



KTH Electrical Engineering



**Fifth International Workshop
on Large-Scale Integration of Wind Power and
Transmission Networks for Offshore Wind Farms
7-8 April, 2005
Glasgow, Scotland**



**Scottish and Southern
Energy**



TSO - Western Part of Denmark



ScottishPower
renewables

Wednesday 6 April 2005

17:30-19:00 Reception, Registration & Snacks at City Chambers, George Square.
(Please try to come in time, we have to leave the building at 19:00)

Thursday 7 April 2005

8:00-9:00 Registration, Location: Room K325, John Anderson Building, Rottenrow East.

9:00 - 9:05 Welcome and Introduction, Thomas Ackermann, KTH

9:05 - 9:15 Welcome from University of Strathclyde, Glasgow

9:15 - 9:20 Structure of the Workshop, Graham Ault, University of Strathclyde

9:20-11:10 Session 1 (Room K325, John Anderson Building, Rottenrow East):

9:20 - 10:45 Presentations: **Rapid Expansion of Wind Generation: British Regulatory and Technical Responses** (20 minutes each)

- *An Introduction To Wind, The Market And The Grid In Britain*, Helen Snodin, Paul Gardner, Nigel Scott, Garrad Hassan
- *Integration Of Wind Into The GB Transmission System*; Lewis Dale, National Grid, UK
- *The Development of Grid Code Requirements for New and Renewable Forms of Generation in Great Britain*, Antony Johnson, Dr Nasser Tleis, Network Design, National Grid Company, Warwick, England
- *Grid Integration Of Offshore Wind In The UK*; Richard Ford, British Wind Energy Association, UK

10:45 - 11:05 Discussions, Discussion leader: Nigel Scott, Garrad Hassan

11:05 - 11:25 Coffee break

11:25-12:45 Session 2 (Room K325, John Anderson Building, Rottenrow East):

11.25 - 12.45 Presentations: **Large-Scale Wind Integration into Power Systems** (20 minutes each)

- *Towards 10,000 MW of Wind in GB by 2010*, Paul van Lieshout, Wind Power Group Manager and Mr David Bailey and Dr Floren Castro, Sinclair Knight Merz
- *Large-Scale Integration of Wind Power Into Power Systems – The Spanish Experience*, Lucy Craig, Garrad Hassan España, Zaragoza, Spain
- *Large-Scale Integration of Off-Shore Wind Power And Regulation Strategies of Cogeneration Plants in the Danish Electricity System*, Poul Alberg Østergaard, Aalborg University, Denmark
- *Long-Term Perspective on Applying Hydrogen as an Energy Carrier in Power and Energy Systems with a Large Amount of Wind Power*, Jens Pedersen, Peter Børre Eriksen, Eltra, Denmark

12:45-13:00 Discussions, Leader: Thomas Ackermann, KTH, Stockholm, Sweden

13:00-14:00 Lunch (The Lord Todd, Cathedral Street)

14:00-15:40 Parallel Session 3a (Room K325, John Anderson Building, Rottenrow East):

14.00-15.20 Presentations: **Power System Operation and Forecasting**
(20 minutes each)

- *Grid Integration of Wind Energy in Germany - Towards Managing 25 GW Offshore Wind Power*, U. Focken, M. Lange, Energy & meteo systems, Oldenburg; B. Graeber, EnBW Trading GmbH, Karlsruhe, Germany
- *Estimation of Fluctuation of Wind Power Generation in Belgium*, Joris Soens, Johan Driesen, Ronnie Belmans, K.U.Leuven, Department Electrotechnical Engineering ESAT-ELECTA, Heverlee, Belgium
- *Forecasting Wind Power Above North And Baltic Sea Using Combined And Refined Numerical Weather Predictions*, Jens Tambke, Carsten Poppinga, Bernhard Lange ForWind - Centre for Wind Energy Research, Oldenburg, Germany; Ulrich Focken, Matthias Lange, Energy & meteo systems GmbH, Oldenburg, Germany; Lueder von Bremen, 3ECMWF - European Centre for Medium-Range Weather Forecasts, Reading, UK; John A.T. Bye, School of Earth Sciences, The University of Melbourne, Australia, Jörg-Olaf Wolff, University of Oldenburg, Germany; Jens Indorf, EWE AG, Oldenburg, Germany
- *Assessment of One Year Wind Measurements on the First Offshore Wind Research Platform in the German Bight - FINO1*, T. Neumann, K.Nolopp, M.Strack, V.Riedel, Deutsches Windenergie-Institut (DEWI), Wilhelmshaven, Germany; K. Herklotz, Federal Maritime and Hydrographic Agency (BSH), Hamburg, Germany

15:20-15:40 Discussions, Discussion leader: Lennart Söder, KTH, Sweden

14:00-15:40 Parallel Session 3b (Room COL420, Colville Building, North Portland Street):

14.00-15.20 Presentations: **Energy Management & Economics** (20 minutes each)

- *Economics of Large-Scale Integration of Wind into the European Grids*, Hans Auer, Carlo Obersteiner, Claus Huber, Thomas Faber, Gustav Resch, Energy Economics Group, Vienna University of Technology, Austria
- *Wind Farms With DFIG as Virtual Power Plants*, K. Rudion, Otto-von-Guericke-University of Magdeburg; A. Orths, Fraunhofer Institute for Factory Operation and Automation IFF Magdeburg; A. Lebioda, Z. Styczynski, Otto-von-Guericke-University of Magdeburg, Germany
- *Modeling Wind in Deregulated Markets – Case Study: Electricity Reliability Council of Texas (ERCOT)*, Sidart Deb and Vikram Singh, LCG Consulting, France
- *Offshore-Wind – Implementing a Powerhouse for Europe*, Sven Teske, Renewable Energy Campaign, Greenpeace International

15:20-15:40 Discussions, Discussion leader: Peter Borre Eriksen, Eltra, Denmark

15:40-16:00 Coffee break

16:00-17:40 Parallel Session 4a (Room K325, John Anderson Building, Rottenrow East):

16.00 - 17.20 Presentations: **Grid Integration Issues - Grid Codes and Advanced Control Strategies** (20 minutes each)

- *Analytical Evidence for the GB Grid Code Compliance Process for Large Wind Farms*, Randell Johnson, Mott MacDonald, UK
- *Wind Farm Controllers With Grid Support*, Poul Sørensen, Anca D. Hansen, Kenneth Thomsen, Risø National Laboratory, Roskilde; Henrik Madsen, Henrik Aa. Nielsen, Niels K. Poulsen, Technical University of Denmark, Lyngby; Florin Iov, Frede Blaabjerg, Aalborg University; Martin H. Donovan, ENERGI E2, Copenhagen, Denmark
- *Advanced Control Strategies to Integrate German Offshore Wind Potential into Electrical Energy Supply*, K. Rohrig, F. Schlögl, R. Jursa, M. Wolff, Institute für Solare Energieversorgungstechnik (ISET), Kassel; Dr. F. Fischer, S. Hartge, Enercon GmbH R&D, Aurich; Dr. B. Valov, Dr. S. Heier, Universität Kassel, Germany
- *Energy Management Application for Large Windfarm Projects*, Laurent Schmitt, Areva T&D Automation, Massy, France

17:20-17:40 Discussions, Discussion leader: Steen Beck Nielsen, SEAS-NVE, DK

16:00-17:40 Parallel Session 4b (Room COL420, Colville Building, North Portland Street):

16.00-17.20 Presentations: **Markets & Economics** (20 minutes each)

- *Minimization of Imbalance Cost Trading Wind Power on The Short Term Power Market*, Julija Matevosyan, Lennart Söder, Royal Institute of Technology, Stockholm, Sweden
- *Incorporation of Wind Power Resources Into the California Energy Market*, Yuri Makarov, James Blatchford, Hani Alarian, Kenneth DeMarse, Michael O'Hara, Michael Scholz, Scott Jercich, Jennie Vidov, Randy Abernathy, David Hawkins, and John Zack, California ISO and AWS Truwind, USA
- *Wind Power Impact On Costs For Regulating Power in Multi-Area Markets*, Elin Lindgren, Lennart Söder, Royal Institute of Technology, Stockholm, Sweden
- *A Strategy For Locating The Least Cost Wind Energy Sites Within an E.U. Electrical Load And Grid Infrastructure Perspective*, Paul Dowling, Brian Hurley, Airtricity, Dublin, Ireland; Dr. Gregor Giebel, Risoe National Laboratory, Roskilde, Denmark

17:20-17:40 Discussions, Discussion leader: Julija Matevosyan, KTH

19:30 Reception and Conference Dinner (20:00), sponsored by Eltra. Entertainment sponsored by Garrad Hassan. (Location. Barony Hall. Rottenrow East)

Friday 8 April 2005

8:40-10:40 Parallel Session 5a (Room K325, John Anderson Building, Rottenrow East):

8:40-10.20 Presentations: **Modelling I** (20 minutes each)

- *Wind Power - Grid Connection and Modelling Requirements*, Steven Stapleton, Siemens Power T&D, Manchester, UK
- *Dynamic Simulation Of DFIGs For Wind Power Plants Using NETOMAC*, G. Duschl, D. Pannhorst, O.Ruhle, Siemens
- *Dynamical Model of Variable Speed WECS: Attend of Simplification*; Francisco M. Gonzalez-Longatt; Universidad Central de Venezuela, Caracas, Venezuela
- *Dynamic Fault Simulation of Wind Turbines using Commercial Simulation Tools*, Torsten Lund, Technical University of Denmark; Jarle Eak, Norwegian University of Science and Technology, Norway; Sanna Uski, VTT Technical Research Centre of Finland; Abram Perdana, Chalmers University of Technology, Sweden
- *Impact of Large Scale Wind Power on Power System Stability*, Ch. Eping, J. Stenzel, TU Darmstadt; M. Pöller, H. Müller, DIGSILENT GmbH, Germany

10.20-10.40 Discussions, Discussion Leader: to be named

09:00-10:40 Parallel Session 5b (Room COL420, Colville Building, North Portland Street):

9.00-10.20 Presentations: **Transmission Solutions I** (20 minutes each)

- *Transmission Strategies for Offshore Windmill Parks*, Georg Balog, Nexans Norway AS, Norbert Christl, Siemens AG.
- *Conceptual Design Of Offshore Wind Power Grid Connections Under Special Consideration Of Minimized Investment And Life Cycle Costs For Losses*, Dr Juergen Bernauer, Dorman Wensky, ABB Utilities, Mannheim, Germany
- *Grid Integration Of Large Offshore Wind Farms Using HVDC*, Lie Xu, Queen's University of Belfast, UK; Bjarne R Andersen, Andersen Power Electronic Solutions, Stafford, UK
- *Inteconnection Of Large Windparks –System Study Of HVDC-Systems*, Günther Brauner, Vienna University of Technology, Austria

10.20-10.40 Discussions, Discussion Leader: Peter Christensen, Denmark

10:40-11:00 Coffee break

11:00-13:00 Parallel Session 6a (Room K325, John Anderson Building, Rottenrow East):

11.00-12.20 Presentations: **Modelling II** (20 minutes each)

- *Modelling of the Vestas V80 VCS Wind Turbine with Low Voltage Ride-Through*, Martin Høgdahl, John Godsk Nielsen, Vestas Wind Systems, Randers, Denmark
- *Modelling And Simulation Of Wind Turbine Generators In Large Offshore Applications*, Paul D Hopewell, William W Price, Nicholas W Miller, Wei Liu, GE Energy
- *Advanced Modeling of the Doubly Fed Induction Generator Wind Turbine Under Network Disturbance*, Slavomir Seman, Florin Iov, Jouko Niiranen, Antero Arkkio, Helsinki University of Technology
- *Modelling And Fault-Ride-Through Operation Of Wind Turbines With Converter Connected Asynchronous Generators*; Vladislav Akhmatov, Eltra, Fredericia, Denmark

12.20-13.00 Discussions, Discussion Leader: Sigrid Bolik, Vestas, Denmark96

11:00-13:00 Parallel Session 6b (Room COL420, Colville Building, North Portland Street):

11:00-12.20 Presentations: **DOWNVind - Project; First Results** (20 minutes each)

- *Electrical System Designs for the Proposed 1GW Beatrice Offshore Windfarm*, Graham Ault, Sinclair Gair, Jim McDonald, University of Strathclyde, Scotland, UK
- *Method for Assessing Offshore Wind Farm Cable Reliability Incorporating Cost Effectiveness of Redundancy*; Georgios Takoudis, Graham Ault, Sinclair Gair, Jim McDonald, University of Strathclyde, Glasgow, Scotland, UK
- *Loss Evaluation of HVAC and HVDC Transmission Solutions for Large Offshore Wind Farms*, Nicola Barberis Negra, Jovan Todorovic, Thomas Ackermann, Royal Institute of Technology, Stockholm, Sweden
- *Economic Comparison and Availability Study of HVAC-HVDC Transmission Systems for Large Offshore Windfarms*, Lazaros Lazaridis, Thomas Ackermann, Royal Institute of Technology, Stockholm, Sweden

12.20-13.00 Discussions, Discussion Leader: Thomas Ackermann, KTH, Sweden

13.00-14.00 Lunch (The Lord Todd, Cathedral Street)

14:00-15:40 Parallel Session 7a (Room K325, John Anderson Building, Rottenrow East):

14.00-15.20 Presentations: **Modelling III** (20 minutes each)

- *Impact of Large Scale Wind Power on Power System Stability*, Ch. Eping, J. Stenzel, TU Darmstadt; M. Pöller, H. Müller, DlgSILENT GmbH, Germany
- *Experiences in Dynamic Behaviour of WEC and Consequences For Further Developments*, Stefan Hartge, Dr. Frank Fischer, Stephan Wachtel, Enercon, Aurich, Gemany
- *Dynamic Performance Testing of Woolnorth Wind Farm*, Marian Piekutowski, Tony Field and Sam Ho, Hydro Tasmania, Australia; Antonio Martinez, Marcus Steel, Stephen Clark, Satendra Bhola, Transend Networks Pty. Ltd, Australia; Henrik Kanstrup Jorgensen, Mujo Obad, Vestas Wind Systems AS, Denmark
- *Improving Voltage Quality in Eastern Denmark with a Dynamic Phase Compensator*, C. Rasmussen, P. Jørgensen, J. Havsager Elkraft System; S.B. Nielsen, N. Andersen SEAS-NVE, Denmark

15.20-15.40 Discussions, Discussion Leader: to be named

14:00-15:40 Parallel Session 7b (Room COL420, Colville Building, North Portland Street):

14.00-15.20 Presentations: **Transmission Solutions II** (20 minutes each)

- *Economic Optimization of Offshore Windfarm Substations and Collection Systems*, Reigh Walling, Thomas Ruddy, GE Energy
- *Power System Balancing with Offshore Wind Power in the Netherlands*, B.C. Ummels, M. Gibescu, W.L. Kling, G.C. Paap, Delft Technical University, The Netherlands
- *European Concerted Action on Offshore Wind Energy Deployment: Inventory and Analysis of Power Transmission Bottlenecks in Eight Member States*, Achim Woyte, 3E, Bruxelles Belgium; Helen Snodin, Paul Gardner, Garrad Hassan, Glasgow, Scotland, UK; Ruud de Brujne SenterNovem, Utrecht, The Netherlands
- *Three-Phase Single-Core Cable System with Core-redundancy*, Heiner Brakelmann, Univercity of Duisburg-Essen; Marten Jensen, GEO mbH, Germany

15.20-15.40 Discussions, Discussion Leader: Graham Ault, University of Strathclyde

15:40-16:00 Coffee break

16:00-16:40 Session 8 (Room K325, John Anderson Building, Rottenrow East):

16.35-17.00 Podiums Discussion, details to be announced

16:40-16:45 **Closing Remarks**

Saturday 9 April 2005; 10:00 – 12:00 Field Trip