Minutes

Meeting name	Frequency changes during large system disturbances workgroup, phase 2 (GC0079)
Meeting number	23
Date	27 October 2014
Time	10.30 – 15.00
Location	ENW Offices, Manchester, M1 4LF (Teleconference option too)

Future meeting dates

Meeting Number	Date
24	24th November
25	19th December
26	22nd January 2015
27	25th February 2015
28	23rd March 2015
29	20th April 2015
30	21st May 2015
31	24th June 2015

1) Introduction & apologies

The group welcomed Karsten Burges (KB) from Ecofys who was attending for the first time.

2) Review of previous minutes & actions

The WG noted comments on the previous minutes and agreed that they could be approved. SB ran through the outstanding actions, or those that had been closed.

GS had sought views on the withstand questionnaire from a large generator perspective and it was due to go to AMPS with the help of JR in due course.

SB advised that the updated terms of reference had been sent to the relevant contact to be approved at the November GCRP. MK noted that the next DCRP is on 4th December and he plans to have them approved there too.

MK has made contact with Dave Spillett re engagement with trade bodies who has written out to relevant ENA contacts to seek interest in phase 2 engagement. No responses have been received as yet.

Re the network characteristics review that MK had written, it was agreed that these could be considered an accurate representation of the network and no-one in the group had any comments or changes.

AD advised that he had not received any data from DNOs. AH indicated he is planning to send some data very shortly.

MK advised that a paper is being written for the November DNO Commercial Operations Group (COG) re phase 2 implementation costs. Given the larger number of affected parties, Ofgem have asked network licensees to consider the approach for funding any changes that the workgroup might propose. DNO commercial managers have agreed this should be articulated as a DNO response and played back to Ofgem. MK summarised that discussions would take place at the COG in November and the DNO's thoughts would be fed back to the WG for potential further consideration.

3) Phase 1 progress

MK advised the group that Dave Spillett has written out asking for an update for the December DCRP. DNOs are likely to be at different stages re phase 1. ENW have had some acknowledgements of the work that is required and some have not responded at all.

MW advised that NPG have written out to all >5MW generators. They will also be running two workshops before Christmas as they have received quite a few responses (mostly asking for what they need to do). The NPG view is that it would be worthwhile running these to try and capture as many generators as possible at one event (~150 contacts).

AH added that WPD are expecting ~200 affected parties. WPD have received ~15 responses with the majority confirming vector shift protection rather than RoCoF protection. Some sites have started making the changes but no response from the majority thus far. MK added that this would probably be similar for other DNOs. MW highlighted the fact that some generators (e.g. EON) would be working across several DNOs and thus it might be worth sharing our respective letter templates that we have sent out to ensure consistency. This was agreed by the group and also considered to be a useful record.

Action All DNOs: Circulate correspondence sent out re phase 1 implementation

4) Phase 2

4a) University of Strathclyde (UoS)

AD ran through a set of slides (circulated to the WG) updating the group on the latest developments and also included some slides from the previous meeting for the benefit of anyone who couldn't attend.

AD advised that he had received costing approval from UoS and Dave Spillett is currently preparing the contractual arrangements.

AD advised that he has used MK's contact (Richard Le Gros) to get some aggregated fault data. MW noted that each DNO sends data to Ofgem who collate it and send back to all DNOs once a year to give the national picture. AD highlighted that he would like figures on the number of faults on the 11kV network that caused disconnection and potential islanding. MK noted that for an 11kV fault, the DNO would often rearrange the network to reconnect supplies in under 3mins, which would be

too short to appear in this report. AH added that DNOs would be asked to provide data on these short-term interruptions in the future. AD advised that he is looking to obtain data on anything that causes circuits to trip, regardless of the duration.

Action AD / MK: AD to send fault data to MK who will see if more can be obtained

MK suggested that his previous summary of HV/LV network characteristics can be considered representative of a typical network given that no comments were received to the contrary. There was agreement on this in the WG.

AD advised the WG that he had not yet received any DNO data. AH noted that WPD was almost ready to send this to AD via post. This initial data is from one 11kV substation with 6 days of data at 1s resolution from the centre of Bristol. AH added that the next dataset would be from a rural substation. AD noted that he was especially after some LV data. MW advised that NPG will have this from CLNR in December (5min resolution on 3k properties for 18months). AD would ideally like a couple of very high resolution datasets to get variability. AH will see if this can be obtained at LV before the rural substation data is collected. AD noted he also has 10min 3-phase LV data from earlier work with SP.

Action AH: Send monitoring data to AD and try and get LV data at 1s resolution

AD is in the process of asking his Mechanical Engineering colleagues if he can use their PV generator on the roof and install some high resolution monitoring equipment to gather some PV profiles. KB offered some high resolution data from Germany. MW added that he might have some data from PV on NPG substation roofs. AH noted that it is unusual to go to such low resolution. AD agreed and added that a few second averages are usually sufficient for most needs.

Action KB: Investigate whether high resolution data on PV from German study can be provided to AD

AD ran through slides from the previous meeting for those who could not attend. MW advised that NPG had information for submission to Elexon on configuration imbalances used to calculate HV losses due to circuit & transformer impedance (only for HH metered sites).

Action MW: Circulate NPG data for half-hourly metered sites to see if it would be useful for DNOs to provide

AD moved on to discuss the possible islanding scenarios. MK suggested that that the study references the loss of primary substation rather than the loss of 33kV feeder and also suggested that the loss of 11kV transformer was included for completeness (although it was agreed that this is a very rare event).

AD recapped the relevant research that was being conducted in France. KB mentioned that he had also spoken to the researchers and noted that they had produced a (confidential) Eurelectric report which they could not discuss but that we may be able to get access to.

Action MK: See if we can have access to the Eurelectric confidential report

MK highlighted the need to ensure Scottish DNO representation as we get into the detail as the Grid Code has lower thresholds in Scotland (down to 10MW).

4b) Ecofys

Introduction

KB opened by expressing Ecofys' view of the problem to be solved and the plan to go about doing so. KB then began a presentation (slides circulated to the WG). He started with a brief background to Ecofys, advising that their clients are typically governmental and NGO. KB noted a similar problem that was identified in Germany (50.2Hz) for which the German regulator sanctioned a directive to change the settings, the cost of which was transferred to network charges. The downside to this was some significant administrative costs that almost outweighed the costs that were trying to be saved through implementing the changes. Now Germany is experiencing a similar problem at 49.5Hz and another directive has been proposed. Around 27GW of generation is at risk which is considered to be unacceptable. 3m PV inverters have been retrofitted, 60k units on LF level. A CBA was conducted which found a balance and only 20k of these units actually need to be changed. The directive is due to come into force in Mar/Apr 2015 and it is expected that there will be an 18month window for the changes to be made, which shouldn't be an issue for most plant.

It had become clear that historically there had not been any quality control on the settings and as such ~10-15% had the wrong settings. It is most likely that the majority of the cost will remain with the plant owner. AH asked if the cap was only associated with the 49.5Hz directive? KB confirmed this and added that under the directive for the 50.2Hz case, all costs were passed through to network charges. GM enquired how successful the 50.2Hz case was considered to have been. KB advised that this work had started slowly and that it was mostly larger plants >100kW but they were expecting 90% of capacity to be retrofitted by end of 2014. The remainder would be done at a later date. That was not including the 10-15% that had incorrect settings. GM asked what the public attitude was to domestic PV changes. KB responded that there seemed to be no problem as there was no charge to the domestic PV owner who seemed quite happy to allow the DNO access to make the required changes. It was initially thought to be a simple task to retrofit (one that an electrician could do) but then became clear that this wasn't the case and that the DNOs would have to do this themselves). Some manufacturers appeared to have adopted an unconventional interpretation of the standards. MK noted the WGs concern here too as the regime is applying standards but in practice there is limited quality control. KB added that this is why testing is so valuable as we can learn a lot.

KB provided the following summary of the two programmes, after the meeting, for information:

50.2 Hz – PV only; 15+ GW of PV and ~1-3 million inverters affected. The programme is running until the end of 2014 (probably a slight extension). All costs have been transferred to the network charges. Monitoring has not been part of the programme – samples taken by some DSO's indicated there is a quality problem.

49.5 Hz – all other DG (much of it CHP and wind), in total 27 GW affected. Cost benefit analysis indicated that retrofitting about 21,000 of the 60,000+ plants would be sufficient to reduce the

capacity at risk to 1 GW or less. The regulation is under consultation now and will be effective from Spring 2015. Most likely, the majority of the cost will remain with the plant owner. To avoid unreasonable cost, there will probably be a cap (€/kW). This is still subject to discussions.

Study scope

KB highlighted the different considerations for different technologies and how the adjustment of settings might well vary (e.g. complex for CHP plant) as would the costs. KB advised that Ecofys approached each technology type individually and got different responses. Hydro for example were more concerned about safety & environmental protection as this impacts water flow and wanted to be confident that there'd be no impact on their licence (there was no day-to-day impact on them). Other technologies were less concerned about 49.5Hz as they disconnected at 49.8Hz. MK asked if the scope was limited to changing protection settings or ensuring a plant will ride through an event. Initially we were just ensuring the settings are changed rather than requirements to ride through. KB noted that the German protection settings to ride through are very simple settings with an upper and lower value which can be adjusted fairly easily. MK noted that there are some DNO relays and we need to be confident these have been, or will be, changed. KB noted that in some cases in Germany plant operators manage these on behalf of DNOs which can make it difficult to identify who is responsible for changes. MK believes that isn't the case in GB.

<u>Action MK</u>: Confirm with DNOs that they have adjusted their RoCoF relay settings

First thoughts

KB advised that initially Ecofys have analysed data sets using desktop analysis and cross correlation. This will then be followed by stakeholder consultation to validate findings.

KB discussed PV first and showed a graph to highlight how there is a moderate cumulative installed capacity of PV but that there is a significant volume of units. This is a technology type where the CBA will be particularly useful. MK noted that the dataset being studied was ENWs and that it most likely includes only sites that ENW have been notified of (not ENW predictions of what's there). MK advised KB that in GB, to be paid the Feed in Tariff (FiT), a user must register through the supplier and the DNO should get notified about these, however in practice they are only notified of about a third of these. FiT payments come directly from the supplier as the supplier does the metering. MW believes that the dataset will be broadly similar for all DNOs and that there is a publically available list of FiTs via Ofgem which KB noted that they have used. KB showed a graph of PV connected voltage levels which showed the majority is connected at MV but noted that the data has not yet been fully analysed.

KB discussed the UK PV market share as manufacturers' assistance is vital. The fact that there are only a small number of manufacturers is good as there are fewer people to engage with. KB did note that this dataset is from 2012 and there has been a fairly steep change in the PV market since then so there may have been a change. KB added that Ecofys have some good personal contacts from their 50.2Hz work. JD asked if there was a similar distribution in that work to which KB responded yes and added that SMA had >50% market share. KB also noted the significant number of manufacturers that have since folded, merged or chosen not to cooperate. JD asked how we'd deal

with any uncooperative inverter manufacturers. KB responded that a simple rule was applied in the change programme in Germany whereby everyone had to make the changes as long as no replacement was required and that for those who could not be contacted for whatever reason, incorrect settings were tolerated. Ecofys had assessed the impact of this and it was not considered to be a significant amount. KB noted the variety of views of the issue amongst manufacturers currently with one particular view being along the lines of "islanding is not a problem". This has implications on their level of support. KB then discussed wind and noted that there are 5 companies with the significant market share and they will consider these first.. MK also noted the need for clarity on the rules around windfarm capacity and whether we were referring to a single turbine or the whole wind farm. It was suggested that we should be consistent with what the RfG states.

Next steps

KB advised that the first task would be to further investigate DNO databases, once relevant non-disclosure agreements were in place, to get a good idea of the generation mix. Ecofys would then prepare a report which would be shown to the WG. During this time, expected to be around a month, Ecofys planned to engage with relevant industry participants. MK advised that if Ecofys required any input or assistance from network licensees, then the WG should be the first port of call.

International experience

KB outlined that Ecofys have colleagues in the Netherlands and US. They also have valuable contacts in Spain (although this wasn't in the agreed proposal) from their experience. Ecofys could offer a workshop on their international experience (again, not in agreed proposal but an option if required).

MK summarised that the slides cover the right areas of research and that it was valuable having KB here to discuss in person. AD added that the technology inventory is very informative and national figures would be useful.

AD asked if it would be possible for KB to provide a contact from one of the PV manufacturers to see if he can acquire an inverter for testing. KB felt that this would be fine. AD added that if he can get an inverter from each of the 4 key manufacturers that'd be ideal. AH suggested that the ENA might have a contact for Fronius.

Non-disclosure agreements were discussed briefly and MK advised he would be happy to circulate the ENW-Ecofys example as a template for others to follow if required.

Action KB: Circulate paper on dealing with solar PV during an eclipse

5) Stakeholder engagement plan

GS started by discussing the timeline for the phase 2 work. AD expects to be finished by March 2015. GS concluded that it would therefore be Feb/March 2015 before the WG had anything new to tell the industry and that it was likely we'd be issuing our consultation in the late spring. It was agreed that this is quite a long timeframe for us to not engage with industry and so it was proposed that a workshop should be scheduled for mid-Jan 2015 to say why we are undertaking this work and incorporate the Ecofys workshop on international experience. KB was comfortable with this and

expected to have some preliminary results by this time. MK added that we should target a wide range of stakeholders and then we may find out about other relevant research. KB noted that this would be a good opportunity to ensure our initial findings are consistent with what a broad industry audience would expect, or have found through previous work. MK suggested a London venue.

Action GS / SB / KB: Initiate discussions on the agenda for mid-Jan 2015 workshop

6) Summary of actions

Name	Action	No.	By
All DNOs	Circulate correspondence sent out re phase 1 implementation	45	24/11
AD / MK	AD to send fault data to MK who will see if more can be obtained	46	24/11
AH	Send monitoring data to AD and try and get LV data at 1s resolution	47	24/11
KB	Investigate whether high resolution data on PV from German study can be provided to AD	48	24/11
MW	Circulate NPG data for half-hourly metered sites to see if it would be useful for DNOs to provide	49	24/11
MK	See if we can have access to the Eurelectric confidential report	50	24/11
MK	Confirm with DNOs that they have adjusted their RoCoF relay settings	51	24/11
KB	Circulate paper on dealing with solar PV during an eclipse	52	24/11
GS / SB / KB	Initiate discussions on the agenda for mid-Jan 2015 workshop	53	19/12

7) Date of next meeting

A teleconference on the 24th November

8) AOB

SB advised that the website was in the process of being updated to reflect the phase 2 work. SB also added that proposed dates for 2015 meetings would be included in the minutes.

JD highlighted the paper that was circulated in advance of the meeting on Irish RoCoF work (written by ESB for the VGB PowerTech conference recently) and added that while it was useful to be aware of this work and the potential risks to synchronous generators it describes, we should note that no quantitative analysis of the risks was provided.

Attendees & Apologies

Attendees

Name	Initials	Company
Mike Kay	MK	ENW (Chair)
Graham Stein	GS	National Grid (Alternative chair)
Scott Bannister	SB	National Grid (Technical Secretary)
Karsten Burges	KB	Ecofys
Adam Dyśko	AD	Uni. Strathclyde
Joe Duddy	JD	RES
Greg Middleton	GM	Deep Sea Electronics
Andy Hood	AH	WPD
Mick Walbank	MW	Northern Powergrid
Sam Turner	ST	Northern Powergrid

Apologies

Name	Initials	Company
Julian Wayne	JW	Ofgem
Martin Lee	ML	SSEPD
Alastair Martin	AM	Flexitricity
Campbell McDonald	CM	SSE Generation
Gareth Evans	GE	Ofgem
John Ruddock	JR	Deep Sea Electronics
Paul Newton	PN	EON
Jane McArdle	JM	SSE Renewables
John Turnbull	JT	EDF Energy
Mick Chowns	MC	RWE
John Knott	JK	SP Energy Networks
Kevin Burt	KB	UKPN