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Wind ramp prediction

– improved predictability for
wind energy production

Vaisala and Xcel Energy are developing a new wind observing and forecasting system to provide critical decision-making support for balancing wind power with traditional fossil fuel generation.

Wind energy is one of the strongest contenders for the position of the fastest growing form of renewable energy today. The World Wind Energy Association (www.wwindea.org) expected double digit growth and a record amount of over 30,000 Mega Watts of newly installed capacity for the global wind energy market in 2009.

As the market takes leaps forward, developing ways to more effectively integrate the growing wind energy production with other means of energy generation is gaining more and more importance. One of the greatest operational obstacles facing wind energy production is the so called 'wind ramp' – or 'wind integration' – problem. The term refers to the measures energy system operators must take when winds change rapidly, causing a sudden increase or decrease in wind power generated by turbines.

Electric utility companies usually have a specific generation configuration consisting of a mix of coal, oil, gas, hydro, wind and nuclear power.

When winds pick up, the amount of power generated by the wind turbines increases rapidly, causing excess power to be injected into the generation system.

As the system is not capable of handling endless amounts of power, the utility company must quickly ramp down generation from other sources and route excess electricity to neighboring utilities, or risk a system collapse. And just as the system is reconfigured for the wind power ramping up, the winds may fade away, causing a sudden need to import power and turn gas turbines on in minutes.

To mitigate the potential 'ramp-down' issue, operating utilities must frequently keep a spinning reserve of gas turbine generators running ready to fill the gap. This, however, is not an ideal solution to the problem as the spinning reserve increases the cost of wind power and often decreases the carbon savings otherwise possible to achieve.

New wind observing and forecasting system in the works

To tackle the issue of wind ramp detection, a major US energy provider Xcel Energy joined forces with Vaisala and the US-based National Center for Atmospheric Research (NCAR) to develop a new wind observing system and a supporting decision support solution.

In the framework of a joint pilot project, scheduled to run for 18 months, Vaisala and Xcel Energy will develop new ways to detect and predict pending wind ramp events. Vaisala's role is to tackle the real-time, 0-3 hour timeframe aspect of the issue by installing and operating an in situ observation network, and developing, together with NCAR, a short-term modeling system feeding a Vaisala-developed, real-time operational decision support system.

The project also provides data from the wind observing system to NCAR to be used in their work on

solving longer-term wind energy predictability issues by refining a forecasting system, with an emphasis on the 3 to 72 hour time horizon.

When completed, the new system will provide critical decision-making support for balancing wind power generation with traditional generation in the zero to three hour time-frame. Being able to better anticipate changes in wind energy output in this short time horizon will improve the reliability of power generation while at the same time reducing operational costs.

Notification 15 minutes to 3 hours in advance

The foundation of Vaisala's approach is a concept involving installation of a high resolution observing network around the wind park of interest to carefully observe the atmosphere. The pilot network consists of ten surface weather stations, a wind profiler, other test instrumentation and data from the US National Lightning Detection Network.

The surface wind stations comprise of eight 10 meter full atmospheric stations and two 60 meter towers with multiple instrumentation levels. A lower atmosphere wind profiler system is utilized to examine winds up to and through the boundary layer.

The observation data will be fed into specially configured mesoscale modeling system collaboratively developed with NCAR. The modeled data will be coupled with statistical modeling and pattern recognition systems, to provide advanced notification of wind ramps with about 15 minutes to 3 hours lead time.

The observations and the results of the various modeling systems will be portrayed within a decision support system designed to provide electrical utility operations staff with visual information about impending wind ramp events including timing, magnitude and type (up or down ramp).

The system is expected to begin prototype operations in mid



High resolution observing systems are a key element in the management of wind ramp events.

2010, and it will be operated and maintained by Vaisala on behalf of Xcel Energy during the initial phases of deployment. Working interactively with Xcel Energy, Vaisala will continue to refine the system during 2010 in order to optimize its performance.

Further information:

www.vaisala.com/weather/applications/windturbines.html