Summary of Meeting and Actions

Meeting Name	Frequency Response Working Group
Meeting No.	9
Date of Meeting	Wednesday, 28th April 2010
Time	10:00am – 3:00pm
Venue	Conference Room B2-1, National Grid House, Warwick

This note outlines the key action points from the ninth meeting of the Frequency Response Working Group.

1) Apologies for Absence

Apologies were received from John Welsh (Scottish Power Systems), Damien McCool (Scottish Power Renewables), Dan Jerwood (GDF SUEZ Energy UK), Bridget Morgan (Ofgem) and Mark Baker (Scottish Power).

2) Minutes from Previous Meeting

The draft minutes of the Grid Code/BSSG Frequency Response Working Group meeting held on 15th February 2010 were approved subject to some agreed amendments and will be accessible from the National Grid Code Website. TI also took away an action to contact Damien McCool to see if he would be continuing with the Working Group.

ACTION: TI

3) System Inertia

In previous meetings it had been discussed that many new and renewable generation technologies do not inherently contribute to system inertia which would result in an increased rate of change of system frequency following a generation loss. AJ added some depth to the subject with a presentation on System Inertia. He ran through a number of scenarios in which various amounts of generation were tripped off the system and the corresponding requirements for Frequency Response and System Inertia to maintain the frequency above 49.2 Hz were determined. He showed that by halving the inertia on the system you will need to increase the number of machines selected for Frequency Response (which increases overall system operating cost) otherwise the frequency will dip below the 49.2 Hz threshold. For a large system loss (e.g. 1800MW) the amount of frequency response required increases substantially as a result of the increased rate of change of frequency fall.

AJ also noted that it would be possible for new and renewable generation technologies to be able to contribute to System Inertia by a modification to the control system. Three wind turbine manufacturers have published information on such systems and discussions are still on-going with other manufacturers. Since the control systems would rely on a df/dt control, which is a noise amplifying process, some consideration will need to be given to adequate filtering. It is suggested such a facility would only be applicable to plant operating in Limited Frequency Sensitive Mode and that a dead band be put in place around ±0.003 Hz/s to minimise wear on the generator, however this value is based on past experience and further evaluation is needed. It was also noted that Hydro Quebec specify the requirement for a equivalent inertia constant of 3.5s in their Transmission System Connection requirements. In addition, the proposed European Grid Code also includes requirements for the provision of synthetic inertia.

AJ concluded that there needs to be coordination between requirements for inertia, delivery of primary response and delivery of secondary response. Issues such as control systems dynamics, dead band and complexity need to be taken into account when considering such a requirement. The group commented that there would need to be close liaison with the manufacturers and that they need to be clear about what they can do to help contribute towards system inertia.

'After looking at the models it was questioned why the step change after tripping appeared to be the same regardless of the system inertia'. AJ explained that the Digsilent Power Factory Model used in the examples shown during the presentation where based on synchronous generator models only where there is direct coupling between the mechanical turbine and Generator. AJ further outlined that due to the conservation of energy, the total energy delivered to the system by the Synchronous Generation, at the instant of the Generation loss, must equal the instantaneous demand, which would take place irrespective of the inertia. Immediately after the generation loss, the mismatch in generation and demand will be reflected by a drop in speed, the rate of fall frequency fall being dependant upon the stored energy in the rotating mass, the size of which would be dependant upon the inertia . However, as the stored energy in the rotating mass is lower in the case with lower inertia, the speed falls more quickly which in turn results in a faster rate of change of system frequency and a larger reduction in demand. In summary, the supplied energy from the rotating masses is equal to the area under the power / time curve not the instantaneous power delivered at the time of the loss. It should also be noted that where the turbine is decoupled from the generator (eg via power electronics), such as in a doubly fed wind turbine or full converter wind turbine, then the active power output of the generator will not be affected by changes in the system frequency or deviations in system frequency, and hence the short term power injected into the network is zero unlike that of a synchronous machine.

Whilst looking at the models the group also commented that it appeared inertia was required immediately at the inception of the generation loss. It was explained that system inertia affects the initial rate of change of frequency before slower acting primary response and secondary response act to subsequently contain and correct the frequency fall. It was also discussed that any solution developed should be tested against the frequency limit of 49.2 Hz and the df/dt limit based on the G/59 setting of 0.125 Hz/s as a starting point.

4) Future Response Market Options Matrix

RT provided a matrix of possible solutions that the group went through and discussed the merits of each option to decide if it was feasible or not. The matrix had three ways of grouping frequency response, by generating unit, company portfolio and by technology. These groups were then compared with whether it would be feasible to trade capacity, delivery, both or neither within each of the three groups. This matrix was then considered from the perspective of the SO, Generator and Supplier to determine which party should have the requirement to procure Frequency Response. Below is an initial summary of the matrix discussed:

	Generating Unit			**Company Portfolio**			**Technology**		
	SO Procures	Generator Procures	Supplier Procures	SO Procures	Generator Procures	Supplier Procures	SO Procures	Generator Procures	Supplier Procures
Tradable Capacity									
Tradable Delivery									
Both Tradable									
Neither Tradable									

Key

	Current Provision
	Feasible Option
	Non Feasible Option
	Option 1

The general response to the matrix was that there are options within all three groups that seem to have the possibility of offering a feasible solution. However, initial analysis

seemed to suggest that a number of portfolio or technology specific solutions, whilst technically feasible, may to be too impractical or costly to implement.

It was commented by one member of the group that, allowing each technology to provide a level of Frequency Response best suited to it might be the most cost effective option, as it would not put expensive and uneconomical requirements on generators. However, it was also pointed out from a system security perspective that, if each technology only produced a level of Frequency Response in relation to its ability and not the requirements of the system, it could leave the system without adequate Frequency Response.

In regards to the portfolio option it was noted that a portfolio could arguably be one unit or a number of units but when any company acquires new units it would alter its Frequency Response requirements and it could be a difficult and costly to setup and monitor.

It was noted, mainly within the generating unit group of the matrix rather than company portfolio and technology, that there seemed some benefit in placing the obligation on Suppliers to procure Frequency Response in proportion to the amount of generation they needed to meet their expected demand. This would allow the correct amount of Frequency Response to be available for any given level of demand, as well as helping Suppliers to understand the benefits associated with services such as Frequency Response. The group also commented that demand is a useful and flexible way to respond to a frequency situation but in the past suppliers have not been able to actively participate to Frequency Response due to the technology.

ACTION: TI – clarify matrix

In discussing the possibility of a Frequency Response market, one group member commented that a clearly defined obligation to provide Frequency Response is necessary and it has to be clearly stated. If a clear definition is not contained within the Grid Code it will make it very difficult for manufacturers to know what requirements they must apply when designing their generation units. A market would also need to give suitable signals far enough in advance in order to be effective as well as having a framework in place that makes it lucrative enough to attract investment.

It was noted that a Cost Benefit Analysis (CBA) would need to be carried out on the various options that the group puts forward. The CBA would also need to take into account issues such a stress on turbines and that response might not be the 10% that currently stands. By carrying out a CBA for each of the options it will be possible to determine the best overall cost option for industry.

5) Options going forward

After discussions around the Future Response Options Matrix, the group agreed on three main areas to investigate further:

1. A possible Grid Code obligation solution - Action on MA
2. a) A Frequency Response Market solution - Action on TI
   b) A Frequency Response Market for delivery - Action on RT
3. Economic Tests that would be applied to a solution - Action on RT

These actions were taken away and progress will be reported at the next Working Group meeting.

6) Next Meeting

The next two meetings of the Working Group are to be agreed via email, possible dates below.

1. 1st June or 3rd June [later confirmed as 1st June 2010 - 10:30am start]
2. Between 6th and 8th July [later confirmed as 8th July 2010 - 10:00am start]

All to be held at National Grid House, Gallows Hill, Warwick.

Appendix 1 – Working Group Attendance

Members Present:

Tom Ireland	TI	Working Group Chairperson
Thomas Derry	TD	Technical Secretary
Antony Johnson	AJ	National Grid
Chris Hastings	CH	Scottish-Southern
William Hung	WH	National Grid
Stephen Curtis	SC	National Grid
Bob Nicholls	BN	E.ON UK
Claire Maxim	CM	E.ON UK
Mike Chowns	MC	RWE
Malcolm Arthur	MA	National Grid
Francois Luciani	FL	British Energy
Raoul Thulin	RT	RWE
Chris Proudfoot	CP	Centrica

Apologies:

Mark Baker	MB	Scottish Power
John Welsh	JW	Scottish Power (DNO Representative)
Damian McCool	DM	Scottish Power Renewables
Dan Jerwood	DJ	GDF SUEZ Energy UK
Bridget Morgan	BM	Ofgem