

PROCEEDINGS

# 13<sup>th</sup> 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



11 - 13 November 2014 | Berlin, Germany

Tera Sponsors:



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# PROCEEDINGS

Edited by Uta Betancourt / Thomas Ackermann

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## **IMPRINT**

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# Welcome to...

## the 13<sup>th</sup> 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 **13<sup>th</sup> 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 Berlin, Germany.

While the first edition of the workshop was held 14½ years ago at the Royal Institute of Technology, Stockholm, Sweden in March 2000 with 4 sessions in total, this year we received again such a large number of outstanding abstracts that we can offer now a two-and-a-half day program with 26 sessions, one session more than last year.

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 year, grid connection of wind power plants using HVDC technology is again a major topic, together with reserve and frequency control issues as well ancillary services from wind turbines. 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 **13<sup>th</sup> Wind Integration Workshop** forms the anchor workshop for related events such as the **4<sup>th</sup> International Workshop on Integration of Solar Power into Power Systems** (November 10-11, 2014), **Tutorials for the Wind Integration Workshop** (November 10, 2014), the **Study trip** (November 14, 2014) and the **Workshop Dinner** (November 12, 2014).

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 wind turbine manufacturers **Enercon** (Germany) and **Siemens Wind Power** (Denmark), our **Giga Sponsors**: the power technology developer **ABB** (Switzerland), the consulting and software company **DigSILENT** (Germany), the technology research company **DNV GL** (Norway) the energy group **DONG energy** (Denmark) and the wind turbine manufacturer **Vestas** (Denmark).

In addition, the workshop is supported by the **IET Digital Library** (United Kingdom), the **Renewables Grid Initiative** (Germany), the **Utility Variable Generation Integration Group UVIG** (USA) and the media partner **Sun&Wind Energy** (Germany).

We would also like to thank all those who supported the organizers of this workshop: all the member of the International Advisory Committee as well as Uta Betancourt, Ines Drewianka and Katharina Fischer (all Energynautics, Germany).

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

**Thomas Ackermann**  
Energynautics

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## Session 1: Keynote Session

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14:00 – 16:10 / 11 November 2014 / Room ECC 1 / Session chair: Thomas Ackermann (Energynautics, Germany)

### **German Energy Transition – The Role of Wind Energy and Grid Integration**

S. Ropenus (Agora Energiewende, Germany)

### **BNetzA's Role in Electricity Grid Development – The Contribution of Wind Energy for the "Energiewende"**

J. Patt (Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railway [Bundesnetzagentur - BNetzA], Germany)

### **Integration of Wind Power into the Electricity System**

O. Feix (50Hertz Transmission, Germany)

### **70% Renewables – Experiences and Solutions of a Large DSO in Northern Germany**

E. Wieben (EWE NETZ, Germany)

### **The Future Interaction of Conventional and Renewable Energies**

(L. Eigenmann, EnBW, Germany)

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16:30 – 18:45 / 11 November 2014 / Room ECC 2 / Session chair: Nicholas Miller (GE Energy, USA)

### **An Objective Measure of Interconnection Usage for High Levels of Wind Integration**

Y. Yasuda (Kansai University, Japan), A. Estanqueiro (LNEG, Portugal), N. Cutululis (DTU, Denmark), E. Gómez-Lázaro (University of Castilla-La Mancha, Spain), J. Kondoh (Tokyo University of Science, Japan), M. Milligan (NREL, USA), H. Holttinen (VTT, Finland), A. Orths (Energinet.dk, Denmark), J. C. Smith (UVIG, USA)

### **Analysis of Methods and Metrics for Flexibility Assessment**

A. Tuohy, E. Lannoye (EPRI, USA), L. Plano (Pacific Gas and Electric, USA)

### **Can the Gas Sector Provide the Flexibility to the Power Sector for the Integration of Renewables?**

K. Schaber, H. Roth, M. Fallahnejad (Stadtwerke München/Municipal Energy Supplier Munich, Germany)

### **Synergies between Wind and Solar Generation and Demand Response: An IEA Task 25 Collaboration**

S. Nolan, D. Burke, H. Wajahat Qazi, D. Flynn, M. O'Malley (UCD, Ireland), J. Kiviluoma (VTT, Finland), M. Hummon, B. Kirby, M. Milligan (NREL, USA)

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E. Tröster, S. Langanke (Energynautics, Germany) (WIW14-3007)

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C. Heinemann, D. Bauknecht, R. O. Harthan, M. Koch, D. Ritter (Öko-Institute, Germany)

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M. Huebel, C. Gierow, M. Richter, J. Nocke, E. Hassel, C. Ziems, A. Berndt, H. Weber (University of Rostock, Germany)

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16:30 – 18:30 / 11 November 2014 / Room ECC 3 / Session chair: Hannele Holttinen (VTT, Finland)

### **Advanced EMS Wind Dispatch Tools for the Power System of Ireland and Northern Ireland**

M. Burke, M. Gallagher (EirGrid, Ireland), C. Martin, R. Lopez (Alstom Grid, France)

### **System Analysis 2014 of German TSOs on Demand for Reserve Generation Capacity**

S. Gröninger, R. Pfeiffer, B. Homburg, M. Rogge (Amprion, Germany)

### **TSO Experience in Introduction of Dynamic Models of Wind Power Plants to Transmission Network Planning Model**

I. Luukkonen, A. Harjula, A.-J. Nikkilä (Fingrid Oyj, Finland)

### **The Impact of Distributed Wind on Bulk Power System Operations in ISO-NE**

C. Brancucci Martínez-Anido, B.-M. Hodge, D. Palchak (NREL, USA), J. Miettinen (VTT, Finland)

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16:30 – 18:45 / 11 November 2014 / Room ECC 1 / Session chair: Jens Fortmann (Senvion, Germany)

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F. de la Fuente, J. Martín (ABB, Spain), P. Skarby (ABB, Switzerland), P. Sandeberg (ABB, Sweden)

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M. J. Mulroy, A. P. Neumann, C Ebden (Offshore Renewable Energy Catapult, United Kingdom)

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J. Sun (Rensselaer Polytechnic Institute, USA)

### **Fault Analysis and Protection of Series-DC Collection Systems for Offshore Wind Power Plants**

S. Shah, H. Guo, J. Sun (Rensselaer Polytechnic Institute, USA)

### **Decision Making Tool: Optimum Power Rating for Substation Transformers in Offshore Power Plants**

M. Almiray, I. Arana (DONG Energy, Denmark), P. Sørensen, I. Kozine, (DTU, Denmark)

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A. Sajadi, K. A. Loparo (Case Western Reserve University, USA), S. Barnes (GE Energy, USA)

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08:00 – 10:15 / 12 November 2014 / Room ECC 2 / Session chair: Corinna Möhrten (Weprog, Germany)

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S. Späth, L. von Bremen, C. Junk (Carl von Ossietzky University Oldenburg, Germany)

### **Observations and Forecasts for Wind Plants**

M. Marquis, J. Wilczak, S. Benjamin, J. Olson, I. Djalalova, J. Carley, L. Bianco, E. James, R. Banta, Y. Pichugina (National Oceanic and Atmospheric Administration, USA), J. Cline (Department of Energy, USA)

### **Probabilistic Wind Power Forecasts Based on the COSMO-DE-EPS Weather Model**

M. Siefert, J. Dobschinski, S. Otterson, T. Kanefendt (Fraunhofer IWES, Germany), K. Lundgren (German Weather Service, Germany), D. Ernst (TenneT TSO, Germany), M. Zirkelbach (50Hertz Transmission, Germany), A. Bergmann-Dick (Amprion, Germany)

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A. Braun, J. Dobschinski (Fraunhofer IWES, Germany)

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### **Optimising the European Transmission System for 77% Renewables by 2030**

T. Brown, P.-P. Schierhorn, E. Tröster, T. Ackermann (Energynautics, Germany)

### **Impacts of Restricted Transmission Grid Expansion in a 2030 Perspective in Germany**

C. Nabe (Ecofys, Germany)

### **Wind Power in a 100% Renewables Scenario for Rhineland-Palatinate**

N. Martensen, E. Tröster, T. Brown, T. Ackermann, S. Geidel, S. Langanke (Energynautics, Germany)

### **Aggregated Representation of Distribution Network Models for Large-Scale Transmission Network Simulations**

Ö. Göksu, M. Altin, P. Sørensen (DTU, Denmark)

### **The Potential of Renewable Energy in the Swedish Distribution Networks**

M. Hansson (Power Circle, Sweden), F. Carlsson (Vattenfall R&D, Sweden)

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08:00 – 10:15 / 12 November 2014 / Room ECC 1 / Session chair: Antje Orths, (Energinet.dk, Denmark)

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R. Görner (ABB, Germany), M. Callavik (ABB, Sweden)

### **Challenges Towards the Deployment of Offshore Grids: the OffshoreDC Project**

N. A. Cutululis (DTU, Denmark), L. Zeni (DTU/DONG Energy Wind, Denmark), W. Z. El-Khatib, J. Holbøll, P. Sørensen (DTU, Denmark), G. Stamatiou, O. Carlson (Chalmers University, Sweden), V. C. Tai, K. Uhlen (NTNU, Norway), J. Kiviluoma (VTT, Finland), T. Lund (Energinet.dk, Denmark), K. Uhlen

### **Electrical Integration of North Sea Wind Power Plants Using Interconnecting Links**

J. Kester, E. Wiggelinkhuizen (ECN, the Netherlands), M. Ars (NUON/Vattenfall, the Netherlands), E. Kontos, P. Bauer (Delft University of Technology, the Netherlands), J. Gazendam (University of Groningen, the Netherlands), F. Nieuwenhout (ECN, the Netherlands)

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P. Sørensen (DTU, Denmark), J. Fortmann (Senvion, Germany), F. J. Buendía (Gamesa, Spain), J. Bech (Siemens Wind Power, Denmark), A. Morales (DigiSILENT Ibérica, Spain), C. Ivanov (ENTSO-E, Belgium)

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T. Gehlhaar (DNV GL – Energy, Germany), P. Gardner (DNV GL - Energy, United Kingdom)

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K. Burges, M. Doering, R. Kuwahata (Ecofys Germany, Germany)

### **Medium-Term Dynamic Studies for a Large Island Power System with High Levels of Wind**

L. McMullan, P. Horan, T. Gallery (EirGrid, Ireland), D. Lewis, K. Creighton (SONI, United Kingdom)

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R. Pietzcker, F. Ueckerdt, G. Luderer (Potsdam Institute for Climate Impact Research, Germany)

### **Where to Install Wind Capacities? – Optimal Deployment from an Energy System Perspective**

H. Hobbie, D. Möst (TU Dresden, Germany)

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G. B. Olesen (Sustainable Energy, Denmark)

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H. Holttinen, J. Kiviluoma (VTT, Finland), J. McCann, M. Clancy (SEAI, Ireland), I. Pineda (EWEA, Belgium), M. Milligan (NREL, USA)

### **Impacts of North African Concentrated Solar Power and Norwegian Hydro Power on Storage Needs in a European Energy System Dominated by Renewables**

A. Kies, L. von Bremen, D. Heinemann (ForWind/University of Oldenburg, Germany), K. Nag, E. Lorenz (University of Oldenburg, Germany)

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11:00 – 13:00 / 12 November 2014 / Room ECC 1 / Session chair: Slavomir Seman (Siemens, Germany)

### **Parametric Variation for Detailed Model of External Grid in Offshore Wind Power Plants**

V. Myagkov, L. Petersen, S. Burutxaga Laza (Aalborg University, Denmark), Ł. H. Kocewiak (DONG Energy, Denmark), F. Iov (Aalborg University, Denmark)

### **Improvement of Grid Harmonic Distortions by an Offshore Wind Power Plant**

E. Lidström, F. Carlsson (Vattenfall, Sweden), N. Ullah, J. Rasmussen, A. Omanovic (Solvina, Sweden)

### **Active Filtering Application in Large Offshore Wind Power Plants**

Ł. H. Kocewiak, O. Holmström, B. Laudal Øhlenschläger Kramer (DONG Energy, Denmark), K. H. Jensen, L. Shuai (Siemens Wind Power, Denmark)

### **New Requirements for Offshore HVDC**

A. Mason (TNEI Services, United Kingdom), C. Cresswell (Senvion, Germany)

### **Evaluation of Power Quality Monitoring Systems in Offshore Wind Power Plants**

Ł. H. Kocewiak (DONG Energy, Denmark), A. Baloi (Polytechnic University of Timisoara, Romania)

## Session 5A: Wind Turbine Modelling

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(Hydro-Québec, Canada)

### **Considerations on the Level of Detail in the Modelling and Simulation of Subsynchronous Resonance in DFIG Based Wind Power Plants**

W. Belkacemi, M. Laubrock (Nordex Energy, Germany), A. Genius (Woodward Kempen, Germany)

### **Characterization of a Power Electronic Grid Simulator for Wind Turbine Generator Compliance Testing**

J. Glasdam (DONG Energy Wind Power, Denmark), V. Gevorgian (NREL, USA), R. Wallen (NREL, USA), C. L. Bak (Aalborg University), Ł. H. Kocewiak, J. Hjerrild (DONG Energy Wind Power, Denmark)

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S. Bolik (Senvion, United Kingdom), C. Cresswell (Senvion, Germany)

### **Short-Circuit Currents of Wind Turbines with Doubly-Fed Induction Generators**

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

### **Loss of Synchronism of Wind Turbine Converters during Low Voltage Grid Faults**

Ö. Göksu, P. Sørensen (DTU Wind Energy, Denmark), F. Iov, C. L. Bak, R. Teodorescu (Aalborg University, Denmark), P. C. Kjær (Vestas, Denmark)

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U. Karaagac, J. Mahseredjian (Polytechnical School of Montréal, Canada), L.-J. Cai (Senvion, Germany)

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F. Van Hulle (XP Wind, Belgium), F. Chapalain (EDSO 4SG, Belgium), N. Cutululis (DTU, Denmark), H. Holttinen, J. Kiviluoma (VTT, Finland), L. M. Faiella (Fraunhofer IWES, Germany), I. Pineda (EWEA, Belgium), M. Rekingier (EPIA, Belgium)

### **Opportunities for GB On and Offshore Wind Power Plants to the System Operator**

A. Ferguson, R. Hodges (TNEI Services, United Kingdom)

### **Control Reserve Provision with Wind Power Plants**

M. Jansen, D. Jost, M. Widdel, M. Siefert (Fraunhofer IWES, Germany)



## Session 5C: HVDC Technology & Offshore Wind Power Plants

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(Dong Energy, Denmark)

### **Study on Key Technologies of VSC-HVDC and Application in Offshore Wind Power Plant in China**

Z. Wang, H. Lin, B. Jiang, J. Wu, G. Wang (Shanghai Jiao Tong University, China)

### **Comparison of Converter-Near Controls for HVDC-connected Offshore Wind Power Plants Focussing on the Dynamic Performance**

R. Bartelt, C. Heising, D. Meyer (Avasition, Germany), V. Staudt (Ruhr-University Bochum, Germany)

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M. Raza, O. Gomis Bellument (Technical University of Catalunya, Spain)

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P. van de Rijt, A. Croes (Tennet TSO, the Netherlands)

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A. Basit, A. Hansen, P. Sørensen, M. Altin (DTU Wind Energy, Denmark)

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R. Bartelt, C. Heising, D. Meyer (Avasition, Germany), V. Staudt (Ruhr-University Bochum, Germany), T. J. Lebioda (Tennet Offshore, Germany)

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S. Uski (VTT, Finland)

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G. Rousi, A. D. Hansen, N. A. Cutululis (DTU Wind Energy, Denmark)

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A. Leike, G. Geislberger, C. Neugebauer, F. Schwimbeck (Siemens, Germany)

### **Topologies for Series-Connected Large-Scale Wind Power Plants Without Increasing System Voltage Level**

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

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E. Ibanez, M. Milligan (NREL, USA)

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W. Kuehn, D. Mueller (Frankfurt University of Applied Sciences, Germany)

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R. Veuillan, I. Azpiri (Iberdrola, Spain)

### **An Alternative Protection Philosophy for Multi-Terminal HVDC**

F. Page, S. Finney, L. Xu (University of Strathclyde, United Kingdom)

### **Doubly-Fed Induction Generator Wind Turbine with VSC-HVDC Grid Connection – Interaction Analyses**

L. J. Cai (Senvion, Germany), U. Karaagac, J. Mahseredjian (Polytechnical School of Montréal, Canada)

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G. Zhu, X. Dui, C. Zhang (Tsinghua University, China)

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F. Jung (University of Bremen, Germany), M. Siefert (Fraunhofer IWES, Germany), C. Büskens (University of Bremen, Germany)

### **High-Quality Wind Power Scenario Forecasts for Decision-Making under Uncertainty in Power Systems**

S. Delikaraoglou, P. Pinson (DTU, Denmark)

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C. Collier (DNV GL, United Kingdom), J. Schipper (DNV GL, Germany), J. Collins (DNV GL, United Kingdom)

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C. Möhrlen (WEPROG, Germany), J. U. Jørgensen (WEPROG, Denmark)

### **How Good is my Forecast? Comparability of Wind Power Forecast Errors**

J. Dobschinski (Fraunhofer IWES, Germany)

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08:00 – 10:15 / 13 November 2014 / Room ECC 3 / Session chair: Poul Sørensen (DTU, Denmark)

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J. Kiviluoma, H. Holttinen (VTT, Finland), R. Scharff (KTH Royal Institute of Technology, Sweden), D. E. Weir (Norwegian Water Resources and Energy Directorate, Norway), N. Cutululis, M. Litong-Palima (DTU Wind Energy, Denmark), M. Milligan (NREL, USA)

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

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J. Aho, L. Y. Pao (University of Colorado Boulder, USA), P. Fleming, E. Ela (NREL, USA)

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Y. Wang, V. Silva (EDF R&D, France), A. Winckels (ENSTA ParisTech, France)

### **Transient Stability and Frequency Response of the US Western Interconnection under conditions of High Wind and Solar Generation**

N. Miller, M. Shao, S. Pajic, R. D'Aquila (General Electric, USA), K. Clark (NREL, USA)

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A. Shabir Ahmadyar, G. Verbič (University of Sydney, Australia)

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### **Low Frequency AC Transmission on Large Scale Offshore Wind Power Plants - Achieving the Best from Two Worlds?**

E. Olsen (Nexans Norway, Norway), U. Axelsson (Vattenfall, Sweden), A. Canelhas (HVDC Tech, United Kingdom)

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J. L. Domínguez-García, M. De Prada-Gil (Catalonia Institute on Energy Research, Spain), O. Gomis-Bellmunt, A. Sumper (Catalonia Institute on Energy Research/CITCEA-UPC, Spain)

### **Low Frequency AC Transmission for Grid Integration of Offshore Wind Power**

M. Jafar, Y. Yang (DNV GL, Norway), A. Yanushkevich (DNV GL, the Netherlands)

### **Grid Connection Design for Gargano Sud Offshore Wind Power Plant**

J. Fodiak, N. Scott, M. Hird (Xero Energy Limited, United Kingdom)

### **DC Connection of Offshore Wind Power Plants without Platform**

J. Pan, S. Bala (ABB Corporate Research, USA), M. Callavik, P. Sandeberg (ABB Grid Systems, Sweden)

### **Voltage Balancing and Control of Series-DC Collection Systems for Offshore Wind Power Plants**

R. Hassan, J. Sun (Rensselaer Polytechnic Institute, USA)

## Session 8A: Wind Power Plants in Low and Medium Voltage Networks

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10:45 – 12:45 / 13 November 2014 / Room ECC 2 / Session chair: Eckehard Tröster (Energynautics, Germany)

### **Wind Power Plants for Weak Grids based on Type IV Wind Energy Converters**

V. Diedrichs (Jade University of Applied Sciences, Germany), A. Beekmann, E. Quitmann, S. Nikolai (Enercon, Germany)

### **Advanced Wind Plant Control Providing Grid Voltage Flicker Reduction**

J. Fortmann, M. Seidel, V. Schulz (Senvion, Germany)

### **Advanced Open Loop Control Strategies for Voltage Control in Medium Voltage Systems with a High Penetration of Wind Power Generation**

E. Wieben (EWE Netz, Germany), S. Nikolai, A. Beekmann (Enercon, Germany)

### **Meeting Grid Code Requirements of Decentralized Power Generators and Plants by Using Voltage Regulating Distribution Transformers as Cost-efficient Component**

J. Langstädtler, J. Döll, M. Brennecke, (FGH, Germany), T. Smolka, M. Sojer, T. Schlegel, T. Funk (Maschinenfabrik Reinhausen, Germany)

### **Fakken Wind Power Plant: a Case of Weak Grid Connection**

J. Martinez Garcia (Vestas, Denmark), S. Thyrhaug (Troms Kraft, Norway), M. Obad (Vestas, Denmark)

### **Wind Integration with Active Network Management (ANM): Learning from Deployment Projects and Future Directions**

G. Ault, R. MacDonald, R. Currie, N. McNeill, A. Gooding, C. Foote (Smarter Grid Solutions, United Kingdom)

## Session 8B: Inertia Issues

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10:45 – 12:45 / 13 November 2014 / Room ECC 3 / Session chair: Tobias Gehlhaar (DNV GL, Germany)

### **Synchronous Inertia Control for Wind Turbines: Adaption of the Virtual Synchronous Machine to Wind Turbines for providing Distributed Contributions to Power System Inertia**

D. Duckwitz, M. Shan, B. Fischer (Fraunhofer IWES, Germany)

### **Operational Experiences with Inertial Response Provided by Type 4 Wind Turbines**

M. Fischer (Enercon Canada, Canada), S. Engelken, N. Mihov, A. Mendonca (Enercon, Germany)

### **Field Measurements for the Assessment of Inertial Response for Wind Power Plants based on Hydro-Québec TransÉnergie Requirements**

M. Asmine, C.-É. Langlois (Hydro-Québec, Canada)

### **Hydraulic-Pneumatic Energy Storage in a Wind Turbine for Enhancing the Power System Inertia**

S. Hippel, C. Jauch (Flensburg University of Applied Sciences, Germany)

## Session 8C: Stability Studies

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10:45 – 12:45 / 13 November 2014 / Room ECC 1 / Session chair: Jian Sun (Rensselaer Polytechnic Institute, USA)

### **Grid Stability in a 100% Renewable Electricity Supply System – Interactions between a High Installed Capacity of Wind Power and the System**

B. Zimmermann, K. Knorr (Fraunhofer IWES, Germany), F. Steinke, P. Wolfrum (Siemens, Germany), T. Leveringhaus (University of Hannover, Germany)

### **Transient Stability Assessment of the GB Transmission System with High Penetrations of Wind Power**

K. Johnstone, R. Tumilty, K. Bell, C. Booth (University of Strathclyde, United Kingdom)

### **Transient Stability Analysis in Japanese Power System Considering Controllability of Wind Turbines**

T. Tsuji, K. Kawamata, T. Oyama (Yokohama National University, Japan), K. Uchida (Waseda University, Japan)

### **Study on the New Urgent-Current-Control Coordination Requirements in Grid Codes for Concentrated-Integration Wind Power from a Perspective of Transient Stability**

D. Zhang, X. Yuan, J. Hu (Huazhong University of Science and Technology, China), Q. Zhou, N. Wang (Gansu Electric Power Corporation, China)

## Session 9A: Grid Code Issues and Tools

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14:00 – 15:15 / 13 November 2014 / Room ECC 2 / Session chair: Magnus Callavik (ABB, Switzerland)

### **European Reactive Current Rise Time Requirements during Fault-Ride-Through from a Full-Converter Wind Turbine Perspective**

M. Curzi, R. Sharma, F. Martin (Siemens Wind Power, Denmark)

### **Power Plant Controller to Manage Network Codes and Contribute to the Network Stability**

J. Brun, C. Durand (Schneider Electric, France)

### **Open Systems for Optimal Integration of Renewable Energy**

S. Ruin (Consultant for TERO and LonMark Ambassador, Sweden/USA)

## Session 9B: Storage Options and Studies

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14:00 – 15:15 / 13 November 2014 / Room ECC 3 / Session chair: Barbara O'Neill (NREL, USA)

### **Wind Curtailment - Assessment of Storage Options for Reduction of Yield Losses**

M. Doering, K. Burges, R. Kuwahata (Ecofys Germany, Germany)

### **Flexible Storage Operation in a Market Environment**

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

### **The GE Hybrid Wind Turbine with Integrated Battery Energy Storage: Concept, Implementation and First Field Test Results**

N. Miller (GE Energy, USA), S. Wachtel (GE Energy, Germany), K. Longtin, J. Sabrsula (GE Renewables, USA) R. Burra (GE GRC, USA)

## Session 9C: Market Design

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14:00 – 15:15 / 13 November 2014 / Room ECC 1 / Session chair: Nickie Menemenlis (IREQ / Hydro Québec, Canada)

### **Towards Electricity Markets Accommodating Uncertain Offers**

A. Papakonstantinou, P. Pinson (DTU, Denmark)

### **Simulation Tool for Integrating Demand Side Response into the Regulating Power Market**

M. Gamst, H. K. Støchkel, P. B. Eriksen, (Energinet.dk, Denmark)

### **Analysis of the Impact of Wind Power Participating in Both Energy and Ancillary Services Markets: The Danish Case**

T. Soares, H. Morais, P. Pinson (DTU, Denmark)

## Session 10: Closing Session - Podiums Discussions

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15:25– 16:30 / 13 November 2014 / Room ECC 1

### Podium discussions

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

## Poster Session Papers

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### Decentralized & Adaptive Load-Frequency Control Scheme of Variable Speed Wind Turbines

B. Hoseinzadeh, F. Faria Da Silva, C. L. Bak (Aalborg University, Denmark)

### Operational Network Topology Changes as a Means of Reducing Power Curtailments of Wind Power Plants

M. Bajor (Institute of Power Engineering Gdańsk Division, Poland)

### The In-Depth Evaluation of Wind Power Forecasting Accuracy in Estonia: The Role of Technical Availability

L. Ulm, I. Palu (Tallinn University of Technology, Estonia)

### Wind Power Production Variations in the Swedish Power System – Case Study 2013

F. Carlsson (Vattenfall R&D, Sweden)

### Quantifying Variability – A Review of Metrics and a Case Study of Net Load Variability

J. Olason, D. Lingfors, M. Bergkvist, J. Widén (Uppsala University, Sweden)

### Market Requirements for Pumped Storage Profitability

K. Salevid, F. Carlsson (Vattenfall, Sweden)

### Impact of Voltage Control of DFIG Based Wind Power Plants on Damping of Power System Oscillations

Y. Xie, X. Yuan, W. He, J. Hu (Huazhong University of Science and Technology, China), K. Ding, N. Wang, (Gansu Electric Power Corporation, China)

### Grid Voltage Measurement using Adaptive Parameter Estimation for Wind Power System

C.-H. Yoo, I.-Y. Chung, S.-S. Hong (Kookmin University Seoul, South Korea), H.-J. Yoo (Samsung Heavy Industries, Korea)

### MAProSy Comparing Analysis Strategies and their Error Influence for Local Wind Power and PV Forecasts

A. Arnoldt (Fraunhofer IOSB-AST, Germany)

### Influence of the Harmonic Distortion Due to Modern Wind Turbines on the Bandwidth Requirement for Flicker Measurement

K. Redondo, A. Lazkano, J. J. Gutierrez (University of the Basque Country, Spain), C. Alvarez, E. Teixeira (E2Q, Spain)

### A Technical Study of the Reactive Power Compensation of a Wind Power Plant to Comply with French Grid Code Requirements

A. Teninge, X. Guillaud (L2EP, France), L. Ruiz Gomez (MAIA EOLIS, France), T. Prevost (RTE, France)

### Influence of Fully Rated Converter Generator Models on Frequency Stability in Power Systems with High Wind Power Penetration

G. Papaioannou, I. Talavera, H. Zimmer, J. Hanson (TU Darmstadt, Germany)

### An Alternative Inertial Control Technology for Full-Converter Wind Turbines

X. Xiong, X. Yuan, J. Hu, W. He (Huazhong University of Science and Technology, China), N. Chen, L. Zhu (CEPRI, China)

### Modeling of DFIG-Based Wind Turbines for Power System Low Frequency Oscillation Studies

F. Deng, X. Yuan, J. Hu, Y. Huang (Huazhong University of Science and Technology, China), K. Ding, N. Wang (Gansu Electric Power Corporation, China)

### A Comparative Analysis of Wind Turbine Generator Technologies for Harsh Environments

I. Davidson (University of KwaZulu-Natal, South Africa), N. K. Amaambo (University of Namibia, Namibia)

### Grid Impedance Measurement Strategies for Evaluation of Grid Accesspoints at High-Voltage-Level

T. T. Do, D. Schulz (Helmut-Schmidt-University, Germany)

### Flexibility and Regulation Capability of Hydropower Systems to Balance Large Amounts of Wind Power

J. Lönnberg, J. Bladh (Vattenfall, Sweden)

### Improvement of NWP Based Short Term Wind Power Forecasts by Postprocessing Using Artificial Neural Networks and Regression

M. Kratzenberg, H. H. Zürn (Federal University of Santa Catarina, Brazil), P. P. Revheim, H. G. Beyer (University of Agder, Norway)

**Effective Wind Speed Estimation and Real-Time Wake Model Re-Calibration for Down-Regulated Turbines**

T. Göçmen Bozkurt, G. Giebel, P.-E. Réthoré (DTU Wind, Denmark), M. Mirzaei, N. K. Poulsen (DTU, Denmark)

**Losses in Armoured Three-Phase Submarine Cables**

T. Ebdrup, F. Faria da Silva, C. L. Bak (Aalborg University, Denmark), C. Flytkjær Jensen (Energinet.dk, Denmark)

**Wind Turbine Transformer Impedance Identification Based on Time-Domain Measurements**

R. Christoffersen (Balslev, Denmark), T. Wederberg Rasmussen (DTU, Denmark), I. Arana Aristi, L. H. Kocewiak (DONG Energy, Denmark)

**Supply and Demand Balance Control of Power Systems with Wind Power Integration Based on Multi-Agent System**

H. Bae, T. Tsuji, T. Oyama (Yokohama National University, Japan)

**Energisation of an MV Electric Boiler for Load Control in Power Systems with Large Share of Renewables**

F. Faria da Silva, C. L. Bak (Aalborg University, Denmark), T. Davidsen (InoPower, Denmark)

**Coordination Between Offshore Transmission Assets A Third Way Approach**

F. Faria da Silva (Aalborg University, Denmark)

**Rapid Fluctuations in Wind Power Production During Severe Storms – A Case Study**

A. L. Løvholm, E. Berge, R. E. Bredesen (Kjeller Vindteknikk, Norway)

**Battery Storage System Size Optimization with Application of Statistical Distribution for Wind Power Forecast Error**

Z. Cai, J. Zhu, P. Stöcker, C. Bussar, L. Moraes Jr., M. Leuthold, D. U. Sauer (RWTH Aachen University, Germany)

**Demand Side Response System Frequency Control using Temperature-Controlled Devices: Potentials and Requirements in Germany by 2020**

L. Wagner, E. Tröster (Energynautics, Germany)

**Cycling Requirements for Conventional Power Plants at High Shares of Renewable Energy**

P.-P. Schierhorn, T. Brown, E. Tröster (Energynautics, Germany)

**Low Frequency AC Transmission- A Valid Alternative for Offshore Wind Farm Connection**

P. Wyllie, Y. Tang, L. Ran (University of Warwick, United Kingdom), J. Yu (ScottishPower Energy Networks, United Kingdom)