

PROCEEDINGS

12th Wind Integration Workshop

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



22 - 24 October 2013 | London, UK

Tera Sponsors:



nationalgrid

Giga Sponsors:

SIEMENS



DONG
energy

Vestas®
Wind. It means the world to us.

Organizer:



PROCEEDINGS

Edited by Uta Betancourt / Thomas Ackermann

12th Wind Integration Workshop

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



22 - 24 October 2013 | London, UK

Tera Sponsors:



Organizer:



Giga Sponsors:



Supported by:



Media Partner:



IMPRINT

Proceedings
of the 12th International Workshop on Large-scale Integration of Wind Power into
Power Systems as well as on Transmission Networks for Offshore Wind Power Plants
published in 2013 by:

Energynautics GmbH
Mühlstraße 51
63225 Langen
Germany
www.energynautics.com
info@energynautics.com

All rights reserved. No part of this publication may be reproduced, transmitted or stored
in a retrieval system in any form or by any means without permission in writing
from the respective author.

ISBN: 978-3-98 13870-7-0

Cover Design by:
Ines Drewianka, Energynautics GmbH, Germany

Printed by:
Kopierart GbR, Berlin, Germany
www.kopierart.de

Welcome to...

the 12th 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 **12th 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 London, United Kingdom.

The first of these workshops was held 13 years ago at the Royal Institute of Technology, Stockholm, Sweden in March 2000 with just 4 sessions in total. This year we received such a large number of outstanding abstracts that we can now offer a two-and-a-half day program with 25 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, grid integration experience for the transmission level as well as the distribution level, market issues and grid codes 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 power plants. The emphasis of this workshop is again on both theoretical discussions 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 **12th Wind Integration Workshop** forms the anchor workshop for related events such as the **Tutorials for the Solar Integration Workshop** (October 20, 2013) and the **3rd International Workshop on Integration of Solar Power into Power Systems** (October 21/22, 2013).

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 British TSO **National Grid** and the wind turbine manufacturer **Enercon** (Germany); our Giga Sponsors: the consulting and software company **DigSILENT** (Germany), the energy group **DONG energy** (Denmark), the wind turbine manufacturers **Siemens Wind** (Denmark) and **Vestas** (Denmark). In addition, the workshop is supported by the European Wind Energy Association **EWEA**, Friends of the Super-grid **FOSG** (Belgium), the **IET Digital Library** (United Kingdom) and the Utility Variable Generation Integration Group **UVIG** (USA), and by our media partner **Bloomberg New Energy Finance** (United Kingdom). And above all, we would like to thank the British TSO **National Grid** for its general support and local assistance.

We would also like to thank all those who supported the organisers of this workshop, especially Helge Urdal (National Grid/now with Urdal Power Solutions, United Kingdom), the International Advisory Committee as well as Uta Betancourt, Jörg Braun and Ines Drewianka (all Energynautics, Germany).

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

Thomas Ackermann
Energynautics

PS: Please take note of the next Wind Integration Workshop: **11-13 November 2014, to be held in Berlin, Germany!**

Table of Contents

Session 1: Keynote Session

13:00 – 15:10 / 22 October 2013 / Room Trinity / Session chair: Thomas Ackermann
(Energynautics, Germany)

Making the Low Carbon Future a Reality

N. Winser (National Grid & ENTSO-E)

Electricity Market Reform in Great Britain

J. Mills (Director EMR, Department of Energy & Climate Change [DECC], United Kingdom)

Future Energy Scenarios for Great Britain

R. Smith (National Grid, United Kingdom)

The GB networks matching the Future Energy Scenarios

P. Sheppard (National Grid, United Kingdom)

Operability. The challenges arising in a low carbon world

P. Lawton, H. Urdal (National Grid, United Kingdom)

Session 2A: Grid Integration Experiences

15:40 – 17:20 / 22 October 2013 / Room Trinity A / Session chair: Helge Urdal
(National Grid, now with Urdal Power Solutions, United Kingdom)

Analysis of High-Wind Events on the Power System of Ireland and Northern Ireland

D. Cashman, S. Power, A. Rogers, J. O'Sullivan (EirGrid, Ireland)

Impact of High Wind Speed Shut-down in the Danish Power System

N. A. Cutululis, M. Litong-Palima (DTU, Denmark), M. H. Bjerger (Siemens Wind Power, Denmark), N. Detlefsen (Energinet.dk, Denmark), P. Sørensen (DTU, Denmark)

Increased Wind Generation in Ireland and Northern Ireland and the Impact on Rate of Change of Frequency

K. Creighton, M. McClure, R. Skillen, J. O'Higgins, T. McCartan (SONI, United Kingdom), A. Rogers (EirGrid, Ireland)

Active Network Management for Integrating Renewable Energy to the Distribution Network - A Commercial Perspective

A. Laguna-Estopier, S. Georgiopoulos, (UK Power Networks, United Kingdom)

Session 2B: Flexibility and Economics of Integration

15:40 – 17:20 / 22 October 2013 / Room Trinity B / Session chairs: Hannele Holttinen (VTT, Finland) /
Simon Müller (IEA, Belgium)

Evaluation of Power System Flexibility Adequacy - The Flexibility Assessment Tool (FAST2)

S. Müller (International Energy Agency, France)

Flexibility Chart - Evaluation on Diversity of Flexibility in Various Areas

Y. Yasuda (Kansai University, Japan), A. R. Årdal (SINTEF, Norway), E. M. Carlini (Terna, Italy), A. Estanqueiro (LNEG, Portugal), D. Flynn (University College Dublin, Ireland), E. Gómez-Lázaro (University of Castilla-La Mancha, Spain), H. Holttinen, J. Kiviluoma (VTT, Finland), F. Van Hulle (XP WIND, Belgium), J. Kondoh (Tokyo University of Science, Japan), B. Lange (Fraunhofer IWES, Germany), N. Menemenlis (IREQ/Hydro-Québec, Canada), M. Milligan (NREL, USA), A. Orths (Energinet.dk, Denmark), C. Smith (UVIG, USA), L. Søder (Royal Institut of Technology/KTH, Sweden)

Wind and Solar Curtailment

D. Lew, L. Bird, M. Milligan, B. Speer, X. Wang (NREL, USA), E. Carlini (TERNA, Italy), A. Estanqueiro (LNEG, Portugal), D. Flynn (University College Dublin, Ireland), E. Gomez-Lazaro (University of Castilla-La Mancha, Spain), H. Holttinen (VTT, Finland), N. Menemenlis (IREQ/Hydro-Québec, Canada), A. Orths (Energinet.dk, Denmark), C. Smith (UVIG, USA), L. Søder (Royal Institut of Technology/KTH, Sweden), P. Sørensen, A. Altiparmakis (DTU, Denmark), Y. Yasuda (Kansai University, Japan)

Integration Costs and Marginal Value - Connecting two Perspectives on Evaluating Variable Renewables

F. Ueckerdt (Potsdam Institute for Climate Impact Research, Germany), S. Müller (International Energy Agency, France), L. Hirth (Potsdam Institute for Climate Impact Research/Vattenfall, Germany), M. Nicolosi (Connect Energy Economics, Germany)

Wind Integration Cost and Cost-Causation

M. Milligan, B. Kirby (NREL, USA), H. Holttinen, J. Kiviluoma (VTT, Finland), A. Estanqueiro (LNEG, Portugal), S. Martín-Martínez, E. Gómez Lázaro (University of Castilla-La Mancha, Spain), I. Pineda (EWEA, Belgium), J. C. Smith (UVIG, USA)

Session 3A: Voltage Control Issues

08:00 – 09:40 / 23 October 2013 / Room Trinity A / Session chair: Bernd Weise (DIGSILENT, Germany)

An Advanced Strategy of Decentralized Voltage Control for Wind Farm with DFIGs

H. Lee, J. Kim, B. Lee (Korea University, South Korea)

Impact of Increasing Distributed Wind Power and Wind Turbine Siting on Rural Distribution Feeder Voltage Profiles

A. Allen, Y. Zhang, B.-M. Hodge (NREL, USA)

Technical Capabilities and Challenges for Wind Power to Provide Voltage Support Services

L. M. Faiella (Fraunhofer IWES, Germany), N. A. Cutululis (DTU, Denmark), F. Van Hulle (XP Wind, Belgium)

Voltage Control with Wind Power Plants: Current Practice with Type IV WTGs in the UK and Ireland

D. McMullin, K. Pierros (Enercon, Germany)

Session 3B: Offshore Wind Power Plants

08:00 – 09:40 / 23 October 2013 / Room Trinity B / Session chair: Michael Frydensbjerg
(Siemens Wind Power, Denmark)

The Kriegers Flak Offshore Wind Power Plant Grid-connection Solution – Influence on Short-term Voltage Stability of the Danish Transmission System

V. Akhmatov, A. Orths, P. Børre Eriksen, H. Abildgaard, M. Powalko (Energinet.dk, Denmark)

Grid Integration of Offshore Wind Power Plants with Oil and Gas Installations – Operation Strategies and Frequency Control Issues

A. R. Årdal, S. D'Arco (SINTEF, Norway), K. Sharifabadi (Statoil, Norway)

Steady State Control Strategy for a Meshed HVDC Grid with Wind Power Plants

K. Yunus, T. Thiringer, O. Carlson (Chalmers University of Technology, Sweden)

Enhanced Dynamic Voltage Stability Support by VSC-HVDC for Offshore Wind Applications using Trajectory Sensitivity Analysis

H. Liu, Z. Chen, C. Liu (Aalborg University, Denmark)

Session 3C: Forecasting I

08:00 – 09:40 / 23 October 2013 / Room Minories / Session chair: Bri-Mathias Hodge (NREL, USA)

Analysis of Variability and Uncertainty in Wind Power Forecasting: An International Comparison

J. Zhang, B.-M. Hodge (NREL, USA), J. Miettinen, H. Holttinen (VTT, Finland), E. Gómez-Lázaro (University of Castilla-La Mancha, Spain), N. Cutululis, M. Litong-Palima, P. Sørensen (DTU Wind Energy, Denmark), A. L. Lovholm, E. Berge (Kjeller Vindteknikk, Denmark), J. Dobschinski (Fraunhofer IWES, Germany)

Impact of Weather Regimes on the Wind Power Ramp Forecast

A. Couto, P. Costa, L. Rodrigues, V. Lopes, A. Estanqueiro (LNEG, Portugal)

Design and Evaluation of an Advanced Short-term Wind Ramp Prediction System

J. Zack (AWS Truepower, USA)

Integration of Wind Power Measurements into the Assimilation Process of the Model COSMO-DE of the German Weather Service - Creating the Forward Operator

A. Wessel, B. Mey, J. Dobschinski (Fraunhofer IWES, Germany), S. Declair, R. Potthast (DWD/German Weather Service, Germany)

Session 4A: Grid Code Issues

10:10 – 12:00 / 23 October 2013 / Room Trinity A / Session chair: TBA

The Power System Will Need More! - How Grid Codes Should Look Ahead

E. Quitmann, E. Erdmann (Enercon, Germany)

The FRT Requirements for Wind Power Plants in the ENTSO-E Network Code on Requirements for Generators - TSOs' and Manufacturers' Views on Requirements, Capabilities of Wind Power Plants and Technical Challenges Related to the NC RfG – short version

J. Fortmann (REpower Systems, Germany), R. Pfeiffer (Amprion, Germany), E. Haesen (ENTSO-E, Belgium), F. Van Hulle (XP Wind, Belgium), F. Martin (Siemens Wind Power, Denmark), H. Urdal (National Grid, United Kingdom), S. Wachtel (GE Energy Consulting, Germany)

Recent and Planned Changes in the Standards and Network Codes for the Grid Connection of Wind Power in Germany

F. Scheben, J. Moeller (M.O.E. Moeller Operating Engineering, Germany)

Quantification of Losses Regarding Active Power Injection Due to New Grid Code Requirements

S. Grunau, F. Gärtner, F.-W. Fuchs (University of Kiel, Germany)

Assessment of the Frequency Settings from Distributed Generation in Germany for the Prevention of Frequency Stability Problems in Abnormal System Conditions

G. Papaefthymiou, R. Kuwahata, M. Doering, K. Burges, J. C. Boemer (Ecofys Germany, Germany)

Session 4B: HVDC Connection Issues

10:10 – 12:00 / 23 October 2013 / Room Trinity B / Session chair: Nicholas Miller (GE Energy, USA)

Requirements for HVDC Connections and DC Connected Power Park Modules in its Role for a Smarter and Greener Transmission System

W. Winter (TenneT TSO, Germany), P. Bertolini (RTE, France), W. Fischer (50Hertz Transmission, Germany), C. Longás Viejo (REE, Spain), M. Norton (EirGrid, Ireland), H. Urdal (National Grid, United Kingdom), E. Haesen, A. Székely (ENTSO-E, Belgium)

HVDC Connected Offshore Wind Power Plants: Review and Outlook of Current Research

J. Glasdam (DONG Energy Wind Power / Aalborg University, Denmark), L. Zeni, M. Gryning (DONG Energy Wind Power / DTU, Denmark), J. Hjerrild, Ł. Kocewiak, B. Hesselbæk, K. Andersen, T. Sørensen, (DONG Energy, Denmark), M. Blanke, P. E. Sørensen, A. D. Hansen (DTU, Denmark), C. L. Bak, P. C. Kjær (Aalborg University, Denmark)

An Assessment of Converter Modelling Needs for Offshore Wind Power Plants Connected via VSC-HVDC Networks

J. Glasdam (DONG Energy/Aalborg University, Denmark), L. Zeni (DONG Energy/DTU, Denmark), J. Hjerrild, Ł. Kocewiak, B. Hesselbæk (DONG Energy, Denmark), P. E. Sørensen, A. D. Hansen (DTU, Denmark), C. L. Bak, P. C. Kjær (Aalborg University, Denmark)

Multiterminal-HVDC Scaled Test Bench for Offshore Wind Transmission Systems Emulation

A. Egea-Álvarez, O J. Rull- Duran, Gomis-Bellmunt, A. Sudria-Andreu (CITCEA-UPC, Spain)

Session 4C: Forecasting II

10:10 – 12:00 / 23 October 2013 / Room Minories / Session chair: TBA

Development of Innovative Weather and Power Forecast Models for the Grid Integration of Weather Dependent Energy Sources

M. Siefert, J. Dobschinski (Fraunhofer IWES, Germany), R. Hagedorn, K. Lundgren (DWD/German Weather Service, Germany), A. Wessel (Fraunhofer IWES, Germany), D. Majewski (DWD/German Weather Service, Germany)

The U.S. Wind Forecasting Improvement Project: Results From the Southern Study Area

J. Zack (MESO, USA), J. Freedman (Atmospheric Sciences Research Center / formerly AWS Truepower, USA), J. Wilczak (NOAA, USA), J. Cline (U.S. Department of Energy, USA), I. Flores (Electric Reliability Council of Texas, USA), J. Schroeder, B. Ancell (Texas Tech University, USA), K. Brewster (Oklahoma University, USA), K. Orwig (NREL, USA), S. Basu (North Carolina State University, USA), V. Banunaryanan (ICF International, USA)

Analysis and Synthesis of Load Forecasting Data for Renewable Integration Studies

N. Steckler, A. Florita, J. Zhang, B.-M. Hodge (NREL, USA)

Analysis of Variability and Predictability Challenges of Wind and Solar Power Generation

J. de Haan, W. L. Kling (Eindhoven University of Technology, the Netherlands)

Are Forecasting Errors of Wind and Solar Power Statistically Dependent?

A. Braun, R. Fritz, S. Otterson (Fraunhofer IWES, Germany)

Session 5A: Frequency Control Issues

13:00 – 15:00 / 23 October 2013 / Room Trinity A / Session chair: Paul Gardner
(GL Garrad Hassan, United Kingdom)

Frequency Response of the US Eastern Interconnection under Conditions of High Wind Generation

N. Miller, M. Shao (GE Energy, USA), K. Clark (NREL, USA)

Frequency Response Capability of the GB System in 2030

S. Kuenzel, L. P. Kunjumammed, B. C. Pal (Imperial College London, United Kingdom)

Synthetic Inertia Control Strategy for Double-fed Induction Generator Wind Turbine Generators Using Energy from DC Capacitor

J. Zhu, H. Urdal, D. Young (National Grid, United Kingdom)

Quantifying the Aggregate Frequency Response from Wind Generation with Synthetic Inertial Response Capability

L. Ruttledge, D. Flynn (University College Dublin, Ireland)

Role of Wind Power in the Primary Frequency Response of an Interconnection

Y. Zhang, V. Gevorgian, E. Ela (NREL, USA), V. Singhvi, P. Pourbeik (EPRI, USA)

Cost-effective Primary Frequency Response at High Asynchronous Generation Levels

J. Kiviluoma (VTT, Finland), F. van Hulle (XP Wind, Belgium), A. Gubina (University College Dublin, Ireland), N. Cutululis (DTU Wind Energy, Denmark)

Session 5B: National Grid's Perspective

13:00 – 15:00 / 23 October 2013 / Room Trinity B / Session chair: Jonathan Horne (MPH Renewable Energy & Power System Consultants, United Kingdom)

Integrated Offshore Transmission

B. Stojkowska, F. Natukunda, S. Ilesanmi (National Grid, United Kingdom)

Managing Uncertainty and Variability of the Wind Resource

A. Richards (National Grid, United Kingdom)

Demand Side Response Potential to Mitigate the Rate of Change of Frequency

N. Gargov, A. Dahresobh, V. Hamidi (National Grid UK, United Kingdom)

Offshore Generation and Transmission in Great Britain - A Review of the Connection Process and Technical Performance Requirements

A. Johnson (National Grid, United Kingdom)

System Strength Considerations in a Converter Dominated Power System – How Can it be Modelled Effectively?

H. Urdal (National Grid, United Kingdom), C. Ivanov (ENTSO-E, Belgium), A. Dahresobh, R. Ierna, J. Zhu, D. Rostom (National Grid, United Kingdom)

Session 5C: Power System Balancing I

13:00 – 15:00 / 23 October 2013 / Room Minories / Session chair: Hannele Holttinen (VTT, Finland)

The Role of Nordic Hydropower to Handle Variations in the Future European Electricity System

L. Göransson, J. Goop, M. Odenberger, F. Johnsson (Chalmers University of Technology, Sweden)

Available Active Power Estimation of Wind Power Plants with 3-Second Data

D. Schneider, S. Tietz, M. Siefert, M. Speckmann (Fraunhofer IWES, Germany)

Impacts of Wind Integration on System Using Dynamic Reserves - Case Study

N. Menemenlis, M. Huneault (IREQ/Hydro-Québec, Canada), A. Robitaille (Hydro-Québec, Canada)

Balancing Options for Renewables Integration in Japan - Data Availability that Would Enable Evaluation

R. Kuwahata (Ecofys, Germany), Y. Yasuda (Kansai University, Japan)

Power Balance Provision through Coordinated Control of Modern Storage Heater Load

H. Qazi, D. Flynn (University College Dublin, Ireland)

Session 6A: Power System Issues

15:30 – 17:20 / 23 October 2013 / Room Trinity A / Session chair: Ana Estanqueiro (LNEG, Portugal)

Considerations of Future Small Signal Stability in GB Networks

L. Vilde, V. Hamidi, (National Grid, United Kingdom)

Mitigation of Subsynchronous Resonance in a DFIG-based Wind Power Plant Connected to Series-compensated Lines Using StatCom

B. Li, H. Xie (ABB China, China), M. M. de Oliveira, C. Heyman, M. Monge (ABB, Sweden)

Loss of Stability Margin Assessment during Wind Power Plant Operation in High Impedance Grids

V. Diedrichs (Jade University of Applied Sciences, Germany), A. Beekmann, K. Busker, S. Nikolai (Enercon, Germany), H. Lorenzen (Jade University of Applied Sciences, Germany)

Evaluation of Wind Power Plants with Variable Speed Wind Turbines for Power Oscillation Damping based on Residues

J. Morató (Parsons Brinckerhoff, United Kingdom, formerly DTU, Denmark), T. Knüppel (DTU, Denmark), J. Østergaard (DTU, Denmark)

Session 6B: New Grid and Generator Technologies

15:30 – 17:20 / 23 October 2013 / Room Trinity B / Session chair: Antje Orths (energinet.dk, Denmark)

Analysis of DC Collector Grid for Offshore Wind Power Plants

M. De Prada-Gil, J. L. Domínguez-García, F. Díaz-González, (Catalonia Institute on Energy Research, Spain), M. Aragüés-Peñalba (CITCEA-UPC, Spain), O. Gomis-Bellmunt (Catalonia Institute on Energy Research/CITCEA-UPC, Spain), D. Berenguel-Centeno, M. Martins, G. Fullana (Alstom Wind, Spain)

A Novel Protection Strategy for Internal Faults for HVDC Connected MVDC Collection Grids for Wind Farms

J. Ehnberg, T. Nordlander (Pöyry Swedpower, Sweden), A. Holm (Vattenfall R & D, Sweden)

Suprapower, a New Project Towards High Power Wind Generators Using Superconductivity

M. Noe (Karlsruhe Institute of Technology, Germany), G. Sarmiento Muñoz (TECNALIA, Spain)

Proposal of a Wind Power Plant Consisting of Series Connected Wind Turbine Generators

S. Nishikata, K. Suzuki, F. Tatsuta (Tokyo Denki University, Japan)

Session 6C: Flexibility with Storage and Demand Side Management

15:30 – 17:20 / 23 October 2013 / Room Minorities / Session chair: David Oram
(National Grid, United Kingdom)

Evaluation of Energy Storages for the Optimization of Wind Energy Integration Based upon Different Forecast Errors Scenarios

S. Klaiiber, O. Warweg, S. Nicolai, P. Bretschneider (Fraunhofer IOSB-AST, Germany)

Pumped Hydro and Compressed Air Energy Storage at High Wind Penetrations

C. O'Dwyer, D. Flynn (University College Dublin, Ireland)

Assessing Smart Grids Projects Capability to Promote Variable Renewable Energy Sources Integration through Demand Side Response

J. Osorio, M. Matos Fernandes (REN, Portugal)

Joint Operation for Mitigating the Power Variability in Balance Circles Included Wind and Cogeneration Units using Heat Storage Tank

L. Varga (E.ON, Hungary), G. Mádi-Nagy (Eötvös University/IP Systems, Hungary)

Session 7A: Grid Code and Power Quality Issues

08:00 – 09:40 / 24 October 2013 / Room Trinity A / Session chair: Eckard Quitmann
(Enercon, Germany)

Overview, Status and Outline of the New Revision for the IEC 61400 -21 – “Measurement and Assessment of Power Quality Characteristics of Grid Connected Wind Turbines”

B. Andresen (Siemens Wind Power, Denmark), P. Sørensen (DTU, Denmark), F. Santjer (DEWI, Germany), J. Niiranen (ABB, Finland)

Grid Code Requirements and their Consequences for PGU’s Protection Concepts

F. Kalverkamp, M. Meuser, J. Bünger, (FGH, Germany), R. Luxenburger (OMICRON, Germany)

Negative Sequence Current Contribution of DFIG Wind Turbines during Asymmetrical Grid Faults

C. Wessels, M. Ruben, M. Laubrock (Nordex Energy, Germany)

Aspects of Relevance of Wind Power in Power System Defense Plans

K. Das, A. Daniela Hansen, P. Sørensen (DTU Wind Energy, Denmark)

Modeling and Mitigation of Harmonics and Harmonic Resonance Involving Wind Inverters

J. Sun (Rensselaer Polytechnic Institute, USA)

Session 7B: AC Connected Offshore Wind Power Plants

08:00 – 09:40 / 24 October 2013 / Room Trinity B / Session chair: Peter W. Christensen
(Vestas, Denmark)

Triton Knoll Offshore Wind Power Plant Transient Studies: Modelling and Study of Transient Effects of Long AC Cable Systems and Reactor Compensation for a Grid Connection

K. L. Koo, Z. Emin (Parsons Brinckerhoff, United Kingdom), S. Wijesinghe, D. Griffiths (RWE NPower Renewables, United Kingdom)

Management of Low Frequency Resonances for Large Scale Offshore Wind Power Plants with Long AC Cable Connections

R. Hodges, S. Dixon (TNEI Sevices, United Kingdom), G. Bathurst (RongXin Power Engineering, United Kingdom)

Harmonic Mitigation Methods in Large Offshore Wind Farms

L. Kocewiak (DONG Energy, Denmark), S. K. Chaudhary (Aalborg University, Denmark), B. Hesselbæk (DONG Energy, Denmark)

Design, Testing, Installation and Operation of Three-core Export Cables for Offshore Applications

J. Karlstrand (JK Cablegrid Consulting, Sweden), O. Unosson (Oscar Unosson, Sweden)

Session 7C: Economic and Market Issues I

08:00 – 09:40 / 24 October 2013 / Room Minories / Session chair: Debra Lew (NREL, USA)

Wind Power Plant Behaviour in a Pay-as-bid Curtailment Market

G. Hawker, L. Kane, K. Bell (University of Strathclyde, United Kingdom)

The Role of Wind and Solar PV in Mitigating the Impact of Uncertainty in the Australian Electricity Industry

P. Vithayasrichareon, J. Riesz, I. MacGill (University of New South Wales, Australia)

Frequency Control Ancillary Services - Is Australia a Model Market for Renewable Integration?

J. Riesz, I. MacGill (Centre for Energy and Environmental Markets, Australia)

A New AS Market to Deal with Wind Power Forecasting Errors: Efficiency Assessment and Analysis of its Capability to Free up More Regulating Power

W. de Boer (DNV-KEMA, the Netherlands), G. Dekker (DNV, Norway), J. Frunt, M. Duvoort (DNV-KEMA, the Netherlands)

Session 8A: Grid Integration Technologies

10:10 – 12:00 / 24 October 2013 / Room Trinity A / Session chair: Nicolaos Cutululis
(DTU Wind Energy, Denmark)

Large Scale Grid Integration of Renewable Technologies on Weak Networks - Challenges & Solutions

M. Tabrizi, Y. Cheng, M. Sahni (PWR Solutions, Germanischer Lloyd, USA), Z. Fan, T. Gehlhaar (Germanischer Lloyd, Germany)

Online Method for the Estimation of the Short Circuit Ratio with Small Grid Perturbation

D. Obradovic, A. Szabo (Siemens, Germany), P. Egedal, K. B. Danielsen, B. Andresen, M. Stoettrup (Siemens Wind Power, Denmark)

Dynamic Line Rating and Ampacity Forecasting as the Keys to Optimise the Grid Connection of RES – Results of the EU Funded TWENTIES Demonstration: Netflex.

H.-M. Nguyen (University of Liège, Belgium), P. Schell (Ampacimon, Belgium), J.-L. Lilien (University of Liège, Belgium)

The Gate-Controlled Series Capacitor for Reactive Compensation of Line-Commutated HVDC

M. Jafar, Y. Yang, G. Dekker (Det Norske Veritas, Norway), T. Langeland (DNV-Kema, Norway), M. Molinas (Norwegian University of Science & Technology, Norway)

Session 8B: Modelling Issues

10:10 – 12:00 / 24 October 2013 / Room Trinity B / Session chair: Eckehard Tröster
(Energynautics, Germany)

Implementation of Draft IEC Generic Model of Type 1 Wind Turbine Generator in PowerFactory and Simulink

H. Zhao, Q. Wu, P. Sørensen (DTU, Denmark), J. Bech, B. Andresen (Siemens Wind Power, Denmark)

Development and Validation of a GE Type-III EMTP-RV Wind Turbine Model for Hydro-Québec's Studies

P. Prud'Homme, M. Fecteau, M. Asmine (Hydro-Québec, Canada), G. Drobnjak (GE Energy Consulting, Germany), E. GURSOY (GE Energy Consulting, Turkey), G. Turmel (IREQ/Hydro-Québec, Canada)

Optimal K-Factor and Active Current Reduction during Fault-Ride-Through of Converter-Connected Generating Units for Power System Stability

B. Weise (DIgSILENT, Germany)

Network Fault Response of Wind Power Plants in Distribution Systems during Reverse Power Flows (Part II)

J. C. Boemer (TU Delft, the Netherlands), B. G. Rawn (KU Leuven, Belgium), M. Gibescu, M. A. M. van der Meijden (TU Delft/TenneT TSO, the Netherlands), W. L. Kling (Eindhoven University of Technology, the Netherlands)

Session 8C: Economic & Market Issues II

10:10 – 12:00 / 24 October 2013 / Room Minorities / Session chair: Jenny Riesz
(University of New South Wales, Australia)

Costs and Benefits of Fossil-Fueled Plant Flexibility

D. Lew, G. Brinkman, G. Stark (NREL, USA), G. Jordan, S. Venkataraman (GE Energy, USA), N. Kumar, S. Lefton (Intertek-APTECH, USA)

The Economics of Energy Storage in the UK, Germany and US

A. Cheung (Bloomberg New Energy Finance, USA)

Cost Benefit Analysis for Reinforcement of the Transmission System to Accomodate Growing Numbers of Renewable Generation in the United Kingdom

E. Ganendra, P. Espie (SKM, United Kingdom)

Macro Economic Evaluation of Proof Methods for the Delivery of Balancing Reserve by Wind Farms

M. Jansen, M. Speckmann, D. Schneider, M. Siefert (Fraunhofer IWES, Germany)

Session 9A: Wind Integration Studies

13:00 – 15:00 / 24 October 2013 / Room Trinity A / Session chair: Charles Smith (UVIG, USA)

Summary of Experiences and Studies for Wind Integration – IEA Wind Task 25

H. Holttinen (VTT, Finland), A. Robitaille (Hydro-Québec, Canada), A. Orths (Energinet.dk, Denmark), I. Pineda (EWEA, Belgium), B. Lange, (Fraunhofer IWES, Germany), E. Carlini (Terna, Italy), O'Malley, J. Dillon (University College Dublin, Ireland), J. O. Tande (SINTEF, Norway), A. Estanqueiro (LNEG, Portugal), E. Gómez-Lázaro (University of Castilla-La Mancha, Spain), L. Søder (Royal Institute of Technology KTH, Sweden), M. Milligan (NREL, USA), C. Smith (UVIG, USA)

Integration of Offshore Wind Power to the U.S. Grid

M. Korytowski (University of Pittsburgh, USA), J. Fodiak (Xero Energy, United Kingdom), J. Daniel (ABB, USA), G. Reed (University of Pittsburgh, USA), N. Scott (Xero Energy, United Kingdom)

Strategies for Alleviating Large Wind Power Curtailments in China

L. Yao, Y. Li, Z. Zhang, Y. Chi, J. Wu (China Electric Power Research Institute CEPRI, China)

Frequency Issues of Island Power Systems with High Penetration of Hydroelectric and Wind Power

J.-D. Schmidt, E. Tröster (Energynautics, Germany), G. Papaioannou, J. Hanson (TU Darmstadt, Germany)

Session 9B: Offshore Grid Issues

13:00 – 15:00 / 24 October 2013 / Room Trinity B / Session chair: TBA

Proving Offshore Wind Power Plants “Do What It Says on the Tin” in the Context of Challenging Grid Code Requirements for Frequency and Voltage Regulation

M. Horley, K. Smethurst (National Grid, United Kingdom)

Technical and Economic Evaluation of a North Sea Grid

T. Drees, C. Linnemann, H. Schuster, A. Moser (RWTH Aachen, Germany), T. Panke, B. Burstedde (University of Cologne, Germany)

Damping Power System Oscillations by VSC-Based HVDC Networks: A North Sea Grid Case Study

M. Ndreko, A. van der Meer (TU Delft, the Netherlands), B. G. Rawn (KU Leuven, Belgium), M. Gibescu, M. van der Meijden (TU Delft/TenneT TSO, the Netherlands)

Design Considerations for Offshore Wind Power Plants Intra-Array Architectures

P. Rollings, A. Hardcastle (SKM, United Kingdom)

OptiArray from DONG Energy: An Automated Decision Support Tool for the Design of the Collection Grid in Large Offshore Wind Power Plants

M. Lindahl (Copenhagen Airports Resource Management Specialist, Denmark), N.-C. Fink Bagger, T. Stidsen (DTU, Denmark), S. Frost Ahrenfeldt, I. Arana (DONG Energy Wind, Denmark)

Session 9C: Power System Balancing II

13:00 – 15:00 / 24 October 2013 / Room Minorities / Session chair: Kamran Sharifabadi
(Statoil, Norway)

Active Power Control Features in the Wind Turbine Controller

E. Bossanyi (GL Garrad Hassan, United Kingdom), A. Ghorashi (Garrad Hassan America, USA)

Assessment of the Impact of Primary Frequency Support on DFIG Wind Turbine Loads

B. Barahona Garzon, R. You (Tsinghua University, China), A. D. Hansen, N. A. Cutululis, P. Sørensen (DTU Wind Energy, Denmark)

Flexibility Screening Tool – Development and Deployment

E. Lannoye (EPRI International, Ireland), A. Tuohy (EPRI, USA)

Wind Powered Industrial Processes - Assessment of Additional Wind Power Integration by Flexible Processing

J. Käufer, R. Pohl, S. Deiringer (SYNLIFT Systems, Germany)

Real-Time Tariffs for Electric Vehicles in Wind Power based Power Systems

H. Morais (Technical University of Denmark, Denmark), T. Sousa, M. Silva, P. Faria, Z. Vale (GECAD/IPP, Portugal)

Session 10: Closing Session - Podiums Discussions

15:30 – 16:30 / 24 October 2013 / Room Trinity / Session chair: TBA

Podium discussions

The contributions and discussions of this session are not part of the proceedings & the USB memory stick.

Poster Session Papers

Benguela Community-UNAM Wind-Power Demonstration Project - Experiences in Implementation

I. Davidson, H. MuAshekele (University of Namibia, Namibia), N. Mukapuli (Benguela Community, Namibia)

Review on Hybrid HVDC Technology for Integration of Offshore Wind Plant

C. Yuan, X. Yang, D. Yao, C. Yue (ABB China, China)

Optimization of Off-Shore Wind Power Plants Collection Grids

J. Ehnberg (Chalmers University of Technology, Sweden), E. Malz (University of Stuttgart, Germany)

A Method of Identifying the Most Critical Wind Power Plant Communication Links in Terms of Power System Security

M. Bajor (Institute of Power Engineering Gdansk, Poland)

Mesoscale Simulations for Generating High Resolution Multi-Year Wind Speed Time Series over Canada to Improve Wind Energy Integration

S. Z. Husain, W. Yu, L. Separovic (Environment Canada, Canada)

Comparison of Modular Multilevel Converters for the Grid Connection of Large-Scale Wind Turbines

M. von Hofen (Leibniz University of Hannover, Germany), L. Baruschka (Protolar, Germany), D. Karwatzki, A. Mertens (Leibniz University of Hannover, Germany)

Advancements in Wind Integration Study Data Modeling: The Wind Integration National Dataset (WIND) Toolkit

C. Draxl, B.-M. Hodge (NREL, USA), K. Orwig (formerly NREL, USA), S. Harrold, J. McCaa (3Tier, USA), W. Jones, K. Searight, D. Getman (NREL, USA), J. Cline, C. Clark (US Department of Energy, USA)

From a Matlab Based Wind Power Forecast to an Integrated EMS Solution

S. Lakkis, W. Grubauer, H. Strasser, G. Lakits (Siemens, Austria)

The Impact of Controlling DFIG-based Wind Turbines with no Crowbar on the System Stability

M. B. C. Salles, R. R. Avila (University of São Paulo, Brazil), A. J. Sguarezi Filho, A. P. Grilo (Federal University of ABC, Brazil)

Wind Power Relationships Homer Methodology Calculation

F. Brihmat, S. Mekhtoub (National Superior Polytechnic School, Algeria)

Coupling of a Wind Power Plant with a Storage Battery to Reduce Unbalance Charges

S. Sperati, S. Alessandrini, M. Benini (RSE, Italy)

Prediction Errors and Balancing Costs in Finland Using Short Term Predictions for Different Geographical Areas

J. Miettinen, H. Holttinen (VTT, Finland)

Methods for Estimating Long-term Average Wind Speed

P. P. Revheim, H. G. Beyer (University of Agder, Norway)

Study of the Interaction Between Wind Power Plants and SMES Systems

F. Milano (University College Dublin, Ireland), R. Zárate-Miñano (University of Castilla-La Mancha, Spain)

Introduction of a New Regional Market Concept for Integration of Renewable Energies

O. Warweg, A. Arnoldt (Fraunhofer IOSB-AST, Germany)

Intelligent Data Mining based Local Wind Power Forecasting

A. Arnoldt (Fraunhofer IOSB-AST, Germany)

An Improved Design Methodology for Interconnecting Large Offshore Wind Power Plants

M. Ali, R. Bryans (TNEI Services, United Kingdom), S. Jafri (University of Manchester, United Kingdom)

Impact of Projected Wind Energy Yield Variation on Optimum Grid Connection for Large Offshore Wind Power Plants

A. Gunatilake, M. Lockett (London Power Associates, United Kingdom)

An Option to Assign Confidence Intervals to Day Ahead Wind Power Forecasts - Example Based on Meteorological Conditions in Norway

H. G. Beyer P. P. Revheim (University of Agder, Norway)

Market Value of Wind Power

J. de Haan, M. A. Shoeb, H. Lopes Ferreira, W. Kling (Eindhoven University of Technology, Netherlands)

Optimal Power Dispatch for Wind Power Plant Control Considering Wake Effects

Y. Zhang, C. Franke, J. Poland, S. Mastellone (ABB Switzerland, Switzerland), K. Kulkarni (ABB India, India) A. Timbus (ABB Switzerland, Switzerland)

The State-of-the-Art of Wind Energy Accommodation in the Rigid Power Grid of Inner Mongolia, China

X. Wang (Inner Mongolia Power Grid, China), Y. Qiao (Tsinghua University, China), Y. Hou, J. Qi (Inner Mongolia Power Grid, China)

High-Voltage-Ride-Through Test System based on Transformer Switching, Realization and Validation

R. Klosse (WindGuard Certification, Germany)

PLEXOS Study of the Italian Power System and Market in the Medium-term: Realities and Expectations of Renewables Integration

G. Bordignon, P. Panagiotakopoulou, C. Papadopoulos (Energy Exemplar, United Kingdom)

Balancing Power and Variable Renewables

L. Hirth (Vattenfall, Germany), I. Ziegenhagen (Prognos, Germany)

Constraints to the Profitable Integration of Wind-based Microgrids as a Function of the Resource Correlation

G. Díaz (University of Oviedo, Spain), C. Viescas (EdP Renewables, Spain), J. Coto, J. Gómez-Aleixandre, A. Diez (University of Oviedo, Spain)

Research on Size and Location of DG with Vulnerable Nodes Identification in the Active Distribution Network

Y. Zhao, Y. An, Q. Ai (Shanghai Jiao Tong University, China)

Methods for Representations of Wind Power Plants for Active Power Studies

A. D. Hansen, N. A. Cutululis, M. Altin (DTU Wind Energy, Denmark)

Power and Voltage Control of a Novel Integrated Wind-Turbine Generator and Tidal-Turbine Generator Inside an Offshore Wind Tower Using a Flywheel Energy-Storage System

L. Wang, C.-N. Li (National Cheng Kung University, Taiwan)

Losses Analysis of Different Grounding Schemes for Transformer-less Wind Turbine with Full-Scale Power Converter

M. Szykiel, R. Teodorescu, S. Munk-Nielsen, C. Busca (Aalborg University, Denmark)

Initializing Network Simulations for Case Studies of Offshore Wind Power and Offshore DC Grid Integration in the Power System of Northern Europe

N. Helistö, S. Uski-Joutsenvuo, (VTT, Finland)

Stability Analysis of a Microgrid System with Large-Scale Wind and Ocean Energy Farms Fed to a Power Grid through an HVDC Link

L. Wang, C.-Y. Lin (National Cheng Kung University, Taiwan)

Strategies for Wind Power Allocation in Europe

L. Reichenberg, A. Wojciechowski, F. Johnsson (Chalmers University of Technology, Sweden)

Availability Growth and State-of-knowledge Uncertainty Simulation for Offshore Wind Power Plants

A. Zitrou, T. Bedford, L. Walls, K. Wilson K. Bell (University of Strathclyde, United Kingdom)