



Ric Austria

Executive Principal

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Mr. Austria is a founder of Pterra, LLC. He has over 35 years experience in electric power transmission planning, operations, voltage simulation and analysis, design and engineering, and brings this knowledge to help clients worldwide in the power industry.

He is a renowned expert in the specialized fields of system reliability, transmission planning, voltage stability and system analysis. He has provided expert testimony in these areas in filings with the FERC, state and local public commissions. He has led and conducted transmission studies in all US interconnections and over 25 national networks worldwide; each of which have determined major investment in transmission, substations, underground and undersea cables, power conditioning equipment and application of new analytical methodologies and technologies. Mr. Austria has spoken at numerous conferences, authored articles and participated in working groups on the subject of electric power transmission.

Mr. Austria was formerly Vice President of Consulting at Power Technologies, Inc. (Schenectady, New York), Vice President of transmission studies at EPRI Solutions, Inc. and Senior Specialist at the National Power Corporation. In these various roles, he was responsible for developing new approaches to providing for reliability in competitive power industry environments.

Mr. Austria is a senior member of the IEEE and its Power Engineering Society and past chair of the Schenectady Section.

Areas of Focus

Transmission planning; voltage control and reactive power planning and design; power system analysis; power system stability; power system reliability; transmission reliability; operations planning; software development; technology roadmapping; planning and operations training; energy markets.

Selected Project Experience

Maryland Public Service Commission, Case No. 9600, on Baltimore Gas and Electric's application to construct the Key Crossing project, a \$200+ million double circuit 230 kV transmission line across the Patapsco River.

FERC Docket ER17-1138 on PJM Interconnection, L.L.C.'s ("PJM") proposal to change its Tariff and Reliability Assurance Agreement to implement more stringent requirements for External Capacity to be qualified to sell capacity into the PJM market.

FERC Docket EL14-000 on complaint by Consolidated Edison Company of New York regarding the proposed cost allocations by PJM Interconnection.

FERC Docket Nos. EL15-37-000 and ER16-120-000 New York Independent System Operator, Inc. (NYISO) to submit tariff revisions governing the retention of and compensation to generating units needed for reliability, including procedures for designating such resources, the rates, terms, and conditions for reliability must run (RMR) service, provisions for the allocation of costs of RMR service, and a pro forma agreement for RMR service.

Designation of Competitive Renewable Energy Zones, PUC Texas. FPL Energy, AES Seawind and Invenergy. Expert witness and testimony services in docket 33672.

FERC Docket ER06-880-003 on transmission projects included in PJM expansion plan. PSEG, PHI, PPL and FirstEnergy companies in the PJM footprint. Expert witness and testimony services.

STATE OF NEW YORK PUBLIC SERVICE COMMISSION, Case No. 06-T-0650, Application of New York Regional Interconnect, Inc. for a Certificate of Environmental Compatibility and Public Need Pursuant to Article VII of the Public Service Law, Expert witness and testimony services.

Confidential Client. Provided expert advice on method and conclusions derived by Southern Company regarding Client's voltage and closing angle stability impacts on the output of a proposed coal plant in southern Tennessee. Identified aspects of analysis that required further review and alternative solutions to constraints on the proposed plants.

Conjunction, LLC, Empire Transmission Line Project. Identified transmission feasibility of various configurations for interconnecting Upstate NY with New York City through DC and AC lines. Developed models for simulating network response with the project in service. Provided expert witness services during public and private meetings and hearings with interested local and industry parties. Conducted System Reliability Impact Study, approved and accepted by TPAS in 2004.

Old Dominion Electric Cooperative, Analysis of High Locational Prices in PJM. Performed electric transmission system analyses to diagnose causes of high locational prices and evaluated remedies to reduce the prices in the area of concern. Identified problem areas. Analyzed the existing transmission system and determined the causes of the high locational prices and provided an estimate of the duration and magnitude of exposure to high prices. Specified a solution to a voltage control problem which was influencing LMPs. (Implemented by ODEC). Identified solutions for congestion costs in the Upper Peninsula.

Oklahoma Gas and Electric Company, Support of Arkansas Market Power Proceeding. Developed TTCs between control areas and control area-to-control area TDFs in the vicinity of the OG&E. Studied the transmission topography of the OG&E system to identify constraints that could impact a market power assessment. Identified realignment of the OG&E area which reflects these constraints. Provided expert testimony to support market power filing in the State of Arkansas.

Review of Transmission Plans Submitted to the Michigan Public Service on behalf of the PSC. Reviewed non-common components of transmission plans submitted by Michigan utilities to the Commission in response to state requirements. Conducted analytical verification of specific bases for the plans. Provided expert testimony to the Commission on the assumptions, procedures and conclusions relating to the submitted plans.

New Jersey Board of Public Utilities. Audited reliability related practices and recent operations of New Jersey electric utilities as part of a forensic investigation of events of July 3-8, 1999. Determined that near voltage collapse event occurred on July 6, 1999 that New Jersey utilities and PJM were not adequately prepared for.

California ISO Trust and Trust Advisory Committee, Operating Reliability Requirements Study. Identified requirements for reliable initial operation of the California ISO. This phase involved the aspect of location-dependent or "must-run" generation and ancillary services, and was completed within a three-month study period. Clarified the issue of "must-run" contracts for the Cal ISO's own task force on Transmission Reliability, as well as all other participants in the nascent ISO and power exchange. Reviewed existing criteria and proposed criteria to maintain or exceed existing transmission service reliability. Identified location-dependent conditions and dispatches, with measures of effectiveness to help formulate alternative reliability-based dispatches.

BC Hydro, Canada, Methodology to Calculate Benefits From Generation-Related Transmission. Developed a methodology to calculate benefits from transmission connecting hydro projects to a power grid. Provided support for expert testimony.

Training Instructor Experience

Voltage Control and Reactive Power Planning Course - principles of voltage control and reactive supply planning in transmission and distribution systems. Covers

equipment characteristics, load modeling, planning criteria, voltage stresses, bulk system operations, reactive planning and analytical modeling.

Advanced Transmission Planning - principles of transmission planning. Covers analytical methods and tools, planning methodologies, planning criteria, industry structures, least cost techniques and a complete case study.

Reliability Assessment Methods - principles of reliability assessment for generation, transmission and distribution systems. Covers outage modeling, reliability criteria, regulatory and industry organizations, mathematical and analytical models, performance measures and composite indices.

Control Center Technologies – hardware, software, processes and operator requirements and roles in modern power system control centers.

Other courses: Optimal Power Flow, Improving Reliability of Large Interconnected Systems, Competitive Markets, Dynamic Simulation for Power Systems, Locational Marginal Pricing Basics.

Publications

1. "Automatic Load Shedding in the Luzon Grid," presented at the 5th IECEP Conference, Manila, Philippines, November 1984, (co-author: F.C. Leynes).
2. "Reactive Power Planning Using an Optimal Power Flow," PTI Newsletter *Power Technology*, Issue No. 60, January 1990, (co-author: J.D. Mountford).
3. "Corrective Action: An Optimal Power Flow Application," PTI Newsletter *Power Technology*, Issue No. 62, July 1990, (co-author: N.D. Reppen).
4. "Applications of the Optimal Power Flow to Analysis of Voltage Collapse Limited Power Transfer," presented at the 1991 Voltage Phenomena Seminar, Deep Creek Lake, Maryland, August 1991, (co-authors: N.D. Reppen, J.A. Uhrin, M.C. Patel, and A. Galatic).
5. "Performance of Methods for Ranking and Evaluation of Voltage Collapse Contingencies Applied to a Large-Scale Network," 1993 IEEE/NTUA joint international power conference on Planning, Operation and Control in Today's Electric Power Systems, Athens, Greece (co-authors: N.D. Reppen, J.A. Uhrin, M.C. Patel, and A. Galatic).
6. "Modern Analytical Tools are Changing the Way Transmission Planning is Done," PTI Newsletter *Power Technology*, Issue No. 74, July 1993, (co-author: F.S. Prabhakara).
7. "An Integrated Approach to Transfer Limit Calculations," *Computer Applications in Power*, January 1995, pp. 48-52, (co-authors: X.Y. Chao, N.D. Reppen and D.E. Welsh).
8. "Practical Determination of Operating Transfer Limits," PICA '95 conference paper, May 1995, (co-authors: X.Y. Chao, N.D. Reppen and D.E. Welsh).
9. "A Closer Look at Transmission Planning in a Competitive Environment," PTI Newsletter *Power Technology*, July 1995, (co-author: M. R. Pangilinan).
10. "Considerations in the Development and Evaluation of Alternatives for Long-Term Transmission," presented at the 11th Conference of the Electric Power Supply Industry (11 CEPSI), October 21-15, 1996, Kuala Lumpur, Malaysia, (co-authors: T.I. Leksan, P. Chonglertvanichkul, G. Behrens, and J. Slapp).
11. "Transmission Planning for Unbundled Generation Expansion," presented at the 11th Conference of the Electric Power Supply Industry (11 CEPSI), October 21-15, 1996, Kuala Lumpur, Malaysia, (co-authors: M.R. Pangilinan and J. Batista Silva).
12. "A Composite Reliability Method for Resource Evaluation of an Island Grid or Local Load," presented at the 11th Conference of the Electric Power Supply Industry (11 CEPSI), October 21-15, 1996, Kuala Lumpur, Malaysia, (co-authors: M. S. Basabe, N. D. Reppen and L.S. Sunico).
13. "Wheeling Tariffs for Transmission Services," presented at the 11th Conference of the Electric Power Supply Industry (11 CEPSI), October 21-15, 1996, Kuala Lumpur, Malaysia, (co-authors: R. Nadira, W. R. Puntel, P. S. Hurley, R. C. Bacani, R. F. Nuqui, M. R. Pangilinan).
14. "Planificacion de Sistemas de Transmision de Energia Electrica en el Futuro: ¿Son Validas las Premisas Tradicionales?," presented at the Latin America Power '97 Conference, April 29-May 1, 1997, Caracas, Venezuela, (co-authors: R. Nadira, L. Cosenza, F. Lecaros, C. Fuentes, M. Avila, and J. Ramirez).
15. "Least-Cost Transmission Planning Considering Power Industry Restructuring," presented at the IASTED Conference, Orlando, FL., October 1997, (co-authors: R. Nadira, L. Cosenza, C. Fuentes, M. Avila, and J. Ramirez).
16. "Managing Information on Transmission System Equipment Reliability," PTI Newsletter *Power Technology*, Third Quarter 1998, (co-author: N. D. Reppen).

17. "A Composite Reliability Assessment Method for a Deregulating Power System," Proceedings of the 13th Conference of the Electricity Power Supply Industry (CEPSI 2000), October 23 - 27, 2000, Manila, Philippines (co-authors: Xiaokang Xu, Moises R. Gutierrez, Baldwin P. Lam, Humberto Burgos-Cruz and Héctor Villarroel-Pedrazas)
18. "Voltage Stability Study of a Practical Power System," Proceedings of the 13th Conference of the Electricity Power Supply Industry (CEPSI 2000), October 23 - 27, 2000, Manila, Philippines (co-authors: Xiaokang Xu and Michael Power)
19. "The State of Voltage Stability Assessment," PTI Newsletter, Power Technology, Issue No. 97, Second Quarter 2001. (co-authors: Xiaokang Xu and Michael Power).
20. "A New Probabilistic Approach for Reliability Assessment of Urban Networks," Accepted for presentation at the IEEE Summer Meeting, Vancouver, British Columbia, Canada, July 15-19, 2001 (co-authors: Xiaokang Xu, M.E.N. du Preez and Deon Very).
21. "Application of FACTS Technology for Increasing Power Transfers of Jiangsu Transmission System," Accepted for presentation at the CIGRE 2001 International Conference on Power Systems (CIGRE ICPS'2001), September 3-5, 2001, Wuhan, Hubei, China (co-authors: Xiaokang Xu, Baldwin P. Lam, Wang Huaming, Fan Haihong, Yang Lin & Wang Xu)
22. "Voltage Stability Assessment of the National Grid System Using Modern Analytical Tools," Accepted for presentation at the 2001 Transmission and Distribution Conference and Exposition, October 28 - November 2, 2001, Atlanta, Georgia, USA (co-authors: Xiaokang Xu and Michael Power)
23. "Assessing the impact of substation-related outages on the network reliability," Proceedings. International Conference on Power System Technology, Year: 2002, Volume: 2, Pages: 844 - 848, (co-authors: X. Xu; B. P. Lam; Z. Ma; Z. Zhu; R. Zhu; J. Hu)
24. "Transmission Planning in the Presence of Uncertainties", presented at the PES 2003 General Meeting, July 13-17, 2003, Toronto Canada (co-authors: Ramon Nadira, Carlos A. Dortolina and Fernando Lecaros).
25. "Transmission Planning Today: A Challenging Undertaking", Electricity Journal, May, 2004 (co-authors: Ramon Nadira, Carlos A. Dortolina and Miguel Avila)
26. Reliability Assessment of an Island Grid System with Central and Distributed Generation Using Monte Carlo Simulations", accepted for presentation at CEPSI 2004 in Shanghai, China, September, 2004. (co-authors Xiaokang Xu, Reiner Kuhr)
27. "Uprating Transmission Voltage - Planning Perspective," Panel Session on Voltage Uprating, IEEE PES Summer 2005, San Francisco, CA, June 14, 2005
28. "Why not Voltage Uprating as a Planning Option?" Pterra Technical Articles published online at www.pterra.com, June 2005
29. "Resource Planning for Island Networks" Pterra Technical Articles published online at www.pterra.com, July 2005.
30. "Overlaying DC Transmission On an AC System" Pterra Technical Articles published online at www.pterra.com, August 2005. (co-authors R. Tapia, K. Dartawan, M. Elfayoumy, M. Gutierrez)
31. "Transmission Planning - Returning to Fundamentals," Pterra Technical Articles published online at www.pterra.com, September 2005
32. "Open Source or Proprietary Data: the Model Dilemma," Pterra Technical Articles published online at www.pterra.com, November 2005 (co-authors M. Gutierrez)
33. "The In-Between Voltage State," Pterra Technical Articles published online at www.pterra.com, December 2005
34. "Steel Mill in the Neighborhood," Pterra Technical Articles published online at www.pterra.com, January 2006 (co-authors K. Dartawan, M. Gutierrez, R. Tapia and C. St. Pierre)
35. "Two Views of Power System Reliability," Pterra Technical Articles published online at www.pterra.com, February, 2006
36. "Steel Mill in the Neighborhood: Part 2 (In Your Backyard)," Pterra Technical Articles published online at www.pterra.com, April 2006 (co-author K. Dartawan)
37. "Subtransmission Planning," Pterra Technical Articles published online at www.pterra.com, June, 2006
38. "Developing Open Form User Models for Dynamic Simulation," Pterra Technical Articles published online at www.pterra.com, February 2007 (co-author M. Gutierrez)
39. "The Voltage Ledge," Pterra Technical Articles published online at www.pterra.com, April 2007
40. "Converging the Power Flow 3: Mitigation" Pterra TechBlog published online at www.pterra.us, October 30, 2009
41. "On the Use of Aggregate Models of a Wind Farm," Pterra Technical Articles published online at www.pterra.com, October 2009 (co-authors J. Chen, M. Gutierrez)
42. "Voltage Stability: The Voltage Ledge Seen Close-Up" Pterra Technical Articles published online at www.pterra.com, October 2009
43. "Converging the Power Flow 3: Mitigation", Pterra Technical Articles published online at www.pterra.com, October 2009
44. "Voltage Stability: The Voltage Ledge Seen Close-Up" Pterra TechBlog published online at www.pterra.us, October 14, 2009
45. "HVDC Technology: DC Overlay on an AC System", Pterra Technical Articles published online at www.pterra.com, November 2009 (co-authors K. Dartawan, M. Elfayoumy, M. Gutierrez, R. Tapia)
46. "Power Flow Solution Techniques", Pterra Technical Articles published online at www.pterra.com, November 2009. (co-authors M. Gutierrez, M. Elfayoumy, R. Tapia)
47. "Power Flow Solution Techniques" Pterra TechBlog published online at www.pterra.us, November 23, 2009 (co-authors: M. Gutierrez, M. Elfayoumy, R. Tapia)

48. "Distributed Generation: Interconnection Steady State Impact" Pterra TechBlog published online at www.pterra.us, November 9, 2010, (co-authors: Jingjia Chen, Ketut Dartawan)
49. "Distributed Generation: Things You Don't Want to Miss!" Pterra TechBlog published online at www.pterra.us, October 12, 2010 (co-author: K. Dartawan)
50. "Distributed Generation Impact: Sympathetic Tripping of Protection Devices" Pterra TechBlog published online at www.pterra.us, September 15, 2010 (co-authors: E. Cano, K. Dartawan)
51. "Projecting Curtailment of Wind Farms Due to Transmission Congestion," Paper presentation at WINDPOWER 2011 Conference & Exhibition, Anaheim, CA, May 22-25, 2011, (co-author: B. Adjemian)
52. "Harmonics Issues that Limit Solar Photovoltaic Generation on Distribution Circuits," World Renewable Energy Forum (WREF 2012), May 13-17, 2012, at the Colorado Convention Center in Denver (co-authors: K. Dartawan, L. Hui - Pterra, M. Suehiro - Maui Electric Co.)
53. "Lanai New Distributed Generation Impact Assessment," Pterra website, October 2012, (co-authors: Ramon Tapia, Jingjia Chen, Jamie Keller)
54. "Load Rejection Overvoltage Issue on Distributed Generation Projects," POWER-GEN International, FL, USA, Nov 12-14, 2013, (co-authors: Ketut, Dartawan, Amin M Najafabadi, Le Hui)
55. "Power Quality Impacts and Mitigation of Distributed Solar Power," presented to the IEEE San Francisco Chapter, California Public Utilities Commission, San Francisco CA, Feb 17, 2016
56. "Approaches to Complying with NERC Standard PRC-019-2 on the "Coordination of Generating Unit or Plant Capabilities, Voltage Regulating Controls, and Protection,"" Pterra Tech Blog, January 2017, (co-authors: F. Luces, T. C Garcia, C. Bautista, M. Gutierrez)
57. "Ground Fault Overvoltage and Distributed Generation: Factors for Occurrence," Pterra Tech Blog, January 2017, (co-authors: K. Dartawan, A. Najafabadi)
58. "Coordinating Generator Unit Capabilities, Excitation System, Voltage Control and Generator Protection," ASME 2017 Power Conference, Charlotte, NC, June 2017
59. "Preparing Dynamic Databases for the Coming of Renewable Energy-based Generation," Conference of Power and Electricity Supply Industry 2018, Kuala Lumpur, Malaysia September 2018, (co-authors: F. Luces, M. Gutierrez)
60. "Coordinating Generator Capabilities With Protection And Excitation System Controls – Case Study For A 230-Mva Steam Turbine Generator Unit," Conference of Power and Electricity Supply Industry 2018, Kuala Lumpur, Malaysia September 2018, (co-authors: F. Luces, C. Bautista, T. Garcia)

Education

M.S. Electric Power Engineering, Rensselaer Polytechnic Institute, Troy, New York, 1988.