Modification proposal:	**Grid Code (GC) GC0151: Grid Code Compliance with Fault Ride Through Requirements (GC0151)**		
Decision:	The Authority[1] directs[2] that the proposed modification to the Grid Code be made		
Target audience:	National Grid Electricity System Operator (NGESO), the Grid Code Review Panel, Grid Code users and other interested parties		
Date of publication:	5 November 2021	Implementation date:	One working day after Authority Decision

Background

On 6 May 2021 National Grid Electricity System Operator (NGESO) wrote an open letter to stakeholders regarding Grid Code compliance with Fault Ride Through (FRT) requirements[3]. In general, FRT requires that plant should be capable of continuing to operate through a 3-phase short circuit applied at its connection point for a period of 140ms then removed. This is considered to be the theoretical worst event that plant could be subjected to, and hence should be capable of withstanding any normal voltage dips occurring on the transmission system. In its open letter, NGESO noted that over the few months running up to the letter they have experienced a growing number of instances where Generator or Network Operators' assets have apparently failed to ride through faults on the National Electricity Transmission System (NETS). NGESO further noted that these faults, which were deemed as normal or routine, were well within the FRT design standards and requirements of the Grid Code and System Operator Transmission Operator Code (STC), and the apparent inability of Users to ride through these normal faults presented a serious risk to the NETS.

[1] References to the "Authority", "Ofgem", "we" and "our" are used interchangeably in this document. The Authority refers to GEMA, the Gas and Electricity Markets Authority. The Office of Gas and Electricity Markets (Ofgem) supports GEMA in its day to day work. This decision is made by or on behalf of GEMA.
[2] This document is notice of the reasons for this decision as required by section 49A of the Electricity Act 1989.
[3] https://www.nationalgrideso.com/news/open-letter-transmission-connected-generation

To address this, NGESO sought confirmation from Users that they are compliant with all aspects of the Grid Code or STC, in particular the FRT capability. They also set out an interim process to manage the operational risks from Users with potential fault ride through issues, whilst full code modifications were developed. This involved Users voluntarily reducing their Import and Export Limit to a level agreed with NGESO until Fault Ride Through compliance could be demonstrated. A number of Users expressed concern with the ESO's interim process, in particular regarding lack of transparency in the level and duration of restrictions applied.

The modification proposal

GC0151 was raised by SSE plc on 23 June 2021 to codify the process to manage Users with potential FRT issues providing User certainty whilst maintaining security of supply and minimising the commercial impact on stakeholders. We received a request from the Grid Code Review Panel (GCRP) Chair on 25 June 2021 that GC0151 be treated as an Urgent Modification Proposal, which we accepted on 2 July 2021[4].

GC0151 comprises 5 modification proposals: the original proposal, and 4 Workgroup Alternative Grid Code Modifications (WAGCMs). The proposals are summarised below.

The original proposal comprises:

- Changes to Operating Code (OC) OC5 such that:
    - where the ESO considers a User to fail to comply with FRT requirements (i.e. a trip concurrent with a transmission fault), the ESO will notify the User who will provide an explanation to the ESO as to why the Users failure to ride through the fault did not breach FRT requirements, and where necessary resolve any non-compliances within 3 months.
    - On receipt of such a notification from the ESO, User's whose export capability is more than 100MW must immediately reduce their export to 70% of the unrestricted capability or the prevailing largest infeed loss risk, whichever is smaller.
    - If after 3 months the User and ESO have not agreed to an explanation or necessary actions to resolve this, the User will be subject to a 50% export limitation.

[4] https://www.ofgem.gov.uk/publications/authority-decision-gcrps-request-urgency-gc0151-grid-code-compliance-fault-ride-through-requirements

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- Changes to OC3 to require the ESO to report on fault events on the NETS, providing voltage waveform data where FRT issues are found, publish a report explaining the events, analysis and information gained as applicable.
- Changes to OC2 to require the ESO to publish daily the largest secured loss of generation or import from Interconnectors for each settlement period. We note that this is the largest infeed loss risk that the NETS must be secured against as per the NETS Security and Quality of Supply Standard (SQSS).

WAGCM1 differs from the original proposal in that:

- Users are required to respond to a potential FRT failure notification from the ESO within 2 hours, or longer where agreed between the User and ESO, in accordance with existing OC10 requirements; and,
- On receipt of a potential FRT failure notification from the ESO, User's must restrict their output to a level, and for a period, as agreed between the User and the ESO. This could be as low as 0 MW.

WAGCM2 proposes changes to the existing Grid Code FRT requirements to correct existing deficiencies. These are broadly to; (1) clarify that there are instances where User plant is permitted to trip where required in order to clear the fault from the transmission system, (2) amend requirements for generating maximum reactive current during faults which may be unachievable for many generators, and (3) amend post fault active power requirements to reflect that low load Generators may have greater oscillations than the requirements currently allow for.

WAGCM3 combines the original proposal and WAGCM 2, and WAGCM4 combines WAGCM1 and WAGCM2.

The proposer considers the Original proposal better facilitates Grid Code objectives; (i)[5] by taking a risk-based approach to managing constraints from potential FRT non-compliances and minimising unnecessary constraints, (ii)[6] by encouraging Users and Network Operators to quickly resolve FRT non-compliances, and (iv)[7] by, amongst other things, clarifying expected actions to be taken by users with Potential FRT issues. We

[5] Grid Code Objective (i); to permit the development, maintenance and operation of an efficient, co-ordinated and economical system for the transmission of electricity.
[6] Grid Code Objective (ii); to facilitate competition in the generation and supply of electricity (and without limiting the foregoing, to facilitate the national electricity transmission system being made available to persons authorised to supply or generate electricity on terms which neither prevent nor restrict competition in the supply or generation of electricity).
[7] Grid Code objective (iv) to efficiently discharge the obligations imposed upon the licensee by this license and to comply with the Electricity Regulation and any relevant legally binding decisions of the European Commission and/or the Agency.

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note that the Workgroup concluded by split vote that the Original proposal, WAGCM1 and WAGCM3 better facilitate the applicable Grid Code objectives.

Grid Code Review Panel recommendation

At the Grid Code Review Panel meeting on 7 October 2021, the Grid Code Review Panel members voted on all four WAGCM's and the original proposal, as well as their preferred GC0151 solution. Their overall recommendation is that all four WAGCM's and the original proposal better facilitate the Grid Code objectives. However, their votes on a preferred solution were split evenly between proposals incorporating the original proposal (Original and WAGCM3) and solutions incorporating WAGCM1 (WAGCM1 and WAGCM4).

Our decision

We have considered the modification proposal and the Final Modification Report dated 11 October 2021. We have considered and taken into account the responses to the industry consultation on the modification proposal which are included in the Final Report[8]. We have concluded that:

- implementation of WAGCM1 of the modification proposal will better facilitate the achievement of the objectives of the Grid Code;[9] and
- approving WAGCM1 of the modification proposal is consistent with our principal objective and statutory duties.[10]

Reasons for our decision

WAGCM2, WAGCM3, & WAGCM4

A number of GCRP members noted in their voting statements that the changes to FRT requirements proposed under WAGCM2 whilst appearing beneficial, have not been fully scrutinised due to GC0151 being progressed as an urgent modification. We agree with this view, and therefore consider changes to the FRT requirements could be progressed as a separate modification should industry desire. Consequently, we rule out WAGCM2, WAGCM3 and WAGCM4.

[8] Grid Code proposals, final reports and representations can be viewed on NGESO's website at: https://www.nationalgrideso.com/industry-information/codes/grid-code/modifications
[9] As set out in Standard Condition C14(1)(b) of the Electricity Transmission Licence, available at: https://epr.ofgem.gov.uk/
[10] The Authority's statutory duties are wider than matters which the Grid Code Panel Review must take into consideration and are detailed mainly in the Electricity Act 1989 as amended.

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However, we note that WAGCM2 highlights a number of deficiencies in the current FRT requirements as mentioned in the summary of WAGCM2, above. We expect the ESO to take these issues into consideration in assessing Grid Code compliance, and when Users are required to provide explanation of a potential FRT non-compliance.

Original and WAGCM1

We note that the main difference between the original proposal and WAGCM1 are (i) the magnitude and duration of required export restrictions, and (ii) the timeframe in which a User is expected to provide an explanation of potential FRT non-compliances and resolve any non-compliances if required. We outline our views against each of these below.

(i) Export restrictions

The primary need for export reductions is to protect the system from the risk of subsequent User trips due to FRT non-compliances. This risk will remain whilst the User is connected to the system, however its impacts will be reduced if the User's export is limited. The impact will also depend on the prevailing system conditions and level and availability of services held by the ESO to control frequency deviations caused by a sudden loss to the system (i.e. a User trip). The ESO determines the appropriate level of services to secure the system via the Frequency Risk and Control Report (FRCR)[11], introduced to the SQSS via SQSS modification GSR027[12]. In doing so, they must secure against, amongst other things, the most onerous loss of power infeed (i.e. the largest infeed loss risk as referenced in the original proposal). We note that in the worst case scenario, a transmission fault could disconnect largest infeed, in which case the services available to the ESO to secure the system may be eroded beyond the level required to contain a concurrent disconnection due to FRT failure.

The original proposal imposes inflexible pre-determined export reductions on Users notified of a potential FRT non-compliance by the ESO. We have a number of concerns in this regard; (1) Where a user chooses to reconnect post-fault, it forces potential FRT risks to remain on the system operating at a level that may not sufficiently reduce the impact of the risk to the NETS to prevent an emergency situation. (2) No consideration is given to instances of multiple potential FRT non-compliances, as seen by the ESO in the

[11] The FRCR can be found on the ESO's website; https://www.nationalgrideso.com/industry-information/codes/security-and-quality-supply-standards/frequency-risk-control-report
[12] Our decision to approve SQSS modification proposal GSR027 can be viewed on our website; https://www.ofgem.gov.uk/sites/default/files/docs/2020/12/sqss_gsr027_authority_decision_0.pdf

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months leading up to its open letter. We further note that multiple concurrent FRT failures caused the 9 August 2019 system incident which triggered the disconnection of circa. 1.1m customers[13]. We note that a number of GC0151 Workgroup members and consultation respondents raised these issues and considered a flexible approach to export restrictions was required, giving consideration to plant capability (e.g. Minimum Stable Operating Limit) and site or system risk.

We consider that Users with potential FRT non-compliances may pose a serious risk to the security of the NETS, and that the ESO requires the flexibility to apply system engineering judgement in mitigating these risks in order to effectively do so. WAGCM1 facilitates this by requiring the ESO and User to agree on a level of output restrictions. We note User concern that reducing to 0 MW may have a significant commercial impact and, depending on prevailing market conditions could lead to increased system balancing costs as well as erode system security margins, creating other security risks. We acknowledge this is a risk, however we consider the ESO must have the ability to completely remove a potential FRT risk where it deems necessary. We note that the ESO stated in its consultation response that WAGCM1 allows full restriction to be agreed in the rare cases where an explanation cannot be quickly determined. We therefore expect instances where the ESO seeks to agree full restriction will be limited, however acknowledge that this will depend on the likelihood of the risk materialising, its impacts on the system, and the ESO's ability to economically mitigate the impacts.

We note that the GC0151 Proposer and other Users expressed concern that the ESO's interim process as set out in its open letter, and WAGCM1, lacked transparency and gave rise to potential discrimination in the treatment of Users. As set out above, we consider a flexible approach to managing FRT risks to be appropriate. We note that WAGCM1 requires Users to restrict their output to a level, and for a period, as agreed between the User and the ESO. In seeking such an agreement, we fully expect the ESO to clearly articulate its justifications for doing so. We also note that both the original proposal and WAGCM1 require the ESO to report on learning arising from the analysis of fault events on the NETS, anonymising User information where appropriate. We expect such learning to include information that could increase transparency in the process (e.g. timeframes for FRT investigations, justification for restrictions sought, common causes of apparent FRT failures, etc.). We further expect such learning to inform future actions taken by the ESO with regards to potential FRT non-compliances. As such, we consider transparency in

[13] Information on the 9 August 2019 system incident can be found in our investigation into the event; https://www.ofgem.gov.uk/publications/investigation-9-august-2019-power-outage

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the process proposed under WAGCM1 to increase over time, and that this will reduce any potential discrimination in the treatment of Users.

We note that WAGCM1 requires export reduction to a level agreed between user and ESO. During the Workgroup, the possibility of Users and the ESO not agreeing an export reduction was discussed. We note that the ESO stated that if no agreement can be found, then users can continue to operate as normal, and the issue can be escalated to the regulator. We note that whilst holders of an Electricity Generation Licence[14] can under condition C9 refer disputes to the Authority for determination, we expect the ESO to use existing provisions, including emergency instructions where necessary, to manage system risks in real time. We further note that we do not expect such situations to arise for a number of reasons; (1) FRT failures can cause damage to both the system and User plant, particularly when at high load. We consider that Users reconnecting post fault without understanding why a trip occurred constitutes poor asset management practice and may pose safety risks. (2) the process under WAGCM1 involves engagement between Users and the ESO, we therefore expect User capability to be taken into account when any restrictions are sought. (3) as mentioned earlier, we expect the ESO to clearly articulate its justification for seeking any export restrictions.

(ii) Timeframe for Users to respond to ESO notification

We note that the 3 month duration under the original proposal intends to provide users adequate time to undertake a full investigation and if necessary, resolve non-compliances. A number of Workgroup members and consultation respondents considered the 2 hour timeframe set out in the ESO's initial letter to industry (and WAGCM1) too short. We note that the ESO proposes to issue a notification as a request for a Significant Incident Report under OC7, for which OC10 specifies User timeframe requirements. OC10 requires Users to provide a full written report within 2 hours, of such a notification, or if not possible, provide a preliminary report followed by a full report. Further, WAGCM1 allows longer time periods for User response to be agreed by the ESO. Due to the risk to system, we consider it prudent for explanations of potential FRT non-compliances to be made available to the ESO as soon as possible. We note we consider it in the interest of Users to respond as quickly as possible in order to return to normal service, or inform the level of restrictions sought. We further note that the ESO have stated that the vast majority of suspected FRT compliance issues can be easily explained based on previous

[14] The Electricity Generation Standard Licence Conditions; https://epr.ofgem.gov.uk/Content/Documents/Electricity%20Generation%20Standard%20Licence%20Conditions%20Consolidated%20-%20Current%20Version.pdf

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investigations. We therefore consider the flexible 2 hour timeframe proposed under WAGCM1 appropriate. We further note that as mentioned earlier, we expect the ESO to include learning on the duration of investigations and restrictions as part of its report's on the learning from fault events. We therefore consider transparency regarding the expected timeframes for response, and typical duration of investigations to increase over time.

We also note User concerns that investigations may rely on data held by the ESO, such as voltage waveform data. We note that the ESO or TO's may have fault recorders local to a User's point of connection and thus fault voltage waveform data which may inform FRT investigations, however this may not always be the case. Regardless, both the original proposal and WAGCM1 require the ESO to provide such data, where applicable, as soon as possible.

Other issues

We note that a consultation respondent requested our confirmation that restrictions imposed on Users as a result of GC0151 would not result in Generators breaching their REMIT obligations[15]. We would assess the compliance of a Generator with its obligations under REMIT on a case by case basis. However, from an engineering perspective, we would expect that export restrictions applied at the request of the ESO as a result of GC0151 would be considered akin to a reduction in the capacity of that unit which was technically available, and thus would not comprise market manipulation. This is the case for both the original proposal and WAGCM1.

Both proposals give rise to the potential for FRT compliant Users to have their export restricted during the period of investigation of a potential FRT non-compliance. Due to the potentially significant risks of FRT non-compliance, we consider it prudent for the ESO to seek to take action to mitigate the risks prior to a full investigation where it deems this necessary. We note that WAGCM1 requires User agreement on restrictions.

[15] Regulation (EU) No 1227/2011 of the European Parliament and of the Council on wholesale energy market integrity and transparency as retained under national legislation. Among other things, these regulations prohibit market manipulation, defined as actions that artificially cause prices to be at a level not justified by market forces. One form of market manipulation described in paragraph 13 of the introduction of the regulations is 'deliberately making it appear that the availability of electricity generation capacity…is other than capacity which is actually technically available'.

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Grid Code Objectives

We consider WAGCM1 of GC0151 will better facilitate Grid Code objectives (i), (ii), and (iii), and has a neutral impact on the other applicable objectives.

(i) to permit the development, maintenance and operation of an efficient, co-ordinated and economical system for the transmission of electricity

As mentioned above, we consider that WAGCM1 recognises the risks posed by potential FRT non-compliances and puts in place a process allowing the ESO to use its engineering judgement to manage these risks as appropriate. Given the FRT failure risks and impacts will vary depending on a number of factors including the prevailing system conditions, we consider a flexible approach to managing FRT risks is key to doing so efficiently. We therefore consider that WAGCM1 better facilitates this Grid Code objective.

(ii) to facilitate competition in the generation and supply of electricity (and without limiting the foregoing, to facilitate the national electricity transmission system being made available to persons authorised to supply or generate electricity on terms which neither prevent nor restrict competition in the supply or generation of electricity)

We note that WAGCM1 (and the original proposal) introduce the possibility that FRT compliant Users could be subject to export restrictions during the period of investigation, where Users agree to this. However, as mentioned earlier, due to the significant risks of User trips to system security, and the increasing number of instances of trips concurrent with a network fault, we consider it prudent for potential FRT non-compliances to be managed with respect to the risks they pose prior to full investigations. Not doing so would shift the risk of non-compliance from Users to the ESO, resulting in increased risk of system disruption or increased operational costs to mitigate the risk. We consider that both such outcomes would negatively impact competition, and therefore consider that WAGCM1 better facilitates this Grid Code objective.

(iii) subject to sub-paragraphs (i) and (ii), to promote the security and efficiency of the electricity generation, transmission and distribution systems in the national electricity transmission system operator area taken as a whole

As mentioned earlier, we consider that the ESO requires the flexibility to apply system engineering judgement in mitigating the risks associated with potential FRT non-

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compliances. We consider WAGCM1 to better ensure that the risks associated with potential FRT non-compliances are secured against the wider risks they pose to system security. We therefore consider that WAGCM1 better facilitates this Grid Code objective.

Decision notice

In accordance with Standard Condition C14 of the Transmission Licence, the Authority hereby directs that WAGCM1 of the Grid Code modification proposal Grid Code GC0151: *'Grid Code Compliance with Fault Ride Through Requirements'* be made.

Martin Queen
Principal Engineer, Analysis and Assurance
Signed on behalf of the Authority and authorised for that purpose

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