Modification proposal:	**GSR027: Review of the NETS SQSS Criteria for Frequency Control that drive reserve, response and inertia holding on the GB electricity system (GSR027)**		
Decision:	The Authority[1] approves[2] the proposed changes to the National Electricity Transmission System Security and Quality of Supply Standards (SQSS)		
Target audience:	National Grid Electricity System Operator, transmission licensees and other interested parties		
Date of publication:	10 December 2020	Implementation date:	1 April 2021

Background

On 9 August 2019, there was a near-simultaneous loss of two large generators and consequential losses of Distributed Energy Resources (DER). These combined power losses went beyond the back-up power generation arrangements that the Electricity System Operator (ESO) had in place to keep the system stable, resulting in significant frequency disruption. This triggered the disconnection, loss of power and disruption to more than one million customers.

Our report into the incident[3] found issue with the processes and procedures the ESO uses to manage system operation in relation to the ESO's estimating and holding inertia and frequency response needed to meet its requirements. We also found issue with the robustness, transparency and interpretation of regulatory requirements.

Both Action 1 of our report on the incident, and Action 5 of the government's Energy Emergencies Executive Committee (E3C) report on the incident[4] require the ESO, in consultation with industry, to undertake a review of the SQSS requirements for holding reserve, response and system inertia. Both actions require the review to consider:

- the explicit impacts of distributed generation on the required level of security;

[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] Our report of the 9 August 2019 power outage can be viewed here: https://www.ofgem.gov.uk/publications-and-updates/investigation-9-august-2019-power-outage
[4] The government's E3C report on the 9 August 2019 power outage can be viewed here: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/855767/e3c-gb-power-disruption-9-august-2019-final-report.pdf

- whether it is appropriate to provide flexibility in the requirements for securing against risk events with a very low likelihood, for example on a cost/risk basis; and,
- the costs and benefits of requiring the availability of additional reserves to secure against the risk of simultaneous loss events.

The SQSS sets out the minimum standard that the ESO is required to use for operating the national electricity system. It specifies the limits of frequency diversions from 50Hz for secured events[5], including the credible loss of transmission circuits or generation connections (or generating unit or groups of generating units sharing a common circuit breaker) and the most onerous loss of power infeed. It requires that the system is secured against the loss of the largest amount of power feeding into it following a secured event. This *loss of power infeed* risk can vary depending on the operation of the largest power sources connected to the system.

To manage frequency the ESO seeks to hold sufficient frequency response, driven by the SQSS requirements, as well as maintain minimum levels of system inertia thereby influencing the rate of change of frequency (RoCoF), and reduce the maximum *loss of power infeed*. In so doing, the ESO takes account of the potential loss of embedded generation as a consequence of the events it secures, although this is not explicitly required by the SQSS. Each of the actions influence one another and current ESO practice is to utilise different combinations of actions for different events. ESO policies in each of these control options are largely internal and not transparent to industry.

GSR027 reviews the criteria for *unacceptable frequency conditions* in the SQSS aiming to ensure the appropriate balance can be reached between the costs of managing system frequency, and the risks mitigated in doing so. It also seeks to increase transparency around how these events are secured and, in particular the treatment of embedded generation that is affected by such events.

The modification proposal

GSR027 has been proposed by the ESO in response to both Action 1 of our report and Action 5 of the government's E3C report on the 9 August 2016 power system incident. It proposes to

[5] The SQSS defines Secured Events as "A contingency which would be considered for the purposes of assessing system security and which must not result in the remaining national electricity transmission system being in breach of the security criteria. Secured events are individually specified throughout the text of this Standard. It is recognised that more onerous unsecured events may occur and additional operational measures within the requirements of the Grid Code may be utilised to maintain overall national electricity transmission system integrity."

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remove the specific SQSS requirements on holding sufficient frequency reserve to manage the *loss of power infeed* risk and introduce a new Frequency Risk and Control Report ("FRCR"). The ESO will be required to use the FRCR to determine the events for which *unacceptable frequency conditions* shall not occur, and hence drive their policies on frequency control. A FRCR Methodology is also introduced as is a Governance Framework setting out the requirements for the ESO to develop the FRCR Methodology and produce an FRCR in line with this methodology. The following SQSS changes are proposed to facilitate this:

- Introduce definitions for 'Frequency Risk and Control Report', 'Frequency Risk and Control Report Methodology' and 'Loss of Power Outfeed'. The definition for 'Loss of Power Outfeed' follows the amended definition for 'Loss of Power Infeed'.
- Amend the definition of:
    - 'Fault Outage' such that it refers to primary transmission equipment and/or user equipment that may or may not result in a loss of power infeed or loss of power outfeed.
    - 'Unacceptable Frequency Conditions' to include that transient frequency deviations outside the limits of 49.5Hz and 50.5Hz shall only persist for a duration and only deviate by a magnitude which ought to reasonably be considered as tolerable (it currently only refers to intervals which ought to reasonably be considered as tolerable). The FRCR will define what is considered reasonable, infrequent and tolerable for each of the criteria. Reference to the minimum *loss of power infeed* risk to be covered by frequency response is removed from as this is to be covered in the new FRCR.
    - 'Loss of Power Infeed' to include import from an external system via HVDC Link, thereby including interconnectors.
- Make changes to Chapter 5 'Operation of the Onshore Transmission System' and Chapter 9 'Operation of an Offshore Transmission System' to:
    - include the most onerous loss of power outfeed in the list of secured events under which *unacceptable frequency conditions* shall not occur.
    - require the ESO to use the latest approved version of the FRCR to determine the events for which *unacceptable frequency conditions* shall not occur, including consideration of consequential loss of DER associated with such event.
    - specify that exceptions to *unacceptable frequency conditions* must be based on the outcome of an assessment conducted in accordance with the FRCR.
- Introduce a Governance Framework as an Annex or Appendix to SQSS. The Governance Framework requires:

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- the ESO to produce, and consult with industry on, a FRCR Methodology designed to facilitate the economic assessment of the risk of *unacceptable frequency conditions* occurring on the National Electricity Transmission System and which of these risks will be secured.
- the SQSS Panel to recommend the FRCR Methodology be used to produce a FRCR.
- the ESO to produce a FRCR each year, which should be submitted to the SQSS Panel for recommendation and the Authority for approval. Further, at least annually, the previous FRCR should be reviewed and improvements considered.

GSR027 intended to include the FRCR Methodology and first FRCR in its proposal. However, we required GSR027 to be submitted to us such that we can make our final decision by mid-December 2020 in order to include Electricity Transmission Licence changes required to implement changes to the SQSS in the Statutory Consultation to make changes to the Electricity Transmission Licence we plan on issuing mid-December 2020. This time constraint meant the FRCR Methodology and first FRCR could not be included in the proposal: the proposal includes an indicative FRCR Methodology to set out the approach that will be used.

The aim of the FRCR Methodology is to set out an objective and transparent framework for the ESO to assess risks associated with frequency deviations, the events which could cause them, their size, the impacts they have, and the cost and appropriate mix of controls to mitigate them. The Illustrative FRCR Methodology presented in GSR027 sets out:

- How events that could lead to unacceptable frequency conditions could be defined. These are presented as BMU (single or group of BMUs) Faults, Transmission faults resulting in infeed or outfeed disconnection, or events leading to DER with Vector Shift Loss of Mains (LoM) protection disconnections. Any subsequent DER with RoCoF LoM protection disconnections arising due to the event will also be considered. The size (size of loss, MW) and probability of events occurring, and for DER, the threshold (eg. RoCoF in Hz) and location where applicable (Vector Shift LoM protection DER), will be considered.
- How impacts of such events could be defined. These are presented as duration, magnitude and frequency of frequency deviation. Consideration of the impact of equipment requirements[6] and automatic actions taken by equipment (eg. protection

[6] For example, Grid Code Connection Condition CC.6.1.3, which defines the duration equipment is required to remain connected to the system during frequency deviations

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schemes, Low Frequency Demand Disconnection[7]) will be taken in defining the impacts of events.

- Which controls available to the ESO to mitigate impacts of events will be assessed. These are presented as Frequency response, LoM loss size reduction, and increasing system inertia for all events, and BMU loss size reduction for specific events. Current ESO practices and variations from this for each control option are presented.
- Potential principles for assessing reliability against cost in the FRCR. To facilitate this, three metrics are presented: a limit on the total cost per year, a limit on how often each impact is expected to occur, and a cost value per avoided occurrence.
- How the events, impacts and controls will be assessed in the FRCR. Each permutation of control options (total of 12 presented) will be assessed against each defined event. To do this, Frequency response, LoM loss size reduction, and increasing system inertia actions required will be determined, the cost of the actions calculated, and the expected loss size for the event calculated (accounting for the BMU loss size and any consequential Vector Shift and/or RoCoF losses). The risk of the event causing any of the defined impacts will be assessed. If required, further action of BMU loss size reduction needed will be determined, the cost calculated, and residual risk and risk reduction be determined. A cost vs. risk curve for each scenario will be produced to allow the effectiveness of each control option permutation to be assessed. An overall recommendation on which set of controls represent the best balance between reliability and cost will be made.

Industry Consultation

A code administrator consultation was held from 23 October 2020 to 6 November 2020 receiving five responses. Three respondents were supportive of the proposed changes and implementation, two did not support neither the change nor implementation.

One respondent commented that the proposal effectively replaces the SQSS minimum frequency control requirements with an external process, and that the minimum requirements should remain mandated in the SQSS. They further commented that the consultation document noted the aim of the modification "is to enable the development of the ESOs policy on reserve, response and inertia holding", and that they consider the ESO should already have such policies, including taking network risks and evolving issues into account. We note that whilst

[7] Low Frequency Demand Disconnection scheme limits falls in frequency by automatically disconnecting demand under specific scenarios.

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GSR027 proposes to remove specific requirements on holding sufficient frequency response to manage the loss of power infeed risk from the definition of *unacceptable frequency conditions*, such requirements are inherent in the FRCR albeit assessed with respect to risk and cost.

They also consider the FRCR process could be implemented via a licence condition and therefore no changes to the SQSS are required. We note that this was discussed at the workgroup where the majority of members believed it most appropriate to include the FRCR Governance Framework as an appendix to the SQSS as did the majority of workgroup consultation respondents.

Another respondent commented that the proposed amendment to the definition of *unacceptable frequency conditions* removed reference to specific limits to system frequency and added greater uncertainty by introducing the term "ought to be reasonably considered as…" to two new metrics (duration and magnitude). We note that whilst at present this adds uncertainty, we understand that the FRCR Methodology requires these statements to be quantified, albeit with respect to risk and cost, as part of the analysis for the FRCR. Whilst the FRCR is separate to the SQSS, it is referenced in the SQSS thereby ultimately making the definition more robust.

NETS SQSS Panel recommendation

The NETS SQSS Panel considered the proposal and consultation responses at the Panel meeting on 18 November 2020, and made their recommendation vote; there were six votes for the proposal and one vote against. Four members considered GSR027 better facilitated SQSS Objectives (i) and (ii) and had a neutral impact on the other SQSS objectives. One member considered GSR027 did not better facilitated SQSS Objectives (i) and (ii) and had a neutral impact on the other SQSS objectives. One member considered GSR027 had neutral impact on all SQSS objectives. Overall, the SQSS Panel recommend by majority that GSR027 be implemented.

The member who voted against GSR027 also submitted a code administrator consultation response, their comments are addressed in the above section.

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Decision notice

This letter sets out the Authority's decision the proposed changes to the NETS SQSS and the reasons for that decision. We have concluded that:

- implementation of the modification proposal will better facilitate the achievement of objective (i) and (ii) of the NETS SQSS[8]; and
- approving the modification is consistent with our principal objective and statutory duties.[9]

Reasons for our decision

We consider the NETS SQSS modifications proposed in GSR027 better facilitate NETS SQSS objective (i) and (ii), and have a neutral impact on the other objectives.

(i) facilitate the planning, development and maintenance of an efficient, coordinated and economical system of electricity transmission, and the operation of that system in an efficient, economic and coordinated manner;

The SQSS, in its current form, specifies a deterministic approach to ensuring *unacceptable frequency* conditions do not arise, requiring that the system is secured against the loss of the largest amount of power feeding into it following a secured event. GSR027 introduces a FRCR to analyse potential events leading to, the impacts of, and options to prevent or manage impacts of *unacceptable frequency conditions* with respect to risk and cost. This aims to ensure the appropriate balance can be reached between the costs of managing system frequency, and the risks mitigated in doing so.

Both respondents to the industry consultation suggested that the first FRCR be published before an SQSS change is considered so that detail on the balance between risk and cost can be viewed to avoid unintended consequences of moving from a deterministic to probabilistic approach. We note that GSR027 has been proposed within a time-frame to allow us to implement the modification by updating the Electricity Transmission licence to refer to a new version of the SQSS from 1 April 2021, and was therefore proposed prior to full development

[8] The NETS SQSS Industry Governance Framework: https://www.nationalgrideso.com/sites/eso/files/documents/NETS%20SQSS%20Industry%20Governance%20Framework%20v1.0%20%2830-03-12%29.pdf

[9] The Authority's statutory duties are wider than matters which NGET must take into consideration and are detailed mainly in the Electricity Act 1989 as amended.

and agreement of the FRCR Methodology and hence FRCR. The FRCR Methodology requires industry consultation and recommendation by the SQSS Panel before an FRCR can be produced, and the FRCR requires SQSS Panels recommendation and Authority approval before it can be used. We note that our proposal to update the Electricity Transmission licence will include a requirement for the ESO to continue to follow current practices to control frequency risks in compliance with the current version of the SQSS until the first FRCR is approved. We therefore consider that detail on the balance between risk and cost will be available and consulted on prior to any changes in practice by the ESO as a result of the FRCR.

Further, the Governance Framework introduced by GSR027 requires that the previous FRCR be reviewed and improvements considered at least annually. This should ensure the appropriate balance between managing risk and the costs incurred in doing so is achieved on an ongoing basis.

We note that the indicative FRCR Methodology states that the initial FRCR will focus on three key areas; (1) Establishing a clear, objective, transparent process for assessing reliability vs. cost, (2) Making the assessment of the risk from the inadvertent operation of LoM protection transparent, (3) Identifying quick, short-term improvements for reliability vs. cost, including the frequency standard that different size loss risks are held to. We consider these areas appropriate and to better facilitate frequency control in an efficient, economic and coordinated manner. Further, the indicative FRCR Methodology presents a non-exhaustive list of events, losses, impacts and controls not explicitly considered in the initial FRCR Methodology, but will be prioritised for future inclusion in future reports. This includes consideration and assessment of simultaneous events such as the events of 9 August 2019. Given the significant increase in complexity, and reduced probability of occurance, of simultaneous events, we consider it appropriate that this not be considered in the initial FRCR Methadology.

In summary, we consider that GSR027 will improve transparency with regards to how the ESO manages and mitigates *unacceptable frequency conditions*, including whether or not events will be secured for and the risks and costs associated with these. We therefore consider that GSR027 will better facilitate this SQSS objective.

(ii) ensure an appropriate level of security and quality of supply and safe operation of the National Electricity Transmission System;

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As noted above, GSR027 aims to ensure the appropriate balance can be reached between the costs of managing system frequency, and the risks mitigated in doing so.

We note that at present, GSR027 removes specific requirements on holding sufficient frequency reserve to manage the loss of power infeed risk from the SQSS, without providing detail on the balance of risk against cost and subsequent impacts of this probabilistic approach. There is therefore a risk that less stringent frequency control policies may be implemented by the ESO as a result of this modification. As previously noted, we consider the procedures implemented by GSR027 ensure any changes in how the ESO manage or mitigate *unacceptable frequency conditions*, or changes to what constitutes an *unacceptable frequency condition*, will arise via a transparent process, and will be consulted on prior to any changes in ESO policy with respect to controlling frequency risks.

Consequential loss of DER played a significant role in causing the 9 August 2019 incident. The SQSS, in its current form, does not explicitly require the ESO to consider consequential loss of DER in respect of *unacceptable frequency conditions*. GSR027 explicitly requires the FRCR assessment includes consideration of any consequential loss of DER therby improving the methodology upon which system security with respect to frequency is based.

We therefore consider that GSR027 will better facilitate this SQSS objective.

Implementation

In this letter we have set out our decision to approve the changes to the NETS SQSS proposed in GSR027. For these changes to take effect we will need to modify the relevant conditions of the Electricity Transmission licence so they refer to the new version of the NETS SQSS. We intend to shortly consult on a new licence modification proposal in order to implement GSR027 from 1 April 2021.

Peter Bingham
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Signed for and on behalf of the Authority

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