

Meeting Note

Meeting name	GC0062: Fault-ride-through
Meeting number	1
Date of meeting	3 December 2013
Time	10:30 – 14:30
Location	National Grid House, Warwick.

Attendees

Name	Initials	Company
Graham Stein	GS	National Grid (Chair)
Tony Johnson	AJ	National Grid
Ben Marshall	BM	National Grid
Paul Wakeley	PW	National Grid (Technical Secretary)
Rui Rui	RR	Iberdola / Scottish Power Renewables
Herve Meljac	HM	EDF Energy
Jonathan Oguntona	JO	RES
Dave Draper	DD	Horizon Nuclear Power

Apologies

Name	Company
John Morris	EDF Energy
Phil Jenner	RWE

In addition to this Meeting note, please refer to the slides for the meeting which have been published to the Grid Code Workgroup webpage:

<http://www.nationalgrid.com/uk/Electricity/Codes/gridcode/workinggroups/Fault+Ride+Through/>

1 Introductions/Apologies for Absence

1. GS welcomed representatives to the meeting and thanked them for volunteering to join the workgroup.
2. GS went through a brief overview of the Fault-Ride-Through Workgroup and the terms of reference¹. Specifically the Grid Code Review Panel has sanctioned the workgroup to:
 - Address the issues identified in GCRP Paper Reference PP12/04 [see footnote for link²], covering fault-ride-through requirements for Synchronous Generators (but not Power Park Modules³);
 - The workgroup will initially consider requirements that apply to directly connected Synchronous Generation and then consider Embedded Synchronous Plant;
 - All proposals are to be considered in the context of the existing GB Grid Code Glossary and Definitions not the ENTSO-E Requirements for Generators (RFG);
 - Any proposals will need to be consistent with the ENTSO-E RFG, which will apply to future GB Generators. At the current time it is expected that following the comitology phase (circa Q1-Q2 2014) the RfG document will be enshrined into European Law. Generators with a contract for connection will then have a 2 – 3 year period to satisfy these requirements which means that by 2016 - 2017 Grid Code will have to have been updated to ensure it is consistent with the requirements of the ENTSO-E RFG regardless of this workgroup.
3. In achieving this, the group is expected to:
 - Understand the implications and interpretation of the Fault-ride-through requirements as defined in the ENTSO-E RFG;
 - Develop specific GB requirements and parameters to ensure consistency with the ENTSO-E RFG including the voltage against time curves;
 - Assess the impact to Stakeholders of early adoption of the ENTSO-E RFG requirements in respect of Fault-ride-through;
 - Provide clarity to all affected User's including the GCRP and JESG;
 - Report back to the GCRP via a Workgroup report by January 2015 but possibly earlier.
4. It was noted that previous workshops on this topic had been held in late 2012 / early 2013. Details of which can be found on the NG website.

2 Current requirements

5. The current GB requirements for Fault-Ride-Through are defined in CC.6.3.15.1(a) (for Faults up to 140ms in duration) and CC.6.3.15.1(b) (for Voltage Dips in excess of 140ms in duration) of the Grid Code. These are often called Mode A and Mode B fault respectively. These requirements apply to both Synchronous plant and Power Park Modules connected to the Transmission Network at Supergrid voltages (>200kV).

¹ <http://www.nationalgrid.com/NR/rdonlyres/CAC62649-962D-4E3C-8BBB-1BEB3CF80A66/62052/GC0062FaultRideThroughToRsv2.pdf>

² Included in papers for January 2012 GCRP at: <http://www.nationalgrid.com/NR/rdonlyres/75FA2248-B3DA-4823-A1DA-2ABCCEC7C016/51220/January12GCRPpapers2.zip>

³ At the Fault Ride Through Workshops held in late 2012 and early 2013 representatives advised that whilst there were still issues with fault ride through associated with Asynchronous Plant, they would not wish to see the current GB Grid Code requirements for Power Park Modules changed until the introduction of the ENTSO-E Requirements for Generators.

6. There was concern that the current GB requirements were particularly onerous in respect of synchronous plant's ability to ride through Mode B faults. It was noted that some parties believed that the current GB requirements were ambiguous, difficult to interpret and hard for generators to demonstrate their compliance with them. This workgroup therefore has the opportunity to improve this situation.
7. It was also suggested that the diagrams in Appendix 4 of the Connection Conditions could be misleading, as they were only indicative of the types of faults that need to be secured against rather than being a definitive set.
8. In addition, a number of areas were also noted that would warrant further investigation, including the initial operating condition of the plant such as System Voltage, Terminal Voltage and Power Factor.

3 ENTSO-E Requirements for Generators Network Code requirements

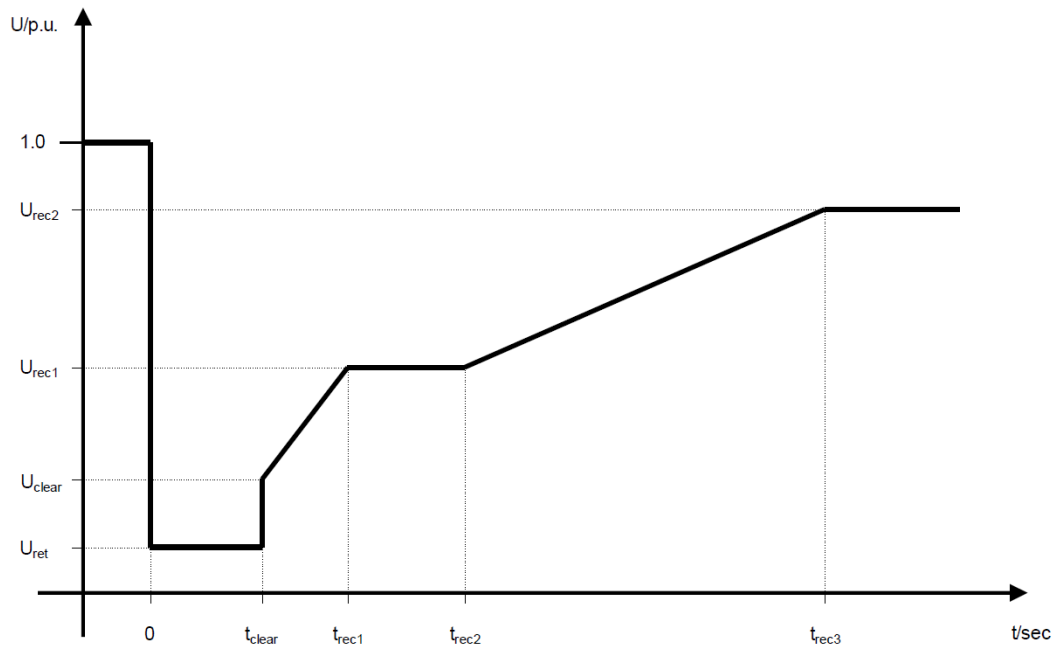
9. The ENTSO-E 'Requirements for Grid Connection Applicable to all Generators' Network Code (commonly known as RFG) is being developed as part of a suite of European Network Codes under the Third Energy Package. The RFG is expected to become law in mid-2014 and is currently in the Comitology process whereby member states agree the text.
10. There are requirements for fault-ride-through in the RFG. The latest version of this code is dated 8 March 2013 and is available on the ENTSO-E website⁴, however, a newer version is expected shortly by the European Commission as part of the Comitology process which may result in an update to the fault-ride-through requirements
11. The fault-ride-through requirements in RFG are given in:
 - Article 9(3) – Requirements for Type B (1MW-10MW below 110kV) and Type C (10MW-30MW below 110kV) Power Generating Modules; and
 - Article 11(3) – Requirements for Type D (>30MW or above 110kV) Power Generating Modules.

In RFG terminology, a Power Generating Module is either a Synchronous Power Generating Module or a Power Park Model. It was noted that the requirements (in particular the voltage against time curves and parameters) are different between Synchronous Generators and Power Park Modules.

12. In both cases requirements are specified for both Synchronous Plant and Power Park Modules. The requirements are specified in three main areas:
 - Specification of a voltage-against-time-curve: All faults which result in voltage deviations above the voltage-against-time-curve must remain stable and connected;
 - Pre-fault and post-fault conditions for the fault-ride through capability must be published by the TSO;
 - Each Network Operator must provide pre-fault and post-fault conditions to the Generator owner to allow them to calculate capability based on
 - Pre-fault minimum short circuit capacity at each connection point expressed in MVA;
 - Pre-fault operating point of the Power Generating Module expressed in Active Power Output and Reactive Power output at the Connection Point and Voltage at the Connection Point
 - Fault-ride-through capabilities in case of asymmetrical faults as defined by the TSO.

⁴ <http://networkcodes.entsoe.eu/connection-codes/requirements-for-generators/>

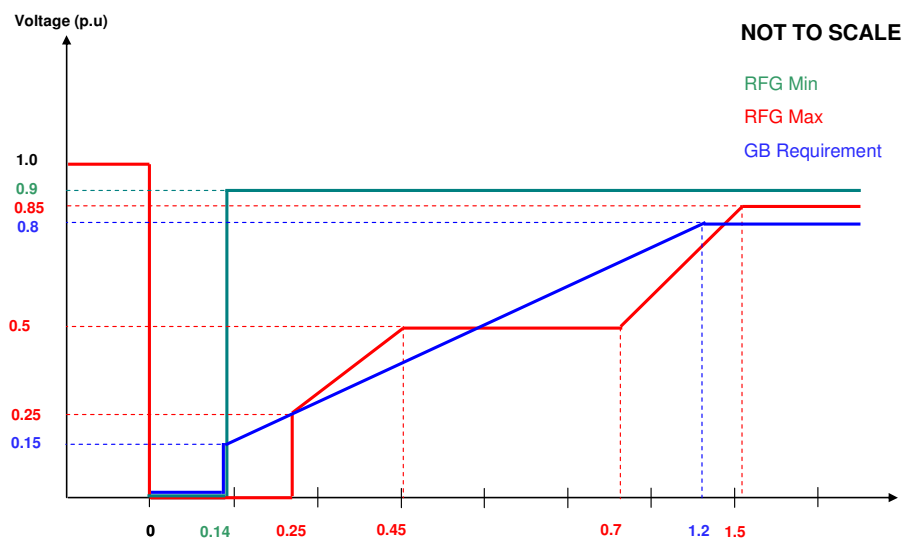
13. Further consideration was given to the Voltage-against-time curve as defined in the RFG for directly connected synchronous plant (Type D in RFG terminology applicable to >30MW plant connected about 110kV). In all cases, the FRT voltage-against-time-profile is defined against a generic curve with parameters to be chosen on a national basis from the ranges stated as shown overleaf.



14. The parameter ranges for Type D Synchronous Plant are taken from Table 7.1 in the NC RFG as shown in the above diagram (Figure 3 from the RFG NC). This curve has been reproduced below with the boundary limits shown. The red curve represents the most onerous requirement possible under the RFG (longest durations at the lowest voltage), whilst the green curve represents the least onerous requirement (shortest duration at the highest voltages). The blue curve is the existing GB Grid Code requirement (CC.6.3.15.1(b)) for comparison.

Voltage Parameters [pu]		Time parameter [seconds]	
U_{ret}	0	t_{clear}	0.14 – 0.25
U_{clear}	0.25	t_{rec1}	$t_{clear} - 0.45$
U_{rec1}	0.5 – 0.7	t_{rec2}	$t_{rec1} - 0.7$
U_{rec2}	0.85 – 0.9	t_{rec3}	$t_{rec2} - 1.5$

15. This provides a family of curves from which GB will need to select a voltage-against-time-profile to demonstrate RFG compliance, as shown in the following figure.



16. It was noted, that many of the problems experienced by synchronous plant are associated with Mode B voltage depressions in the range 0.3 – 0.5pu. The most onerous requirements in the RFG (red curve) are less demanding of the generator.
17. An issue was identified with the RFG FRT requirements in that it specifies the voltage-against-time-profile at the connection point rather than at the Supergrid Voltage level which the GB Grid Code currently requires.

4 ENTSO-E Requirements for Generators Network Code requirements

18. In defining the future focus of the workgroup, there is a need for two key areas of work to be understood to inform future debate. Specifically:
 - What can large directly synchronous plant achieve in terms of riding through faults; and
 - What are the requirements for the GB Transmission system in term of fault-ride-through provision? This will particularly focus on Synchronous Generators connected to weak sections of the Transmission Network which are operating at leading power factors during minimum demand conditions. Equally the impact of a Transmission System fault adjacent to a high concentration of generation needs to be understood to prevent the risk of cascade failure and generation losses in excess of the minimum infrequent infeed loss.
19. The first issue can be considered initially by reviewing compliance data from existing generators and then potentially consulting manufacturers / trade associations. The second issue can be addressed through dynamic studies against a range of faults on the Transmission Network. Workgroup members are asked to consider how they can contribute to the overall understanding of the issue by providing example and data.
20. These two issues are expected to form the basis of the agenda at the next workgroup meetings.
21. A proposed way forward for GB for directly connected synchronous plant will be to balance the requirements of the transmission system, with the ability of the plant to satisfy the fault ride through requirements, within the RFG framework.

5 Actions

ID	Actions	Owner	Status
1	Circulate Grid Code Panel Paper pp12/14 on FRT	NGET	Complete
2	Setup meetings for 2014 (Next meeting in early February, then at 8 to 10 week intervals)	NGET	Open
3	Prepare an initial review of fault ride through compliance in GB	NGET	Open
4	Prepare preliminary analysis of voltage recovery profiles and a proposal for analysis required to demonstrate the need case.	NGET	Open