Minutes

Meeting name	Frequency changes during large system disturbances workgroup, phase 2 (GC0079)
Meeting number	30
Date	21 May 2015
Time	10.30 – 15.00
Location	Electricity North West Offices, Linley House, Dickinson Street, Manchester, M1 4LF (teleconference option also)

Future meeting dates

Meeting Number	Date
31	24th June 2015

1) Introduction & apologies

2) Review of previous minutes & actions from meeting 29

Please see latest version of action log for open and closed actions. The various comments from the previous minutes were noted. MK & ML are to further discuss one particular comment regarding clearance times before the minutes can be approved. Note that one action was added from the previous minutes which was missed off (#111, see summary of actions below / action log)

Action MK / ML: Discuss comments on previous minutes and revert back so SB can finalise and publish to website

3) Phase 1 update

MK provided a brief update to advise the workgroup that we are expecting a phase 1 update in time for the next DCRP which will be reported back at the next meeting.

4) Phase 2 update

4a) Ecofys

KB provided an update to the workgroup. Please refer to associated slides on the workgroup website.

Slide 2: JR noted that there was no mention of diesel generators in KB's report. MK asked if these were running in parallel and if the data would show this. MW suggested that examples might be those generators that provide STOR services. KB advised that he had used CHP & biogas as terminology and that there is likely to be some diesel generators included in this. JR asked whether it would be worth speaking to some manufacturers such as Cummins / Volvo. CM suggested AMPS. ML added that any standby plant converted to STOR would be connected up with full G59 protection. MK asked if we had data on these. JR suggested that aggregators might help us. ML added that anything greater than 1MW would have been reported. KB should have some of this data from NPG, ENW, SSEPD. MW noted that NPG data would have included STOR and the fuel type would have been included. AD noted that it is important to make an assumption on the diesel sites as they directly go into risk assessment.

MK asked if the conclusion that AD should draw from Slide 2 is that LV islanding scenarios would not exist or rather there are no explicit LV internal RoCoF protection.

ML did a quick check of the data he had already provided and found substantial sized diesel stations in SEPD (50MW) and also SHEPD (128MW). MK asked if the majority would be connected at HV or LV to which ML responded that the SSE boundary was >1MW so likely HV but cannot confirm. MW noted that at HV you would expect to see external RoCoF protection but smaller sites at HV might have vector shift rather than RoCoF. MW will enquire with protection engineers if there is a general threshold.

KB noted that the analysis used to produce the graph is on the safe side. AD asked if it would be possible to see slide 2 in terms of numbers of connections instead of capacities. KB confirmed and will send the data tables.

Action KB: Provide AD with data tables behind graphs in his presentation from 21/5/15

Slide 3: AD noted that this confirms what he has seen in his simulations. JR expressed concern there is no upper limit for the design criteria. MK noted that RfG will require us to specify an upper limit for the plant. AD suggested two stage RoCoF settings with an explicit upper limit which trips (no time delay) and a lower limit to be measured over 500ms.

Slide 4: It was noted that RoCoF protection is seen as plant protection rather than network protection for some generators and manufacturers might claim they will ride through but there is no evidence of this. Do we need to take measures to remove this risk? MK was not aware that this had given us a problem before re plant protection and added that it doesn't feel like a big risk here. ML responded to a session that Vector Shift should be recommended rather than RoCoF by expressing concern about whether we should we be recommending a move to vector shift without studying that too. CM asked if this was in the scope of the workgroup. MK suggested that it may not be explicitly in scope but also not out of scope. KB suggested we present options only. JR added that Vector Shift is one of the options in G59.

Re the second bullet on slide 4 (PV and modern wind inverter ride through) ML agreed but asked if the power output decreased as if so, the RoCoF would be much worse. He asked if when testing, the inverter continue to produce same rate of power. IA responded that one of the inverters he'd tested did reduce output during the RoCoF event (no power output for 1sec) and this was only for one

inverter. ML noted that this might make the RoCoF event worse. ML will discuss further with IA and AD. KB highlighted two difficulties; whether it is representative of the whole population and not being able to test wind turbines due to size. Anything <5MW has no fault ride through. GS added that if we now identify emerging risks then we should recognise this in management of the system. KB advised that his final report and conclusions would be provided w/c 25/5/15.

Action IA/AD / ML: Arrange an offline discussion around testing of higher RoCoF levels

Action KB: Final conclusions and report to be circulated w/c 25/5/15

Action ALL: Provide KB with comments on final conclusions & report within a week of receiving

4b) PNDC / University of Strathclyde (UoS)

PNDC Presentation

Ibrahim Abdulhadi (IA) from the Power Networks Demonstration Centre at UoS provided an overview of the testing. IA prepared slides (for workgroup only) for the update so please refer to these alongside these minutes. Testing was only finished the day before the update from IA so the presentation showed the initial results & main findings only. IA noted that throughout testing they had tried to stay between the under/over frequency limits of the inverters. IA couldn't find a NDZ. MW suggested the verification of any metering anomaly by observing elsewhere. GS and MK suggested further investigation to remove any doubt.

IA suggested that we may need to anonymise the results for each inverters. There was a discussion around the frequency trace and how results might differ depending on where the fault occurs geographically. MK added that there might be a risk that close to the fault we might observe higher RoCoF levels. He also asked if the test equipment can generate a higher RoCoF value.

UoS Presentation

AD provided an update on his research. Slides were prepared so please refer to these alongside these minutes.

AD noted that PNDC had covered the WP1 update. AD started with a WP3 update (DG register analysis). He has good data from WPD & ENW and some data from UKPN that needs updating. This data has GSP names rather than primary substations but AD has spoken to MB to get the updated records. The five most common groups are SM, PV, SM-PV, PV-DFIG and SM-PV-DFIG.

AD updated on WP2. The PV model was not stable. ML noted that the Spanish incident had a number of different inverters involved which was thought to be important. MK highlighted that the information on the Spanish case would be useful for AD's work and this has been circulated previously. GS added that the Spanish case told us to look at examples of multiple inverters, but it was difficult to draw further conclusions from the information available. MW asked AD if his

conclusion was therefore that there is no NDZ for PV on its own and so it won't form a stable island as the PV inverter trips under all PNDC tests. AD confirmed this and added that this essentially reduced the most common groups to be studied to four as we can remove PV on its own. MK suggested that in preparing our workgroup report we should use the Spanish experience when drawing conclusions to explain why this won't be a concern in GB. AD noted the different conditions in the Spanish case.

Based on these findings, for the groups where no RoCoF trip condition was observed, the risk assessment would be presented based on voltage and frequency as RoCoF is inactive. MW asked if the main cause of RoCoF non operation was due to time delay i.e. not sustaining the 1 Hzs^{-1} for 500ms.

MK asked if the frequency oscillation was real or the nature of simulations. There was a discussion around deliberate islanding for outage conditions. ML noted that most machines are constant P & V and not specific frequency controlled.

It was felt that it is the grouping which seems to cause the problem. ML suggested it would be worth doing tests on the unit that didn't trip to see what level it does trip at. JR suggested we might be seeing the Spanish case but for different types rather than different manufacturers.

AD advised on the next steps, which were to finish the simulations for the four groups to give a set of NDZs. Then AD would complete a risk assessment based on each group, considering the population of each group. AD hopes to complete the simulations before the next meeting. MK suggested that AD summarise his draft conclusions for the workgroup to consider and think through alongside the slides, especially as some conclusions are counter-intuitive.

Action AD: Summarise draft conclusions for WG to consider

5) System RoCoF Limits

GS went through the paper he circulated in advance of the meeting as the question was raised at a previous meeting as to who sets the system limits for RoCoF and inertia. GS advised that National Grid currently operates the system basis to a limit of 0.125 Hzs^{-1}. This isn't explicitly published but is in the public domain via workgroup discussions. GS noted that if we assume that 0.125 Hzs^{-1} is not high enough to impact on generator equipment then we can ignore withstand for now. However if we raise the RoCoF limit then we could consider operating to a limit and would need to establish what the equipment withstand limit might be. Previous discussions suggest that withstand capability might need to be expressed with certain time conditions. CM queried if that was for new plant or all equipment. The inertia requirement comes from the draft Operational Security Codes (OSC).

CM suggested changing 'generation' to 'generation mix' so as to capture that interconnectors are considered too, as they are expected to play a much greater role in GB. OSCs are a good place for these inertia requirements which is for the GC0048 workgroup. GS noted that it is worth capturing in our report that these are factors worth considering.

CM asked how it was possible to set a safety margin when you are operating right up to the 0.125 Hzs^{-1} limit. CM felt there was need for a safety factor to be sure plant is running safely. He added that the limit could be set to $1Hzs^{-1}$ but not all generators might be able to change to that and may need to change their settings to protect them. MK added that RfG specifies for new plant only. CM noted that some of this will come out of the operational codes in due course.

CM noted that Ireland has 0.5 Hzs^{-1} withstand and want to change to 1.0 Hzs^{-1}. By way of an example, CM has just commissioned a new CCGT with 0.5 $Hzs^{-1}$and changing that to 1.0 Hzs^{-1}would be very difficult to apply into contracts. It was noted that the Irish codes are retrospective. GS added that there are not going to be increases to the limit without consideration. CM suggested that it was easier to write in higher rates initially into contracts rather than change.

MK suggested that we might need to reassess what limits we think the system might need and factor in the marginal costs to design to higher standards. CM reiterated the point about what constituted a reasonable safety standard. GS will apply comments to the paper to produce a second version. MK suggested that we do need a rationale value for withstand for new plant.

Action GS: Update system inertia limits paper following WG feedback

6) Date of next meeting

24 June 2015. It was agreed this would be a face-to-face meeting in Manchester.

7) Summary of actions / next steps

WG Member	Action No.	Action	Due
IK / ML	111*	Provide Scottish DG data to AD on primary substations (installed capacity for each technology) to ensure data used by AD is representative of the whole of GB	24/6
MK / ML	112	Discuss comments on previous minutes and revert back so SB can finalise and publish to website	24/6
KB	113	Provide AD with data tables behind graphs in his presentation from 21/5/15	24/6
IA / AD / ML	114	Arrange an offline discussion around testing of higher RoCoF levels	24/6
KB	115	Final conclusions and report to be circulated w/c 25/5/15	3/6
ALL	116	Provide KB with comments on final conclusions & report within a week	10/6
AD	117	Summarise draft conclusions for WG to consider	3/6
GS	118	Update system inertia limits paper following WG feedback	24/6

**Added to actions from meeting 29*

Attendees		
Name	**Initials**	**Company**
Mike Kay	MK	ENW (Chair)
Graham Stein	GS	National Grid (Alternative chair)
Scott Bannister	SB	National Grid (Technical Secretary)
Adam Dyśko	AD	Uni. Strathclyde
Ibrahim Abdulhadi	IA	Uni. Strathclyde (PNDC)
Karsten Burges (T-con)	KB	Ecofys
Julian Wayne (T-con)	JW	Ofgem
Mick Walbank	MW	Northern Powergrid
Sam Turner	ST	Northern Powergrid
John Ruddock	JR	Deep Sea Electronics
Martin Lee (T-con)	ML	SSEPD
Ioannis Koutsokeras	IK	SP Energy Networks
Campbell McDonald	CM	SSE Generation
Apologies		
Joe Duddy	JD	RES
Alastair Martin	AM	Flexitricity
Gareth Evans	GE	Ofgem
Paul Newton	PN	EON
John Turnbull	JT	EDF Energy
Ken Morton	KM	HSE
Andy Hood	AH	WPD
Michael Doering	MD	Ecofys
Greg Middleton	GM	Deep Sea Electronics
Lorna Short / Mick Chowns / Jacob Allinson	LS / MC / JA	RWE
Kevin Burt / Miguel Bernardo	KEB / MB	UKPN