

## Workgroup Consultation Response Proforma

### GC0137: Minimum Specification Required for Provision of GB Grid Forming (GBGF) Capability (formerly Virtual Synchronous Machine/VSM Capability)

Industry parties are invited to respond to this consultation expressing their views and supplying the rationale for those views, particularly in respect of any specific questions detailed below.

Please send your responses to [grid.code@nationalgrideso.com](mailto:grid.code@nationalgrideso.com) by 5pm on **30 April 2021**. Please note that any responses received after the deadline or sent to a different email address may not receive due consideration by the Workgroup.

If you have any queries on the content of this consultation, please contact Kavita Patel [Kavita.patel@nationalgrideso.com](mailto:Kavita.patel@nationalgrideso.com) or [grid.code@nationalgrideso.com](mailto:grid.code@nationalgrideso.com)

Respondent details	Please enter your details
<b>Respondent name:</b>	AlastairFrew
<b>Company name:</b>	Drax
<b>Email address:</b>	Alastair.frew@drax.com
<b>Phone number:</b>	07730697290

### For reference the Applicable Grid Code Objectives are:

- To permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity*
- Facilitating effective 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);*
- 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;*
- 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; and*
- To promote efficiency in the implementation and administration of the Grid Code arrangements*

**Please express your views regarding the Workgroup Consultation in the right-hand side of the table below, including your rationale.**

Standard Workgroup Consultation questions		
1	Do you believe that the GC0141 Original	yes

	Proposal better facilitates the Applicable Objectives?	
2	Do you support the proposed implementation approach?	yes
3	Do you have any other comments?	<p>Possible drafting change to definition of Grid Forming Capability as proposed “whose <b>Active Power</b> output is directly proportional to the <b>difference between the</b> magnitude and phase of its <b>Internal Voltage Source</b>, <b>and</b> the magnitude and phase of the voltage at the <b>Grid Entry Point</b> or <b>User System Entry Point</b> and the sine of the <b>Load Angle</b>.” Also in the next paragraph “with a bandwidth that is less than a defined value as shown by the <b>control</b> system’s <b>NFP Plot</b> “. And finally grammatical change “rule are <b>only</b> allowed <b>only</b>”</p> <p>In terms of the definitions of GBGF-S and GBGF-I which category would a synchronous condenser with a Statcom fit into and more specifically going forward what is the plan for categorisation of combinations?</p> <p>How are power swings and oscillatory responses triggered by a system faults without an infeed loss going to be categorised and assessed? Then the more complicated situation where there is a fault and an infeed loss?</p> <p>Definition of Control Based Real Droop Power would read better “<b>Control Based real Droop Power</b> <del>output</del> is the <del>injection or absorption transfer</del> of <b>Active Power</b> <del>injected or absorbed</del> by a <b>Grid Forming Plant</b> to and from the <b>Total System</b> during a <del>deviation of the System Frequency</del> <del>deviation</del> away from the <del>normal Target System Frequency</del> “. Also in the next paragraph should the 1 second actually refer to Maximum Capacity or Registered Capacity or should in not be referring to a offered service capability value which might be the full Maximum Capacity but equally may not.</p> <p>Definition of Real Inertia Power would read better “The <del>transfer injection or absorption</del> of <b>Active Power</b> <del>injected or absorbed</del> by a <b>Grid Forming Plant</b> to and from the <b>Total System</b> during a <b>System Frequency</b> change.”. Also suggest changing “<del>Since the frequency of rotation of the Internal Voltage Source of a Grid Forming Plant is the same as the System Frequency for normal operation</del>, the <del>amount</del> <b>Active Power</b> supplied or absorbed by the <b>Grid Forming Plant</b> is a function of the energy storage capability of the <b>Internal Voltage Source</b> and <b>ROCOF</b>,”</p> <p>Definition of Internal Voltage Source would read better “For a <b>GBGF-I Plant</b> there <del>must be an</del> impedance with <del>only real physical values</del>, between the <b>Internal Voltage Source</b> and the <b>Grid Entry Point</b> or <b>User System Entry Point</b> <del>can only have real physical values</del>.”</p> <p>Definition of Damping Active Power would read better “The <b>Active Power</b> naturally <del>injected or absorbed</del></p>

	<p>supplied by a <b>Grid Forming Plant</b> as a result of to reduce power oscillations in the <b>Total System</b>. More specifically, <b>Damping Active Power</b> is the <del>result</del> response of <b>Grid Forming Plant</b> to an oscillation between the voltage at the <del>terminals</del> <b>Grid Entry Point or User System Entry Point of a Grid Forming Unit</b> and the voltage of the <b>Internal Voltage Source</b> of the <b>Grid Forming Unit</b>."</p> <p>Definition of Defined Damping Active Power is not clear and the reference just uses the same terms so there is no real definition.</p> <p>Definition of Grid Oscillation Value would read better "This <del>has a defined</del> is an injected test frequency at normal System Frequency with a superimposed oscillatory response overlayed onto it with an amplitude of 0.05 Hz peak to peak at a frequency of 1 Hz and is used for the rating of the <b>Defined Damping Active Power</b>."</p> <p>There are a number of references to <b>Phase Jump Angle</b> in bold as a defined term but it is not in the definitions list and new to be defined.</p> <p>Definition of Phase Jump Active Power implies all power flows for these events are export is that correct?</p> <p>Definition of Phase Jump Angle Limit is it not "The <del>minimum</del> <del>maximum</del> defined <b>Phase Jump Angle</b> for a when applied to a <b>GBGF-I Plant</b> will result in a linear controlled response <del>remaining in linear control</del> without activating current limiting functions.</p> <p>Definition of Phase Jump Angle Withstand is it not "The maximum <b>Phase Jump Angle</b> <del>for a</del> when applied to a <b>GBGF-I Plant</b> will result in the <b>GBGF-I Plant</b> remaining in <del>stable</del> operation <del>and</del> with current limiting functions <del>activated</del>"</p> <p>Definition of Phase Jump Angle Rating is it not clear what this is and how it can be greater than the Phase Jump Angle Limit as this Limit has current limiters activated so there must be the greatest current. Equally how can the peak current rating be higher?</p> <p>Definition of Control Based Real Power is it not "<b>Control Based Real Power</b> is the <b>Active Power</b> output supplied by a <b>Grid Forming Plant</b> through controlled means based on operator adjustment selectable setpoints (these may be <del>it</del> manual or automatic)." Also "<b>Control Based Real Power</b> does not include <b>Active Power</b> components of <b>Real Inertia Power</b>, <b>ROCOF Response Power</b>, <b>Damping Active Power</b> and <b>Phase Jump Active Power</b> proportional to <del>System Frequency, slip or deviation that provide damping power</del> which are used to emulate the <del>natural damping</del> functions provided by a real <b>Synchronous Generating Unit</b>."</p> <p>Definition of Control Based Reactive Power is it not "<b>Control Based Reactive Power</b> is the <b>Reactive Power</b> output supplied by a <b>Grid Forming Plant</b> through controlled means based on operator adjustment</p>
--	--

	<p>selectable setpoints (these may be manual or automatic)."</p> <p>Definition of Network Frequency Perturbation Plot "A <b>Network Frequency Perturbation (NFP) Plot</b> is a form of Bode Plot which plots the amplitude (%) <b>and Phase (degrees)</b> of the <b>resulting</b> output oscillation <b>and Phase (degrees) to the frequency of responding</b> to an applied input oscillation <b>across a frequency base. This plot will be used</b> <del>The purpose of which is</del> to assess the capability and performance of a <b>Grid Forming Plant</b> and to ensure it does not pose a risk to other <b>Plant</b> and <b>Apparatus</b> connected to the <b>Total System</b>.</p> <p>Definition of Nicholls Chart "For a <b>GBGF-I Plant</b> a <b>Nicholls chart</b> is derived from the open loop Bode plots that are used to produce an <b>NFP Plot</b>. The <b>Nicholls Chart</b> plots open loop gain versus open loop phase angle. This enables the open loop phase for an open loop gain of 1 to be <b>identified immediately defined</b> for use in defining the <b>GBGF-I's</b> equivalent <b>Damping Factor</b>"</p> <p>ECC.6.3.5.3(v) new sentence seems to apply all requirements and studies in ECC.6.3.19 to synchronous generator is that correct or should it be modified as follows "<b>GBGF-I should also</b> be capable of satisfying the <b>Grid Forming Capability</b> requirements defined in ECC.6.3.19;"</p> <p>ECC.6.3.16.1.1 seems to say that GBGF-I are only provide ECC.6.3.19 services and not ECC.6.3.16, how will this work with the commercial arrangements which are currently unavailable. It has been suggested that there will be some sort of day ahead market, but if a user only provides ECC.6.3.19 they will be supplying the service whether or not they are being paid. Or is this saying whilst providing Grid Forming Services ECC.6.3.16 does not apply?</p> <p>ECC.6.3.19.3 (i) not sure of the purpose of this paragraph if you are a user you need to comply with these by default.</p> <p>ECC.6.3.19.3 (v)(c) suggest change to "being designed so as not to cause any undue interactions which could cause damage to the <b>Total System</b> or other <b>User's Plant</b> and <b>Apparatus</b> <del>connected to it.</del>"</p> <p>ECC.6.3.19.3 (v)(e) in ECC.6.3.13 there are different RoCoF values some with a measurement period of 500ms others with a measurement period of 1s, what measurement period applies here and which are values are being replaced by the 2Hz/s, also there is a 2.5Hz/s is it being reduced? Would it not be better to take a similar approach to ECC.6.3.16 with ECC.6.3.13. Where ECC.6.3.16, has been copied into ECC.6.3.19.5 and rewritten with the Grid Forming requirements and the statement that ECC6.3.16 does not apply when providing Grid Forming Services. If a new ECC.6.3.19.x section was written with all the specific number changed as required this would then be clearer.</p> <p>ECC.6.3.19.3 (v)(f) suggest change as follows "<del>operate over the range shown in Figure ECC.6.3.19.3. GBGF-I</del></p>
--	--

		<p><b>Plant</b> with an importing capability mode of operation such as <b>DC Converters, HVDC Systems</b> and <b>Electricity Storage Modules</b> are required to have <b>an predefined frequency response operating characteristic</b> over the full import and export range <b>which is contained within the envelope defined by the red and blue lines shown in Figure ECC.6.3.19.3. This characteristic shall submitted to the Company.</b></p> <p>ECC.6.3.19.3 (vii) suggested change “<del>For</del> <b>When</b> submitting either Figure ECC.6.3.19.3.2 (a) or Figure CC.6.3.19.3.2 (b), each <b>User</b> or <b>Non-CUSC Party</b> can use their own design,”</p> <p>ECC.6.3.19.3 (xi) but numbered (vi) the units of MWs should be MJ.</p> <p>ECC.6.3.19.4 not really sure why these subsections are not just a continuation of ECC.6.3.19.3, but ignoring that some of the subpoints are not capabilities and therefore the text does not make complete sense.</p> <p>Figure ECC.6.3.19.5(a) should this not be more similar to ECC.6.3.6(a) with the lines come from the bottom left hand corner and not the bottom right hand corner?</p> <p>ECC.6.3.19.5.8 is blocking allowed if the at the agreed overvoltage?</p> <p>ECC.6.6.1.9 does this requirement apply to both <b>GBGF-I</b> and <b>GBGF-S</b>? Also this a very high sample rate making frequency and RoCoF measurements in half a cycle can this actually be done to any accuracy and are there commercially available instruments with is level of accuracy? This will also create a lot of data what are the data retention requirements for this equipment?</p> <p>ECC.6.6.1.10 similarly does this requirement apply to both <b>GBGF-I</b> and <b>GBGF-S</b>?</p> <p>ECC.6.6.3.2 does this requirement apply to both <b>GBGF-I</b> and <b>GBGF-S</b> as there are no tests in the ECP section applying to <b>GBGF-S</b> plant? As before, but this now an extremely high sample rate making frequency and RoCoF measurements in 1ms (1/20 of a cycle) can this actually be done to any accuracy and are there commercially available instruments with is level of accuracy?</p>
4	Do you wish to raise a Workgroup Consultation Alternative Request for the Workgroup to consider?	no

Modification Specific Workgroup Consultation questions		
5	Do you believe it is appropriate specify GB Grid Forming as a non-mandatory requirement in the Grid Code and be accessed by future market arrangements rather than as a mandatory requirement?	yes
6	Do you believe the current proposal is sufficiently flexible and facilitates a range of technologies? If not, please state why you feel this to be the case and what type of technologies have been excluded?	yes
7	Do you believe the proposal will result in excessive equipment costs? This excludes development costs whilst recognising plant can be also be de-loaded?	Click or tap here to enter text.
8	Do you believe the proposed Grid Code proposals sit better in the Planning Code, Connection Conditions / European Connection Conditions and Compliance Processes / European Compliance Processes bearing in mind the proposals are non-mandatory or do you think it would be better to have a new standalone section	It is better to have all requirements in the existing sections rather than moving them in to stand alone sections.