Frequency Changes During Large System Disturbances WG Meeting 3

Attendees

Name	Initials	Company
Mike Kay	MK	Chair
Robyn Jenkins	RJ	Technical Secretary
Joe Helm	JH	Northern Powergrid
Martin Lee	ML	SSEPD
William Hung	WH	National Grid
Geoff Ray	GR	National Grid
Graham Stein	GS	National Grid
Paul Newton	PN	EON
Campbell McDonald	CM	SSE Generation
Adam Dysko	AD	Strathclyde University
Apologies		
Joe Duddy	JD	RES
Gareth Evans	GE	Ofgem
John Turnbull	JT	EDF Energy
Mick Chowns	MC	RWE
John Knott	JK	SP Energy Networks

Actions

The Workgroup discussed the ongoing actions; details of these discussions are captured in the action log or on the meeting agenda.

Meeting Objectives

The key objectives of this meeting are:

- Finalise notes for early engagement with Industry on proposed RoCoF changes
- Agree measures to mitigate RoCoF risk to manageable level
- Agree questions to be sent to affected stations

Presentation from Strathclyde

AD from Strathclyde University gave a very informative presentation on LoM protection. The presentation gave a background on LoM protection in the UK and international scene and some information on existing research work, some of the proposed changes in settings and possible RoCoF alternatives.

When discussing islanding, MK questioned how the Irish are addressing their risk in this area. AD noted he had done some hardware testing. It was suggested that MK should write to Gorman Hagan of Northern Ireland Electricity, who commissioned the work, to suggest sharing the outcome of the research.

When discussing unintentional islanding the Workgroup debated the safety implications of such an event.

AD highlighted that LOM should be sensitive under all possible load and generation scenarios, the most challenging scenario is where the local load closely follows the generator output in terms of active and reactive power.

AD noted that current practice in dedicated LOM protection and highlighted some of the pros and cons;

- Rate of Change of Frequency (RoCoF) – good sensitivity but prone to spurious tripping.
- Voltage Vector Shift (VS) – Fast but poor sensitivity to genuine LOM events and prone to spurious tripping.
- Reverse VAR Protection – Can fail if he load power factor is close to unity and/or the island contains long cables.
- Intertripping – best performance but the cost is high and can become overcomplicate in some parts of the system.

AD presented a summary of practices of DG Protection in different countries, based on some wok done by CIGRE under WG B5-34. On detection of unintended islanding, all countries were reported to use Voltage and/or frequency based protection, some use direct transfer tripping while some use RoCoF and Vector Shift.

WH indicated that only six countries (ie UK, Australia, Austria, Belgium, Canada and Italy) were reported to use RoCoF and VS based protection. AD's presentation slide indicated that a new directive by the Italian Regulatory Authority issued in 2012 gives new protection requirements in the technical document implying these relay types are not allowed.

AD presented information on Systematic LOM relay testing under ETR 139. He explained that the modelling was done based on assumptions of loads within the island, the load was static and inertia normal. All details are contained within the document, owned by the ENA. JH added that he had received permission from the ENA to circulate a copy of ETR 139 to the Workgroup members.

The main findings include

- LOM is affected primarily by the generation technology, synchronous generators are the most challenging.
- Stability causes more problems than sensitivity. Improvements in stability can be achieved by providing additional time delay which does not significantly compromise sensitivity.
- Significant difference in performance between different relay manufacturers was noted, mainly in terms of stability.

AD explained some modelling he carried out based on the system event on the 28th September. He presented data based on PMU frequency records from Strathclyde, Manchester and Imperial, from this he noted that there were differences in the frequency recorded across the sites. AD's observations on the modelling are:

- df/dt seen by he DG depends on the position in the network and position in relation to the initiating event;
- df/dt calculated by the relay depends on the frequency and RoCoF calculation method (i.e. mainly the averaging period);
- Applying additional time delay increases relay stability; and
- Applying additional frequency dead band (e.g. 49.5Hz/s to 50.5Hz/s) will block RoCoF operation during the majority of system wide events.

The workgroup discussed increasing RoCof setting to 0.5Hz/s with a 0.5 second delay, which could be the first step to minimise RoCoF risk. The Workgroup thought this might be a short term viable option subject to further investigation and risk assessment. The workgroup noted that changing the setting a second time to 1Hz/s with 0.5 second delay from April 2014, as was suggested by National Grid, may be difficult as a longer timeframe may be required to assess the implication on plant and to allow time to visit the sites for relay resetting. There was debate that the change should be to 1Hz/s with a 0.5 second delay in one step to minimise the cost of resetting the relay. WH noted that National Grid would prefer this option, provided it is acceptable to the DNO and generating communities.

WH thanked ML for the protection setting guidance information for hydro and power park sites used in the SSE (North) area. He noted that for existing plant (between 1991-2010) the settings are 0.5 Hz/s for Synchronous and 3 Hz/s for Non-synchronous plant with both time setting requirement on 6 cycles. A 0.5 Hz/s setting in the GB system is therefore not new.

WH presented some slides indicating that the 0.5Hz/s setting should be incorporated in the requirement as soon as practically possible. Consideration should also be given to include a frequency deadband range (ALSTOM Grid MiCOM P341 has a default range of 49.5 to 50.5 Hz/s). Both of these will improve the relay operational stability and also reduce the risk of tripping unnecessarily.

Notes for early engagement with Stakeholders.

The workgroup discussed the necessity to engage with both affected stations and relay manufacturers early.

The total generation volume with potential RoCoF Risk derived from the 2007 ENA data was agreed to be around 6.2 GW and generation installed after 2007 through the ROC and FiT schemes (2-3 GW) could take this to a total of up to 8 to 9 GW. This will impose significant RoCoF risk on system security.

The current affected station list (DCRP paper 12-02-04) indicates total volume of 5MW and above stations to be 4.3GW, however concern was noted that large volumes of below 5MW including PV could be overlooked as their RoCoF risk on the system could be significant in the coming years.

It was agreed that the plant of capacity below 5MW should not be ignored but in the mean time the initial focus should be on larger plant as the information on these sites, including contact details, is available. For contacting the stations, WH had circulated suggested questions prior to the meeting. These are also listed in his presentation. The workgroup discussed these questions and agreed that the question regarding the type of relay installed should be expanded to include some of the most common types. ML noted that responses to this may be few and far between. MK acknowledged that to complete a survey of all/most DG it may require someone to visit the sites individually. GS added that any information is better than no information.

To engage with manufacturers, ML drafted an open letter which was circulated to the group for comment. CM noted concerns that letters such as this will mean that manufacturers will put caveats into contracts to increase costs post 2014. ML noted that the only other option would be to make the decision and tell them it is necessary. GS commented that there is already uncertainty in this area in the RfG European

Network Code, and this is not making that any worse. MK suggested that alongside the note, stakeholders should be invited to a workshop, hosted by the WG.

PN added that publishing a letter with numbers in this early could create more uncertainty than not telling them. GS noted that engaging early is better as settings are unlikely to stay 0.125 Hz/s. WH drew the attention to the WG that the RoCoF issues were discussed widely during the G83 reviewing process and this is reflected in the current G83/2 document.

'National Grid have advised that…larger rates of change of frequency might need to be withstood without tripping, as system inertia decreases at times when a high proportion of the load is being met by generation without inertia.'

*'Note: **Manufacturer**s considering new designs should allow for the RoCoF where is required to be increased to, up to 2 Hz/s per second, as proposed in the new European network codes, which are expected to come into force over the period 2014/2015. Under these conditions RoCoF will cease to be an effective loss of mains protection and it is unlikely to be permitted in revision of this document.'*

RJ and GS agreed to look at the letter again taking into account comments received, then circulate around the workgroup and the GCRP for approval at the Panel meeting on Wednesday 16th January.

The workgroup agreed to meet again in 3 to 4 weeks time.