

Curriculum Vitae

Brendan Kirby

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Professional Experience:

1994-Present: **Sr. Researcher**, Power Systems Research Program, Oak Ridge National Laboratory. Research interests include electric industry restructuring, unbundling of ancillary services, distributed resources, demand side response, energy storage, renewable resources, advanced analysis techniques, superconductive cables, transformers and devices, advanced overhead and underground transmission design, and power system security. In addition to the research topics listed above activities have included the Assignment to FERC Technical Staff to support reliability efforts including NERC/FERC reliability readiness audits. 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. Conducted research projects concerning restructuring for the NRC, DOE, EEI, numerous utilities, state regulators, and EPRI.

Consulting, Consulting privately with utilities, renewable generators, ISO/RTOs, IPPs, loads, interest groups, regulators, and others on electric utility restructuring and other issues. Testified as an expert witness in FERC and state litigation.

1991 to 1994: **Power Analysis Department Head**, Technical Analysis and Operations Division. Primary responsibility was to support the Department of Energy in the management of 5000 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, managing the development of a computer based operator assistant to aid in making real-time power purchase decisions. Conducted computer based simulations of the loads and the interconnected network which supplies them. Simulations included large scale load flows, short circuit studies, and transient stability studies. They also included extensive specialized modeling for analysis of electrical, mechanical, and thermal performance under balanced and unbalanced conditions. Responsible for maintaining close ties with technical personnel from the various utilities which supply power to the diffusion complex to exchange data and perform joint studies.

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.

1985 to 1991: **Electric Power Planning Section Head**, Enrichment Technical Operations Division with substantially the same responsibilities as stated above.

1977 to 1985: **Technical Computing Specialist**, Electrical Engineering and Small Computing Section, Computing and Telecommunications Division. Time was evenly divided between power system studies as described above and minicomputer work. The minicomputer work supported laboratory data collection and experiment control.

1975 to 1976: **Engineer**, Electrical Engineering Department, Long Island Lighting Company, Hicksville, New York. Responsible for electrostatic and magnetic field strength modeling as well as sound level testing and analysis.

Education:

1977 - M.S.E.E., power option, Carnegie-Mellon University, Pittsburgh, Pa.

Worked under a Department of Transportation contract studying more efficient means of energy use in rail systems.

1975 - B.S.E.E., Lehigh University, Bethlehem, Pa., cum laude, Eta Kappa Nu, the Electrical Engineering Honorary, and Phi Eta Sigma, the freshman Honorary.

Professional Affiliations and Awards:

- Licensed professional engineer
- 1985, 1986, 1987, 1990, and 1992 Awards for power system related work
- Senior Member of the IEEE and the IEEE Power Engineering Society
- DOE Q clearance

Recent Publications:

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

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

B. Kirby, 2007, *Load Response Fundamentally Matches Power System Reliability Requirements*, IEEE Power Engineering Society General Meeting, June

B. Kirby, 2006, *Ancillary Services: Technical and Commercial Insights*, Wärtsilä North America Inc., December

B. Kirby, 2006, *Demand Response For Power System Reliability: FAQ*, ORNL/TM 2006/565, Oak Ridge National Laboratory, December

J. Kueck, B. Kirby, T. Rizy, F. Li, N. Fall, 2006, *Economics of Reactive Power Supply from Distributed Energy Resources*, Electricity Journal, December

B. Kirby, 2006, *The Role of Demand Resources In Regional Transmission Expansion Planning and Reliable Operations*, ORNL/TM 2006/512, Oak Ridge National Laboratory, July

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

M. Milligan, H. Shiu, B. Kirby, K. Jackson, 2006, *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, June

H. Shiu, M. Milligan, B. Kirby, K. Jackson, 2005, *California Renewables Portfolio Standard Renewable Generation Integration Cost Analysis: Multi-Year Analysis Results And Recommendations*, The California Energy Commission, December

B. Kirby, M. Milligan, 2005, *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, May

B. Kirby, 2004, *Frequency Regulation Basics and Trends*, ORNL/TM 2004/291, Oak Ridge National Laboratory, December

J. Kueck, B. Kirby, L. Tolbert, T. Rizy, 2004, *Voltage Regulation: Tapping Distributed Energy Resources*, Public Utilities Fortnightly, September

B. Kirby, M. Milligan, Y. Makarov, J. Lovekin, K. Jackson, H. Shiu, 2004, *California RPS Integration Cost Analysis-Phase III: Recommendations for Implementation*, California Energy Commission, July

J. Kueck, B. Kirby, 2004, *Measurement Practices for Reliability and Power Quality*, ORNL/TM-2004/91, Oak Ridge National Laboratory, June

J. Kueck, B. Kirby, 2004, *Demand Response Research Plan to Reflect the Needs of the California Independent System Operator*, ORNL/TM 2004/2, Oak Ridge National Laboratory, January

B. Kirby, M. Milligan, Y. Makarov, D. Hawkins, K. Jackson, H. Shiu, 2003, *California RPS Integration Cost Analysis-Phase I: One Year Analysis of Existing Resources*, California Energy Commission, December

B. Kirby, J. Kueck, 2003, *Spinning Reserve from Pump Load: A Technical Findings Report to the California Department of Water Resources*, ORNL/TM 2003/99, Oak Ridge National Laboratory, November

E. Hirst, B. Kirby, 2003, *Water Heaters to the Rescue: Demand Bidding in Electric Reserve Markets*, Public Utilities Fortnightly, September

R. Cowart, J. Raab, C. Goldman, R. Weston, J. Schlegel, R. Sedano, J. Lazar, B. Kirby, E. Hirst, 2003, *Dimensions of Demand Response: Capturing Customer Based Resources in New England's Power Systems and Markets. Report and Recommendations of the New England Demand Response Initiative*, New England Demand Response Initiative, July

B. Parsons, M. Milligan, R. Zavadil, D. Brooks, B. Kirby, K. Dragoon, J. Caldwell, 2003, *Grid Impacts of Wind Power: A Summary of Recent Studies in the United States*, EWEC Wind Energy Journal, June

E. Hirst, B. Kirby, 2003, *Allocating Costs of Ancillary Services: Contingency Reserves and Regulation*, ORNL/TM 2003/152, Oak Ridge National Laboratory, Oak Ridge TN, June

J. D. Kueck, B. J. Kirby, 2003, *The Distribution System of the Future*, The Electricity Journal, June

B. Kirby, E. Hirst, 2003, *Technical Issues Related To Retail-Load Provision of Ancillary Services*, New England Demand Response Initiative, May

E. Hirst, B. Kirby, 2003, *Opportunities for Demand Participation in New England Contingency-Reserve Markets*, New England Demand Response Initiative, May

J. Kueck, R. Staunton, B. Kirby, 2003, *Microgrids and Demand Response: How Software Controls*

Can Bridge The Gap Between Wholesale Market Prices and Consumer Behavior, Public Utility Fortnightly, May 15

B. Kirby, 2003, *Spinning Reserve From Responsive Loads*, ORNL/TM 2003/19, Oak Ridge National Laboratory, Oak Ridge TN, March

J. D. Kueck, R.H. Staunton, S. D. Labinov, B.J. Kirby, 2003, *Microgrid Energy Management System*, ORNL/TM 2002/242, Oak Ridge National Laboratory, Oak Ridge TN, January

B. Kirby, J. Dyer, C. Martinez, R. Shoureshi, R. Dagle, 2002, *Frequency Control Concerns In The North American Electric Power System*, ORNL/TM 2003/41, Oak Ridge National Laboratory, Oak Ridge TN, December

B. Kirby, M. Ally, 2002, *Spinning Reserves from Controllable Packaged Through the Wall Air Conditioner (PTAC) Units*, ORNL/TM 2002/286, Oak Ridge National Laboratory, Oak Ridge TN, November

B. Kirby, R. Staunton, 2002, *Technical Potential For Peak Load Management Programs in New Jersey*, Oak Ridge National Laboratory, Oak Ridge TN, November

R. Lee, S. Hadley, C. Liu and B. Kirby, 2002, *Electricity Transmission Congestion in The U.S.*, Oak Ridge National Laboratory, Oak Ridge TN, June

B. Kirby, J. Van Dyke, C. Martinez and A. Rodriguez, 2002, *Congestion Management Requirements, Methods and Performance Indices*, ORNL/TM-2002, Oak Ridge National Laboratory, Oak Ridge TN, June

B. Kirby and E. Hirst, 2002, *Reliability Management and Oversight*, U.S. Department of Energy National Transmission Grid Study, May

E. Hirst and B. Kirby, 2002, *Transmission Planning and the Need for New Capacity*, U.S. Department of Energy National Transmission Grid Study, May

J. Kueck, B. Kirby and L. Markel, 2002, *Best Practices For Distribution – Phase 2 Report – A Toolkit of Noteworthy Reliability Measurement Practices*, Oak Ridge National Laboratory, Oak Ridge TN, March

B. Kirby and J. Kueck, 2002, *Re Electricity Costs: How Savvy Building Owners Can Save*, Strategic Planning for Energy and the Environment, Vol. 21, No. 3

W. P. Poore, T. K. Stovall, B. J. Kirby, D. T. Rizy, J. D. Kueck, and J. P. Stovall, 2002, *Connecting Distributed Energy Resources to the Grid: Their Benefits to the DER Owner/customer, the Utility, and Society*, ORNL/TM-2001/290, Oak Ridge National Laboratory, Oak Ridge TN, February

J. Eto, C. Goldman, G. Heffner, B. Kirby, J. Kueck, M. Kintner-Meyer, J. Dagle, T. Mount, W. Schultze, R. Thomas, R. Zimmerman, 2002, *Innovative Developments in Load as a Reliability Resource*, IEEE Power Engineering Society, February

R. Staunton, J. Kueck, B. Kirby, J. Eto 2001, *Demand response: An Overview of Enabling Technologies*, Public Utilities Fortnightly, November

B. Kirby 2001, *Restructured Electricity Markets Offer Increased Complexities and Opportunities for Cogeneration*, Cogeneration and Competitive Power Journal, fall

E. Hirst and B. Kirby 2001, *Key Transmission Planning Issues*, The Electricity Journal, October

C. R. Hudson, B. J. Kirby, J. D. Kueck, R. H. Staunton 2001, *Industrial Use of Distributed Generation in Real-Time Energy and Ancillary Service Markets*, ORNL/TM-2001/136, Oak Ridge National Laboratory, Oak Ridge TN, September

E. Hirst and B. Kirby 2001, *Transmission Planning: Weighing Effects on Congestion Costs*, Public Utility Fortnightly, July

B. Parsons, Y. Wan, B. Kirby, 1999, *Wind Farm Power Fluctuations, Ancillary Services, And System Operating Impact Analysis Activities In The United States*, National Renewable Energy Laboratory, Golden CO, July

J. D. Kueck, B. J. Kirby, J. Eto, R. H. Staunton, C. Marnay, C. A. Martinez, C. Goldman 2001, *Load as a Reliability Resource in Restructured Electricity Markets*, ORNL/TM-2001/97, Oak Ridge National Laboratory, Oak Ridge TN, June

E. Hirst and B. Kirby 2001, *Transmission Planning for a Restructuring U.S. Electricity Industry*, Edison Electric Institute, Washington, DC, June

R. Hudson, B. Kirby, Y. Wan 2001, *Regulation Requirements for Wind Generation Facilities*, American Wind Energy Association, June

B. Kirby and E. Hirst 2001, *Real-Time Performance Metrics for Generators Providing the Regulation Ancillary Service*, The Electricity Journal, April

E. Hirst and B. Kirby 2001, *Metering, Communications and Computing for Price-Responsive Demand Programs*, April

B. Kirby and E. Hirst 2001, *Using Five-Minute Data to Allocate Load-Following and Regulation Requirements Among Individual Customers*, ORNL/TM-2001-13, Oak Ridge National Laboratory, Oak Ridge TN, January

E. Hirst and B. Kirby 2001, *Measuring Generator Performance in Providing Regulation and Load-*

Following Ancillary Services, ORNL/TM-2000-383, Oak Ridge National Laboratory, Oak Ridge TN, January

E. Hirst, B. Kirby, 2001, *Real-Time Balancing Operations and Markets: Key to Competitive Wholesale Electricity Markets*, January

E. Hirst and B. Kirby 2000, *Retail-Load Participation in Competitive Wholesale Electricity Markets*, Edison Electric Institute, Washington, DC, and Project for Sustainable FERC Energy Policy, Alexandria, VA, Dec

J. Cadogan, M. Milligan, Y. Wan, and B. Kirby 2000, *Short Term Output Variations in Wind Farms - Implications for Ancillary Services in the United States*, October

B. Kirby and J. Kueck 2000, *How Buildings Can Prosper By Interacting With Restructured Electricity Markets*, ACEEE, August

B. Kirby and E. Hirst 2000, *Pricing Ancillary Services so Customers Pay for What They Use*, EPRI, July

E. Hirst and B. Kirby 2000, *Time-Averaging Period for the Regulation Ancillary Service*, IEEE Power Engineering Review, July

M. Gallaher, S. Johnston, and B. Kirby 2000, *Changing Measurement and Standards Needs in a Deregulated Electric Utility Industry*, National Institute of Standards & Technology, May

B. Kirby 2000, *Restructured Electricity Markets Offer Increased Complexity and Increased Opportunities*, Association of Energy Engineers, Globalcon 2000, April

B. Kirby and E. Hirst 2000, *Bulk-Power Reliability and Commercial Implications of Distributed Resources*, NARUC, April

B. Kirby and T. Key 2000, *Technical Evaluation of Operational and Ownership Issues of Distributed Generation*, Office of Ratepayer Advocates, California Public Utility Commission, Rulemaking 99-10-025, April

E. Hirst and B. Kirby 2000, *Bulk-Power Basics: Reliability and Commerce*, The Regulatory Assistance Project, Gerdiner, ME, March

B. Kirby and J. Kueck 2000, *Review of the Structure of Bulk Power Markets*, ORNL/TM-2000/41, Oak Ridge National Laboratory, Oak Ridge TN, January

B. Kirby and E. Hirst 2000, *Customer-Specific Metrics for The Regulation and Load-Following Ancillary Services*, ORNL/CON-474, Oak Ridge National Laboratory, Oak Ridge TN, January.

E. Hirst and B. Kirby 2000, *Ancillary Services: A Call for Fair Prices*, Public Utilities Fortnightly, January

B. Kirby and N. Lenssen 1999, *Shifting the Balance of Power: Grid Interconnection of Distributed Generation*, E Source, The Distributed Energy Series, Boulder, Colorado, October

E. Hirst, B. Kirby and S. Hadley 1999, *Generation and Transmission Adequacy in a Restructuring U.S. Electricity Industry*, Edison Electric Institute, Washington, DC, June

B. Ernst, Y. Wan and B. Kirby 1999, *Short-term Power Fluctuation of Wind Turbines: Looking at Data from the German 250 Mw Measurement Program from the Ancillary Services Viewpoint*, American Wind Energy Association Windpower '99 Conference, Washington, DC, June

B. Kirby and E. Hirst 1999, *Load as a resource in Providing Ancillary Services*, American Power Conference, Chicago, Illinois, April

B. Kirby and E. Hirst 1999, *Maintaining System Black Start in Competitive Bulk-Power Markets*, American Power Conference, Chicago, Illinois, April

E. Hirst and B. Kirby 1999, *What is System Control*, American Power Conference, Chicago, Illinois, April

E. Hirst and B. Kirby 1999, *Technical and Market Issues for Operating Reserves*, The Electricity Journal, March

B. Kirby and E. Hirst 1999, *New Blackstart Standards Needed for Competitive Markets*, IEEE Power Engineering Review, Vol. 19, No. 2, pp9, February

E. Hirst and B. Kirby 1999, *Does Block Scheduling Waste Money?*, Electrical World, January/February

E. Hirst and B. Kirby 1998, *Operating Reserves and Bulk-Power Reliability*, Energy International Journal, Vol. 23, No. 11, pp. 949-959

B. Kirby and E. Hirst, 1998, *Generator Response to Intrahour Load Fluctuations*, IEEE Transactions on Power Systems, Vol 13 #4, PE-627-PWRS-0-12-1997, November

E. Hirst and B. Kirby, 1998, *Defining Intra- and Interhour Load Swings*, IEEE Transactions on Power Systems, Vol 13 #4, PE-628-PWRS-0-12-1997, November

E. Hirst and B. Kirby, 1998, *The Functions, Metrics, Costs, and Prices for Three Ancillary Services*, Edison Electric Institute, Economics Department, October

B. J. Kirby, J. D. Kueck, A. B. Poole 1998, *Evaluation of the Reliability of the Offsite Power Supply*

as a Contributor to Risk of Nuclear Plants, ORNL/NRC/LTR/98-12, Oak Ridge National Laboratory, Oak Ridge TN, August.

E. Hirst and B. Kirby 1998, *Ancillary Services: The Forgotten Issue*, Electric Perspectives, July-August

B. Kirby, E. Hirst 1998, *Voltage Control In A Changing US Electricity Industry*, Utilities Policy, Vol 7, No. 2, June

E. Hirst and B. Kirby 1998, *Simulating the Operation of Markets for Bulk-Power Ancillary Services*, The Energy Journal, Vol. 19, No. 3

E. Hirst and B. Kirby 1998, *Creating Markets for Ancillary Services*, Pricing Energy in a Competitive Market, EPRI, June

E. Hirst and B. Kirby 1998, *Maintaining Reliability in a Restructured Industry*, Public Power, May-June

B. Kirby and E. Hirst 1998, *Characteristics of Concern in Supplying, Consuming, and Measuring Ancillary Services*, The Future of Power Delivery in the 21st Century, The Electric Power Research Institute, Palo Alto, California, May

E. Hirst and B. Kirby 1998, *Ancillary Services: The Neglected Feature of Bulk-Power Markets*, The Electricity Journal, April.

E. Hirst and B. Kirby 1998, *Unbundling Generation and Transmission Services for Competitive Electricity Markets*, ORNL/CON-454, Oak Ridge National Laboratory, Oak Ridge TN, January.

E. Hirst and B. Kirby 1998, *Unbundling Generation and Transmission Services for Competitive Electricity Markets: Examining Ancillary Services*, The National Regulatory Research Institute, January.

B. Kirby and E. Hirst 1997, *Ancillary-Service Details: Voltage Control*, ORNL/CON-453, Oak Ridge National Laboratory, Oak Ridge TN, December.

E. Hirst and B. Kirby 1997, *Cutting Electricity Costs for Industrial Plants in a Real-Time World*, Public Utilities Fortnightly, December.

E. Hirst and B. Kirby 1997, *Ancillary-Service Details: Operating Reserves*, ORNL/CON-452, Oak Ridge National Laboratory, Oak Ridge TN, November.

E. Hirst and B. Kirby 1997. *Ancillary Services: The Neglected Feature of Bulk-Power Markets*, Electricity Journal

E. Hirst and B. Kirby 1997, *Creating Competitive Markets for Ancillary Services*, ORNL/CON-448, Oak Ridge National Laboratory, Oak Ridge TN, October.

B. Kirby, E. Hirst, B. Parsons, K. Porter, and J. Codagan, 1997, *Electric Industry Restructuring, Ancillary Services, and the Potential Impact on Wind*, American Wind Energy Association, June

E. Hirst and B. Kirby, 1997, *Dynamic Scheduling Can Enable Competitive Markets*, Public Utility Fortnightly, April, 15

E. Hirst and B. Kirby, 1997, *Ancillary-Service Details: Dynamic Scheduling*, ORNL/CON-438, Oak Ridge National Laboratory, Oak Ridge TN, January

E. Hirst and B. Kirby 1996, *Costs for Electric-Power Ancillary Services*, Electricity Journal, Volume 9, Number 10, December.

E. Hirst and B. Kirby 1996, *Ancillary-Service Details: Regulation, Load Following, and Generator Response*, ORNL/CON-433, Oak Ridge National Laboratory, Oak Ridge, TN, September.

B. Kirby and E. Hirst 1996, *Unanswered Questions Ancillary Services*, Electric Perspectives, July-August

B. Kirby and E. Hirst 1996, *Unbundling Electricity: Ancillary Services*, IEEE Power Engineering Review, June

B. Kirby and E. Hirst 1996, *Ancillary Services and the use of FACTS Devices*, The Future of Power Delivery Conference, EPRI, April

B. Kirby and E. Hirst 1996, *Ancillary-Services Costs for Twelve U.S. Electric Utilities*, ORNL/CON-427, Oak Ridge National Laboratory, Oak Ridge, TN, March.

E. Hirst and B. Kirby 1996, *Electric-Power Ancillary Services*, ORNL/CON-426, Oak Ridge National Laboratory, Oak Ridge, TN, February

E. Hirst and B. Kirby 1996, *Ancillary Services*, American Power Conference, Chicago, Illinois, February

B. Kirby and E. Hirst 1996, *Supplemental Comments on Ancillary Services*, Testimony before the U.S.A. Federal Energy Regulatory Commission, Washington, DC, January

E. Hirst and B Kirby 1995, *Devil in the Details!*, the Electricity Journal, Vol. 8, Num. 10, December

E. Hirst and B. Kirby 1995, *Testimony Before The U.S.A. Federal Energy Regulatory Commission, Ancillary Services*, Federal Energy Regulatory Commission, Washington, DC, June

B. Kirby, E. Hirst, and J. VanCoevering 1995, *Unbundling Electric Generation and Transmission Services*, Energy, Vol. 20, No. 12, pp. 1191-1203, Elsevier Science Ltd.

P. Barnes, W. Dykas, B. Kirby, S. Purucker, and J. Lawler 1995, *The Integration of Renewable Energy Sources into Electric Power Transmission Systems*, ORNL-6827, Oak Ridge National Laboratory, Oak Ridge, TN, June

W. P. Dykas, B. J. Kirby and J. P. Stovall 1995, *Superconducting Magnetic Energy Storage (SMES), Utility Application Study of Municipal Light & Power, Anchorage, Alaska, Draft*, ORNL-6877, Oak Ridge National Laboratory, Oak Ridge, TN, June

B. Kirby, E. Hirst, and J. VanCoevering 1995, *Identification and Definition of Unbundled Electric Generation and Transmission Services*, ORNL/CON-415, Oak Ridge National Laboratory, Oak Ridge, TN, March.