PROCEEDINGS

11th International Workshop on Large-Scale Integration of Wind Power into Power Systems as well as on Transmission Networks for Offshore Wind Power Plants

13 - 15 November 2012
Lisbon, Portugal

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Welcome
to the 11th International Workshop on Large-Scale Integration of Wind Power into Power Systems as well as on Transmission Networks for Offshore Wind Power Plants

We have the great pleasure to welcome you to the 11th edition of the *International Workshop on Large-Scale Integration of Wind Power into Power Systems as well as on Transmission Networks for Offshore Wind Power Plants* in Lisbon, Portugal.

While the first of these workshops was held 12½ years ago at the Royal Institute of Technology, Stockholm, Sweden in March 2000 with 4 sessions in total, this year we received such a large number of outstanding abstracts that we can offer now a two-and-a-half day program with 26 sessions.

While the focus of the first workshop was on HVDC transmission technology, including HVDC transmission networks, the key topics have changed continuously over the past years, reflecting the shifting focuses in the area of wind integration: modelling issues, national grid integration experience, market issues as well as grid code issues were key topics of previous workshops. This way, the workshop has developed into a renowned international platform for discussing the subject of grid integration of wind power into existing power systems.

The general purpose of this workshop, however, has not changed over the past years: It is to get researchers, economists and practicing engineers from different fields relating to wind power and transmission systems to exchange their knowledge and discuss their experience in the area of large-scale integration of wind power into power systems and transmission networks for offshore wind farms. The emphasis of this workshop is again on both theoretical discussion and practical applications.

Because of the high interest in the workshop proceedings, we will again submit this year's proceedings to international libraries and organisations who operate citation index systems such as the (i) FIZ - Fach Informations Zentrum Karlsruhe, (ii) Elsevier, (iii) ETDE, (iV) Reuters, (V) Compendex, (Vi) ThomsonCitationIndex so that the proceedings are more easily available for academia and industry world-wide.

The *11th Wind Integration Workshop* forms the anchor workshop for a number of related events such as the *Tutorials for the Solar Integration Workshop* (November 11, 2012) and *Tutorials on Wind Turbine Modelling* (November 12/13, 2012) and the *2nd International Workshop on Integration of Solar Power into Power Systems* (November 12/13, 2012).

This workshop would not be possible without our sponsors and we would like to thank them for their support. Our **Tera Sponsors** this year are: the Portuguese TSO ***REN*** and the wind turbine manufacturer ***Enercon*** (Germany), our **Giga Sponsors**: the consulting and software company ***DIgSILENT*** (Germany), the energy group ***DONG energy*** (Denmark), the renewable energy consultancy ***GL Garrad Hassan*** (USA) and the wind turbine manufacturer ***Siemens Wind*** (Denmark). In addition, the workshop is supported by the Spanish Wind Energy Association ***aee*** (Spain), the European Wind Energy Association ***EWEA,*** Friends of the Supergrid ***FOSG***, the ***Renewables Grid Initiative*** (Germany), the Utility Variable Generation Integration Group ***UVIG*** (USA) and the publisher ***renovávais magazine*** (Portugal). And above all, we would like to thank the Portuguese TSO ***REN*** for its general support and local assistance.

We would also like to thank all those who supported the organizers of this workshop: José Osorio (REN) and Ana Estanqueiro (LNEG, Portugal), the International Advisory Committee as well as Uta Betancourt, Jörg Braun and Ines Drewianka (all Energynautics, Germany).

Enjoy some inspiring days in Lisbon and seize the numerous networking possibilities!

Thomas Ackermann
energynautics

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Economic Evaluation of Short-Term Wind Power Forecasts in ERCOT: Preliminary Results
K. Orwig (NREL, USA), V. Banunarayanan, S. Nasir (ICF International, USA), B.-M. Hodge, G. Brinkman, E. Ela, M. Milligan (NREL, USA), J. Freedman (AWS Truepower, USA)

Common Characterization of Variability and Forecast Errors of Variable Energy Sources and their Mitigation Using Reserves in Power System Integration Studies
N. Menemenlis, M. Huneault (IREQ/Hydro-Québec, Canada), A. Robitaille (Hydro-Québec, Canada), H. Holttinen (VTT, Finland)

Use of Offsite Data to Improve Short Term Ramp Forecasting
A. Suzukui (GL Garrad Hassan, United Kingdom), P. Shaw, C. Collier (GL Garrad Hassan, USA), J. Parkes (GL Garrad Hassan, United Kingdom), L. Landberg (GL Garrad Hassan, Denmark)

Session 8C: Frequency/Inertia Response

11:20 – 13:00 / 15 November 2012 / Room Castelo VIII/IX / Session chair: Poul Ejnar Sørensen (DTU Wind, Denmark)

Ancillary Services for the European Grid with High Shares of Wind and Solar Power
F. Van Hulle (EWEA, Belgium), H. Holttinen, J. Kiviluoma (VTT, Finland) N. Cutululis (DTU, Denmark)

Assessment and Implementation of Inertial Response from Variable Speed Wind Turbines
G. Xu, L. Xu, J. Morrow (Queen's University Belfast, United Kingdom)

Delivering Combined Droop and Inertial Response from Wind Plant to the GB Power System
L. Wu, D. Infield (University of Strathclyde, United Kingdom)

Real-time System-wide Inertia Estimation in Power Systems with High Wind Penetration Levels
M. R. Bank Tavakoli, M. Power, L. Ruttledge, D. Flynn (Unversity College Dublin, Ireland)

Frequency Controlling Wind Power - Modelling of Control Strategies
M. Wang-Hansen, R. Josefsson, H. Mehmedovic (ÅF, Sweden)

Session 9A: HVDC Technology II

14:00 – 15:40 / 15 November 2012 / Room Alfama / Session chair: T.B.A.

Power-electronic Asset Characteristics for HVDC-connected Offshore Grids
C. Heising, D. Meyer, R. Bartelt (Avasition, Germany), M. Koochack Zadeh, T. J. Lebioda, J. Jung (TenneT Offshore, Germany)

Investigation of Steady State Operation and Dynamic Performance of a MMC Based HVDC Link
E. N. Abildgaard, Ø. A. Rui (Statnett, Norway), M. Molinas (Norwegian University of Science and Technology, Norway)

Reliability Analysis of HVDC Grid Combined with Power Flow Simulation
Y. Yang, T. Langeland, J. Solvik (DNV, Norway), E. Stewart (DNV KEMA, USA)

Examination of Fault Ride-Through Methods for Off-Shore Wind Farms Connected to the Grid through VSC-Based HVDC Transmission
U. Karaagac, J. Mahseredjian, H. Saad (Polytechnical School of Montreal, Canada), S. Jensen, L. Cai (REpower, Germany)

Session 9B: Grid Code Issues

14:00 – 15:40 / 15 November 2012 / Room Castelo I/II / Session chair: T.B.A.

50/60 Hz Grid Code Test and Verification Experience
Z. Fan (GermanischerLloyd, Germany), J. Meggers (GL Garrad Hassan, Germany), T. Wehrend, T. Gehlhaar (Germanischer Lloyd, Germany)

FGW's Experiences with and Solutions for the Integration of Renewables into the German Grid
J. Rauch (FGW, Germany), J. Möller (M.O.E., Germany)

Transient Control of Grid-connected Converters for Wind Turbines to Fulfill Future Grid Codes
D. Tong, X. Yuan, J. Hu (Huazhong University of Science and Technology, China)

Flexible Fault Ride Through of DFIG Wind Turbines with DC-Chopper Solution
C. Wessels, M. Laubrock, U. Bellgardt (Nordex Energy, Germany), A. Genius (Woodward Kempen, Germany)

The Influence of Reactive Current on Wind Farm LVRT Behavior
Q. Li, M. Zhang, J. He, S. Qin (China Electric Power Research Institute, China)

Session 9C: Modelling II

14:00 – 15:40 / 15 November 2012 / Room Castelo VIII/IX / Session chair: Jens Fortmann (REpower Systems, Germany)

Generic Simplified Simulation Model for DFIG with Active Crowbar
F. Jiménez Buendía (Gamesa, Spain), B. Barrasa Gordo (Assystem Iberia, Spain)

A Wide-Band Equivalent Model for the Full-Converter Based (Type-4) Wind Power Plant
D. N. Hussein, R. Iravani (University of Toronto, Canada)

Power System Modelling at the Interplay of Markets, Control and Engineering
J. Frunt, G. Dekker, W. de Boer, M. Duvoort (DNV KEMA, the Netherlands)

Session 10: Closing Session – Podium Discussions

16:00 – 17:00 / 15 November 2012 / Room Alfama / Session chair: T.B.A.

Podium discussions -Participants:
Paul Gardner (GL Garrad Hassan, United Kingdom) et al.

The contributions and discussions of this session are not part of the proceedings.

Poster Presentations

ACE-netting Between Germany, Western Denmark, the Netherlands and Switzerland
J.E.S. de Haan, A. Virag, I. Lampropoulos (Eindhoven University of Technology, the Netherlands), J. Frunt (DNV KEMA, the Netherlands), W. Kling (Eindhoven University of Technology, the Netherlands)

Grid Integration Aspects within Wind Farm Projects
R. van de Sandt, H. Bußmann (Fichtner, Germany)

Schematic Network Based on German Power System to Support Research Projects
F. Florez, T. Degner (Fraunhofer IWES, Germany), S. Mesa (XM TSO, Colombia)

Virtual Power Players Dealing With Excessive Wind Power Situations Using Real Time Pricing
P. Faria, Z. Vale, H. Morais (GECAD Polytechnic of Porto, Portugal)

Small-Signal Stability Analysis of DC-Link Voltage Control System Affected by Synchronization Control in a Wind Turbine Connected to Weak Grid
Y. Huang, X. Yuan, J. Hu (Huazhong University of Science and Technology, China)

Comparing Two Statistical Local Wind Power Forecasting Methodologies
A. Arnoldt, M. Agsten, P. Bretschneider (Fraunhofer IOSB-AST, Germany)

Regulation of the Wind Power Production: Contribution of the Electric Vehicles and Other Energy Storage Systems
C. B. Mateus, A. Estanqueiro (LNEG, Portugal)

Wind Energy Management for Smart Grids with Storage Systems
M. Gascó (University of Alicante, Spain), A. Rios (European University of Madrid, Spain)

Grid Integration Study of a Wind Farm in a 220 kV Grid
E. Teixeira, C. Alvarez-Ortega (Energy to Quality, Spain)

Wind Turbines for Bridge Structures and for Built-Environment Wind Turbines
L. Åkesson (SP Technical Research Institute of Sweden, Sweden)

Examining the Variability of Wind Power Output in the Regulation Timeframe
B.-M. Hodge, S. Shedd, A. Florita (NREL, USA)

Modelling Wind Speed Parameters for Computer Generation of Wind Speed in Flanders
M. Gay, M. Van Dessel (Lessius Mechelen,Belgium), J. Driesen (KULeuven, Belgium)

Evaluation of Different Operational Strategies for Lithium Ion Battery Systems Connected to a Wind Turbine for Primary Frequency Regulation and Wind Power Forecast Accuracy Improvement
M. Świerczyński, D. I. Stroe, A. I. Stan, R. Teodorescu, S. J. Andreasen (Aalborg University, Denmark)

Offshore Grid Transmission Planning Using Approximated HVDC Power Flows
S. Shariat Torbaghan, B. G. Rawn, M. Gibescu, M. van der Meijden (TU Delft, the Netherlands)

Artificial Intelligence to Predict Short-term Wind Speed
T. Pinto, J. Soares, S. Ramos, Z. Vale (Polytechnic of Porto, Portugal)

Evaluation of Planetary Boundary Layer Parameterizations in the WRF Model for Wind Energy Applications at Ceará State, Brazil
C. Melo, P. Carvalho (DEE - UFC, Brazil), J. Leal Júnior (FÍSICA - UECE, Brazil)

Maximising Value of Wind Power Allocation: A Multi-objective Optimisation Approach
L. Reichenberg, J. Goop, F. Johnsson, M. Odenberger (Chalmers University of Technology, Sweden)

An Introduction to Variable-Energy-Rexource Integration Analysis
E. Toolson (Energy Exemplar LLC, USA)

Design of Efficient and Reliable Cluster Collection Systems
J. Pan, S. Bala (ABB Corporate Research, USA), O. Apeldoorn, S. Ebner (ABB, Switzerland), M. Reza (ABB Corporate Research, Sweden), Stephan Ebner (ABB Switzerland)

Investigating the Benefits of Loss Minimization in Wind Farms by Optimal Control
A. Timbus, C. Franke (ABB Corporate Research, Switzerland), C. Bănceanu, I. Vrânceanu, R. Teodorescu, A. Adamczyk (Aalborg University, Denmark)

A Simplified Approach to Detect Undervoltage Tripping of Wind Generators
L. Sigrist, L. Rouco (Comillas University Madrid, Spain)

Assessment of a Methodology for Transmission Expansion Planning around the North Sea
S. Jaehnert, H. Farahmand, S. Völler, O. Wolfgang, D. Huertas-Hernando (SINTEF, Norway)

Transmission Infrastructure Development Criteria for Interconnecting Large Scale Wind Generation
V. Banunarayanan, K. Collison, K. Kumaraswamy, (ICF International, USA)

Variation Management through Spatial Distribution of Wind Power Capacity
L. Göransson, L. Reichenberg, F. Johnsson (Chalmers University of Technology, Sweden)

Pressure Coefficient Evolutions on the Blades of a Savonius Rotor
A. Chauvin, S. Guignard (Laboratoire IUSTI, France), B. Kamoun (Laboratory of Applied Physics, Tunisia)

Workshop Participants

Workshop Information