

## Meeting Note

<b>Meeting name</b>	GC0062: Fault-ride-through
<b>Meeting number</b>	7
<b>Date of meeting</b>	Friday 24 <sup>th</sup> April 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>Karim Karoui</b>	KK	GDF Suez
<b>Hervé Meljac</b>	HM	EDF Energy
<b>Dave Draper</b>	DD	Horizon Nuclear Power
<b>Philip Belben</b>	PB	Horizon Nuclear Power
<b>Maxim Buquet</b>	MxB	GE Energy
<b>Marc Barbier</b>	MB	GE Energy
<b>Hervé Biellmann</b>	HB	GE Energy
<b>Campbell McDonald</b> [On the phone]	CM	SSE

## 1. Introductions

GS welcomed all attendees to the meeting. One industry representative was unable to make the revised meeting date – Mayure Daby (Ofgem). Isaac Gutierrez initially requested to attend but advised he will wait for if /when the GC0062 work extends to embedded non-synchronous generation.

## 2. Minutes of previous meeting

No corrections were raised in the meeting for the previous minutes. Initial comments were provided via email by HM and PB, which were discussed with AJ, but not finalised. RJW will therefore re-circulate the minutes and confirm the associated correspondence with HM, PB and AJ before finalising and uploading to the website.

## 3. Update on Actions

All open actions were addressed in AJ's presentation.

AJ gave the background to GC0062 for new attendees. He advised that the approach taken will facilitate early adoption of the Requirements for Generators (RfG) technical requirements for Mode A faults (i.e. secured faults up to 140ms in duration). He advised that GB management of Mode B faults has been the primary focus of the work so far, as it was principally this issue that had been raised in EDF's paper Ref PP12/04.

It is recognised that Fault Ride Through in respect of Embedded Generation will also need to be considered as the second phase of this work. GCRP approval will probably be needed to extend the group's terms of reference (ToR) and industry representation to consider this. [ACTION – RJW/GS]

AJ confirmed that RfG only defines the requirements for "secured faults" (i.e. Mode A). Mode B therefore will largely reflect existing Grid Code requirements, but the voltage duration curve will be substantially revised based on the minimum needs of the Transmission System and the ability of Synchronous Generating Units to satisfy the revised requirements. CM suggested that this approach should be checked against the GC0062 ToR [associated with action above].

AJ anticipates a draft workgroup report will be ready for circulation in July, for consideration at the September GCRP.

RI suggested to generator representatives that they should check with NGET to confirm the machines and models used by NGET for modelling purposes are correct, and provide updates to assumptions if necessary. [ACTION – Generator Reps]

CM queried the Type D [RfG] banding based on connection voltages. RJW advised RfG 'Type D' generators will be those connected at 110kV or greater, or those with unit capacity greater than a MW threshold still to be defined for the GB synchronous area. This is likely to be between 50-75MW (and less than 110kV), but this will not be confirmed until RfG becomes EU law. To assist understanding RJW will circulate the latest draft RfG of [ACTION – RJW]. AJ believed that the new provision introduced by GC0062 could help existing generators, including those with derogations.

KK stated that critical clearing time determines whether a fault is Mode A or Mode B.

PB asked the group how generators could perform simulations to prove compliance.

AJ clarified the requirements:

### Mode A Faults

- NGET will provide pre and post fault short circuit infeed
- NGET will define the pre fault Generator operating conditions (e.g. Max Output and fully underexcited (i.e. max lead)
- Fault applied at Transmission System for 140ms at the closest point to the Generator
- The pre-fault Transmission System voltage would be 1.0p.u
- The post fault Transmission System voltage would be assumed to be 0.9p.u on fault clearance (see discussion below)
- Under the above test, the Generator would be required to remain connected and stable (i.e. not pole slip) and the post fault voltage profile needs to remain above the orange line defined by the voltage against time curve provided
- NGET to define active power recovery requirements following fault clearance

### Mode B Faults

- NGET will provide the pre fault short circuit infeed. This will remain the same both pre-fault and post fault.
- NGET will define the pre fault Generator operating conditions (e.g. Max Output and fully underexcited (i.e. max lead)
- The pre-fault Transmission System voltage would be 1.0p.u
- The post fault Transmission System voltage would be assumed to be 0.9p.u on fault clearance
- The Generator should run a set of studies to ensure the Generating Unit remains stable and connected (i.e. not pole slip) for a set of voltage deviations which are on or above the orange line of the voltage (Slide 21) of the presentation given at the meeting (e.g. 33% retained voltage at 140ms, 50% retained voltage at 450ms, 85% retained voltage for 3 minutes).
- NGET to define active power recovery requirements following fault clearance.

For the proposed Mode A curve, HM felt returning to 0.9 p,u post fault penalised generators too much, but AJ confirmed this was to protect the system against a post-fault reduction in voltage due to an increased post fault impedance or changes in power flow. HM and DD stated that the maximum impedance between the Generator and System is the current assumption for compliance, and this assumes a worst case scenario. RI and GS confirmed that for Mode A faults, consideration needs to be given to close up network faults and the post fault conditions.

HM sought clarity on the pre/post fault network status. AJ agreed that NGET needs to set out clear guidance (compatible with RfG) [ACTION – AJ].

RI stated that the Mode A parameters will follow at a later date. It was advised that the Mode A requirements would also need to consider the impacts of the SQSS.

HM agreed to circulate RTE's testing guidelines for French generators [ACTION – HM – COMPLETE] [http://clients.rte-france.com/hm/fr/mediatheque/telecharge/reftech/20-10-14\\_article\\_8-3\\_v3.pdf](http://clients.rte-france.com/hm/fr/mediatheque/telecharge/reftech/20-10-14_article_8-3_v3.pdf) [Page 63]

### Discussion on Mode A requirements

PB asked whether a trip is permitted or not in the simulation. AJ confirmed this would not be possible if the post fault voltage remained above the permitted voltage against time curve (as it would not be compliant). AJ advised that any legal text would indicate this [ACTION – AJ]. *Post Meeting Note:- This issue has been further considered and discussed between PB and AJ. PB has rightly pointed out that the requirement could imply that the Generator has to ensure the post fault voltage profile is maintained above the defined voltage against time curve and has requested if this point could be clarified. PB has therefore requested clarification if there is a new requirement on Generators not to cause a voltage dip below the set profile and to define what is meant by "not permitting a trip" during simulation studies. [ACTION – AJ to Confirm]*

KK asked whether generators tripping off might be useful. The consensus of the group was that bad design should not be accommodated in the solution. DD also reminded the group that TSO requirements also need to be considered. KK stated that power quality should also be a factor. It was noted that a lower orange line would make compliance easier but that system stability would be poor. AJ reiterated DD's point about the Network Operator requiring a specific level of performance and the need to satisfy the requirements of the SQSS. PB also noted that the Mode A voltage against time curve was not entirely clear advising there needed to be a clear distinction between a design requirement and an operational requirement. He went on to state that the design requirement should demonstrate the ability of the generator to remain connected and stable when subject to a close up solid three phase short circuit fault at the Connection Point for up to 140ms with the pre and post fault short circuit levels at the Connection Point included within the study. In other words the design requirement should be assessed against a clearly defined fault.

It was noted that the voltage against time curve was largely academic as the voltage recovery would be a function of the pre and post fault short circuit level at the connection point and the type of Generation connected. PB advised that the voltage against time curve could be interpreted in a number of ways, for example is the Generator permitted to trip if the post fault voltage dips below the permitted voltage against time curve or is there a requirement for the Generator to keep the post fault voltage above the prescribed voltage against time curve which would drive an operational requirement.

**Discussion on Mode B requirements**

AJ asked the workgroup whether the proposed curve was acceptable. HM reiterated that requiring the post fault voltage to return to 0.9p.u voltage (pu) unduly penalised the generator; and that actual grid behaviour needed to be considered (grid strength post fault, impedance etc.). RI/AJ would check back on this and review accordingly [ACTION – RI/AJ]. RI indicated that the legal text would ideally quantify the test requirement, but this would need to be agreed both within National Grid and externally. It was suggested that one more workgroup meeting would be needed to finalise this. DD asked NGET how much longer was left on the work for GC0062 (current ToR); RI responded that an internal conversation was required first. GS then outlined a proposed timetable for conclusion, subject to RfG's entry into force but it is envisaged that for the first phase of the work (i.e. Large Directly connected Generators connected at 400 or 275kV) a draft report would be available to workgroup members in July with submission to the GCRP in September.

#### 4/5. GE Presentation & Discussion

Representatives from General Electric Energy presented their simulations of plant operation under the most onerous Voltage vs Time requirements prescribed in the Netherlands, using the Trafford Gas turbine Power Station (640MW) as an example. They also presented findings on the impact on plant auxiliaries under the same conditions.

#### 6. Next Steps

GS and AJ outlined what was to follow after this meeting:

- NGET internal discussion on simulation compliance requirements
- NGET to circulate proposed legal text
- NGET to propose and arrange next meeting
- NGET to continue to draft workgroup report (for possible circulation at next meeting)

Workgroup representatives reiterated their concerns about the purpose of the curve for simulation and operational compliance, and that this should be clarified. HM stated that the test procedure should be clearly defined. RI confirmed the workgroup report would define the rationale and test criteria behind the proposed curve.

GS and RJW agreed to consider possible alterations to the workgroup Terms of Reference so that Mode B faults could be considered. The existing ToR assumes that the RfG requirements would address the issues raised in EDF's original paper (Ref PP12/04) but it was noted that this is not the case. The outcome of this work would therefore be Mode A (which would consider early adoption of the RfG requirements) and Mode B which would contain a revised voltage duration curve whose purpose was to address the issues raised in EDF paper Ref PP12/04 .

#### Open Actions

ID	Actions	Captured	Owner	Status
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	Open
19	Work group report to be prepared reflecting interim position pre-final RFG draft.	WG 6	NGET	Open
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
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
22	NGET to circulate latest draft version of RfG	WG 7	NGET	Open
23	NGET to provide clear guidance on pre/post fault network status for modelling	WG 7	NGET	Open
24	Legal text to state that tripping is not permitted in compliance simulations	WG 7	NGET	Open
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	Open

**Closed Actions**

<b>ID</b>	<b>Actions</b>	<b>Captured</b>	<b>Owner</b>	<b>Status</b>
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