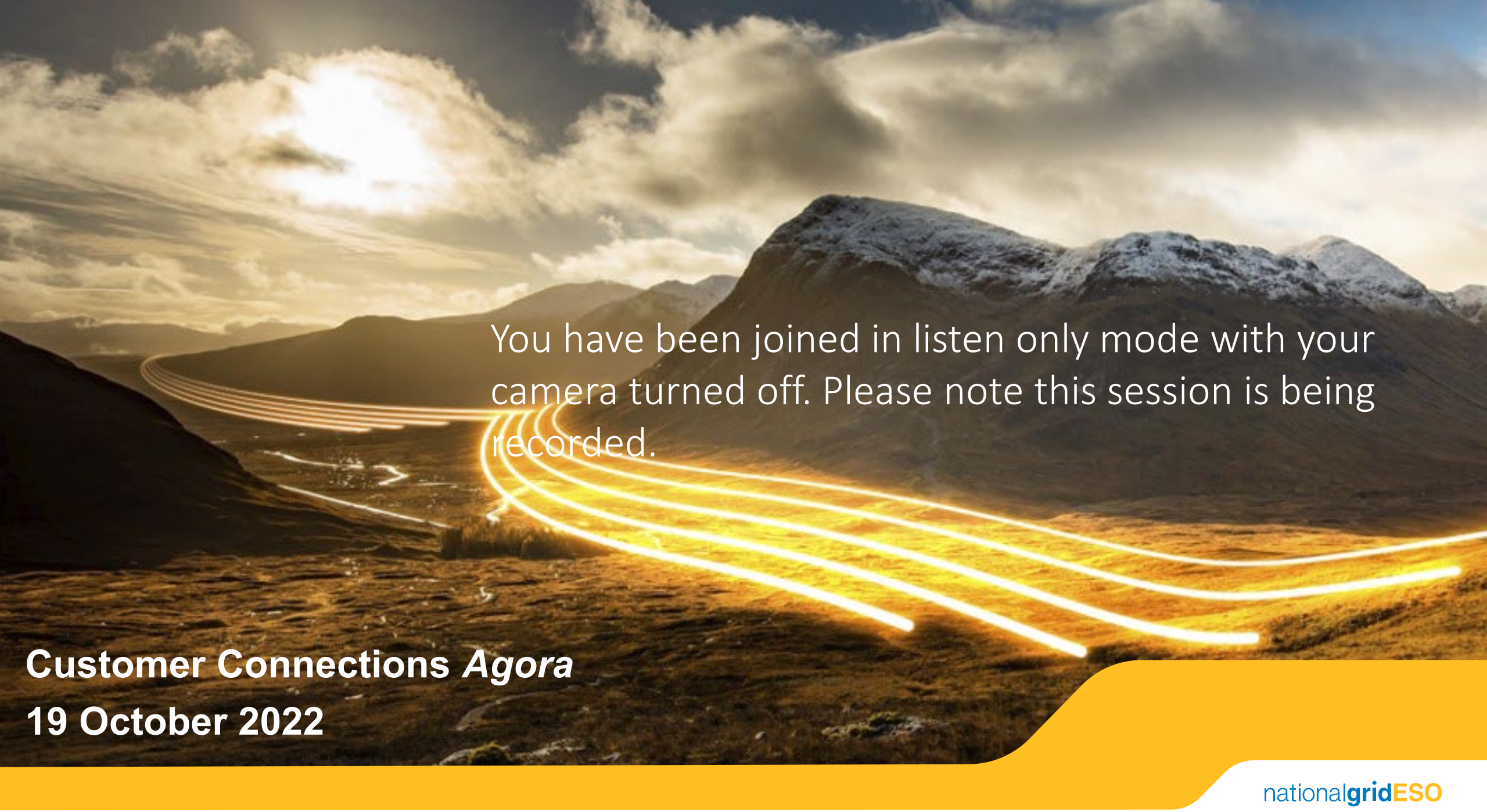

Customer Connections *Agora*

19 October 2022

nationalgridESO

Introduction

The Customer Connection Agora Sessions are aiming to:

- ✓ Provide an opportunity to learn about a variety of subjects such as Connection Processes, Connections-related Codes and Policy Changes, Network Operability, Operational Compliance, Security and Liabilities, Cancellation Charges and more;
- ✓ Increase the visibility of the Electricity Connections Team to our customers, stakeholders and the wider electricity market;
- ✓ Facilitate updates on our key workstreams and initiatives, as well as enable engagement and interaction via the Question and Answer segment.

Next Agora

16 November 2022

10.00am - 10.45am

nationalgridESO

October ‘22 Agora presented by

Biniam Haddish

Electricity Connections Compliance Manager

Networks

Gideon Miti

Engineering Compliance

Networks

Arnaldo Rossier

Engineering Compliance

Networks

Agenda

- Compliance Process and Overview of Modelling Modification - GC0141 – Grid Code Modification
- Limited Frequency Sensitive Mode
- Questions and Answers

Please ask questions using chat functionality or Slido with code #Agora. We aim to get through as many questions as possible.

GC0141 – Compliance Process and Modelling Grid Code Modification

Please ask any questions in the meeting chat

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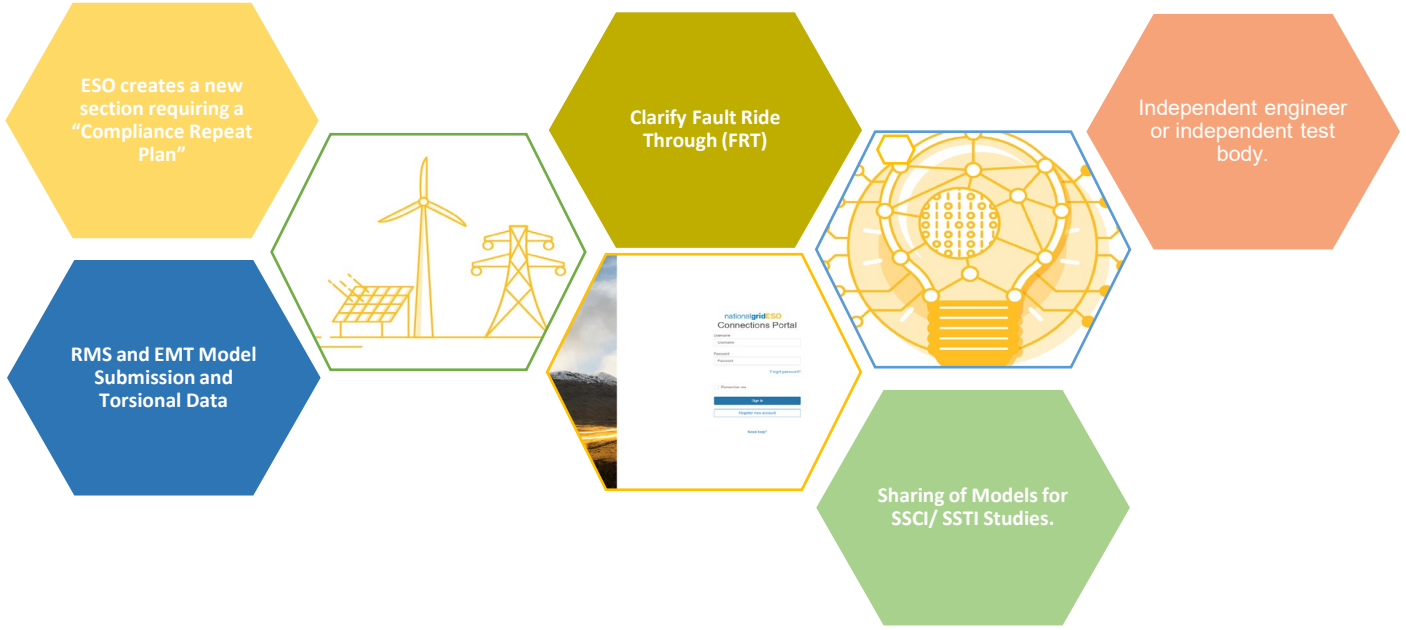
Introduction

GC0141 Grid Code modification intends to improve modelling, clarify Fault Ride Through (FRT) compliance requirements and improve the compliance process for complex connections.



- The modification is to be implemented 10 working days following the Authority decision.
- Once the proposed Grid Code changes are approved by the Authority, the Grid Code will take precedence over the Bilateral Agreement for connections after the activation date included in the Planning Code. PC.A.9.

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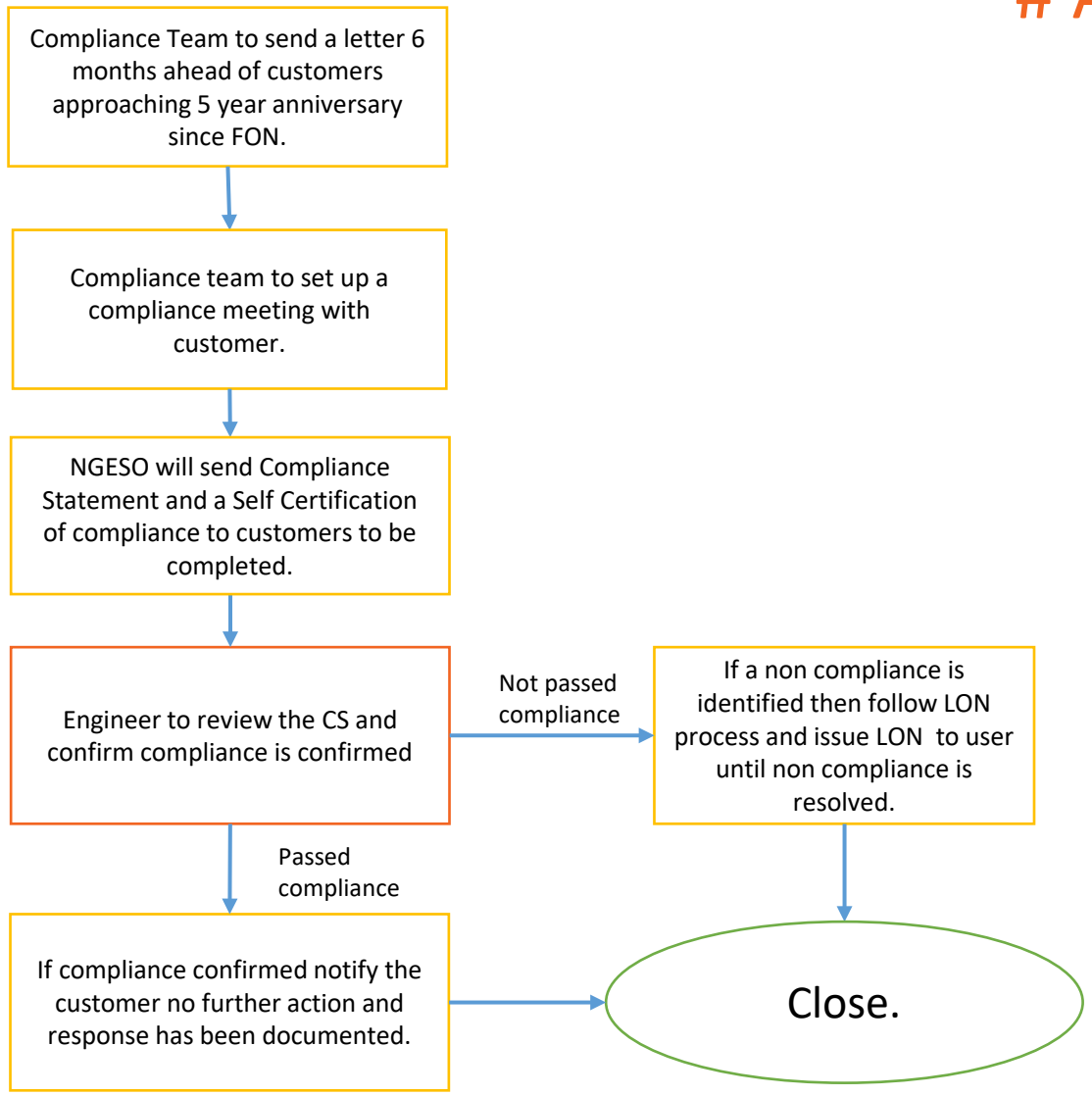
Compliance Repeat Plan

GC0141 creates a new section requiring a "Compliance Repeat Plan" for users to confirm compliance with their Grid Code obligations to National Grid ESO every 5 years.

- National Grid ESO will provide guidance on how the dates for older stations confirming continued compliance should be managed and spread so that portfolio users (and ESO) do not face an impractical influx of work.
- National Grid ESO will notify the provider with a six-month reminder to ensure compliance is met within the five-year requirement to ensure ample notice for preparation and delivery.



RMS,EMT Model and Torsional Data Submission

For NGESO to be able to efficiently and economically operate the GB transmission system, which is evolving faster than ever before, and to keep accommodating increasing levels of inverter dominated technologies, GC0141 has included new requirements on the control and protection system models' users are required to submit for the company to assess and maintain adequate levels of system performance.

PC.A.9 specifies the models needed, including software tool types, and the minimum level of associated data that the user is expected to provide to the Company on both RMS and EMT platforms. PC.A.9 also includes details on the models' performance requirements.

RMS,EMT Model and Torsional Data Submission

GC0141 as proposed by NGESO requires all the generators in the system to provide details of synchronous plant shaft data to assess in a timely manner whether there is a potential for Sub-Synchronous Torsional Interaction to arise as result of new connection to the GB transmission system.

RMS,EMT Model and Torsional Data Submission

DRC Schedule 1 contains a section to allow exchange of mechanical parameters (shaft data) with ESO. A shaft report (normally produced by manufacturers) should be submitted / referenced. The report should contain system diagram(s) showing major components and use the standard units as specified in DRC Schedule 1 as well as the following infomation.

Reduced Shaft system model input parameters (example given in diagrams):

- Number of poles
- Reduced number of masses of the multi mass model (typically 5 to 8 masses)
- Moment of inertia J [kgm²] for each mass
- Stiffness constants between each mass K [Nm/rad]
- Damping constants D [Nms/rad]
- Relative steam power in [pu] for different turbine sections

Mechanical eigenfrequencies and eigenvectors as calculated by the manufacturer including the verification between the reduced and the original multi-mass shaft system model. Any assumptions / assumed constants should also be stated in the report.

MECHANICAL PARAMETERS *(PC.A.5.3.2(a))*				
The number of turbine generator masses		□		DPD II
Diagram showing the Inertia and parameters for each turbine generator mass for the complete drive train	Kgm^2	□		DPD II DPD II
Diagram showing Stiffness constants and parameters between each turbine generator mass for the complete drive train	Nm/rad	□		DPD II DPD II
Number of poles		□		DPD II
Relative power applied to different parts of the turbine	%	□		DPD II
Torsional mode frequencies	Hz	□		DPD II
Modal damping decrement factors for the different mechanical modes		□		DPD II

Independent Engineer or Independent Test Body

Following Ofgem requests for NGESO to consider whether there is a need for independent scrutiny within the compliance process, NGESO discussed with the GC0141 working groups options leading to three options.

- NGESO propose Independent Engineer required for all connections.
- Working Group proposed alternative to appoint Independent Engineer for more complex connections with a export capacity above 100MW.

Independent Engineer scope would be review of simulation studies assumptions and results only.

Sharing of Models for SSCI/ SSTI Studies

GC0141 specifies the need for sharing control and protection system models so that NGESO can meet his license obligations.

The obligations to provide these models, as specified in PC.A.9, are on the user.

GC0141 permits manufacturers to share the model directly with NGESO to help with manufacturers concerns over sharing confidential data. However, this is only available provided the manufacturer enter into a Generic Confidential Agreement with the Company.

Clarify Fault Ride Through (FRT)

GC0141 provides additional details on the duration Generators connected to the system are required to remain connected system following system faults.

The modification on FRT requires Generators to stay connected for up to 30 minutes following a transmission system fault. This is to ensure operational reserve has been restored before the system is ready to cope with a new fault, i.e. secondary frequency response timescales.

Limited Frequency Sensitive Mode

National Grid ESO

Gideon Miti - Engineering Compliance

19th October 2022

nationalgridESO

PREAMBLE

- **Unprecedent Winter Ahead**
- **Concerted Effort Required from all Stakeholders**
- **Generators to Ensure Compliance with LFSM Requirements**

Plant performance at 50.4Hz and above or 49.5 Hz and below is not tested often in real-life conditions and assurance is required that action will take place.

LIMITED FREQUENCY SENSITIVE MODE

LFSM forms part of the Frequency Risk and Control Report (FRCR) assessment to ensure the frequency remains with acceptable limits.

- Operating Mode for Majority of the Time
- Mandatory Requirement
- Not an Ancillary Service so no payment
- Plant should respond to help control extreme frequency

LIMITED FREQUENCY SENSITIVE MODE

- **GB Code – High Frequency (BC3 for Gensets)**
- **EU Code – High Frequency (All Plant)**
  – Low Frequency (Type C and D)

BALANCING CODE 3 - LFSM

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BC3.7.2 Plant In Limited Frequency Sensitive Mode

BC.3.7.2.1 Plant in Limited Frequency Sensitive Mode applicable to GB Code Users

The following requirements are applicable to **GB Code Users** in respect of **Plant** operating in **Limited Frequency Sensitive Mode**. For the avoidance of doubt, these requirements do not apply to **EU Generators** and **HVDC System Owners** for whom the requirements of BC.3.7.2.2 apply.

(a) Each **Synchronised Genset** (or **DC Converter** at a **DC Converter Station**) operating in a **Limited Frequency Sensitive Mode** which is producing **Active Power** is also required to reduce **Active Power** output in response to **System Frequency** when this rises above 50.4 Hz. In the case of **DC Converters** at **DC Converter Stations**, the provisions of BC3.7.7 are also applicable. For the avoidance of doubt, the provision of this reduction in **Active Power** output is not an **Ancillary Service**. Such provision is known as "**Limited High Frequency Response**".

(b) (i) The rate of change of **Active Power** output must be at a minimum rate of 2 per cent of output per 0.1 Hz deviation of **System Frequency** above 50.4 Hz.

(ii) The reduction in **Active Power** output must be continuously and linearly proportional, as far as is practicable, to the excess of **Frequency** above 50.4 Hz and must be provided increasingly with time over the period specified in (iii) below.

(iii) As much as possible of the proportional reduction in **Active Power** output must result from the frequency control device (or speed governor) action and must be achieved within 10 seconds of the time of the **Frequency** increase above 50.4 Hz.

(iv) The residue of the proportional reduction in **Active Power** output which results from automatic action of the **Genset** (or **DC Converter** at a **DC Converter Station**) output control devices other than the frequency control devices (or speed governors) must be achieved within 3 minutes from the time of the **Frequency** increase above 50.4 Hz.

(v) Any further residue of the proportional reduction which results from non-automatic action initiated by the **Generator** or **DC Converter Station** owner shall be initiated within 2 minutes, and achieved within 5 minutes, of the time of the **Frequency** increase above 50.4 Hz.

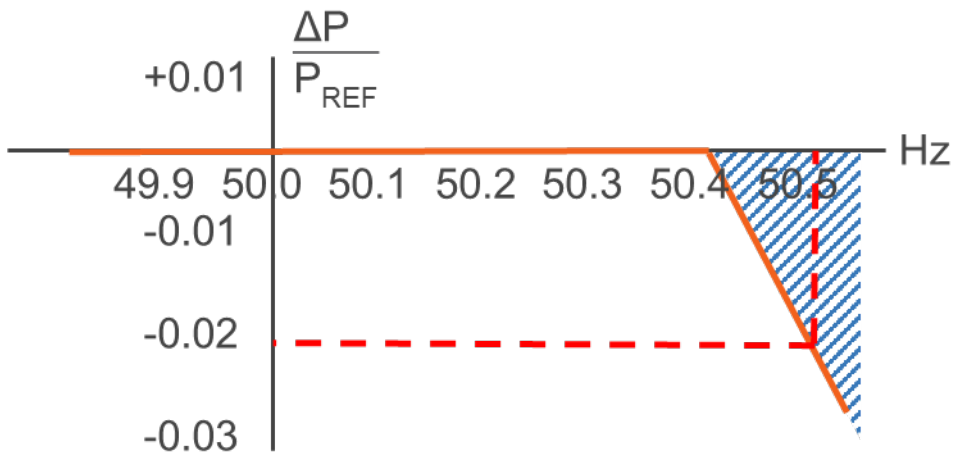
(c) Each **GB Code User** in respect of a **Genset** (or **DC Converter** at a **DC Converter Station**) which is providing **Limited High Frequency Response** in accordance with BC3.7.2 must continue to provide it until the **Frequency** has returned to or below 50.4 Hz or until otherwise instructed by **The Company**.

LIMITED HIGH FREQUENCY RESPONSE

Gensets are required to reduce Active Power when frequency rises above 50.4Hz at a minimum rate of 2% of output per 0.1Hz deviation above 50.4Hz.

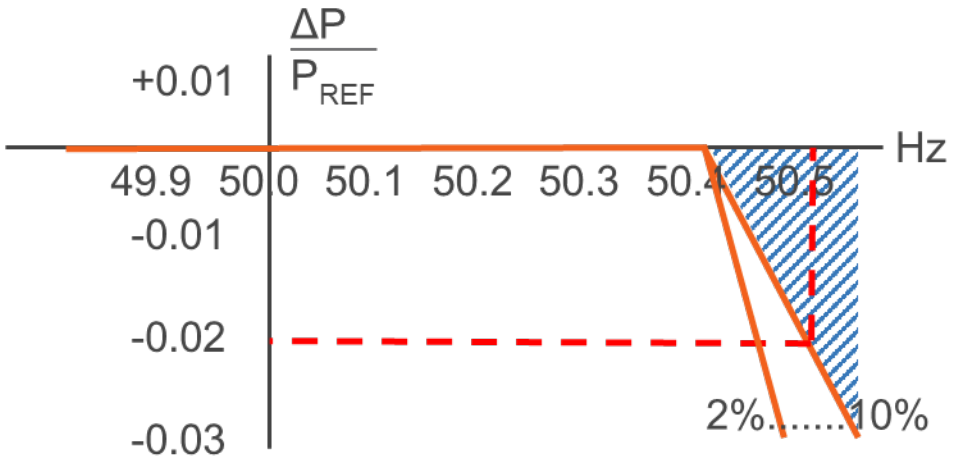
LIMITED FREQUENCY SENSITIVE MODE – OVER FREQUENCY

The rate of change of Active Power output must be at a minimum a rate of 2 percent of output per 0.1 Hz deviation of System Frequency above 50.4Hz, a droop of 10% as shown in the Figure below.



LIMITED FREQUENCY SENSITIVE MODE – OVER FREQUENCY

This would not preclude a EU Generator or HVDC System Owner from designing their Power Generating Module with a Droop of less than 10% but in all cases the Droop should be 2% or greater.



LIMITED FREQUENCY SENSITIVE MODE – UNDER FREQUENCY

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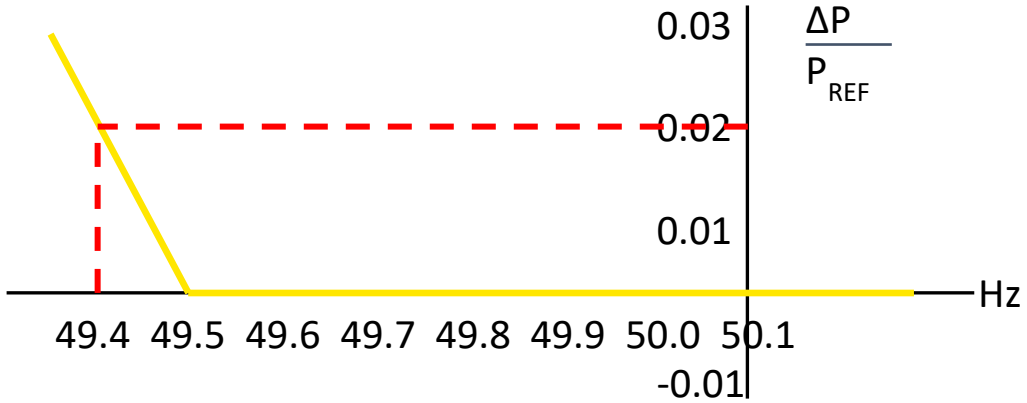
Each Type C Power Generating Module and Type D Power Generating Module (including DC Connected Power Park Modules) or HVDC Systems operating in Limited Frequency Sensitive Mode shall be capable of increasing Active Power output in response to System Frequency when this falls below 49.5Hz.

LIMITED FREQUENCY SENSITIVE MODE – UNDER FREQUENCY

The rate of change of Active Power output must be at a minimum a rate of 2 percent of output per 0.1 Hz deviation of System Frequency below 49.5Hz, a droop of 10% as shown in the Figure below.



Q&A

Please ask any questions in the meeting chat

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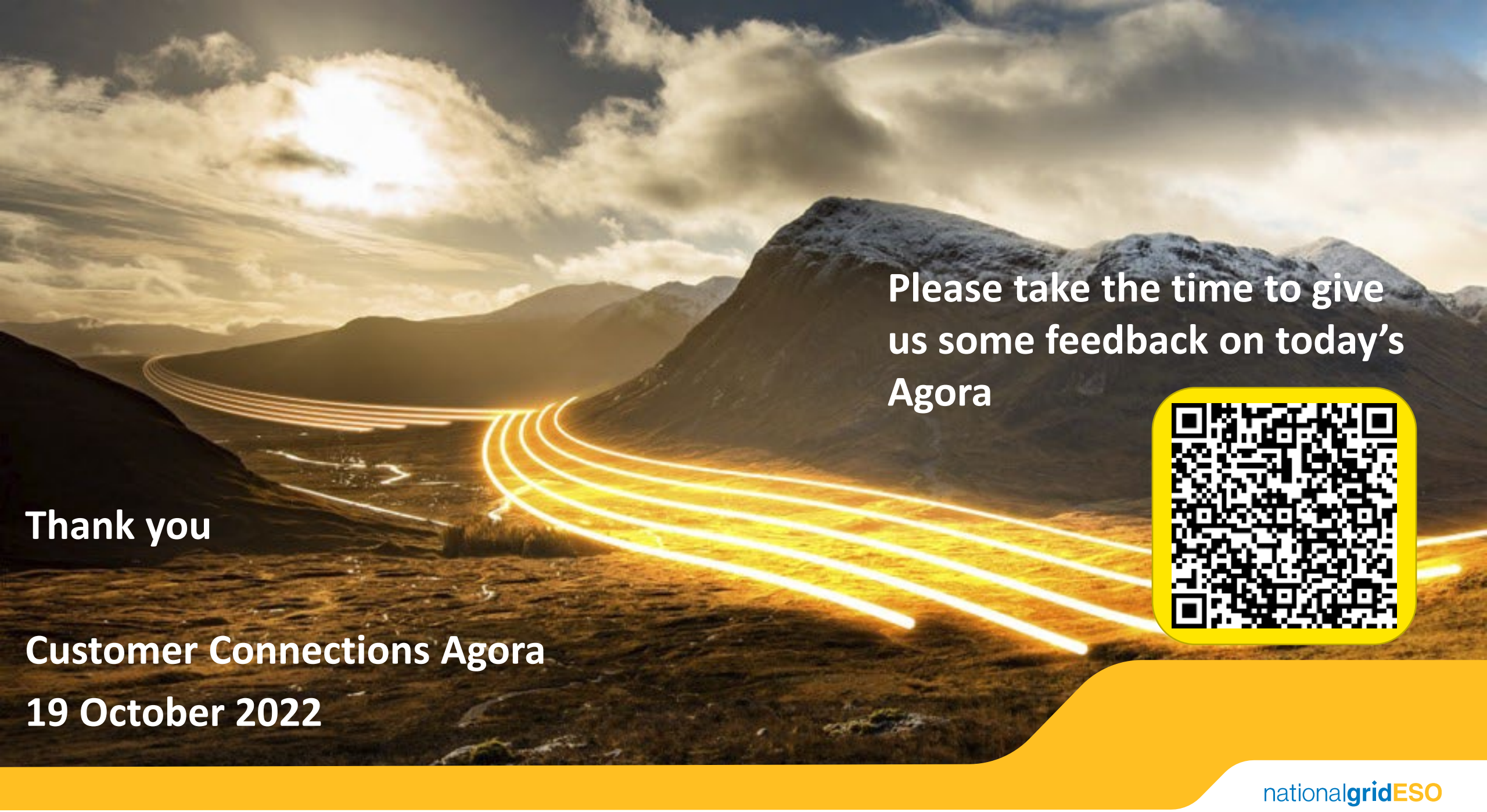
Please take the time to give us some feedback on today's Agora
Thank you
Customer Connections Agora
19 October 2022