

## Minutes

|                       |   |
|-----------------------|---|
| <b>Meeting name</b>   | Frequency changes during large system disturbances workgroup, phase 2 (GC0079)                                  |
| <b>Meeting number</b> | 26  |
| <b>Date</b>           | 22 January 2015   |
| <b>Time</b>           | 10.30 – 15.00   |
| <b>Location</b>       | Electricity North West Offices, Linley House, Dickinson Street, Manchester, M1 4LF (teleconference option also) |

### Future meeting dates

| Meeting Number | Date                           |
|----------------|--------------------------------|
| 27             | 25 <sup>th</sup> February 2015 |
| 28             | 23 <sup>rd</sup> March 2015    |
| 29             | 22 <sup>nd</sup> April 2015    |
| 30             | 21 <sup>st</sup> May 2015      |
| 31             | 24 <sup>th</sup> June 2015     |

**Stakeholder workshop:** Fri 20<sup>th</sup> March, London (venue TBC)

### 1) Introduction & apologies

### 2) Review of previous minutes & actions from meeting 25

The working group acknowledged minor amends and agreed that the minutes could be approved.

All open actions were discussed with updates provided where necessary. SB asked if we would like to see phase 1 letter templates from SP before closing the action. MK offered to help with this.

**Action MK:** Contact John Knott to confirm SP's progress regarding correspondence with customers on implementing phase 1 and also to get the appropriate contact for Ecofys to speak to at SP for their research

### 3) Phase 1 update

MK noted that he had circulated the first responses from the DNOs regarding the phase 1 changes, collated by Dave Spillett. MK noted that there is still work to be done. For example, several responses have been received from generators saying they understand what is required but have not specified the dates for when changes will have been made. Therefore some work is required to establish the dates by which each generator will have made the changes. However we have reported to the DCRP and Ofgem so it's now the responsibility of the generator. JW highlighted a discrepancy between the number of sites referenced in the phase 1 Report to the Authority and the phase 1 update data provided by the DNOs recently. JW noted that more >5MW sites had been identified than those sites that were recently reported, by the DNOs, to be impacted by the changes. JW wanted to bring to the groups attention and GS took an action to investigate the discrepancy further.

**Action GS:** Compare latest phase 1 update figures with the workgroup's previous assessment

## 4) Phase 2 update

### 4a) Ecofys

KB delivered a presentation updating on Ecofys progress since the last meeting a month ago. KB cited the personal challenge to communicate technical information to a non-technical community. KB has not yet revised his original phase 2 research report following comments received from the WG but he expects to be able to circulate this w/c 26/1/15. KB noted that he had exchanged some data with AD. MK believes that SP are the only DNO that Ecofys do not have contact details for and will obtain this as part of his action to speak with JK re phase 1 letters.

KB summarised what Ecofys have learnt from its discussions on RoCoF. It is important to distinguish between LoM and robustness. PV manufacturers do not seem concerned with high RoCoF values as they are trusting the inverter will stay on and they only need assurance that equipment won't be damaged if a RoCoF event occurs i.e. that some protection will trigger. ML noted that this is part of the problem because this protection triggers and we lose customers. KB agreed but noted that these only trigger at much higher values (4Hz/s). AD added that testing will verify these figures. KB also noted the difficulty he has had to get a value from manufacturers.

AH mentioned pole slipping vs torque and the consequences of pole slipping. KB referenced a KEMA study and will circulate to the WG. JD added this was some RoCoF withstand protection work from ~2years ago.

#### **Action KB:** Circulate KEMA study

KB noted that in Denmark there is a higher RoCoF withstand capability but it is hard to differentiate between vector shift and RoCoF protection from manufacturers.

KB mentioned extensive discussions with German DSOs and circulated a relevant paper. It was noted that there have been very few reported instances of islanding in GB and it is hard to find people with working knowledge of this. It was agreed that it is quite possible that instances occur but are not noticed as the primary focus is reconnection of customers. The question was asked of how it is reconnected as this is when someone would notice the out of sync reclose plus the customer loss of supply. JW noted that when a trip occurs, we don't know how long the island has been there for. ML advised that SSE have no system for recording islands and he surveyed control engineers who estimate there are ~1/yr. MK added that it is not a reporting requirement. CM informed the WG of two instances on the transmission system. One example was a hydro generator. ML added that there was some wind generators too in 2011. MW added that from the DNO side, NPG control engineers don't monitor generator output through SCADA so might not be aware of it.

KB noted the other point is if you acknowledge islands might occur then the main reason for LoM is for health and safety and HSE requirements (workers assuming a line is deenergised and could get injured). There is a view that this is already covered in GB by existing procedures relating to safety switching and earthing.

MW highlighted the possibility of using data from LCNF projects on areas where PV is connected where transformers are at float or zero. The question was raised of the actual chances of an island forming to which AD advised he would like to try and answer this question in his research.

KB further discussed international experience (Denmark, Netherlands, US)

MK suggested it would be good to see the data behind the report. AD has seen this and KB will circulate to the group.

**Action KB:** Circulate the data behind Ecofys report for WG information

GS added that there is data AD needs for his work and for cost analysis (how many installations need to be changed). AD added that the population of RoCoF was the main thing missing from the Ecofys report including the share of different LoM protections. MK noted that we have a view on what the protection is but it's not necessarily correct. AD added that this may not be easy to collect. MK noted that we are now finding out through phase 1 what protection is there, which is proving to be different to what we expected. GS highlighted the need to establish the population of RoCoF based protection machines so we know what, if any, the retrofit requirements are. MK added that we need to understand the susceptibility of the installed generators <5MW to RoCoF as some will have RoCoF protection but others won't. For example, what is the immunity of vector shift to RoCoF. GS added that it provides justification for the report to the authority. MW noted that GC42 changes will cover RoCoF protection setting changes too but it takes time and we won't know anything about G83. KB asked if the DNOs knew the proportion of LoM protection in their network. MK responded that the generators just require some form of LoM, they can choose whichever type they want. There might be some information on this but unlikely to be accurate so we would need to write to them all and they probably won't know. MK added that this is where the WG need Ecofys to gather as good data as possible.

JW noted that we know the total GW from the FIT register. Also, for solar PV, four manufacturers cover ~96% so test those four main types. GS noted that the Ecofys report will gather data on the population, AD can then test out some of the various statements in that report as we are not going to get to a list of exact number of sites with RoCoF settings. JW suggested G83 certificates as another possible information source. AD asked if this is not recorded when the generator is commissioned. MW advised that NPG provide duplicate protection (the only DNO to do so) and instruct generators to have same settings. AH enquired about the size threshold. MW advised that it was for G59 and above. They commission it but we have our own G59 protection. JW queried how it will disconnect, at what RoCoF and what impact it has on the equipment. AD noted he could easily test a G59 inverter in the lab to see how vector shifts responds to high RoCoF values.

MK asked if KB could explain the best view of the population so we know what to test. KB did not look into the share of plant with RoCoF protection but will investigate how this can be covered. AD noted that we can assume but that this inflates the risk.

#### **4b) University of Strathclyde (UoS)**

AD delivered a presentation on his phase 2 research progress. This complemented a report that AD circulated prior to the meeting with a general update and timeline for latest work plan. Please refer to the presentation as many of the following supporting notes complement these slides. AD began by outlining the 4 work packages that would be undertaken. AD advised the group that the main constraint for WP1 is the lack of suitable physical PV inverter. AD has engaged with existing contacts and has received a positive response from Siemens. It is hoped they, along with SMA, will provide an inverter for testing.

AD surmised that WP2 covers any work that can't physically be tested in PNDC. He aims to find the most stable scenario for an islanding situation. MW asked if we were planning on applying the same settings as in phase 1. MK suggested that we'd likely apply 1Hz/s. AH noted that it was correct to try a range of options as AD is intending to benchmark. MK noted that we should focus on options 5, 6 & 7 as options 3 & 4 are not feasible options due to National Grid requirements.

AD discussed the gathering of data in WP3. MK noted the need to be sure there are no significant demand changes from 2008 to 2015 so our profiles are a fair comparison. JW added that the biggest change may be the reactive power demand. AD asked about the load behaviour if half load was used to which MK responded that it would not be very different as it would be erring on the side of stability. AD explained he is still hoping for another record from AH and outlined some revised data requirements to be actioned.

**Action AH:** Provide data to AD (1s resolution data from example 11kV feeder or substation in WPD with min load <5MW & data from a small (c100kW) PV plant at 1s resolution for 1week

**Action MK:** Provide data to AD (the equivalent data to that provided from 10-16 Dec 2014 at 1s resolution for 1 week but for the LV side of the 11kV transformer)

ML offered to provide some LV loading data at 5s resolution but AD politely declined as he wants to keep to 1s for the load data. There was a discussion around gathering data on short-term interruptions. ML offered to do some analysis.

**Action ML:** Provide data to AD (guidance on how to estimate short-term interruptions)

MK enquired as to why 3s had been used for the non-detection zone to which AD advised that this was used in phase 1. AD ran through 4 possible island formation scenarios to be studied. This prompted further discussion around each of these scenarios. ML noted that studying multiple generators together would be useful for scenario 1. MW highlighted Appendix 7 of the Long Term Development Statement (LTDS) as a data source for AD. Further discussion ensued around further data requirements.

**Action All DNOs:** Provide data to AD on the distribution of generators at their primary substations (particularly clusters connected at the same primary substation)

**Action KB:** Ask manufacturers for the control characteristics of their Voltage Control products

**Action All DNOs:** Provide AD with their view of what size the boundary should be between HV/LV connected DG

**Action GS / AD:** Explore the possibility / feasibility of purchasing an inverter for testing at UoS

AD discussed his proposed methodology, targeting the 4 key groups of generator (wind, hydro, PV, biomass). CM noted that hydro was not necessarily just synchronous and the majority of small hydro were actually induction. AH agreed. AD suggested that he remove this category from his scenarios.

JW started a short discussion on the specific settings that will be recommended for phase 2. He asked if they would be as per phase 1 or different. AD advised he'd be using the same settings for his modelling and that there was an argument for using 0.5Hz/s for synchronous generators and 1Hz/s

for everything else for <5MW. JD noted that we have to be careful that any class of generator that has reduced requirements doesn't grow into a problem area. MK suggested this is something we address in the consultation.

ML noted that there may be occasions where groups of generators actually create an island together as they are not large enough to meet demand in isolation but the combination of a number of generators can sustain demand in an island.

AD discussed his revised work plan timescales. He expects to be completing work around the end of March and hopes to have a significant dataset to present around the end of February. He did note that he relies heavily on his PNDC colleagues and as a result is bound by their timescales. However they aim to start work w/c 9<sup>th</sup> Feb. JW advised that Ofgem would be happy to have 2 modifications, one new and one for existing if that was deemed appropriate by the WG.

CM queried whether RoCoF withstand was part of the ToRs for the WG. GS noted that protection and withstand proposals need to be complementary.

#### 5) Stakeholder workshop update

Stakeholder workshop is to be held on 20<sup>th</sup> March 2015 in London. Venue TBC. MK, KB, GS & SB have held the date.

#### 6) Withstand questionnaire update

GS advised that the questionnaire is ready to go out but that he wanted CM to have a chance to provide his comments. GS summarised that the idea was to ask manufacturers what they knew about their RoCoF withstand capability. We were not expecting a large response but felt it was prudent to attempt to gather this information anyway. The aim was that it was visible to anyone interested (generator owners as well as manufacturers). CM noted that if it was just targeted at manufacturers for the future then this is fine. CM added that alignment with the RfG is important and that connected / operational generators are a whole different area. MK noted that there is nothing in the current codes that specifies RoCoF. However JD noted that it does allow you to set a limit. GS added that this is dealt with in LFCR in terms of protection, withstand, and operating the system, all of which are separate. He added that LFCR is quite prescriptive. MK noted that it's an important point as this covers what's within the ToRs. RoCoF withstand based on new plant is much easier than establishing the operating levels. GS noted that it would be phased changes but LFCR does oblige you to fix a number. CM asked what withstand we were referring to. GS suggested the questionnaire will give us an opener. AH noted the need to tie it down.

**Action GS:** Brief the WG on the LFCR requirements relating to RoCoF

**Action GS:** Revise and issue withstand questionnaire

**Action SB:** Provide a brief update re stakeholder workshop plans in the minutes (in lieu of cancelled agenda item due to time)

## 7) Summary of actions / next steps

| Name     | Action  | No. | By   |
|----------|---|-----|------|
| MK       | Contact John Knott to confirm SP's progress regarding correspondence with customers on implementing phase 1 and also to get the appropriate contact for Ecofys to speak to at SP for their research | 71  | 25/2 |
| GS       | Compare latest phase 1 update figures with the workgroup's previous assessment  | 72  | 25/2 |
| KB       | Circulate KEMA study  | 73  | 25/2 |
| KB       | Circulate the data behind Ecofys report for WG information  | 74  | 25/2 |
| AH       | Provide data to AD (1s resolution data from example 11kV feeder or substation in WPD with min load <5MW & data from a small (c100kW) PV plant at 1s resolution for 1week)                           | 75  | 25/2 |
| MK       | Provide data to AD (the equivalent data to that provided from 10-16 Dec 2014 at 1s resolution for 1 week but for the LV side of the 11kV transformer)   | 76  | 25/2 |
| ML       | Provide data to AD (guidance on how to estimate short-term interruptions)   | 77  | 25/2 |
| All DNOs | Provide data to AD on the distribution of generators at their primary substations (particularly clusters connected at the same primary substation)  | 78  | 25/2 |
| KB       | Ask manufacturers for the control characteristics of their Voltage Control products   | 79  | 25/2 |
| All DNOs | Provide AD with their view of what size the boundary should be between HV/LV connected DG   | 80  | 25/2 |
| GS / AD  | Explore the possibility / feasibility of purchasing an inverter for testing at UoS  | 81  | 25/2 |
| GS       | Brief the WG on the LFCR requirements relating to RoCoF   | 82  | 25/2 |
| GS       | Revise and issue withstand questionnaire  | 83  | 25/2 |
| SB       | Provide a brief update re stakeholder workshop plans (in lieu of cancelled agenda item due to time)   | 84  | 25/2 |

## 8) Date of next meeting

25<sup>th</sup> February 2015.

## 9) AOB

None.

**Attendees & Apologies****Attendees**

| <b>Name</b>                          | <b>Initials</b> | <b>Company</b>                      |
|--------------------------------------|-----------------|-------------------------------------|
| Mike Kay                             | MK              | ENW (Chair)                         |
| Graham Stein                         | GS              | National Grid (Alternative chair)   |
| Scott Bannister                      | SB              | National Grid (Technical Secretary) |
| Julian Wayne                         | JW              | Ofgem                               |
| Adam Dyśko                           | AD              | Uni. Strathclyde                    |
| Karsten Burges                       | KB              | Ecofys                              |
| Joe Duddy                            | JD              | RES                                 |
| Andy Hood                            | AH              | WPD                                 |
| Mick Walbank & Sam Turner            | MW / ST         | Northern Powergrid                  |
| Campbell McDonald                    | CM              | SSE Generation                      |
| Martin Lee (T-con)                   | ML              | SSEPD                               |
| Kevin Burt & Miguel Bernardo (T-con) | KEB / MB        | UKPN                                |

**Apologies**

|                 |    |                      |
|-----------------|----|----------------------|
| Greg Middleton  | GM | Deep Sea Electronics |
| John Ruddock    | JR | Deep Sea Electronics |
| Alastair Martin | AM | Flexitricity         |
| Gareth Evans    | GE | Ofgem                |
| Paul Newton     | PN | EON                  |
| Jane McArdle    | JM | SSE Renewables       |
| John Turnbull   | JT | EDF Energy           |
| Mick Chowns     | MC | RWE                  |
| John Knott      | JK | SP Energy Networks   |
| Matthew Penrose | MP | HSE                  |
| Michael Doering | MD | Ecofys               |
| Lorna Short     | LS | RWE                  |