



## Operational Requirements for Managing Wind Generation

The Electric Reliability Council of Texas (ERCOT), has 9,317 megawatts of wind generation capacity interconnected and operating in the ERCOT system – more than any other state in the country. But wind generation can create unique transmission planning issues and operational challenges because it often blows the most during periods of low electricity demand and because wind is typically more abundant in remote locations. In ERCOT's case, almost 90 percent of the wind is located in West Texas, away from the primary load centers.

As wind generation has increased, ERCOT has worked with generation owners and market participants to improve the tools for managing the operational challenges associated with the variability and uncertainty of wind generation, particularly in five key areas: dispatching, forecasting, ancillary services, accurate modeling, and interconnection standards.

### Dispatching

To manage transmission congestion between the west and north zones, operators must have the ability to reduce wind generation as necessary to maintain transmission equipment within rated limits.

- Wind generation resources are required to submit curtailment offers in the balancing energy market that contain a megawatt amount and price at which they are willing to curtail generation – often a negative offer because zero fuel cost and production tax credits offset the payment to generate.
- To avoid frequency spikes, wind generation units are limited in how fast they can respond when released from dispatch instructions.

In addition to zonal transfer limits, ERCOT can curtail wind generation for local transmission problems through unit-specific instructions. The nodal market, scheduled to “go live” Dec. 1, 2010, will allow operators to manage wind curtailments more efficiently through unit-specific offers and instructions.

### Forecasting

Forecasting is one of the key tools necessary to address the variability and uncertainty of wind generation's fuel source. ERCOT has incorporated wind forecasts in day-ahead plans and current-day reserve planning to avoid over/under commitment of fossil generation.

### Ancillary Services

Variability of wind generation increases the need for additional reserves that can respond to frequency deviations. ERCOT has incorporated wind forecast uncertainty into operational reserve requirements for non-spinning reserves (resources offline but available within 30 minutes); and frequency and regulation reserves (resources online and immediately available).

### Accurate Modeling

Accurate models of generation and transmission equipment are essential for transmission planners to adequately plan and design a reliable transmission system and to perform the real-time contingency analysis that is required for reliability. ERCOT uses models that include the protection system – the lines that are used to collect the output of the individual wind turbines and other devices that represent the wind plant's interaction with the power system.

### Interconnection Standards

Voltage support has traditionally been provided by fossil generation, but high levels of wind generation may result in economic de-commitments of fossil generation.

- Wind generation is required to provide voltage support and meet voltage ride-through requirements when a fault occurs on the transmission system.
- New wind plants are required to provide primary frequency response.
- Additional data for wind forecasting is required including site-specific, real-time wind speed; wind direction; barometric pressure; and temperature.