

## Meeting Note

<b>Meeting name</b>	GC0062: Fault-Ride-Through
<b>Meeting number</b>	8
<b>Date of meeting</b>	Wednesday 29 <sup>th</sup> July 2015
<b>Time</b>	10:00 – 14:00
<b>Location</b>	National Grid House, Warwick.

## Attendees

<b>Name</b>	<b>Initials</b>	<b>Company</b>
<b>Graham Stein</b>	GS	National Grid (Chair)
<b>Tony Johnson</b>	AJ	National Grid
<b>Richard Ierna</b>	RI	National Grid
<b>Richard Woodward</b>	RJW	National Grid (Technical Secretary)
<b>Dimitri Nesterov</b>	KK	GDF Suez
<b>Hervé Meljac</b>	HM	EDF Energy
<b>Clément Amérigo</b>	CA	EDF Energy
<b>Jeremy Barreau</b>	JB	EDF Energy
<b>Dave Draper</b>	DD	Horizon Nuclear Power
<b>Philip Belben</b>	PB	Horizon Nuclear Power
<b>Campbell McDonald</b> [On the phone]	CM	SSE

## 1. Introductions

GS welcomed all attendees to the meeting. HM introduced the workgroup to his colleagues CA and JB; he confirmed that CA would be taking his place on this workgroup due to a change of roles. The workgroup thanked him for his contribution to GC0062.

## 2. Minutes of previous meeting

The minutes of the last meeting were accepted with changes submitted by PB and appended by AJ. PB raised a small amendment at the meeting relating to the maximum impedance and minimum fault level which was also accepted. RJW will publish on the website.

## 3. Presentation (update on open actions)

For the benefit of the workgroup, AJ and DD clarified the difference between the GB Grid Code requirement (as per the FRT Issue Paper (PP12/04), namely the focus on Mode B faults, and the RfG requirement for Mode A (via voltage vs. time curve). AJ confirmed that RfG had been adopted by EU member states on 26 June 2015, and therefore the text was finalised.

### Terms of Reference

AJ summarised the objective of GC0062, explaining that the initial paper was raised by EDF and that as discussed already, RfG's FRT requirement would not mitigate this.

AJ queried with the workgroup, whether the workgroup report should include the work on Mode A (for RfG), or just focus on Mode B as per the original issue paper. DD recommended including everything done by GC0062 to date, with a focus on Mode B, but definitely including work on Mode A. HM agreed that the issues are similar regardless of whether faults are Mode A or B (it's still low voltage ride through), including demonstrating compliance. Addressing both at the same time would be more efficient in terms of engagement (consultations etc.) for GC0048 [RfG implementation].

CM queried whether the workgroup had fulfilled the ToR, and why a change to the ToR hadn't been proposed to the GCRP as discussed at meeting 7. Additionally, CM believed that RfG requirements should be addressed in another phase, and that the WG report should not partially cover off the Mode A requirements. AJ agreed that embedded non-synchronous had not yet been considered and was still to be completed. GS clarified the ToR permitted consideration of embedded generation. PB still had reservations that more work was needed on Mode A, but that the progress of GC0062 should be captured in the WG report. AJ stated this work would be documented, but proposed that only Mode B would be the focus of the recommended legal text. GS had reservations of the high volume of the change to the legal text if both Mode A and Mode B were considered which would make it difficult for the Panel to make a decision.

CM explained that without an RfG focus, Ofgem and industry stakeholders may be confused by the intent. GS confirmed the approach to make a change to the GB code, albeit NGET's licence requires them to consider the impact of European legislation when considering code modifications/changes (i.e. RfG). AJ and RJW clarified the work on-going for GC0048 in regards to planning the delivery of work-streams including Fault Ride Through, and how GC0062 linked into that.

[ACTION: RJW/AJ liaise via GC0048 on agreeing structure for delivering FRT packages on Mode A, i.e. consulting on large non-synchronous and embedded) within the RFG implementation]

It was agreed that the best approach would be to document the full findings of the workgroup in the report but recommend that only the Mode B proposals are taken forward as a GB Grid Code change. The work completed on Mode A faults could then be used by the GC0048 Workgroup as a fast track to preparing the fault ride through proposals.

### Summary of Proposals

Largely covered in discussion above

### RfG Developments and Mode A/B requirements proposal

AJ/RJW/DD/HM discussed RfG determination of new vs existing and clarified 'main plant items' as per the final RfG document.

*Mode A - Determination of Short Circuit Levels and responsibilities*

AJ explained how pre/post short circuit levels are used in defining compliance via simulations, using the example in the slides. Numerous generation technologies and connections scenarios mean that it is easier for NGET to provide pre and post short circuit values at the connection site rather than an equivalent. AJ then clarified assumptions and fixed variables for the simulations, including Transmission System circuit parameters and circuit breaker operating times and the pre fault conditions of the generator under assessment.

In terms of responsibilities – HM queried whether the requirement for generators to model the auxiliaries was excessively onerous for smaller thermal plants. AJ agreed and advised this requirement would not be included within the in the legal text. HM stated a preference for operating standards for this aspect. PB queried what NGET's objective was here; AJ confirmed the TSO view was that generators should remain connected and stable at the connection point for a fault up to 140ms in duration. In other words the Generator should remain connected and stable for 140ms with the post fault voltage trace remaining above the voltage against time curve. HM advised that on slide 20 the Generator should be shown as unstable.

RI explained the modelling which would be undertaken to prove compliance to NGET.. PB queried how compliance could be monitored over time; and situations where tripping would be permitted and what NGET were doing for reinforcement to prevent worse-case scenarios. AJ explained that the key point is the requirement for the Generator to remain connected and stable for a fault up to 140ms. The voltage against time curve is more arbitrary as the post fault voltage profile is largely dependent upon the strength and topology of the network. RI queried whether the line was as low as possible to ensure generators remain stable and connected, which was really what NGET are after.

PB raised concerns that compliance wasn't overly taxing for faults up to 140ms in duration. AJ and DD clarified that staying stable was the key factor. AJ expanded that in retrospect slide 22 should have shown pole slipping of the Generator as HM had previously mentioned. AJ also noted that for voltage dips in excess of 140ms then the Mode B requirements would be applicable which would be outside the remit of RfG. In terms of the post fault voltage profile, after clearance of a 140ms fault, the voltage profile had been set so as to ensure the transmission system was robust to the majority of faults secured under the SQSS. DD queried why 'permitted to trip' was considered in terms of compliance – AJ confirmed this was due to RfG requirements, but ideally the criteria should be set such that if the voltage against time criteria was set correctly, the majority of stable cases should be above the defined voltage against time curve and an unstable case would transit through the voltage against time curve under which case tripping would be permitted. PB challenged that NGET needs to be comfortable that the curve presents a legitimate worst case scenario so that this curve works. Otherwise re-working may be required. AJ confirmed that it was in NGET's interest that the solution did not cause issues for operating the system. PB confirmed more work was needed to agree a Mode A solution given the ambiguity involved. GS then reiterated the decision of the workgroup that the emphasis should be spent on focusing on the Mode B solution.

### **Mode B**

AJ explained the anticipated legal text changes for Mode B, and applicability. As part of the presentation RI went through the two methods against which compliance assessment for Fault Ride Through could be assessed, these being either application of a fault adjacent to the HV terminals of the Generator Transformer (Method 1) or insertion of an infinite capacity transformer connected in parallel to the line feeding the infinite bus (Method 2). Under Method 1, the voltage dip as seen at the HV terminals of the Generator Transformer would result in a decaying voltage dip as a result of the decaying flux dynamics in the machine. As such determination would be required to establish what test criteria should be used to assess compliance for a specific voltage dip. For example, if the test was required for a 50% voltage dip, should the 50% voltage dip be assessed against the start of the dip, the average or the end of the dip. In the case of Method 2, the insertion and removal of the transformer will result in a straight line voltage dip (as currently shown in Slide 32 of the presentation) and Figures CC.A.4A.3(a), CC.A.4A.3(b) and CC.A.4A.3(c) of Appendix 3 of the Grid Code Connection Conditions. RI also noted that as part of these studies the fault level under which the studies should be run was also critical. He also noted that the short circuit level under which the test criteria should be applied was based on the MVA rating of the machine. This was based on an average short circuit level across the system which was considered a reasonable criteria based on the minimum needs of the Transmission System. HM RI and AJ explained how these requirements were separate to the SQSS requirements which are designed to only cover secured faults. RI confirmed Mode B may not be possible for *all* generators but re-iterated that the purpose of the Mode B requirement was to safeguard the total system in the event of a major fault which was cleared in

backup operating times. DD sought clarification on what the fault level tables were for. RI confirmed the studies were a sanity check for compliance, and that it was accepted that generators at these levels should be stable given these fault levels. GS confirmed this was a generic requirement, which made things easier to understand and provided a consistent requirement for Generators to assess compliance. Generators were concerned that they had modelled based on minimum fault levels. RI believed the proposed method was more robust. He went on to say that Mode A is assessed against the requirements of the SQSS and Mode B is assessed against a generic requirement which is sensible but reasonably taxing in terms of stability. PB queried whether generators needed to meet the Mode B fault ride through requirements based on a site specific fault level or a generic fault which would be specified in the Grid Code.

### Next Steps

AJ confirmed the change to the Mode B legal text was largely to the revised voltage duration curve,, though PB urged more codified prescription. AJ queried whether the generator fault (Method 1) or transformer switch (Method 2) should be used for compliance studies. PB stated a preference for the generator (“shunt model”) method as it was more realistic to actual conditions. RI provided details of some more modelling on pole slipping based on the two methods,. HM asked that both methods were explained to assist generators. AJ advised that as part of the new provisions he wanted to ensure that the requirements, in particular the methods of assessing compliance were as clear as possible and were detailed in the Grid Code. RI confirmed that two methods were set out for generators using different modelling programmes. DD suggested more flexibility on the approach the better it should be for compliance.

### Legal text

AJ presented the legal text, showing the proposed curves. CM again queried whether a definition of Mode A/Mode B (missing from the current draft legal text) was required to assist understanding of the requirement. AJ outlined the opinions of industry stakeholders in terms of splitting the requirement for synchronous vs non-synchronous [ACTION on AJ to ensure this is included in the workgroup report]. GS suggested packaging up the proposed legal text in a workgroup report – he then asked where the study methods should be located. AJ advised this could be in either the guidance notes or Grid Code. [ACTION: AJ and RI to draft workgroup report including legal text and approach on Mode A; AJ to confirm with compliance team location of study methods, i.e. in the Grid Code or not]. HM stated that there was no governance or document control for a guidance note, and that this text should therefore be put in the Grid Code, and the workgroup agreed. As a final point, it was noted that whilst the draft legal text could be provided for Mode A, only the legal text for Mode B should be put forward to the GCRP and ultimately consulted upon for inclusion in the GB Grid Code.

## **4. EDF Presentation & Discussion**

HM presented EDF’s findings on system modelling for Mode B, based on the voltage vs time curves proposed during the working group. HM advised that based on the studies run, a return to 0.9 p.u. voltage was found to be significantly more onerous than 1.0 pu, so it was recommended that NGET adopt this. This view was also supported by the remainder of the workgroup.

## **5. Next Steps**

GS and AJ outlined the next steps after this meeting:

- NGET to draft workgroup report, including proposed Mode B legal text
- NGET to circulate the above
- NGET to propose and arrange next meeting (October)
- NGET to consider RfG implementation approach for Mode A faults, along with wider project planning exercise and report back

## Actions

<b>ID</b>	<b>Actions</b>	<b>Captured</b>	<b>Owner</b>	<b>Status</b>
16	Industry are invited to engage with NGET to ensure National Grid are appropriately modelling the new large nuclear fleet in System studies (Extended at WG 6)	WG 5/6	Industry / NGET	Open
18	Review Emergency Restoration Code for overlapping requirements with FRT and RFG	WG 6	NGET	Closed
21	Generator representatives to check with NGET that machines and models used for modelling purposes are correct, and provide updates to assumptions if necessary	WG 7	NGET	Open
24	Legal text to state that tripping is not permitted in compliance simulations	WG 7	NGET	Will be clarified in Legal text
25	RI/AJ would review whether post fault voltage returning to 0.9p.u voltage (pu) is unduly penalising for generators, or whether system issues dictate	WG 7	NGET	Closed
26	AJ/RI to draft workgroup report including legal text for Mode B; provide tentative guidance on solution for Mode A (RfG) [also see action 24)	WG 8	NGET	Open
27	AJ to confirm with compliance team location of study methods, i.e. locate in the Grid Code or not	WG 8	NGET	Open

## Closed Actions

ID	Actions	Captured	Owner	Status
7	NGET to provide details of the single-machine model to workgroup members, to allow them to run their own studies	WG 4	NGET	Closed
8	Confirm protection operating times with NGET protection specialist and ensure that studies are representative of actual operating points.	WG 4	NGET	Closed
9	NGET and industry parties to consider further study work as outlined in paragraph <b>Error! Reference source not found.</b>	WG 4	NGET / Industry	Closed
10	NGET to identify if green voltage against time curve has presented in meeting No 4 had been forwarded to Generator manufacturers	WG5	NGET	Closed
11	Industry parties to request further parameters / details from NGET if they are unable to access the PowerFactory single machine model.	WG 5	Industry	Closed
12	For the next meeting, NGET to prepare: <ul style="list-style-type: none"> <li>• A summary of the workgroup findings and proposal, as a slide pack, for discussion.</li> <li>• Consider the impact of the proposals on the large nuclear Generating fleet</li> <li>• Consider further the requirement of specifying the fault-level at either a local or global level.</li> </ul>	WG 5	NGET	Closed
13	Superimpose the orange voltage against time curve on top of the RfG requirement	WG 5	NGET	Closed
14	Change the date in the terms of Reference to March 2015 instead of March 2014.	WG 5	NGET	Closed
15	For the next meeting, Industry parties are asked to consider: <ul style="list-style-type: none"> <li>• The stability of their station auxiliaries against the proposed curve</li> <li>• Where possible, to undertake some further analysis – particularly of large plant – against the proposed GB curve.</li> </ul>	WG 5	Industry	Closed
17	NGET to check GB interpretation of RFG to allow 'Mode A' (Secured) and 'Mode B' (Unsecured) faults with ENTSOE-E	WG 6	NGET	Closed
18	HM agreed to circulate RTE's testing guidelines for French generators	WG 7	Industry	Closed
19	Work group report to be prepared reflecting interim position pre-final RFG draft.	WG 6	NGET	Closed
20	Consider extension of GC0062 terms of reference (ToR) and industry representation to consider work on Embedded Generation and Mode B faults.	WG 7	NGET	Open
22	NGET to circulate latest draft version of RfG	WG 7	NGET	Closed
23	NGET to provide clear guidance on pre/post fault network status for modelling	WG 7	NGET	Open