Facilitation of Renewables Forum

Crowne Plaza Hotel, Dundalk

10th June 2010

Facilitation of Renewables Forum

Agenda

Session 1

Chair: Dermot Byrne, Chief Executive, EirGrid

10.00am	Opening Remarks *Dermot Byrne,* Chief Executive, *EirGrid*
10.15am	EirGrid Overview - Results and Conclusions *Jon O'Sullivan, Manager Operations Policy and Performance, EirGrid*
10.35am	Independent Reviewers Statements *Mark O'Malley, UCD, Peter Harte, SWS Energy*
10.55am	Work Package 3: Results and High Level Conclusions *Jens Boemer, Ecofys & Karsten Burges, Ecofys*
11.30am	Questions from Audience
11.40am	**Break:** Tea and Coffee

Session 2

Chair: Dick Lewis, Manager, Grid Operations Planning, SONI

12.00pm	Work Package 1: Detailed Modelling Assumptions and Methodology *Steve Stapleton, Siemens PTI*
12.40pm	Work Package 2: Detailed Modelling Assumptions and Methodology *Alan Mullane, Ecar*
1.20pm	Questions from Audience
1.30pm	Closing Comments followed by Lunch *Jon O'Sullivan, Manager Operations Policy and Performance, EirGrid*

Note

The presentations from this forum and the Facilitation of Renewables Report will be available on the EirGrid website tomorrow, Friday 11th June. All registered delegates will receive an email containing a link to the presentations and the report.

A hard copy of the Facilitation of Renewables Report will also be available at the end of June. Please contact the EirGrid Customer Relations Team to request same.

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Facilitation of Renewables

Early in 2009, EirGrid and SONI (EirGrid group) initiated a suite of studies - entitled the Facilitation of Renewables - designed to examine the technical challenges with integrating significant volumes of windfarms onto the power system of Ireland and Northern Ireland. It was envisioned that the output of these studies would provide the necessary information to develop a cogent and consistent operational strategy to manage the island power system in a safe secure manner. To this end three separate internationally recognised consultancy firms Siemens-PTI, Ecar and DigSilent-ECOFYS were engaged to perform the various distinct technical studies and to rigorously analyse and challenge the outputs in conjunction with EirGrid and SONI engineers and independent industry peer reviewers Mr. Peter Harte – SWS Windfarms and Professor Mark O'Malley from UCD.

Ireland and Northern Ireland have ambitious targets for electricity generated from renewable resources by 2020 which will predominantly be achieved with windfarms. The currently installed windfarms of 1700 MW provides over 10% of the electricity produced in Ireland and Northern Ireland per annum. However to meet the policy objectives targets at least 6000 MW of windfarms are required by 2020. This amount of windfarms will at times represent well in excess of 50% of the generation of the total power system in real time. To put this in context the level of instantaneous penetration on the complete power system of Ireland and Northern Ireland is and will rise to levels which will not be experienced by any other complete power system including continental Europe, Scandinavia and USA for many decades to come.

Due to the technical characteristics of windfarms the increasing instantaneous penetration will alter the dynamic characteristics of the power system. These changes to the characteristics need to be understood in order to develop an operational strategy to manage the power system in a secure reliable manner consistent with and complementary to the renewable targets. This has been previously recognised in the All Island Grid Study which recommended further follow on studies specifically to analyse the dynamic properties of a power system with large amounts of wind. These Facilitation of Renewables studies provide the first significant modelling of power system behaviour at these unprecedented instantaneous penetrations of wind and as such address a wide variety of distinct technical challenges.

The key findings from the studies indicate that the integrity of the frequency response and the dynamic stability of the power system are compromised at high instantaneous penetrations of wind. While there are mitigation measures which can be employed, it will be necessary, in order to operate a secure power system, to limit or "curtail" at times the aggregate output of windfarms on the island. For frequency response some of the key mitigation measures are disabling/replacing aspects of the standard distribution connected protection schemes for windfarms as well as ensuring that conventional generators provide appropriate reserve in a timely manner following an energy imbalance. In addition the capability of all generators to withstand high rates of frequency change will need to be reviewed. To mitigate the dynamic stability problems the use of fast acting reliable reactive power response devices during and following disturbances are required – this could be achieved by installing devices such as synchronous compensators, and/or requiring all windfarms and conventional generators to have the a specific capability.

In addition to these key findings the modelling suggested that the voltage and reactive behaviour of the system will require significant management and is directly related to the performance of all generators on the island as well as how the network is developed. Finally the studies did indicate that voltage disturbances could result in the temporary loss of windfarm output. At high instantaneous penetrations this could result in a voltage dip inducing significant frequency response challenges on the power system. This requires further analysis in order to fully quantify the effect

and assess the consequences and potential mitigation approaches. As this is based on extremely high penetrations of wind there is sufficient time for EirGrid to further analyse this issue.

Overall, the findings indicate that to operate the power system securely a limit on the aggregate windfarm output is required at times. This will be related to the capability of the conventional and renewable generation, the protection of distribution connected windfarms and the level of imports and exports on the system.

Using the key findings EirGrid has modelled the impact of potential operational strategies on the energy generated from wind as well as the potential curtailment of windfarms in 2020. This additional modelling assumed that the transmission and network capability was such that there were no network limitations on windfarm output. With an installed capacity of just over 6,000 MW Ireland and Northern Ireland can reach 40% target from renewable resources (38% from wind, 2% from hydro). However the operational strategy employed has a significant bearing on this. Figure 1 shows how the level of curtailment varies for different operational strategies on maximum wind levels – for example with a 70% maximum wind limit and exports available the curtailment is approximately 5-6%. Figure 2 shows how different operational strategies on maximum wind levels impact on total annual wind energy (for the previously example there would be 38% energy). A critical assumption is that all generators perform as required. This is not always the case today, and if this continues it is likely to lead too significant further curtailment of windfarms.

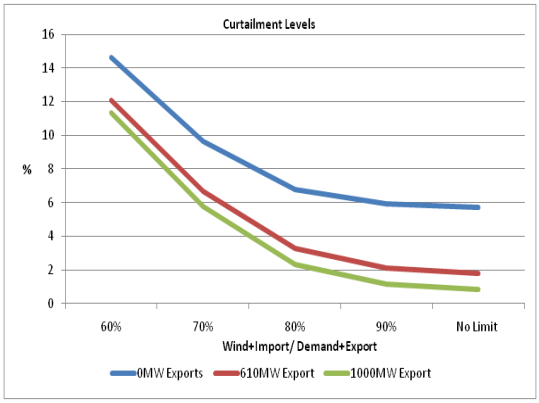

Figure 1: Wind curtailment level for differing Max Wind levels

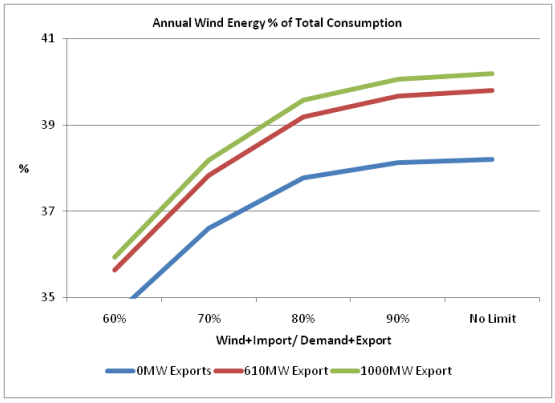

Figure 2: Annual Wind Energy for differing max wind levels

In summary because of the unprecedented amounts of wind generation in real time that the power system of Ireland and Northern Ireland will experience to meet the policy targets, EirGrid have completed a series of groundbreaking studies on the dynamic characteristics of power systems. The results are the first of their kind and provide sufficient information that EirGrid are confident that secure and reliable operational strategies can be developed so that by 2020 Ireland and Northern Ireland can meet the renewable targets set down in policy. This is based on four key assumptions:

- That the use of standard protection relays on the distribution network as well as the capability of generators to ride through high rates of change of frequency need to be reviewed;
- That the conventional generators meet the standards of reserve (especially primary) that the models provided indicate and that the Grid Code requires;
- That all windfarms have the appropriate control, capability and response, particularly for voltage reactive support during disturbances, as stipulated in the Grid Code. That operational strategies to beneficially use this embedded capability are developed; and
- That appropriate operational strategies are developed and implemented allowing for the installed capabilities to be utilisied to the benefit of the power system and policy targets.