lower wind integration costs and increase the levels of wind penetration that can be cost-effectively managed on grid systems.

In order to address this challenge a short-term ramp-event forecast system that is designed to provide estimates of the probability of occurrence for large ramp events over the next 0 to 6 hr period as well as the probabilities for the characteristics (e.g. duration, amplitude etc.) of those events has been developed. The system is intended to predict ramp events for individual wind generation facilities and aggregates of those facilities.

There are four key components in the short-term ramp forecast system. These are (1) a region-specific ramp-event classification scheme that categorizes ramp events by the types of meteorological processes that cause them; (2) a customized use of data types and analysis and prediction tools for each category of ramp events; (3) the execution of Numerical Weather Prediction (NWP) models in a rapid update cycle (RUC) mode; (4) a scheme that combines the output from NWP models and the most recent data from on-site and off-site locations to obtain frequent (as often as every 15 minutes) updates on the probabilities of ramp event and their characteristics.

The system employs three innovative components have not previously been used in wind ramp prediction systems. These are: (1) ramp-type-specific prediction algorithms; (2) NWP models operated in a rapid update cycle (RUC) mode; and (3) a scheme that statistically combines NWP-RUC model output with recent measurement data to obtain frequent forecast updates. Since the forecasts are probabilistic, the probability forecasts are evaluated with the Ranked Probability Skill Store (RPSS) metric. This metric rewards the reliability, sharpness and resolution characteristics of probability forecasts. The system was deployed in the last quarter of 2009 for the grid system in the state of Texas in the United States. A brief description of the prediction system and the initial performance results will be presented.