

Wind Generation in Power Systems: A Short Course on the Integration and Interconnection of Wind Power Plants into Electric Power Systems

September 14-17, 2009, Renaissance Charleston Historic District, Charleston, SC

Wind power is the fastest growing form of generation in the world today, growing worldwide at the rate of 36% more than in 2007. Today, there is over 25,170 MW of wind capacity installed in the US, and over 120,791 MW of wind capacity installed worldwide. The new projects in the US completed in 2008 alone account for about 42 percent of the entire new generation capacity added during the year. The American Wind Energy Association projects that an additional 5,000 MW of new capacity will be commissioned this year.

In order to properly study and evaluate the impact of this new capacity, which behaves differently than more conventional fossil generation, an understanding of its characteristics is essential. This short course will provide an introduction to the underlying technology of wind turbine generators and wind power plants, how to model them for power system analysis purposes for planning and operating studies, and an introduction to using actual models in simulation programs.

This course is intended to provide the necessary background for engineers and researchers on the interconnection and integration of wind generation power plants into electric utility systems. It is also geared towards experts already working in this area, as there will be an opportunity to exchange knowledge and discuss experiences from around the globe. Experts from the US and Europe will provide state-of-the-art knowledge and expertise on the application of power system engineering methods to address the incorporation of wind power plants into electric power systems.

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In addition, the European instructors will provide insights on dealing with high wind power penetration levels in European networks – for example, average wind power penetration levels of 20-30 % with peak penetration levels of up to 100%.

Target Audience

This course is targeted towards power systems engineering and management personnel from utilities, RTOs, ISOs, and ITCs as well as consultants, manufacturers and developers involved with the evaluation and planning of the interconnection and operation of new wind plants. Regional planning entities and regulatory authorities will also benefit from this course.

Topics Background

- Utility wind integration state of the art
- Costs and benefits of large scale integration of wind power
- Discussion of different wind turbine design concepts

Power System Planning Issues

- Basic aspects of network integration
- Capacity value and cost of ancillary services
- Experiences with wind power integration in the US and Europe

Power System Operation Issues

- Power system operation and balancing: evaluation and management of the uncertainty of short-term wind power variations
- Wind forecasting: Available tools and methods for short and medium term forecasting for improved power system operations planning
- Voltage control, power quality and protection issues
- Grid codes and recent US and European experiences
- High penetration issues

Wind Turbine Modeling and Simulation

- Introduction to wind turbine modeling and simulation
- Wind turbine control issues
- Dynamic simulation studies related to wind power
- Specific simulation experiences, e.g., voltage control, reactive power control, low voltage ride-thru, system stability

Costs

UWIG Members – USD 1695

Non-Members – USD 1995

Government – USD 1695

Academic/Faculty – USD 1295

Space is limited to the first 35 registrants. The cost covers breakfast, coffee breaks, and lunch daily as well as a reception and a group dinner. Course materials and a copy of the book *Wind Power in Power Systems*, Editor: Thomas Ackermann, Publisher: Wiley & Sons, will be provided.

About the Instructors

THOMAS ACKERMANN – CEO, Energynautics & Lecturer – Royal Institute of Technology, Stockholm, Sweden

Thomas Ackermann, Ph.D. is CEO of Energynautics, a German-based research and consulting company in the field of wind power and power systems. He provides research and consulting services for wind turbine manufacturers, project developers and investors as well as for transmission system operators; among others, regarding the

integration of wind power into power systems. He has worked in the wind power industry in Europe, Asia, Australia/NZ and North America and currently also lectures at the Royal University of Technology (KTH) in Stockholm, Sweden. He is the editor of the book "Wind Power in Power Systems," and editor of the Wind Energy Journal, both published by Wiley & Sons. He holds the degree of a Diplom Wirtschaftsingenieur (M.Sc. in Mechanical Engineering combined with an MBA) from the Technical University Berlin/ Germany, a M.Sc. in Physics from Dunedin University/ New Zealand and a Ph.D. from the Royal University of Technology in Stockholm/ Sweden.

DICK PIWKO – Director of Power Systems Engineering – GE Energy

Dick Piwko is Director of Power Systems Engineering with GE's Energy Applications and Systems Engineering group in Schenectady, NY. His responsibilities include management of large-scale system studies, power plant performance testing, control system design, analysis of interactions between turbine-generators and the power grid, and overall performance of large interconnected power grids. He has led numerous system design projects involving high-power electronics, including HVDC, static var systems, and thyristor controlled series capacitors. He recently contributed to GE's development of the Variable Speed Transformer (VFT), a new technology for transferring power between asynchronous power grids.

Dick is a Fellow in the IEEE and has served as chairman of the IEEE Transmission and Distribution Committee and the HVDC and Flexible AC Transmission Subcommittee. He is presently chairman of the IEEE Wind Power Coordinating Committee and a member of the NERC Task Force on Integrating Variable Generation.

REIGH WALLING – Director of Energy Applications and Systems Engineering – GE Energy

Reigh Walling is a Director of Energy Applications and Systems Engineering for GE Energy and is involved in a wide range of power system issues including wind generation systems as well as ac and HVDC transmission and distribution technologies. He

was a co-developer of GE Wind Energy's unique windfarm voltage and reactive power control system, and recently led a major wind integration study for the Electric Reliability Council of Texas (ERCOT).

Reigh is a Fellow of the IEEE, has authored over thirty-five papers, and has been awarded ten patents. He has chaired several working groups of the IEEE Power and Energy Society, and is presently the co-chair of the Short-Circuit Current Characteristics of Wind Generation working group.

BOB ZAVADIL – Vice President and Principal Consultant – EnerNex Corporation

Robert Zavadil has worked on electric power system issues for wind generation for over 15 years. His clients include wind turbine designers and manufacturers, project developers and operators, transmission service providers and ISOs, and research and development organizations including NREL and EPRI. He serves as an observer on the NERC Integration of Variable Generation Task Force.

Bob earned his BS in Electrical Engineering from South Dakota State University and began his career as a special studies engineer in the Transmission and Distribution Engineering Division of the Nebraska Public Power District. He is a member of the IEEE Power Engineering, Power Electronics, and Industrial Applications Societies.

MARTIN HØGDAHL – Converter Control – Vestas

Martin received his M.Sc.EE. in 1996 from Aalborg University. From 1997 to 1999 he worked for Ericsson DiAx in the R&D department. He received a Ph.D. from Aalborg University in 2003 for his work in the field of distribution network modeling. Since 2002, he has been working in the R&D department at Vestas in wind turbine modeling using the PSCAD simulation tool.

MICHAEL MILLIGAN – Principal Analyst – National Renewable Energy Laboratory

Michael Milligan works on the electric grid integration team at National Renewable Energy Laboratory, where he has analyzed various aspects of electricity supply related to wind energy since 1992. He has worked on issues such as the ancillary service impacts of wind generation, impact of balancing area

combined operations on wind integration, impact of RTOs and ISOs on wind integration, the value of accurate wind forecasting, optimal selection of geographically disperse wind power plants, modeling wind plant variability, and reliability contribution and capacity credit of wind power plants. He is a member of the IEEE Wind Power Coordinating Committee and the NERC Integration of Variable Generation Task Force, has authored or coauthored more than 85 papers, reports, and book chapters, and regularly participates in technical advisory committees for wind integration studies around the U.S.

Before coming to NREL, Michael worked in the electric utility industry, where he was involved with load forecasting, rate analysis, and electricity production simulation. He has M.A. and Ph.D. degrees from the University of Colorado, and a B.A. from Albion College.

JOE SULLIVAN – PRODUCT MANAGER – WindLogics, Inc.

As Product Manager, Joe works in concert with the WindLogics Operations Center to deliver met data management services and utility-scale energy forecasts for developers, operators and utilities. He is also responsible for developing new, state-of-the-art measurement, forecasting and visualization techniques to manage data and forecast wind power, through internal R&D projects with the company's Research and Development Groups. As a result of these efforts, Joe is thoroughly familiar with the data requirements, and corresponding WindLogics offerings, for successful renewables integration and operational compliance.

Joe joined WindLogics in 2007, after 10 years in broadcast meteorology. He has extensive experience in operational forecasting and is well-versed in technical weather software, numerical weather models, radar systems and graphics presentation software. Joe holds a B.S. in Earth Science-Meteorology from St. Cloud State University (MN).

MICHAEL KENNEDY – Senior Electrical Engineer – Vestas

Michael Kennedy joined Vestas as a senior electrical engineer over 4 years ago and provides technical support to the customers, sales team and project technicians of Vestas Americas. It was in the early 80's that Kennedy first became involved with wind

turbines, when the turbines of the day were being integrated into small power systems in remote areas of Australia. In the intervening time, Kennedy provided consulting services to the mining, oil, and gas, manufacturing and utility sectors in Australia, Asia and North America. He received his Bachelor of Engineering degree from the Western Australian Institute of Technology, now Curtin University.

DALE OSBORN – Transmission Technical Director– Midwest ISO

Dale Osborn is the Transmission Technical Director for the Midwest ISO. Wind generation issues, economic long range transmission expansion and voltage stability are his main focus. He serves as one of the Directors of UWIG for the ISO/RTO sector. He is vice chair of the IEEE Wind Power Coordination Committee and serves on the NERC Integration of Variable Generation Task Force. He serves on the DOE Peer Review for the Wind Energy Program. He is a registered engineer in the state of Nebraska.

He worked for ABB for nineteen years in various positions involving Static VAR System design and performance verification, HVDC studies, and small SVC applications for industry including a wind farm. Previously, he worked for the Nebraska Public Power District for 10 years as the Manager of Power Resource and Transmission Planning. He has a BSEE and MSEE from the University of Nebraska at Lincoln.

Location and Accommodations

The course will be conducted at the Renaissance Hotel Charleston Historic District in Charleston, South Carolina.

This hotel is Marriott's newest upscale property in historic Charleston. The hotel is blocks away from the City Market and King Street and convenient to attractions, dining, and nightlife. Learn more at <http://www.marriott.com/hotels/travel/chsbr-renaissance-charleston-hotel-historic-district/>.

Individuals are responsible for their own room reservations. You should contact:

Renaissance Hotel
68 Wentworth Street
Charleston, SC 29401
843-534-0300
Reservations 800-605-1498

When making reservations, refer to the group code UWIC to receive the group rate of \$189/night plus applicable taxes. You will not be guaranteed the group rate or availability after the cut off date of Monday, August 24.

Registration

Online registration is available at <http://www.uwig.org/shortcourse2009.html>. Registrations can be paid by check, credit card (Visa, MasterCard, American Express, and wire transfer (with prior approval).

Cancellations and Refunds

All requests for refunds must be submitted to UWIG in writing. Refunds may not be processed until after the course takes place. There is a \$US300 cancellation fee up to September 8, after which the fee increases to \$US750 for cancellations made by September 11. Registrations can be transferred within an organization. Refunds for no shows will be granted only under extreme circumstances. Payment must be received by September 8 or the registration may be cancelled.

Optional Program

Attendees can attend an optional session on Thursday morning, September 17. This will consist of an interactive demonstration of the use of wind plant models for power system analysis software applications for short circuit and stability studies. A discussion of the work of the UWIG Wind Plant Modeling and Interconnection Study User Group will follow. This program is available at no additional charge, but does require advance registration.

Credit for Attendance

2.4 Continuing Education Units will be awarded to course attendees.

For More Information

Questions should be directed to:

Sandy Smith
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