

Transmission Innovation Symposium: Modernizing the U.S. Electrical Grid

May 19-20, 2021

Symposium Organizers

Jeff Dagle, Pacific Northwest National Laboratory

Jeff Dagle has worked at the Pacific Northwest National Laboratory since 1989 and currently manages several projects in the areas of transmission reliability, including the North American SynchroPhasor Initiative (NASPI). Over the past several years, he has served on three National Academies study committees generating reports relevant to analytics, resilience, and the future of the power grid. He is a Senior Member of the Institute of Electrical and Electronics Engineers (IEEE), a member of the National Society of Professional Engineers (NSPE), and is a licensed Professional Engineer in the State of Washington. He received BS and MS degrees in Electrical Engineering from Washington State University.

Joseph H. Eto, Lawrence Berkeley National Laboratory

Joseph H. Eto is a staff scientist at the Lawrence Berkeley National Laboratory where he is a senior advisor to the Electricity Markets and Policy Department in the Energy Analysis and Environmental Impacts Division, and a strategic advisor to the Grid Integration Group in the Energy Storage and Demand Resources Division. Joe has authored over 250 publications on electricity reliability, transmission planning and operations, demand response, distributed generation, utility integrated resource planning and demand-side management, and building energy-efficiency technologies. Joe received an AB in philosophy of science and an MS in energy and resources from the University of California, Berkeley. He is a registered professional Mechanical Engineer in the State of California.

Sandra Jenkins, US DOE Office of Electricity

Sandra Jenkins is a program manager in the Advanced Grid Research and Development Division in the Office of Electricity at the U.S. Department of Energy. Her program focuses on Transmission reliability, resilience, and renewable integration. She previously worked on the DOE Quadrennial Energy Review in the Energy Policy and Systems Analysis office. Sandra has her master's degree in Technology and Policy from MIT and her bachelor's degree Electrical Engineering from University of Massachusetts Amherst.

Keynote Speakers

Patricia Hoffman, US DOE Office of Electricity

Serving as the Principal Deputy Assistant Secretary for the Office of Electricity (OE) at the U.S. Department of Energy (DOE), Ms. Patricia A. Hoffman also served as Acting Under Secretary for Science and Energy from January 2017 until November 2017 when the U.S. Senate confirmed Mark Menezes as Under Secretary of Energy. Ms. Hoffman served as Acting Assistant Secretary for OE from January 2017 until October 2017 when the OE Assistant Secretary was confirmed by the U.S. Senate. Ms. Hoffman was named Assistant Secretary for OE from June 2010 to January 2017, after serving as Principal Deputy Assistant Secretary since November 2007. Prior to joining OE, she was the Program Manager for the

Federal Energy Management Program within the Office of Energy Efficiency and Renewable Energy at DOE. Ms. Hoffman holds a Bachelor of Science and a Master of Science in Ceramic Science and Engineering from Pennsylvania State University.

Wanda Reder, Grid-X Partners, LLC

Wanda Reder is President and Chief Executive Officer of Grid-X Partners, LLC, a woman-owned provider of strategic management consulting services for utility clients and their stakeholders, providing business and technology expertise to support operations, projects and future grid goals. Prior to joining Grid-X Partners, she served as the Chief Strategy Officer at S&C Electric Company. Prior to S&C, she has held leadership positions at two major investor-owned utilities. Her pioneering work has led to smart grid deployments and wind, solar energy, and utility-scale battery storage integration into traditional utility systems. An IEEE Fellow, Reder was recognized with the 2014 IEEE Richard M. Emerson Award for her leadership in the IEEE Smart Grid program and in the continued growth of the Power and Energy Society (PES), including the creation of its Scholarship Fund program. Reder was the first woman president of PES and is responsible for the launch of the IEEE Smart Grid, positioning IEEE as the leading source for information on smart-grid technology. Reder is a member of the US Department of Energy's Electricity Advisory Committee. She is also a member of the National Academy of Engineering and a candidate for 2017 IEEE President-Elect.

White Paper Authors

Anjan Bose, Washington State University

Dr. Anjan Bose is a Regents Professor and the Distinguished Professor of Power Engineering at Washington State University, where he has served as the Dean of Engineering. He is a leading expert on the operation and control of the power grid with over 45 years of experience in industry, academe and government. His pioneering works in real time analysis software for control centers and grid operator training simulators are used around the world. He has been recognized by the IEEE with several awards including IEEE Fellow, elected to the US, Chinese and Indian National Academies of Engineering and served as the President of the Washington State Academy of Sciences. He has served as an advisor to many companies and several national governments around the world.

Madhu Chinthavali, Oak Ridge National Laboratory

Madhu Chinthavali received his MS and PhD degrees in electrical engineering from the University of Tennessee, Knoxville, TN, USA, in 2003 and 2015, respectively. He is currently leading the Power Electronics System Integration Group, Oak Ridge National Laboratory (ORNL), Knoxville, TN, USA. He is also the Principal Investigator for ORNL's wide bandgap device program, including testing, packaging, designing, and integration activities. His research experience and interests cover power electronics applications in transportation electrification, renewables, building energy integrations, and energy storage systems, wireless and wired charging systems, integrated power electronics architectures, and highpower applications.

Jeff Dagle, Pacific Northwest National Laboratory

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Society of Professional Engineers (NSPE), and is a licensed Professional Engineer in the State of Washington. He received BS and MS degrees in Electrical Engineering from Washington State University.

Benjamin F. Hobbs, Johns Hopkins University

Benjamin Hobbs is the Theodore M. and Kay W. Schad Professor of Environmental Management at Johns Hopkins University, where he uses systems analysis and economics to improve electric utility planning, operations and policy, as well as management of environmental and water resources systems. Hobbs was founding director of Johns Hopkins' Environment, Energy, Sustainability & Health Institute, and is on the Leadership Council of its successor, the O'Connor Sustainable Energy Institute. He holds a joint appointment in the Department of Applied Mathematics and Statistics. A member of the Johns Hopkins faculty since 1995, he is co-director of the USEPA Yale-JHU Solutions for Energy, Air, Climate, and Health (SEARCH) Center, an interdisciplinary team that studies how power generation trends, climate change and public policy interact to affect air quality. He chairs the Market Surveillance Committee of the California Independent System Operator. Hobbs also is a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) and the Institute for Operations Research & Management Science (INFORMS). Hobbs received his BS degree from South Dakota State University, a master's degree in resources management and policy from SUNY-Syracuse, and a PhD in environmental systems engineering from Cornell University.

Tom King, Oak Ridge National Laboratory

Tom King, Jr. is the Director of the Sustainable Electricity Program at Oak Ridge National Laboratory (ORNL) in Tennessee, where he is responsible for leading, coordinating and implementing ORNL's research and development portfolio conducted within the DOE's the Office of Electricity Delivery and Energy Reliability and Office of Energy Efficiency and Renewable Energy. In 2012, Mr. King took on a joint role with the University of Tennessee, where he serves as the Director of Innovation & Industry for the NSF/DOE Engineering Research Center, CURENT. The Center focuses on wide area situational awareness and wide area controls of the electric grid. Prior to joining ORNL, Tom was employed at Progress Energy where he held various management positions in the fossil generation area. He also was a program manager at DOE working in areas of distributed energy and industrial technologies. He holds a B.S. degree in Mechanical Engineering from Clarkson University and an M.S. in Materials Engineering from Rensselaer Polytechnic Institute. He also received a Master's of Business Administration from the University of Tennessee.

Edgar Lara-Curzio, Oak Ridge National Laboratory

Edgar Lara-Curzio received a BSc degree in Engineering Physics from the Metropolitan University (Mexico City) and a PhD degree in Materials Engineering from Rensselaer Polytechnic Institute. His areas of expertise include the development and characterization of materials for power generation and for the conversion, transmission, utilization and storage of energy. Lara-Curzio has authored or co-authored more than 250 articles in peer reviewed journals or conference proceedings, four book chapters, six U.S. Patents and coedited 16 books. Lara-Curzio is a Fellow of the American Ceramic Society, Fellow of ASTM, and a member of Alpha Sigma Mu the International Metallurgical Honorary Society. In 2019 he was named "Distinguished Graduate" of Mexico's Metropolitan University.

Jessica Lau, National Renewable Energy Laboratory

Jessica Lau is a Senior Technical Manager at the National Renewable Energy Laboratory where she leads a variety of projects on modeling and informing power systems reliability, resilience, and economics. She currently leads a team of over 40 in modeling and software development to enhance national situational awareness and planning for extreme events. Jessica has over twelve years of experience in bulk electric

system planning and utility distribution planning. She was at ISO New England for nine years in System Planning and Operations. Jessica has a BS in Electrical Engineering and Math from the University of Massachusetts Amherst and a MS in Power Systems Management from Worcester Polytechnic Institute.

Zhi Li, Oak Ridge National Laboratory

Zhi Li received his PhD in electrical engineering from Washington State University in 2011. He was a postdoctoral research associate with Oak Ridge National Laboratory since 2012 and became a R&D associate in 2015. His research areas include innovative power flow control technologies, electromagnetic fields modeling and analysis for power grid applications, and high voltage engineering.

Chen-Ching Liu, Virginia Polytechnic and State University

Chen-Ching Liu is American Electric Power Professor and Director, Power and Energy Center, at Virginia Tech. He served as Boeing Distinguished Professor of Electrical Engineering at Washington State University from 2011-2017. During 1983-2011, he was on the faculty of University of Washington, Iowa State University, and University College Dublin, Ireland. Professor Liu received an IEEE Third Millennium Medal in 2000 and the Power and Energy Society Outstanding Power Engineering Educator Award in 2004. In 2013, Dr. Liu received a Doctor Honoris Causa from Polytechnic University of Bucharest, Romania. He chaired the IEEE Power and Energy Society Fellow Committee, Technical Committee on Power System Analysis, Computing and Economics, and Outstanding Power Engineering Educator Award Committee. Chen-Ching is the U.S. Representative on the CIGRE Study Committee D2, Information Systems and Telecommunication. Professor Liu is a Fellow of the IEEE, Member of Virginia Academy of Science, Engineering, and Medicine, and Member of the U.S. National Academy of Engineering.

Mike W. Marshall, Oak Ridge National Laboratory

Mr. Marshall has 40 years of experience in electric power system generation, transmission, and distribution. He is a Senior IEEE member and is a licensed Professional Engineer. His areas of expertise include Transmission and Distribution system engineering and design, system reliability and resiliency assessment, and large scale renewable generation and integration. His experience includes working on major projects for utilities in North, Central, and South America, Africa, and Europe.

Chris O'Reilley, Oak Ridge National Laboratory

Mr. O'Reilley is Senior Technical Staff Member at Oak Ridge National Laboratory (ORNL) within the Power Resilience Group. His current research focuses on grid resilience and reliability and includes being the project manager or principal investigator on several DOE OE and EERE projects. His expertise includes utility automation, utility communication, SCADA systems, metering, smart grid/microgrid, telecommunication technologies, data analysis and integration, business planning/cost benefit analysis, and solution implementation oversight. Prior to joining ORNL in 2019, He served as the Program Manager for the ORNL IDIQ and GSA Advanced Metering Project and has managed other Federal contracts He was also the Portfolio Manager for CSRA/GDIT's Energy Analysis and Sustainable Operations group. Mr. O'Reilley received an MBA from the University of Phoenix, MS from Pennsylvania State University, and BS in Electrical Engineering from Villanova University.

Tom Overbye, Texas A&M University

Thomas J. Overbye is a Professor and holder of the O'Donnell Foundation Chair III in the Department of Electrical and Computer Engineering at Texas A&M University (TAMU). Prior to joining TAMU in 2017 he was a Professor at the University of Illinois at Urbana-Champaign. He received his BS, MS, and Ph.D. degrees in Electrical Engineering from the University of Wisconsin-Madison. Before starting his academic career he was employed with Madison Gas and Electric Company. He is the original developer of

PowerWorld Simulator, a co-founder of PowerWorld Corporation, and an author of a widely used Power System Analysis and Design book. He was also the recipient a University of Wisconsin-Madison College of Engineering Distinguished Achievement Award, the IEEE Power and Energy Society Outstanding Power Engineering Educator Award, and is a member of the US National Academy of Engineering. Dr. Overbye has extensive experience in many aspects of electric power systems, including participating in or leading numerous large-scale electric grid studies.

Dave Schoenwald, Sandia National Laboratories

David Schoenwald is a Principal Member of the Technical Staff in the Electric Power Systems Research Department at Sandia National Laboratories. Dr. Schoenwald focuses on control system design to improve dynamic stability of electric power systems. He also develops performance standards for grid-scale energy storage applications. Before joining Sandia, he was with Oak Ridge National Laboratory, where he designed control systems for manufacturing applications. He was also an adjunct assistant professor in the Electrical Engineering Department, University of Tennessee, Knoxville, where he taught a graduate course on nonlinear control systems. Dr. Schoenwald received an R&D 100 award in 2017 for development of an inter-area oscillation damping controller for the western North American power grid. He received the 2017 Outstanding Engineer Award of the Albuquerque Section of the IEEE. He served as Technical Co-Chair of the 2017 Electrical Energy Storage Applications & Technologies (EESAT) Conference. Dr. Schoenwald received his PhD in electrical engineering from The Ohio State University.

Travis M. Smith, Oak Ridge National Laboratory

Travis M. Smith is a member of the Research Staff in the Power and Energy Systems group at ORNL. He is a Senior IEEE member, a member of the NCEES exam development committee, and is a licensed Professional Engineer. He has a combined total of 30 years power systems experience, including Federal and Private Utilities, Consulting, and Research. His research focus includes power system simulation and modeling, system protection, substation design, wind/solar generation interconnection, microgrid protection, and power quality analysis.

Emma M. Stewart, National Rural Electric Cooperative Association

Emma Stewart, Ph.D. is chief scientist of the National Rural Electric Cooperative Association (NRECA) where she works to expand the leadership of NRECA and electric co-ops in the scientific and engineering communities. She leads the Business & Technology Strategies team to further advance research into grid resilience and reliability, transmission and distribution, cybersecurity and more. Dr. Stewart most recently served as Associate Program Leader, Defense Infrastructure, at Lawrence Livermore National Laboratory in California. She also managed the Grid Integration Group at Lawrence Berkeley National Laboratory, led the distribution planning, modeling and analysis consulting group at BEW Engineering, a DNV Company, and performed research on hydrogen fuel cells and other hydrogen programs at Sandia National Laboratory. She earned her Ph.D. in Electrical Engineering and Master of Engineering degree from the University of Strathclyde, Glasgow, Scotland.

Lingwei Zhan, Oak Ridge National Laboratory

Lingwei's research interests include advanced grid monitors, PMU, synchrophasor measurement algorithms, wide-area power system monitoring, renewable energy sources, FACTs, and HVDC. He holds three US patents in advanced grid sensors and published over 40 articles. He was NASPI Outstanding Student of the Year 2015 in recognition of his significant contributions to synchrophasor technology. He was an R&D100 Awards winner for developing low-cost synchronized measurement device.

Panelists

John Buechler, Eastern Interconnection Planning Collaborative

John Buechler is Executive Director of the Eastern Interconnection Planning Collaborative (EIPC), and works as an independent consultant. Prior to joining EIPC, Mr. Buechler was the Executive Regulatory Policy Advisor at New York Independent System Operator (NYISO), where he advised the NYISO's CEO, officers and Board on key regulatory issues. Previously, he worked as senior executive consultant at KEMA Consulting, and was the Project Managing Director for the New York ISO with overall responsibility for the transition of the New York Power Pool to an Independent System Operator. Mr. Buechler has an MS in Management from the Polytechnic Institute of New York, and a BEE in electrical engineering from Manhattan College and is a Life Member of the IEEE.

Sandra Ellis, Pacific Gas and Electric

Sandra Ellis is Interim Director, Transmission Grid Operations at Pacific Gas & Electric (PG&E) where she is responsible for the safe, reliable, compliant, and event-free operation of PG&E's electric transmission system. Dr. Ellis has been with PG&E since 2004, serving most recently as senior manager of the Transmission Operations Engineering team. Dr. Ellis earned B.S. and Ph.D. degrees in Electrical Engineering from the University of California, Berkeley, and M.S. in the Electric Utility Management Program from New Mexico State University. Dr. Ellis holds a NERC System Operator Certification for a Reliability Coordinator and is a Licensed Professional Engineer in the state of California. Dr. Ellis is a Senior Member of IEEE.

Matthew Gardner, Dominion Energy

Matt Gardner is Director, System Protection with Dominion Energy's Power Delivery Group. In this role, Matt oversees the company's System Protection organization, including both engineering and field operations responsibilities. His organization also includes Dominion Energy's T&D Protection and Control Standards, Data Engineering and Analytics, and Operations Engineering Studies groups. Since joining Dominion in 2008, Matt has held various roles in planning, operations, and engineering. Outside of Dominion Energy, Matt has a range of experiences spanning industry, academic, and regulatory domains. As an IEEE Senior Member, Matt stays deeply involved in industry groups such as the IEEE Power and Energy Society, Cigré, EPRI, and the North American Transmission Forum, to name a few. Matt also has a passion for the development of future generations of technical talent for our industry and is actively involved with a broad number of academic institutions and consortia, including Virginia Tech. Speaking of Virginia Tech, Matt received his PhD degree in Electrical Engineering from Virginia Tech where he was a Bradley Fellow. He also holds BS and MS degrees in Electrical Engineering from Virginia Tech. Matt is a licensed Professional Engineer in the Commonwealth of Virginia.

Tim Heidel, VEIR, Inc.

Tim Heidel is Chief Technology Officer at VEIR, Inc. where he is helping develop a new generation of cost effective, high capacity, long distance transmission lines using high temperature superconductors. Prior to joining VEIR, Dr. Heidel was an investor at Breakthrough Energy Ventures (BEV) where he focused accelerating the development and adoption of new approaches for controlling and optimizing the transmission and delivery of electric power, particularly in the context of high renewable generation penetrations. Prior to joining BEV, Tim was Deputy Chief Scientist at the National Rural Electric Cooperative Association (NRECA) where he led technology development R&D programs in the areas of electric utility data analytics and grid cybersecurity. Prior to joining NRECA, Dr. Heidel served as a Program Director at the Advanced Research Projects Agency-Energy (ARPA-E), where he managed a portfolio of over 75 research projects in the areas of electric power systems engineering and power

electronics. Tim began his career as the Research Director for MIT's "Future of the Electric Grid" study, coordinating research efforts from economics, policy and electrical engineering on the most important challenges and opportunities that are likely to face the U.S. electric grid over the next several decades. Dr. Heidel holds SB, MEng, and PhD degrees in Electrical Engineering and an MS in Technology and Policy from the Massachusetts Institute of Technology.

Jeffrey G. Hildreth, Bonneville Power Administration

Jeffrey Hildreth currently works at the Bonneville Power Administration's Carey High Voltage Lab in Vancouver, WA. He graduated from the Georgia Institute of Technology, Atlanta GA, with a BS degree in Electrical Engineering in 1995 and a MS degree in Electrical Engineering in 2002. His employment experience includes the design of high-speed digital circuits at Intel Corporation in Portland, OR and the testing of power system components at the NEETRAC High Voltage Lab in Forest Park, GA. His interests include power systems, high voltage testing, grid modernization, and specialized field measurements.

Leonard Kula, Independent Electricity System Operator

Leonard Kula is Chief Operating Officer and Vice-President, Planning, Acquisition and Operations for the Independent Electricity System Operator (IESO). In this role, Mr. Kula is responsible for the reliable and efficient Ontario-wide power system both today and in the future. This includes planning, market design, resource and transmission acquisition, real-time operations and engineering. Prior to this position, Mr. Kula held a number of positions of increasing responsibility at the IESO since joining the organization in 1999. Mr. Kula began his career at Ontario Hydro in 1986 designing control systems and building simulators for Ontario's nuclear power generators. Mr. Kula holds a BSc in Mechanical Engineering from the University of Calgary, MAsc in Mechanical Engineering from the University of Waterloo, and MBA from York University. He is registered as a Professional Engineer in Ontario.

Ken McIntyre, Midcontinent Independent System Operator

Ken McIntyre is the Executive Director, System and Operations Integration at Midcontinent Independent System Operator (MISO). He has 25 years of direct experience in the power industry and energy sector as a grid operator, planner and design engineer, consultant, regulator and executive. He has been a member and chair of various industry leadership and regulatory committees and had the honor to be in roles that foster the development of others whilst serving the community. Prior to MISO, Ken had success as vice president and director of Standards and Compliance at the North American Electric Reliability Corporation (NERC). Before NERC, Ken served as vice president of Planning and Operations for the Electric Reliability Council of Texas (ERCOT), as well as a lengthy engineering and operations career at Powerlink Queensland, a transmission utility in Australia. Mr. McIntyre earned a bachelor's degree in Electrical/Electronic Engineering from the University of Southern Queensland and a master's degree in Business from Charles Sturt University.

Andrew Phillips, Electric Power Research Institute

Dr. Andrew Phillips is Vice President of Transmission and Distribution Infrastructure at the Electric Power Research Institute. He provides executive oversight and direction for research, development and demonstration programs addressing T&D infrastructure including issues and opportunities in diverse areas such as asset performance and management, data analytics, reliability, robotics and sensors. During his career at EPRI, Dr. Phillips has led the industry in developing advanced approaches and technologies to manage a range of T&D assets.

Ryan D Quint, North American Electric Reliability Corporation

Ryan Quint is the Senior Manager of BPS Security and Grid Transformation at the North American Electric Reliability Corporation. His primary focus areas include grid transformation, enabling emerging technologies, security integration, and integration of inverter-based technologies and distributed energy resources. Prior to joining NERC in 2015, Dr. Quint previously worked at Dominion Virginia Power and the Bonneville Power Administration. Dr. Quint received his PhD from Virginia Tech and is a registered professional engineer.

Greg Zweigle, Schweitzer Engineering Laboratories

Greg Zweigle is a R&D Fellow Engineer at Schweitzer Engineering Laboratories (SEL). He joined SEL in 1998 as a software engineer and later worked as a Senior Research Engineer and Principal Research Engineer. Dr. Zweigle has a PhD in Electrical Engineering and Computer Science, MS in Physical Chemistry, MS in Electrical Engineering from Washington State University, and BS in Physics from Northwest Nazarene University.