

# WORKSHOP

## Integration of Wind Power into Power System: Key Issues

### 1. Abstract

Wind power is undergoing the fastest rate of growth of any form of electricity generation in the world. Ambitious goals for wind power development have been set by many countries. The resource potential is large; with many countries having wind regimes that could serve as a significant energy source. Electrical power systems must supply energy in close balance to demand. The average load varies in predictable daily and seasonal patterns, but there is an unpredictable component due to random load variations and unforeseen events. On the other hand, *Wind energy conversion systems* (WECS) are characterised by large variations in production. Wind resources vary on every time scale: seconds, minutes, hours, days, months and years. Both electricity supply and demand are variable. The issue, therefore, is not one of variability or intermittency per se, but how to predict, manage and ameliorate variability and what tools can be utilised to improve efficiency. The major issues of wind power integration are related to changed approaches in operation of the power system, connection requirements for wind power plants to maintain a stable and reliable supply, extension and modification of the grid infrastructure, and influence of wind power on system adequacy and the security of supply. The objective of this workshop is to present key issues related to the integration of wind power into power systems.

### 2. Outline

1. **Introduction**
2. **Wind Power Technologies.**
3. **Design and operation of the power system:** reserve capacities and balance management, short-term forecasting of wind power, demand side management and storage and optimisation of system flexibility;
4. **Wind Power integration studies.**
5. **Grid infrastructure issues:** optimisation of present infrastructure, extensions and reinforcements, offshore grids and improved interconnection;
6. **Grid connection of wind power:** grid codes and power quality and wind power plant capabilities;

### 3. Tutorial Duration

One hour.

#### 4. Instructor Affiliation

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#### 5. Instructor Biography

**Francisco M. Gonzalez-Longatt** is currently a Lecturer in Electrical Engineering in the Faculty of Engineering and Computing, University of Coventry and he is Vice-President of Venezuelan Wind Energy Association. His academic qualifications include first Class Electrical Engineering of Instituto Universitario Politécnico de la Fuerza Armada Nacional, Venezuela (1994), Master of Business Administration (Honors) of Universidad Bicentennial de Aragua, Venezuela (1999) and PhD in Electrical Power Engineering from the Universidad Central de Venezuela (2008). He is former associate professor on Electrical engineering Department of Universidad Nacional Politécnico de la Fuerza Armada Nacional, Venezuela (1995-2009). He was formerly with the School of Electrical and Electronic Engineering, The University of Manchester as Postdoctoral Research Associate (2009-2011). His main area of interest is integration of intermittent renewable energy resources into future power system and smart grids.

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## 6. List of Relevant Publications in this Area by the Instructor:

- [1] **F. Gonzalez-Longatt**, P. Regulski, H. Novanda, V. Terzija "Impact of Shaft Stiffness on Inertial Response of Fixed Speed Wind Turbines" *Automation of Electric Power Systems*, Vol 8, No 8, April 2012. (DOI: 10.3969/j.j.issn.1000-1026.2012.08.001).
- [2] **F. Gonzalez-Longatt**, "Impact of Synthetic Inertia from Wind Power on the Protection/Control Schemes of Future Power Systems: Simulation Study". *DPSP 2012 - Protecting the Smart Grid, The 11th International Conference on Developments in Power System Protection*, 23-26 April 2012, Birmingham, UK. ACCEPTED
- [3] **F. González-Longatt**, P. Regulski, P. Wall, V. Terzija. "Induction Generator Model Parameter Estimation using Improved Particle Swarm Optimization and On-Line Response to a Change in Frequency". *IEEE PES General Meeting 2011*, 24 – 29 July 2011, Detroit, USA. (Available online DOI: 10.1109/PES.2011.6039373)
- [4] **F. González-Longatt**, P. Regulski, V. Terzija. "Procedure for Estimation of Equivalent Model Parameters for a Wind Farm using Post-Disturbance On-line Measurement Data". *IEEE PES: European conference and exhibition on Innovative Smart Grid Technologies (ISGT-EUROPE 2011)*, 11-13 October 2011, Manchester, UK.
- [5] **F. González-Longatt**, P. Regulski, P. Wall, V. Terzija. "Fixed Speed Wind Generator Model Parameter Estimation using Improved Particle Swarm Optimization and System Frequency Disturbances". *IET Renewable Power Generation Conference 2011*, 6 - 8 September 2011, Edinburgh, UK.
- [6] **F. González-Longatt**, P. Wall, V. Terzija. "Impact of the shaft stiffness in the inertia response of Fixed speed wind turbines based on single cage induction generator". *Advanced Power System Automation and Protection (APAP2011)*. 16-20 October 2011. Beijing, China. (ISBN: 978-1-4244-9619-8).
- [7] Lei, D., **F. Gonzalez-Longatt**, et al. (2013). "Two-Step Spectral Clustering Controlled Islanding Algorithm." *IEEE Transactions on Power System*, Vol 28 (1), Pag. 75-84.