Summary of Meeting and Actions

Meeting Name	Frequency Response Technical Sub Group
Meeting No.	1
Date of Meeting	Monday, 15th November 2010
Time	11:00am – 3:30pm
Venue	31 Homer Road, Solihull - National Grid Office

This note outlines the key action points from the first meeting of the Frequency Response Technical Sub Group.

1) Introductions, Minutes and Apologies

TI introduced himself and proved a high level summary of the background and purpose of the technical Sub Group. As this was the inaugural meeting there were no previous minutes to approve. The members all introduced themselves, the companies they represent and how they feel they will contribute to the Sub Group's work.

The Grid Code change process was discussed to ensure all members understood how the group's work fitted in with that of the parent Frequency Response Working Group.

Apologises were received from Simon Lord, Alastair Frew, Martyn Cunningham and Steven Curtis.

2) Draft Terms of Reference

The Sub Group reports to the Frequency Response Working Group, who had produced some draft Terms of Reference, which were discussed. TI agreed to upload these onto the Working Group's webpage and email around a link.

Action: TI

The question was raised as to how Ireland has been dealing with Frequency Response and inertial requirements as a result of the deep penetration of wind on their network. It was stated that recently the amount of demand that was met by wind power had exceeded 50% for the first time. TI explained that National grid representatives had been discussing the topic with both an Irish Transmission System Operator and the Irish regulator. TI agreed to discuss the matter and provide an update at the next meeting.

Action: TI

A member questioned whether it was necessary to model a largest single loss of 1320MW as well as 1800MW as it was likely this was about to become the standard. National Grid explained that firstly the Authority was yet to agree to the changes and also under the proposed revision to largest single loss, there still existed situations when the frequency response requirements would be set by the need to manage a 1320MW within the normal infeed loss criteria. Consequently the Sub Group agreed it needed to consider both sizes of loss.

The Sub Group agreed that a deliverable should be to calculate the volume of frequency response and inertia requirements for the transmission system. Clarification was sought on what was meant in the ToR as "Per MW basis". TI explained that, if time permitted the WG had hoped that a total volume could be converted into a 'per MW' basis to help translate the requirement into a simple obligation. The Sub Group concluded that it was not clear on what basis this was to be performed and that with only a very limited number of meetings this would be challenging and therefore suggested that the volume requirement should be completed first. TI agreed to feed this back to the Working Group and subject to agreement to remove the "per MW" element from the ToR.

Action: TI

Clarification was requested as to whether National Grid is differentiating between 'inertia' and 'frequency response'. National Grid responded that they are, as they are inherent different

characteristics; inertia is very rapid and sourced from the rotating mass of the generator whereas FR is slower acting but longer lasting and is produced by controlling the power production or conversion processes driving the machine.

National Grid was asked whether their provision of Frequency Response had been considered. Such a service has been discussed although this would require a change to National Grid's Transmission Licence.

It was discussed, and agreed, that Users other than just generation should be considered to provide inertia such as on the demand side.

The proposed scope of work will require substantial technical study processing resource which National Grid confirmed it intended to provide this although any additional support of expertise that can be provided by the Working Group will be extremely useful.

The Sub Group agreed the Terms of Reference following the removal of the "per MW" wording.

3) Technical background and recent work

National Grid reported that 40 GW of wind projects have signed connection agreements as has a very significant volume of future nuclear generation. A plausible scenario for the future is that demand is met using wind generation only for some periods of the year with considerable variation in the generation mix as weather conditions change. For example, last week 2GW of wind generation output was metered in GB for the first time and only 24 hours later this had reduced to almost zero.

The current Grid Code requirements are for primary, secondary and high response at various specified timescales and for Limited Frequency Sensitive Mode operation, with no explicit mention of inertia. The question was raised by MC as to whether current synchronous generators actually deliver inertia as units on limited frequency sensitive mode may be controlled in such a way that inertia is suppressed, because their control systems will act (as designed) to maintain constant machine output. MC continued that inertia is actually a type of response rather than a natural, inherent characteristic.

SW confirmed that the output of such a machine would have to be examined to test this theory. JD suggested that if you could deploy enough long term measurement you could conclude how much existing generation actually provides the expected change in output.

Frequency Response Issues
A recent paper produced by National Grid described a future scenario where the secured loss is 1800MW and there is 25GW of demand met by synchronous generation (ie a 'low wind' conditions). Under this scenario frequency could not be contained to the necessary limits under the plant conditions and assumptions studied, illustrating the need to re-visit frequency response requirements and the assumptions used to derive these. This could in turn impact on any synthetic inertia requirement and hence a recommendation was made to convene a working group to develop a coherent approach to response and inertia for larger infeed losses.

Current Synthetic inertia proposals

Outline initial synthetic inertia proposals have been developed by the FR Working Group and to date, National Grid has received useful feedback from manufacturers on these although additional comments are being sought. Initial proposals have been presented to Grid Code Review Panel to keep members informed.

A simple model has been produced and was discussed. The model included:

- Both wind and conventional generation
- Tripping a single generator (both at 1320MW and 1800MW)
- Demand is 25GW and has static and rotating elements
- Frequency response is provided by a single generator

- Wind generator is a static generator

The proportion of static and dynamic demand had been verified following a previous system incident. Confirmation of this split was sought and it was suggested that information can be drawn from the Technical Recommendation G64 (induction machines).

A diagram showing the initial proposed synthetic inertia proposals was discussed as were the potential issues of recovery periods and excess mechanical loads

It was noted that if inertia is not provided the rate of change of system frequency could be very high and this could impact on the protection setting on embedded generators as detailed in G59/G74.

MC informed the group that Anthony Johnston (National Grid) had produced some charts for a 25GW, 1800MW scenario within the Frequency Response Working Group. SW agreed to discuss this previous work with AJ and report back to the Sub Group.

Action: SW

4) Synthetic Inertia Issues

Initially, a deadband of 0.003Hz/s had been proposed but this was now consider to be too narrow and would lead to synthetic inertia being triggered too often. National Grid confirmed that SI was expected to be called upon relatively infrequently.

One manufacturer had highlighted that a turbine could not provide Synthetic Inertia at the same time as it was riding through a fault. In addition it was considered challenging for a turbine to provide Frequency Response and Inertia at the same time. MC recalled that an initial assumption was that SI was only to be provided by PPM in limited frequency sensitive mode.

The 'recovery period' was discussed and the importance of avoiding a ‘double dip’ was emphasised. Further studies need to be performed to assess this. Filtering of df/dt also needs to be considered and addressed.

The aim of the work was agreed as to:

- Understand whether proposed SI requirements can be met
- Develop a coordinated approach
- Determine what further work must be carried out
- Refine proposed obligations/ requirements
- Propose Grid Code drafting.

The question was raised as to whether a turbine needs to run effectively constrained so as to provide frequency response or SI recovery. National Grid responded that it really wants to avoid this. National Grid has developed its thinking on the assumption that wind will not be spilled to provide a synthetic inertia capability as it would mean permanent and persistent diminution of the carbon emission reduction potential of wind generation. The Sub Group also concluded that the manufacturers need to consider all the mechanical components in their plant to ensure that the extra stress can be withstood.

To date the assumption has been made that SI has generally been produced by invertor action rather than pitching action. There is some concern that the conventional wind turbines may not be able to provide more power, when running at max, without up rating the associated plant e.g. gearboxes. Also, this boost might have an impact on the reactive power capability of the machine.

SW mentioned a publicly available paper written by a wind turbine manufacturer on how synthetic inertia can be achieved and agreed to circulate.

Action: SW

5) Discussion and initial feedback

Frequency Response

GS summarised some potential areas for further consideration such as suitability of single bus models, largest loss assumptions, demand inertia, generator mix and minimum demand assumptions.

The Sub Group discussed whether a single bus or multiple bus model should be used. The conclusion was that a single bus was sufficient for the purposes of evaluating frequency response and synthetic inertia requirements. Factors such as local oscillations should be considered when evaluating the practical implications of delivering a df/dt triggered action. Wider system issues such as inter-area oscillations would also need to be evaluated but this was considered unachievable within the timescales of this working group.

The anticipated ratio of 'defig' versus full power convertor use for wind turbines was discussed as were implications of designs using gear boxes.

The control of Power Park Module was discussed, which could be on an aggregate or an individual unit basis. PPM aggregation was thought to be too slow, certainly far slower that the initial proposed time scale of 200ms. In fact this timescale was considered difficult to achieve on an individual unit basis. National Grid responded that the 200ms arose from a system requirement not a unit ability and that it could be relaxed if it could be demonstrated that frequency changes could still be managed. An alternative could be to define a curve of required inertia vs time of response. SW agreed to report on the relationship between delay and system requirements.

Action: SW

A representative from Nordex offered to set up a data collating exercise from two existing wind farms, one in southern England and one in Scotland. The criteria would be how many times the frequency moved by 10mHz in 200ms.

Action: PT

TI agreed to send round a recent Grid Code Review Panel paper on rate of change of frequency.

Action: TI

National Grid agreed that the alternative approach to using df/dt criteria is to look at absolute frequency settings as a quicker and simpler solution. MC suggested that both could be modelled on real data and see which works best.

The group also discussed Offshore turbines, connected by HVDC, which would require a frequency triggering signal.

It was confirmed that the models no not incorporate any explicit assumptions for photo voltaic generation (the scenarios investigated represent overnight situations) or from tidal generation.

6) AOB

There were no items.

7) Date of Next Meetings

The next meeting is scheduled for Friday 3rd December and the intention is to conclude business sufficiently early to allow member to catch flights back to their respective countries.

Appendix 1 – Working Group Attendance

Members Present:

Tom Ireland	TI	Working Group Chair
Alan Mason	AM	REpower
Bjorn Andresen	BA	Siemens Wind Power
Chris Hastings	CH	SSE
Damien McCool	DM	EDP Renewables
Francois Luciani	FL	EDF Energy
Geraldine Bryson	GB	Electricity North West
Graham Stein	GS	National Grid
Joe Duddy	JD	Renewable Energy Systems
Ken Lennon	KL	SP Power Systems
Mick Chowns	MCh	RWE Innogy
Peter Thomas	PT	Nordex
Sohnke Schierloh	SS	Enercon
Stewart Whyte	SW	National Grid
Tim Moore	TM	UK Power Networks
Tony Lakin	TL	Turbopowersytems

Apologies:

Alastair Frew	AF	Scottish Power
Martyn Cunningham	MCu	Scottish Power
Jytte Kaad Jenson	JKD	Vestas
Simon Lord	SL	First Hydro
Steve Curtis	SC	National Grid