QUALIFICATION STATEMENT OF

BRENDAN KIRBY

Witness for Northwest Wind Group

Q. *Please state your name, employer, and business address.*

A. My name is Brendan Kirby. I am a licensed professional engineer and a private consultant, located at 2307 Laurel Lake Rd, Knoxville, TN 37932.

Q. *In what capacity are you employed?*

A. I am a private consultant working for the American Wind Energy Association.

Q. *Please state your educational background.*

A. I received a B.S.E.E. with Honors from Lehigh University in 1975 and a M.S.E.E., power option, from Carnegie-Mellon University in 1977.

Q. *Please summarize your professional experience.*

A. I have been a private consultant since 2008 with a number of clients, including the National Renewable Energy Laboratory, the American Wind Energy Association, the Electric Power Research Institute, the National Regulatory Research Institute, the Oak Ridge National Laboratory, utilities, renewable generators, ISO/RTOs, IPPs, manufacturers and others. My practice focuses on power system reliability, ancillary services, responsive load, wind and solar integration, electric utility restructuring, and other issues. I served as a member of the NERC Standards Committee and authored a NERC-certified course on Introduction to Bulk Power Systems: Physics / Economics / Regulatory Policy. I have published over 150 papers, articles, and reports on ancillary services, wind integration, restructuring, the use of responsive load as a bulk system reliability resource, and power system reliability. I actively participate in the NERC Generator Verification Standards Drafting Team.

From 1994 to 2008, I was a senior researcher at the U.S. Department of Energy's Oak Ridge National Laboratory. My research interests included electric industry restructuring, unbundling of ancillary services, wind integration, distributed resources, demand side response, energy storage, renewable resources, advanced analysis techniques, and power system security. In addition to the research topics listed above, activities included: NYISO Environmental Advisory Council, assignment to FERC Technical Staff to support reliability efforts including NERC/FERC reliability readiness audits, Technical Advisory Committee for the 2006 Minnesota Wind Integration Study, DOE Investigation Team for the 2003 Blackout, the IEEE SCC 21 Distributed Generation Interconnection Standard working group, DOE National Transmission Grid Study, staff to the DOE Task Force on Electric System Reliability, and NERC IOS Working Group. I conducted research projects concerning restructuring for the NRC, DOE, EEI, numerous utilities, state regulators, and EPRI. I hold a patent for demand response providing power system regulation.

From 1991 to 1994, I was the Power Analysis Department Head, Technical Analysis and Operations Division at the Department of Energy's Oak Ridge Gaseous Diffusion Plant. My primary responsibility was to support the Department of Energy in the management of 7000 MW of uranium enrichment capacity. The most significant feature of this load was that 2000 MW were procured on the spot energy market from multiple suppliers, requiring rapid response to changing market conditions. Support included technical support for power contract negotiations, development of the real-time energy management strategy, and managing the development of a computer-based operator assistant to aid in making real-time power purchase decisions. I conducted computer-based simulations of the loads and the interconnected network which supplies them. I

was responsible for maintaining close ties with technical personnel from the various utilities which supplied power to the diffusion complex to exchange data and perform joint studies. I provided consultation services on a large range of power system concerns, including: cogeneration opportunities, power supply for the Lawrence Livermore National Laboratory M.F.T.F. facility, capacity at EURODIF, power supply for the Strategic Petroleum Reserve, power supply for large pulsed fusion loads, and wheeling.

From 1985 to 1991, I was the Electric Power Planning Section Head, Enrichment Technical Operations Division with substantially the same responsibilities as stated above. From 1977 to 1985, I was a Technical Computing Specialist, Electrical Engineering and Small Computing Section, Computing and Telecommunications Division at the Oak Ridge Gaseous Diffusion Plant, where my time was evenly divided between power system studies as described above and minicomputer work. From 1975 to 1976, I was an Engineer in the Electrical Engineering Department of the Long Island Lighting Company. I was responsible for electrostatic and magnetic field strength modeling as well as sound level testing and analysis.

I have had several relevant papers published that are listed below:

1. B. Kirby, M. Milligan, E. Ela, Oct. 2010, *Providing Minute-to-Minute Regulation from Wind Plants*, 9th International Workshop on Large-Scale Integration of Wind Power.

2. M. Milligan, B. Kirby, J. King, S. Beuning, Oct. 2010, *Benefit of Regional Energy Balancing Service on Wind Integration in the Western Interconnection of the United States*, 9th International Workshop on Large-Scale Integration of Wind Power.

3. M. Milligan and B. Kirby, Aug. 2010, *Market Characteristics for Efficient Integration of Variable Generation in the Western Interconnection*, NREL/TP-550-48192.

4. J. Smith, S. Beuning, H. Durrwachter, E. Ela, D. Hawkins, B. Kirby, W. Lasher, J. Lowell, K. Porter, K. Schuyler, P. Sotkiewicz, July 2010, *Impact of Variable Renewable Energy on US Electricity Markets*, IEEE PES.

5. E. Ela, B. Kirby, E. Lannoye, M. Milligan, D. Flynn, B. Zavadil, M. O'Malley, July 2010, *Evolution of Operating Reserve Determination in Wind Power Integration Studies*, IEEE PES.

6. B. Kirby and M. Milligan, *Utilizing Load Response for Wind and Solar Integration and Power System Reliability*, WindPower 2010.

7. M. Milligan, B. Kirby, and S. Beuning, *Combining Balancing Areas' Variability: Impacts on Wind Integration in the Western Interconnection*, WindPower 2010.

8. P. Denholm, E. Ela, B. Kirby, and M. Milligan, Jan. 2010, *The Role of Energy Storage with Renewable Electricity Generation*, NREL/TP-6A2-47187.

9. M. Milligan, K. Porter, E. DeMeo, P. Denholm, H. Holttinen, B. Kirby, N. Miller, A. Mills, M. O'Malley, M. Schuerger, Nov./Dec. 2009, *Wind Power Myths Debunked*, IEEE Power and Energy.

10. B. Kirby, M. Milligan, July 2009, *Capacity Requirements to Support Inter-Balancing Area Wind Delivery*, NREL/TP-550-46274.

11. M. Milligan, B. Kirby, R. Gramlich, M. Goggin, July 2009, *Impact of Electric Industry Structure on High Wind Penetration Potential*, NREL/TP-550-46273.

12. M. Milligan, B. Kirby, July 2009, *Calculating Wind Integration Costs: Separating Wind Energy Value from Integration Cost Impacts*, NREL/TP-550-46275.

13. B. Kirby, M. Milligan, *An Examination of Capacity and Ramping Impacts of Wind Energy on Power Systems*, Electricity Journal, Aug./Sept. 2008, Vol. 21, Issue 7.

14. M. Milligan, B. Kirby, *The Impact of Balancing Area Size and Ramping Requirements on Wind Integration*, Wind Engineering Vol. 32, No. 4, 2008.

15. B. Kirby, M. Milligan, July 2008, *Examination of Capacity and Ramping Impacts of Wind Energy on Power Systems*, NREL/TP-500-42872.

16. E. Ela and B. Kirby, July 2008, *ERCOT Event on February 26, 2008: Lessons Learned*, NREL/TP-500-43373.

17. M. Milligan, B. Kirby, *Analysis of Sub-Hourly Ramping Impacts of Wind Energy and Balancing Area Size*, WindPower 2008, NREL/CP-500-43434.

18. K. Dragoon, B. Kirby, M. Milligan, *Do Wind Forecasts Make Good Generation Schedules?*, WindPower 2008, NREL/CP-500-43507.

19. B. Kirby, M. Milligan, 2008, *Facilitating Wind Development: The Importance of Electric Industry Structure*, The Electricity Journal, Volume 21, Issue 3, April, *and* National Renewable Energy Lab, NREL/TP-500-43251, May.

20. M. Milligan, B. Kirby, *The Impact of Balancing Areas Size, Obligation Sharing, and Ramping Capability on Wind Integration*, American Wind Energy Association, WindPower 2007.

21. Y. Wan, M. Milligan, B. Kirby, *Impact of Energy Imbalance Tariff on Wind Energy*, American Wind Energy Association, WindPower 2007.

22. B. Kirby, Apr. 2007, *Evaluating Transmission Costs and Wind Benefits in Texas: Examining the ERCOT CREZ Transmission Study*, The Wind Coalition and Electric Transmission Texas, LLC, Texas PUC Docket NO. 33672.

23. B. Kirby, M. Milligan, E. Wan, *Cost-Causation-Based Tariffs for Wind Ancillary Service Impacts*, American Wind Energy Association, WindPower 2006.

24. M. Milligan, H. Shiu, B. Kirby, K. Jackson, *A Multi-year Analysis of Renewable Energy Impacts in California: Results from the Renewable Portfolio Standards Integration Cost Analysis*, American Wind Energy Association, WindPower 2006.

25. *Renewable Generation Integration Cost Analysis: Multi-Year Analysis Results And Recommendations*, The California Energy Commission, May 2006.

26. B. Kirby, M. Milligan, *A Method and Case Study for Estimating The Ramping Capability of a Control Area or Balancing Authority and Implications for Moderate or High Wind Penetration*, American Wind Energy Association, WindPower 2005.

A complete list of my publications is available at www.consultkirby.com.

Q. *Please state your experience as a witness in previous proceedings.*

A. I have testified as an expert witness in FERC and state proceedings. This is my first time serving as a witness in a BPA rate case.