UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Integrating Renewable Resources	)	Docket No. AD09-4-000
Into the Wholesale Electric Grid	)	

STATEMENT OF BRENDAN KIRBY,
CONSULTANT TO THE AMERICAN WIND ENERGY ASSOCIATION
MARCH 2, 2009 TECHNICAL CONFERENCE

My name is Brendan Kirby. I am a consultant representing the American Wind Energy Association. I appreciate the opportunity to speak today. I will try to offer some insights from the dozens of wind integration studies that have been performed in the US and Europe, and from the experiences I have followed. I have spent much of my career analyzing system operations mechanisms, power markets, and ancillary services.

Wind Integration Is A Cost Issue, Not A Reliability Issue

Reliability requirements are a given – you can always carry enough reserves and curtail excess wind generation to assure reliability. We are only talking about cost. Reliability must be maintained and reliability will be maintained. Most importantly for power system customers but it is also in the wind industry's interest to have a reliable power system to deliver its product to its customers.

High wind penetration can be achieved at reasonable cost without compromising reliability through reliability rules, scheduling practices, and market structures that provide access to the response capabilities of conventional generators and that reduce net load and wind variability and uncertainty through aggregation.

Changes in power system practices have been required with each new generation technology. The efficiencies offered by large thermal generators could only be obtained with larger reserve sharing pools and with adequate transmission. Similarly, the benefits of low-marginal-cost nuclear power could only be obtained with sufficient attention to the reliability of off-site power supply and accommodating the minimum load problem that nuclear plants introduced.

The NERC variable generation report finds three areas need attention in order to reliably integrate large amounts of variable generation into the power system:

- wind forecasting
- flexibility in power system design and power system resources (generation and responsive load)
- significant investment in transmission both to access location-constrained wind and solar generation and to provide access to flexible system resources (generation and responsive load)

AWEA supports this study and efforts to implement its recommendations.

Wind Integration Costs Can Be Modest:
Studies around the world have shown that very high wind penetration can be achieved:

- Germany 15% wind energy penetration - €2.10/MWH
- Nordic 20% wind energy penetration - €2.05/MWH
- UK 20% wind energy penetration - €4.05/MWH
- Ireland 15% wind energy penetration - €0.50/MWH

In the United States a number of well run integration studies have found moderate wind integration costs:

- Minnesota 25% energy from wind - $4.41/MWH (worst of 3 years)
- Arizona Public Service 14% capacity penetration - $4.08/MWH
- California GE/Pier 20% capacity penetration - $0.69/MWH

Wind Integration Impacts Can Be Estimated Reliably
Wind integration studies have advanced and can now do a good job of estimating wind integration costs, especially for large amounts of wind and high wind penetrations. Meso scale wind modeling is a great benefit. It provides wind speed data, converted to wind plant power output, for as many wind plants as desired, synchronized to historic power system load data at ten minute time steps for long stretches, typically three years. The impact of wind power plant output can now be accurately modeled using power industry standard tools of security constrained unit commitment and economic dispatch. This type of analysis provides the most accurate assessment of cost impacts while assuring power system reliability. We are concerned that some system operators have not performed studies to help plan appropriately for the levels of variable generation that are expected in their areas.

The importance of industry structure
Evaluation Tool: The handout describes an evaluation tool that can be used to assess the ability of a Balancing Area or region to accommodate large amounts of wind generation by judging the Balancing Areas performance and capabilities in eleven important areas.

Balancing Area Size Or Balancing Area Cooperation
Wind generation greatly benefits from aggregation, both with additional wind generation and with load. Variability is often largely uncorrelated so relative variability is greatly reduced when the geographic and electrical scope of the operating area is increased. This can be from balancing area consolidation or from cooperation among balancing areas with sub-hourly scheduling of inter-BA transfers. The Midwest Independent System Operator has lower wind integration costs because it covers a large geographic area with diverse load and a large pool of generators that can provide response.

Wind integration costs are further reduced if the wind resource is geographically diverse as opposed to being concentrated in a small area within the BA.

Sub-Hourly Schedules Or Sub-Hourly Markets

Wind integration costs are reduced when there is a large pool of conventional generators with the ability to respond to varying power system needs, including wind variability. Sub-hourly energy markets that clear every 5 minutes, or sub-hourly scheduling of generation in regions that do not have formal sub-hourly markets, reduces the need for regulation, the most expensive ancillary service. BAs with sub-hourly markets obtain significant response from energy producing generators at little or no cost to the power system. This is true with or without wind but it is especially important for wind integration where the variability is not predominantly in the minute-to-minute regulation time frame but is in the sub-hourly to multiple hour time frame that is better served by the movement of energy producing generators that are on the margin. MISO, CAISO, PJM, and the NYISO all have reduced wind integration costs because they operate 5 minute energy markets.

Similarly, having the ability to adjust energy schedules faster than once an hour when it benefits both the sending and receiving balancing area reduces wind integration costs by providing greater access to the physical response capability that already exists in the conventional generation fleets in both the sending and receiving BA's territories.

Non-Spinning and Supplemental Operating Reserves

Large wind events are infrequent and relatively slow. They are much slower than the sudden failure of a conventional generator. The reliability needs created by large wind events most closely match the capabilities of non-spinning reserve and supplemental operating reserve. These reserves are supplied by generators and responsive loads that stand ready to respond within 10 or 30 minutes. The reserve standby costs are much lower than regulation, the minute-to-minute service which is used to balance fast, random variations in load-net wind. Non-spin and supplemental reserves cost only about $1.50/MW-hr on average for 2008 in NY and California as compared to regulation which cost $33 to $60/MW-hr on average in 2008.

But large wind events typically do not qualify for non-spinning or supplemental operating reserve response, again because they are too slow. Instead, some BAs compensate for large infrequent wind events with regulation, a service that is 10 to 50 times as expensive as non-spinning and supplemental operating reserves. Rules should be changed to allow non-spinning reserve and supplemental operating reserves to be used to compensate for large wind ramps.

Physical Assets: Transmission, Generation, and Load

Regional transmission planning that results in a robust transmission system capable of integrating operations over an entire region helps reduce wind integration costs while it helps reduce the price of delivered energy to customers.

Flexible generation with low minimum load and fast ramping capability helps reduce wind integration costs as does responsive load. Both need market and reliability rules that allow and encourage their response.

Status of Wind Integration Capabilities Today
Large balancing authorities with sub-hourly energy markets and a geographically diverse wind resource such as MISO have reasonably low wind integration costs. Smaller balancing areas that only allow hourly scheduling, internally and with neighbors, typically have unnecessarily high wind integration costs.

Thank you

Submitted Written Material:

- "System Evaluation Tool" description
- Gramlich, R. and Goggin, M. 2008, *The Ability of Current U.S. Electric Industry Structure and Transmission Rules to Accommodate High Wind Energy Penetration*, 7th International Workshop on Large Scale Integration of Wind Power and on Transmission Networks for Offshore Wind Farms