

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 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 or grid.code@nationalgrideso.com

Respondent details	Please enter your details
Respondent name:	Julian Werrett
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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 Proposal better facilitates the Applicable Objectives?	N/A

2	Do you support the proposed implementation approach?	Yes
3	Do you have any other comments?	<p>Please refer to technical notes below:</p> <p>GBGF-I = IVS behind an impedance. Hardware now is the same ie converter IVS behind filter+trafo inductance. Must have ability to change Volt & Ph. Impt to note that not immediately react rapidly to changes in the grid phase for Normal Operating conditions.</p> <p>GBGF-I = must provide (i)phase jump + (ii)inertial/rocof + (iii)damping + (iv)control power. Although (ii-iv) can be provided with traditional grid following (PLL synchronized) units with outer controls, (i) requires voltage vector control instead of current control >> avoid high BW D+Q loop? (Enstore Guide 8.5 p24)</p> <p>Avoid use of PLL as it prevents the output power of converter responding to changes in grid phase angle. (WG Consultation pg.7 & Enstore Guide 8.5 p24) >> slow down the PLL as it leads to fast converter ph changes to match grid phase changes? (fit VSM structure into PLL loop)</p> <p>Is PLL still present as VSM uses PLL for Rocof Power (Fg measurement, shown in WG Consultation fig.9 p23), which is not used in normal operation as power-based synchronization? However VSM0H does not require any PLL (no inner loop?) similar to droop << How does GBGF apply to islanding operation?</p> <p>For GBGF- I systems that have a source of continuous power, like wind and solar power systems, it is essential that an independent fast acting energy store is used inside the system to ensure the correct delivery of the RoCoF response power and to avoid the “Double Frequency Dip” effects produced by the designs of some existing static Power Converters””” (Enstore Guide 8.5 p18) << relevant for onshore/HVAC WPP directly connected to grid; HVDC-OWPP may require storage (or wind spill) to support MMC GBGF-I.</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?	<p>YES. Providing grid forming capability is an important service to the electricity grid similar to actual power supply and it should therefore be seen as a market regulated arrangement. It makes sense for developers to implement grid forming functionality in their converter design however the grid forming capability shall be non-mandatory.</p> <p>Developers will need to carryout internal assessment to decide if supplying grid forming capabilities are economically sensible for the individual project.</p> <p>The Grid Forming Capability should be implemented as a market regulated service with clear and generic (technology neutral) qualification requirements.</p> <p>It will also need to be clarified if some or all of the “Technical Performance Requirements”, will have to be met if a Generator/HVDC converter has opted to provide GB Grid forming services.</p>

6	<p>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?</p>	<p>We agree that Grid Forming Capability should also include large scale HVDC Converter stations [as planned for the future connection of offshore windfarms]. However the OFTO regulatory framework will need to be changed to allow such large HVDC assets to participate in the proposed commercial market.</p> <p>Hybrid Power Plants [ie a combination of wind, solar, battery] could also be included as an aggregated unit to provide GB Grid Forming & blackstart.</p> <p>Black-start capability could also be one of the services that a large HVDC converter/windfarm could provide, and included in the “Technical Performance Requirements”</p>
7	<p>Do you believe the proposal will result in excessive equipment costs? This excludes development costs whilst recognising plant can be also be de-loaded?</p>	<p>Yes we understand that there will be some extra cost for the equipment however Grid Forming is a critical next step to ensure GB grid stability as large synchronous machines are removed from the transmission system.</p> <p>However, to meet technical requirements for a Grid Forming converter, it is necessary to de-load a windfarm. In that case, a framework to compensate the loss in the revenue due to lost generation shall be established. For HVDC connected windfarms specifically this solution would need additional components and equipment offshore to provide the service.</p> <p>Energy storage at onshore HVDC (GBGF-I) may be needed to provide inertial power, although VSM0H (limited Inertia+Damping power; high Band Width requirements) are not precluded in Grid Code. Cost benefit in HPP may be better.</p> <p>Is it necessary to provide all the “Technical Performance Requirements”? Can some services eg phase jump, damping, vector shift control be provided as separate services, and you are paid for what you provide?</p>

8	<p>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</p>	<p>We think it should have its own standalone section where it is clear that it is non-mandatory to avoid confusion.</p> <p>How would the GBGF Grid Code be adapted to be included in the Network Restoration codes for the blackstart capability option (relaxations due to wind power fluctuations, eg for pumped hydro)?</p> <p>Will the definition of GBGF be the same in the context of blackstart, or instead, for example is Grid Leading behaviour preferred in the initial energization stage?</p> <p>In islanded operation, given that external grid is absent or weak, and may not have traditional Pf-QV coupling, so maybe that VSM based GF methods are not the best. Is this within scope of Grid Code? What rules apply in Grid Forming controls, since inertial response may not be the best approach in this instance, and may need to be adapted?</p>