



## Design and Operation of Power Systems with Large Amounts of Wind Power

### Third Progress Report

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Hannele Holttinen, Ph.D., Operating Agent (OA)  
VTT Technical Research Centre of Finland



### 1. Background and goals

The Annex 25 was approved by ExCo #56 in 2005 and will run for 3 years 2006-2008.

The existing targets for wind power anticipate a quite high penetration of wind power in many countries. It is technically possible to integrate very large amounts of wind capacity in power systems, the limits arising from how much can be integrated at socially and economically acceptable costs. In recent years, several reports have been published in many countries investigating the power system impacts of wind power. However, the results on the costs of integration differ and comparisons are difficult to make due to different methodology, data and tools used, as well as terminology and metrics in representing the results. An in-depth review of the studies is needed to draw conclusions on the range of integration costs for wind power. This requires international collaboration. As system impact studies are often the first steps taken towards defining wind penetration targets within each country it is important that commonly accepted standard methodologies are applied related to these issues.

The objective of Task 25 is to analyse and further develop the methodology to assess the impact of wind power on power systems. The Task will establish an international forum for exchange of knowledge and experiences related to power system operation with large amounts of wind power. The challenge is to create coherence between parallel activities with Transmission System Operators other R&D Task work. The participants will collect and share information on the experience gained and the studies made up to and during the task. The case studies will address different aspects of power system operation and design: balancing, grid impacts and capacity credit of wind power. The main emphasis is on the technical operation. Costs will be assessed when necessary as a basis for comparison. Also technology that supports enhanced penetration will be addressed: wind farm controls and operating procedures; dynamic line ratings; storage; demand side management DSM etc.

The Task will start with producing a state-of-the-art report on the knowledge and results so far and end with developing guidelines on the recommended methodologies when estimating the system impacts and the costs of wind power integration. Also best practice recommendations may be formulated on system operation practices and planning methodologies for high wind penetration.

## 2. Progress toward goals

The international forum for exchange of knowledge and experiences has been established through the 3 meetings organised during the first year 2006. There has been TSO participation in all meetings. In addition, two working groups in CIGRE have been contacted: C6.08 Integration of a large share of fluctuating power (under Study Committee SC C6 on distributed generation) and WG C1.3. Also ETSO has been contacted to collaborate with their new international cooperation European Wind Integration Study (EWIS), no news after ExCo 58 on this, the EU funded part of EWIS will only start in May the earliest.

The kick-off was held in Kassel, Germany, hosted by ISET. Participants from 7 of the interested 12 countries were present. The 1<sup>st</sup> meeting was held in Hanasaari, Finland, May 23<sup>rd</sup> -24<sup>th</sup> 2006 hosted by VTT, in conjunction with the Nordic Wind Power Conference Participants from 10 countries were present and EWEA as an observer. The 2<sup>nd</sup> meeting was held in Oklahoma City, October 23-26<sup>th</sup> 2006, hosted by UWIG, in conjunction with the UWIG fall seminar. There was a special session for Task 25 in UWIG seminar and the participants were also welcomed to join the UWIG member workshops where some European experience was also presented. 19 people from 9 countries were present, France (EdF) and Canada (Hydro Quebec) as observers (see figure 1).



**Fig 1. Oklahoma meeting of Task 25 – participants.**

In the meetings, all participants have made presentations of the wind integration issues in their country, results so far and on-going activities.

A review process for the existing studies has started by collecting information of existing national case studies and writing the State-of-the-art report.

### 3. Specific technical activities

A paper describing the Task and outlining the on-going activities in participating countries was written in February 2006 and presented as a poster in EWEC2006 and NWPC2006.

A paper describing the results of existing wind integration work was written in September 2006 and presented in Global Wind Power Conference GWPC2006 Adelaide 18-22th September and Delft workshop for offshore and large scale integration 25<sup>th</sup> October. Presentations of the first results were also given by the OA in UWIG seminar, Oklahoma, October 2006; EWEA Grid Conference, Brussels, November, 2006 and IEA workshop, Paris, December, 2007.

A collaborative journal article on “Wind integration experience from areas with large penetrations” coordinated by Lennart Söder, KTH was presented at Nordic wind power conference May 2006, with experience from Germany, Denmark and Sweden. It was further expanded to a journal article with added experience reported from Ireland and New Mexico, US, and published in IEEE Transactions on Energy Conversion, early 2007. One collaborative journal article is under work: joint paper with Task 24 (Canada) on “Using standard deviation as a measure of increased reserve requirement needs for wind power” (Hannele Holttinen, Brendan Kirby, Michael Milligan, Tom Molinski, Viktoria Neimane). One idea for collaborative journal article has emerged during the State-of-the-art report process, going into more detail about variability of wind power in different regions (Nordic, US, Portugal, Ireland, Germany, perhaps also more).

The State-of-the-art report has been written. Some parts still need to be completed and the summary parts are on a first draft commenting round. The report will be finished hopefully in April, and the publication will be discussed in the following meeting May 7<sup>th</sup> in Milan. A conference paper to EWEC2007 will be written in April summarizing the results. There will be a special session in EWEC2007 for Task 25 giving the summary and short presentations from 12 participants.

### 4. Administrative issues

The participation of the Task is presented in *Table 1*. There are altogether 12 participants that have joined the meetings. The formal letters addressed to IEA headquarters for joining the Annex have been sent from 10 countries and EWEA. Spain has found a new interested party and funding for 2 years. An email round from the participants in January found no objections for Spain to join only for 2 years (2007 and 2008). ExCo guiding on this issue will be asked for in the meeting.

No response from Italy has been received after initial interest in the proposal phase in 2005. France and Canada joined one meeting as observers, but did not join the Annex. No news from Australia since October (NEMMCO was considering participation).

The project www pages are maintained by ExCo Secretary and the OA at [www.ieawind.org](http://www.ieawind.org). A library of the existing articles and reports has been set up but still needs updating.

There are also tasks starting with other IEA IA:s (DSM and Hydrogen) related to wind integration, as well as the IEA G8 related work. As the DSM new Task OA is also from VTT, Finland, there was a meeting with OAs in March going through the objectives of the Tasks. The DSM Task is organizing a kick-off meeting in May. The first phase of their Task will start by summer and last for one year. The scope is large and involves mostly information collection and some analysing. Task 25 and 24 could contribute to part of their information collection (characteristics and integration

needs of wind integration and hydro as storage) as well as part of the analysis planned. Most of the other work they do is relevant information that can be summarised in Task 25 final report.

*Table 1 Task 25 participation as of March, 2007.*

	<b>Country</b>	<b>Institution</b>	<b>Commitment</b>
1	Denmark	Risø National Laboratories (Peter Meibom) TSO Energinet.dk (Antje Orths)	Confirmed
2	EWEA	European Wind Energy Association (Frans van Hulle)	Confirmed
3	Finland	VTT Technical Research Centre of Finland (OA) (TSO Fingrid will follow the national project)	Confirmed
4	Germany	ISET (Cornel Ensslin) TSO E.ON (Lutz Hofmann) TSO RWE (Bernhard Ernst) (Ecofys participated in the kick-off meeting)	Confirmed
5	Ireland	To be confirmed (University of Dublin and TSO Eirgrid have participated)	Confirmed
6	Norway	SINTEF (John Olav Tande) Statkraft (Espen Hagstrøm)	Confirmed
7	Netherlands	we@sea, ECN (Jan Pierik)	Confirmed
8	Portugal	INETI (Ana Estanquero) TSO REN (João Ricardo) INESC-Porto (J. Pecas Lopes) UTL-IST (Rui Castro)	Confirmed
9	Spain	University of Castilla La Mancha (Emilio Gomez) TSO REE participated in kick-off	To be confirmed
10	Sweden	KTH (Lennart Söder)	Confirmed
11	UK	Centre for Distributed Generation and Sustainable Electrical Energy (Goran Strbac)	Confirmed
12	USA	NREL (Brian Parsons) UWIG (Charles Smith)	Confirmed

## **5. Plans for the next term**

April...May will be devoted to finalizing state-of-the-art report and EWEC2007 paper summarizing the results from wind integration studies so far and first results from review process for methodologies. Coordination will be needed to successfully manage the special session for Task 25 in EWEC'2007 with 13 presentations.

The library in the www pages of Task 25 will be complemented and updated.

Journal articles from some of the issues in the State-of-the-art report will be written. Further collaboration with CIGRE and ETSO will be looked for, perhaps in form of presenting the State-of-the-art report results from the review of existing studies.

The next meeting will take place 7th May in Milan in conjunction with EWEC'2007, hosted by EWEA. A joint meeting with Task 24 Wind&Hydro has been suggested to Oslo, fall 2007, hosted by Statkraft.