Stage 3: Workgroup Report	At what stage is this document in the process?
# GC0096 ## Modification Title: Energy Storage	01 Proposal Form 02 Workgroup Consultation **03 Workgroup Report** 04 Code Administrator Consultation 05 Draft Grid Code Modification Report 06 Final Grid Code Modification Report

Purpose of Modification: This proposal seeks to modify the Grid Code to define the appropriate technical requirements for Storage technologies connecting to the Transmission System and associated changes to the Grid Code requirements for making a connection.

	This document contains the discussion of the Workgroup which formed in January 2017 to develop and assess the proposal, the responses to the Workgroup Consultation which closed on 11 January 2019, the voting of the Workgroup held on 13 Month 2019 and the Workgroup's final conclusions.
	**High Impact**: Developers of new Storage schemes – either standalone or co-located; Transmission System Operator; Distribution Network Operators.
	**Medium Impact** None.
	**Low Impact** None.
	***The Workgroup concludes:*** All Workgroup Members concluded that the Original proposal facilitates the Applicable Grid Code Objectives better than the baseline. No potential Workgroup Alternative Grid Code Modifications (WAGCMs) were proposed.

Contents

Timetable

The Code Administrator recommends the following timetable:

Initial consideration by Workgroup	January 2017
Workgroup Consultation issued to the Industry	7 December 2018
Workgroup Consultation closes	11 January 2019
Modification concluded by Workgroup	February/March 2019
Workgroup Report presented to Panel	25 April 2019
Code Administration Consultation Report issued to the Industry	29 April 2019
Draft Final Modification Report presented to Panel	30 May 2019
Modification Panel decision	30 May 2019
Final Modification Report issued the Authority	w/c 10 June 2019
Decision implemented in Grid Code	w/c 15 July 2019

Any questions?

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1 About this document

This document is the Workgroup Report that contains the discussion of the Workgroup which formed in January 2017 to develop and assess the proposal, the responses to the Workgroup Consultation which closed on 11 January 2019 and the voting of the Workgroup held on 13 March 2019.

GC0096 was proposed by National Grid[1] and was submitted to the Grid Code Review Panel for its consideration in May 2016. The Panel decided to send the Proposal to a Workgroup to be developed and assessed against the Grid Code Applicable Objectives.

GC0096 aims to modify the Grid Code to define the appropriate technical requirements for Storage technologies connecting to the Transmission System and associated changes to the Grid Code requirements for making a connection. The Workgroup consulted on this Modification and a total of 8 responses were received. These responses can be views in Annex 4 of this Report.

Workgroup Conclusions

At the final Workgroup meeting, Workgroup members voted on the Original proposal and unanimously agreed that the Original Proposal better facilitates the Grid Code Applicable Objectives better than the baseline.

The full Terms of Reference can be found in Annex 2.

Table 1: GC0096 Terms of Reference

Specific Area	Location in the report
a) Workgroup meeting one: "Definitions" We will determine which Storage categories shall be the focus of the workgroup; either "Energy Storage" or "Electricity Storage", or both. Once agreed, we will form a high-level working definition (noting the link to the BEIS/Ofgem call for evidence) to set the context for delivering the next workgroup deliverables. We will also consider how this definition links with existing Transmission Generation or Demand users looking to co-locate their Plant with Storage.	Section 3 and 4

[1] National Grid's Transmission Licence was legally separated, during the course of GC0096 (from 1st April 2019 onwards) from a combined SO and TO organisation (referred to then as 'NGET') into NGESO for system operation (SO) and NGET for transmission owner (TO). For ease of reading 'NGESO' and 'NGET' are used in this report on the basis of that legal separation.

b) Workgroup meeting two-to-three – "Technical and Planning Requirements" We will form the minimum Grid Code technical requirements applicable to Storage equipment defined above - either via a stand-alone connection or co-located with an existing user, ensuring consistency and transparency with other classes of Transmission System user.	Section 3 and 4
c) Workgroup meeting four – "Structure" consideration of how (or if), the outcomes from the previous workgroup meetings need to be structured in the Grid Code via legal text changes.	Section 3 and 4
d) Specific	Section 3 and 4

Acronym Table

Acronym	Meaning
ESO	Electricity System Operator
DNO	Distribution Network Operator
SOGL	System Operation Guideline[2]
HVDC	High Voltage Direct Current
RFG	Requirements for Generators[3]
NGET	National Grid Electricity Transmission (TO)
DCC	Demand Connection Code[4]
NGESO	National Grid Electricity System Operator (SO)
EFR	Enhanced Frequency Response
ECPs	European Connection Procedures
CUSC	Connection and Use of System Code

[2] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017R1485&from=EN

[3] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R0631&from=EN

[4] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R1388&from=EN

2 Original Proposal

Section 2 (Original Proposal) is sourced directly from the Proposer and any statements or assertions have not been altered or substantiated/supported or refuted by the Workgroup. Section 4 of the Workgroup contains the discussion by the Workgroup on the Proposal and the potential solution.

Defect

This Modification was raised by the National Grid Electricity System Operator, NGESO in May 2016 to introduce the appropriate Grid Code provisions for Energy Storage[5] devices. This is particularly significant given that technical requirements for Energy Storage devices are not covered under the three EU Connection Network Codes.

Energy Storage devices have the capability to act as a source of either export of electricity onto the network (akin to generation) or import of electricity from the network (akin to demand). It is therefore necessary to ensure the existing set of requirements are consistent in terms of Energy Storage devices within the existing industry codes, whilst giving due consideration to compatibility with developments needed in other code areas (for example: the Planning Code and the Data Registration Code) and ensures equitable treatment with other Users.

Given that Energy Storage devices are a growing sector, it was proposed that this paper was also circulated to the Distribution Code Review Panel as similar issues are likely to be faced at a Distribution Code level. This was done, and whilst GC0096 included Distribution Code stakeholders, including DNO representatives, the focus of the Workgroup was on Grid Code changes. Any Distribution Code changes will be consequential from GC0096, using the proposed solution as a basis.

To ensure consistency with their Generation and HVDC Counterparts, it was agreed by the Grid Code Review Panel that the proposed definitions and technical requirements for Storage should be applied to the Grid Code text as approved by Ofgem to incorporate European Codes Requirement for Generators and High Voltage Direct Current Codes. As a consequence, this report and the corresponding legal text, has been updated to address these changes which were implemented into the Grid Code (Issue 5 Revision 22) on 16 May 2018.

What

NGESO raised a modification to address this defect in May 2016, and the GC0096 Workgroup was formed in the summer of 2016.

[5] As set out in Section 3 and the legal text, the proposed definition of which is, in the form of 'Electricity Storage, as: "Is the conversion of electrical energy into a form of energy which can be stored, the storing of that energy, and the subsequent reconversion of that energy back into electrical energy in a controllable manner"

Two workshops with Storage developers and the wider industry were convened in August 2016 by the NGESO (but not the GC0096 Workgroup) to consider the scope of the modification.

Following these workshops, the primary focus of the GC0096 Workgroup was set to consider how to define 'Storage' unambiguously in the Grid Code; to understand how 'Storage' could be deployed (either on its own or as part of an existing scheme); and to assign proportionate minimum technical requirements for new connections which support the technology's flexibility.

The issue has been complex largely as result of:

i. The large number of different 'Storage' technologies now commercially available;

ii. The variations in which they may be configured either as part of a new development or an existing development; and

iii. The need to ensure equitable treatment with Generation, HVDC and Demand technologies as codified in the three EU Connection Network Codes (RfG, HVDC and DCC) which currently exclude storage other than pumped storage.

Why

NGESO has received a number of connection applications for transmission connected energy Storage devices which can both import and export electricity to the National Electricity Transmission System (NETS) for which, in the view of the Proposer and some Workgroup members, there is currently a lack of clear provisions in the Grid Code.

Given that NGESO has received a significant degree of interest from further potential connecters, in particular, it is highly likely that additional connection applications will be received in the near future. This modification proposal identifies a need to clearly specify Grid Code requirements for a range of energy Storage technologies connected in a range of different configurations which could reasonably be considered to fall outside of the existing code provisions.

This modification proposal seeks to assess the appropriate Grid Code provisions for energy Storage devices. This is particularly significant given that energy Storage devices are not covered under EU codes. Furthermore, energy Storage devices have the capability to act as a source of either generation or demand.

In the view of the Proposer, it is therefore necessary to establish a set of requirements which are consistent with existing industry codes, gives due consideration to compatibility with developments needed in other code areas (for example the Planning Code and the Data Registration Code).

The Proposer believes that there is currently a lack of bespoke requirements in the Grid Code for a diverse range of energy Storage devices (other than for pumped Storage). Parties who own energy Storage devices and use the NETS will be expected to meet applicable sections of the Grid Code which are consistent with the existing requirements, including those recent provisions introduced following implementation of Requirements for Generators (RfG) and HVDC European Network Codes and the Demand Connection Code (DCC) Network Code. There is a need, therefore, to consider code developments which account for a range of technology solutions and different operational characteristics whilst recognising the capability of the Storage equipment. For example, the technical requirements for an asynchronous battery Storage device connected via DC converter may be most closely aligned to those of an HVDC converter or Power Park Module under the current code, whereas the technical requirements for a synchronous compressed air energy Storage device, may be most closely aligned to the existing treatment of a synchronous generator.

In addition, it is also recognised that certain types of storage technology such as Synchronous Compensators, Synchronous Flywheels or Regenerative Braking Systems are not necessarily controllable and therefore should be treated separately from the general requirements for storage which are being proposed for this modification.

In the view of the Proposer, presently, the application of these requirements is subject to interpretation of the current Grid Code and codified clarity is required. All aspects of energy Storage devices should be considered from the perspective of both bespoke energy Storage installations as well as energy Storage devices which are part of a hybrid power plant with a mix of technology types.

In summary, Connection applications for Storage technologies such as batteries have become increasingly more common on the Transmission and Distribution systems in recent years, particularly since National Grid's Enhanced Frequency Response (EFR) tender in 2016.

Furthermore, BEIS and Ofgem have kicked off reviews of how to encourage greater flexible operation on the GB (whole) electricity system, with a view to maximising competition in the provision of services and lowering energy costs for end consumers. This has led the wider industry, including network licensees, to consider what they can do to better support Storage.

This Modification specifically looks at improving the Grid Code to satisfy these objectives so as to ensure maximum flexibility both for developers and Network Owners/Operators. The view of the proposer is that the Grid Code needs to line up with Ofgem's approach to Storage which treats it in the same way as Generation.

How

In the view of the Proposer, the Grid Code does not currently consider energy or electricity 'Storage' technologies as a distinct category of User (Pump Storage aside). When Storage developers request Transmission connections, NGESO have had to deem this equipment as generation, demand, or an interconnector to allow a connection offer to be prepared.

This workaround has the potential to treat Storage inconsistently. Any adjustments to connection agreements to determine how to connect Storage is set out in Connection Agreements. These are set out in the CUSC (not the Grid Code) as exhibits and are publicly available on the NGESO website[6].

3 Proposer's Solution

High level summary of proposed changes

The Proposer proposes that amendments are made to the Glossary and Definitions of the Grid Code to explicitly set out the requirements on Storage users. These definitions would make it clear what is meant by 'Storage', and how Storage technologies can be deployed in "Connection Schemes"– both as standalone installations or co-located with generation.

With those definitions in place, an update of the remaining parts of the Grid Code in particular the European Connection Conditions have been prepared which set out the proposed level of technical requirements which apply to these various Storage configurations. Whilst not all the new definitions have been listed below, the principle ones have been summarised so the reader has a general understanding of how the updates have been made to the remining parts of the code. In summary, however, and as noted earlier, the general approach has been to apply the same principles that already exist to synchronous and non-synchronous generation by changes to these definitions.

New definitions

The new / amended definitions are noted below and are direct extracts from the proposed Glossary and Definitions changes arising from GC0096. In summary, the important

[6] The Connection Application can be found at https://www.nationalgrid.com/sites/default/files/documents/CUSC%20Exh%20B_V1.15_06%20May_16.pdf

The Connection Offer document can be found at: https://www.nationalgrid.com/sites/default/files/documents/CUSC%20Exh%20C_v1.8_06%20May_16.pdf

definitions are “Electricity Storage”, “Electricity Storage Module”, “Electricity Storage Unit” and “Storage User”.

An Electricity Storage Module is defined as “Is either one or more Synchronous Electricity Storage Unit(s) or Non-Synchronous Electricity Storage Unit(s) which could also be part of a Power Generating Module. For the avoidance of doubt, Non-Controllable Electricity Storage Equipment would not be considered to be classed as an Electricity Storage Module or as an Electricity Storage Unit”.

An Electricity Storage Unit is defined as “A Synchronous Electricity Storage Unit or Non-Synchronous Electricity Storage Unit”.

The definition of Onshore Generating Unit has been defined as “Unless otherwise provided in the Grid Code, any Apparatus located Onshore which produces electrical energy by converting or re-converting another source of energy, including, an Onshore Synchronous Generating Unit or Onshore Non-Synchronous Generating Unit which could also be part of a Power Generating Module or an Electricity Storage Module”. Similarly, the definition of Offshore Generating Unit has been defined as “Unless otherwise provided in the Grid Code, any Apparatus located Offshore which produces electrical energy by converting or re-converting another source of energy, including, an Offshore Synchronous Generating Unit or Offshore Non-Synchronous Generating Unit which could also be part of a Power Generating Module or Electricity Storage Module”

The definition of Power Generating Module has also been changed to “Either a Synchronous Power Generating Module, a Synchronous Electricity Storage Module, a Power Park Module or a Non-Synchronous Electricity Storage Module owned or operated by an EU Generator”.

Putting this another way, the definition of Generating Unit and Power Generating Module have been updated to include Electricity Storage Units and Electricity Storage Modules such that any obligation that applies to a Generating Unit or Power Generating Module will also include storage. Where there are specific requirements on Storage (for example low frequency demand disconnection) within the main body of the Grid Code which explicitly apply to storage these are explicitly defined in the main body of the Grid Code text (for example in OC.6.6.6).

In terms of classification, and to ensure consistency with Ofgem’s Licensing proposals, storage is being treated in the same way as Generation. It is proposed that these requirements would apply going forward and not retrospectively. Whilst Storage has specifically been excluded from the requirements of the three European Connection Network Codes (Requirements for Generators (RfG), HVDC Code and Demand Connection Code (DCC)), the Proposers view and that of Ofgem, agree that any new requirements going forward should be consistent with the European Connection Conditions (ECC’s) and not the CC’s whilst specifically noting that in doing so, Generators who own and operate Electricity Storage Modules would not be bound by the requirements of the three EU Connection Codes as they are not enforceable under EU law. This issue has been addressed through the definition of “Storage User” and how it sits within the definition of an EU Code User.

It is also worth noting that whilst preparing this modification, the opportunity was taken to amend the definition of Pumped Storage Plant to form Pumped Storage Plant and Existing Pumped Storage Plant. Pumped Storage Plant would apply to any Pumped Storage Plant going forward and hence captured under the ECC whereas an Existing Pumped Storage Plant would revert back to the Dinorwig, Ffestiniog, Cruachan and Foyers Power Stations. The advantage of this approach is that if a new pump storage plant were to connect to the GB System in the future, it would be caught by the requirements of the ECC's and hence RfG, whereas there would be no risk of any unintended consequences for existing Pumped Storage Plant. To facilitate this change, the definition of "Pump Storage" has been changed to "Pumped Storage" and the definition of Existing Pump Storage Unit has also been added so as not to cause any unintended consequences for existing Pumped Storage Stations.

A Workgroup Member stated that there would also need to be a change to the definition of existing Pumped Storage Plant and Pumped Storage Plant in the Balancing and Settlement Code. It was also noted that a check of the other industry codes be carried out so as to prevent the risk of any unintended consequences.

As part of the Workgroup consultation, a number of parties who provided comments felt that it was appropriate for new Pumped Storage plant to be integrated into the definition of Electricity Storage. The Proposer agrees with this in principle however is concerned that Pumped Storage falls under the auspices of RfG whereas Electricity Storage does not. The Proposer has therefore not included pumped storage within the definition of Electricity Storage but has developed the legal text such the requirements upon future Pumped Storage Plant are consistent with those for Electricity Storage Modules.

Further details and back to the changes to the Glossary and Definitions as a result of these proposals are summarised in the Definitions section of this report below.

Changes to the European Connection Conditions

The legal text provided in Annex 3 sets out the requirements applicable to Electricity Storage Modules which are treated in the same way as Power Generating Modules.

		Electricity Storage Modules			
Grid Code Ref	**Requirement**	**Onshore Synchronous**	**Offshore Synchronous**	**Onshore Non-Synchronous**	**Offshore Non-Synchronous**
ECC.6.1.2	Frequency Range	Y	Y	Y	Y

ECC.6.1.4	Voltage Range	Y	Y	Y	Y
ECC.6.1.5 – ECC.6.1.7	Power Quality – Direct Connections only	Y	Y	Y	Y
ECC.6.2	General Requirements	Y	Y	Y	Y
ECC.6.3.2	Reactive Capability	Y	N[1]	Y	N[1]
ECC.6.3.3	Output Power with falling frequency	Y	Y	Y	Y
ECC.6.3.4	Reactive Capability for HV System Voltage Changes	Y	Y	Y	Y
ECC.6.3.5	Black Start (Not Mandatory)	Y	Y	Y	Y
ECC.6.3.6	Ability to Modulate Active and Reactive Power in response to frequency and voltage variations	Y	Y	Y	Y
ECC.6.3.7	Frequency Response	Y	Y	Y	Y
ECC.6.3.8	Voltage Control	Y	N	Y	N
ECC.6.3.9	Steady State Load Inaccuracies	Y	Y	Y	Y
ECC.6.3.10	Negative Sequence Loadings	Y	Y	Y	Y
ECC.6.3.11	Neutral Earthing	Y	Y	Y	Y
ECC.6.3.12	Frequency and Voltage Deviations	Y	Y	Y	Y
ECC.6.3.13	Frequency, rate of change of frequency and voltage protection setting arrangements	Y	Y	Y	Y
ECC.6.3.14	Fast Start Capability	Y	Y	Y	Y
ECC.6.3.15	Fault Ride Through	Y	Y	Y	Y

ECC.6.3.16	Fast Fault Current Injection	Y	Y	Y	Y
ECC.6.3.18	System to Generator Operational Intertripping Schemes	Y	Y	Y	Y
OC6.6	Frequency Sensitive Relays and load shedding	Y	Y	Y	Y
ECC.6.5.2	Control Telephony / System Telephony	Y	Y	Y	Y
ECC.6.5.6	Operational Metering	Y	Y	Y	Y
ECC.6.5.8	Electronic Data Communication Facilities	Y	Y	Y	Y
ECC.6.5.9	Fax Machines	Y	Y	Y	Y
ECC.6.5.10	Busbar Voltage – Direct Connections only	Y	Y	Y	Y
ECC.6.6	Monitoring	Y	Y	Y	Y
ECC.7	Site Related Conditions	Y	Y	Y	Y
ECC.8	Ancillary Services	Y	Y	Y	Y
PC	Planning Code Data	Y	Y	Y	Y

[1]Note AC connected Offshore Power Generating Modules have a restricted reactive capability range. Electricity Storage Modules, being a subset of Power Generating Modules will be treated in the same way.

Does this modification impact a Significant Code Review (SCR) or other significant industry change projects, if so, how?

No.

Consumer Impacts

In the view of the Proposer, this proposal, by facilitating a greater level of connections of Storage to the system should increase the level of competition within ancillary services markets and improve the NGESO's ability to procure economic options for system balancing. It also provides clarity to the technical requirements expected of Storage providers and ensures consistency with other technologies for which Grid Code

requirements already apply. The resulting saving in balancing costs will have a positive impact on end consumer bills. It also has the option to provide greater flexibility to developers in satisfying Grid Code requirements which could be achieved through a mix of conventional technologies and Storage and also provides benefits to the Electricity System Operator and Network Operators in facilitating improved plant performance.

4 Workgroup Discussions

The Workgroup convened 12 times between January 2017 and March 2019 to discuss the issues, detail the scope of the proposed defect, devise potential solutions and assess the proposal in terms of the Applicable Grid Code Objectives.

The Workgroup discussed a number of the key attributes under GC0096 and these discussions are described below.

At the meeting held on the 15 January 2018, the proposer advised that the treatment of frequency response was different between Synchronous and Non-Synchronous Generation technologies and should this exception also apply to Storage Technologies. In response, a workgroup member suggested that the text proposed for the EU Connection Network Code (Requirements for Generators) should be adopted on the basis of equitable frequency response treatment between Synchronous and Non-Synchronous Generation Technologies. Other Workgroup members agreed with this approach and as such the work was placed on hold (following approval from the Grid Code Review Panel) until the Requirement for Generators and High Voltage Direct Current modifications GC0100 – GC0102 were approved by Ofgem (which would have been required before 17th May 2018) to meet the EU deadline. Whilst one Workgroup member did note that the three EU Connection Codes explicitly exclude storage, and questioned if Storage should be applied to the Connection Conditions or European Connection Conditions, the view of the Proposer was that the European Connection Conditions (i.e. the Requirements for Generator requirements) should apply as a GB modification to ensure consistency with their Generation counterparts. The issue was also raised with Ofgem for determination and is discussed below.

The Proposer presented the defect that they had identified in the Modification proposal. The discussions and views of the Workgroup are outlined below.

It was also noted in the Workgroup that existing connections who had already applied for a connection would not be affected by these GC0096 proposed changes and that appropriate transitional arrangements would need to be put in place so that existing projects were not affected by the GC0096 changes.

Background

To ensure consistency with their Generation and HVDC counterparts, it was agreed at the Workgroup meeting held on 15 January 2018, that the proposed definitions and technical requirements for Storage should be applied to the Grid Code text as approved by Ofgem to incorporate RfG and HVDC Connection Codes following consultations GC0100, GC0101 and GC0102. As a consequence, and following a number of meetings with the Workgroup in the Summer and Autumn of 2018, the report and the corresponding legal text was updated to address the subsequent Grid Code changes. The proposed legal text to implement the storage related changes into the Grid Code has been prepared which includes the RfG drafting implemented in May 2018.

In the summer of 2018 following updates to the legal text (which included placing the storage requirements onto the RfG text) one Workgroup member voiced concern that as the three EU Connection Codes (RfG, HVDC and DCC) explicitly excluded storage and therefore the proposed legal text drafting related to storage should be integrated into the Connection Conditions (CC's) rather than the European Connection Conditions (ECC's). The Proposer's view is that the ECC's should be used (rather than the CC's) on the basis of the need to ensure consistency between the requirements for generation and storage. Following the same approach is also important for co-located sites where generation and storage will be integrated side by side.

This issue (of treating generation and storage the same) has been raised with Ofgem and they have advised that they do not consider that inserting the Electricity Storage requirements proposed through GC0096 in the European Connection Conditions (ECC's) section of the Grid Code would breach Article 3, paragraph 2 of Commission Regulation (EU) 2016/631 establishing a Network Code on the Requirements for Grid Connection of Generators ("the RfG").

Ofgem agree that the Connection Conditions (CC's) section of the Grid Code are likely to become obsolete, certainly in respect of new connections, and that once the European Network Codes (ENCs) are in force, all connection requirements for new connections to the system will be found in the ECC's section of the Grid Code. From that perspective, it seems pragmatic that the connection requirements for Electricity Storage are to be found in the ECC's section of the Grid Code. The Ofgem view was that should the Workgroup take this view, the legal text will need to be drafted such that it's very clear to Users or classes of Users what types of equipment the ECCs apply to and in doing so that the requirements on Storage are not caught by the requirements of the EU Connection Codes (i.e. RfG, HVDC and DCC) and that the obligations on Storage are not enforceable under EU law.

In response, National Grid as proposer of GC0096 supported this view from Ofgem and have amended the draft legal text. In capturing this point, a new term "Storage User" has been created which explicitly excludes such User's from having to satisfy the requirements of the EU Connection Network Codes. In addition, and to explicitly make it clear that the EU Connection Codes do not apply to Storage User's, amendments have been made to section 1.1 of the ECC's and section 1.1 of the ECP's.

At this point, it is worth noting that the EU Connection Stakeholder Committee have recently established several[7] Expert Groups of which one is tasked with evaluating the technical requirements for storage. It is unclear at this stage how this may or may not affect the European Network Codes (in particular RfG), however should RfG be updated to include storage in the future, (and notwithstanding wider issues such as Brexit) the approach adopted in GB and the proposed GB Storage modifications should be relatively straight forward to implement should RfG or the European Network Codes be updated at some time in the future.

During the early Workgroup discussions and prior to Ofgem's view of how storage should be treated from a Licensing perspective, the Proposer's initial approach was that storage should be treated as a new category of User (namely an Electricity Storage Facility Owner"). On this basis, earlier versions of the Grid Code legal drafting were prepared which resulted in extensive changes to all sections of the Grid Code.

In parallel with this drafting, Ofgem consulted on a modified generation licence, which clarifies storage as a subset of generation and its treatment in the applicable industry codes for storage. As part of this consultation (earlier in 2018) it was noted that Ofgem will implement changes to the generation licence to include storage via statutory consultation. In addition, the UK Government will define storage in primary legislation when Parliamentary time allows. At the Workgroup meeting on 24 October 2018 and noting the above issue on licensing, it was noted that the Grid Code legal text could be made significantly simpler if Electricity Storage was rolled into the existing definitions of Generator, Power Station and Power Generating Module. Not least, it was also recognised that consequential changes to other industry codes such as the CUSC and Distribution Code could be made significantly simpler if this approach was adopted.

National Grid was initially concerned that some parties (exempt from owning a Generation Licence such as Network Operators or their affiliates) may have problems with this if they wished to have an installation comprising solely of Electricity Storage Modules. The current licensing arrangements do prevent Licensed Network Operators from owning and operating storage devices, however in the view of the Proposer it would not preclude a company (as part of a separate business) from owning and operating a storage facility providing it could be demonstrated that there was no conflict of interest between the licensed network business and storage business. Other Workgroup members expressed concern around the intrinsic conflict of interest that would arise where an asset owner acts in a system operation role. It is anticipated that this may be resolved with the forthcoming publication of the EU Clean Energy Package.

On this basis and in view of the significant benefits and simplifications to the draft Grid Code changes, following the Workgroup meeting on 24 October 2018, the proposed legal text was updated to incorporate storage within the definition of Generator, Power Station and Power Generating Module whereas previously separate terms had been used.

[7] Three groups have been set up covering (i) storage (ii) pump storage and (iii) mixed customer use sites (such as those with generation and storage or demand and storage for example).

How will the solution address the defect?

In the view of the Proposer, the Grid Code does not currently consider energy or electricity 'Storage' technologies as a distinct category of User (Pump Storage aside). When Storage developers request Transmission connections, the Electricity Transmission System Operator) have had to deem this equipment as generation, demand, or an interconnector to allow a connection offer to be prepared.

This workaround has the potential to treat Storage inconsistently. Any adjustments to connection agreements to determine how to connect Storage is set out in Connection Agreements. These are set out in the CUSC (not the Grid Code) as exhibits and are publicly available on the National Grid website[8].

Who will be affected by the proposed solution?

According to the Proposer, this Modification should clarify what is currently an ambiguous treatment of Storage for a new developer of new Electricity Storage schemes. This should improve the understanding of developers of the requirements for using the Transmission system, and avoid workarounds by the GBSO when preparing connection offers and agreements. However, according to another Workgroup member, there was already a well established, unambiguous, treatment of Storage (e.g. Pumped Storage) within the Grid Code which did not require the introduction of a potentially discriminatory 'new' approach via GC0096. The Proposer however noted that the current Grid Code provisions for Storage do not reflect the characteristics of non-pumped storage type technologies, such as batteries and that RfG applies to new Pumped Storage plant but does not apply to Storage.

Storage when co-located with renewables allows a more flexible operation which should enable greater levels of low-carbon generation to be used on the Transmission System, at points where it is more useful and reduce the need to schedule other forms of generation. It was noted that this already occurred today (in respect of co-located Pumped Storage and run of River Hydro) and was already permitted and addressed in the current Grid Code (and CUSC).

[8] The Connection Application can be found at https://www.nationalgrid.com/sites/default/files/documents/CUSC%20Exh%20B_V1.15_06%20May_16.pdf

The Connection Offer document can be found at: https://www.nationalgrid.com/sites/default/files/documents/CUSC%20Exh%20C_v1.8_06%20May_16.pdf

The additional technical capability of Storage when co-located with renewable generation should also aid a User's ability to participate in Ancillary Services with the NGESO or simply to have a more flexible plant which is both of benefit for the developer and NGESO.

An important part of this work is the implication on User's who have already committed to projects but have not yet connected to the System (transmission and distribution connected). In general, the Grid Code applies upon Completion Date (i.e. the date from when the User first connect their Plant to the System). It is therefore possible that a developer who applied for a connection to the Transmission System would, as a condition of their connection, have to satisfy the requirements of the Bilateral Connection Agreement. They therefore place contracts for their equipment on the basis of the requirements in the Bilateral Agreement but it is possible that a Generator could be in the process of building their plant when the Grid Code updates are approved. In order to prevent this situation from arising, it was initially proposed to update the legal text so that the Grid Code requirements become effective from the date of signing their main contract for plant items rather than the Completion Date. A specific consultation question was raised on this issue and following the consultation it was suggested that the requirements become effective on two criteria, these being (i) the date upon which the contract for main contract items being signed (which would be following Ofgem's approval date for the Grid Code Modification and (ii) the date upon which the plant first connected to the System (this being 1 year after Ofgem's approval date for the Grid Code Modification). It is believed this approach would be consistent with the same approach used for the other EU Connection Codes and minimises any risk for those projects in the current design and development phase.

As part of this work, it is also noted that this GC0096 Workgroup does not include the requirements of the System Operator Guideline (SOGL) GC0106 in respect of data. That said, there is a separate Workgroup GC0117 (Improving transparency and consistency of access arrangements across GB by the creation of a pan-GB commonality of PGM requirements). It is expected that storage should not be outside the scope of this work bearing in mind storage will be treated in the same way as generation.

Wider Context

Wider policy work led by BEIS and Ofgem on improving market access to flexibility sets an important context for this modification. On one of the target areas, an associated call for evidence in December 2016 highlighted the need for better facilitation of new connections for flexible parties.

GC0096 is therefore known to BEIS and Ofgem, and is seen as an enabler to address this point. It is important that any wider changes which may be proposed to the regulatory frameworks or licences in the near future by BEIS/Ofgem in relation to flexibility may require further work.

A Storage working group under NGESO's Power Responsive initiative is investigating how to better support balancing services participation from flexible parties. Further information on NGESO's Power Responsive initiative is available from the following link.

http://powerresponsive.com/

That group is not reviewing transmission connection conditions or supporting technical requirements, so can be viewed as complimentary but separate to the outcomes of GC0096.

Finally, modifications to the CUSC to better reflect Storage Users are currently being considered though this is expected to be limited now that Storage is being treated as a subset of Generation. Some coordination between Grid Code and CUSC stakeholders have taken place to ensure compatibility for the proposed Grid Code changes. Nevertheless, any decision on potential CUSC mods lies with that Code and is not determined by GC0096, which can continue in isolation.

In addition, current requirements in the Distribution Code place obligations on Licence Exempt Embedded Medium Power Stations (LEEMPS) to meet specific obligations under the Grid Code (PC3.3 and CC.3.3/ECC.3.3). A Licence Exempt Embedded Medium Power Station is defined within the Distribution Code and to ensure the provisions for Storage also apply to Licence Exempt Embedded Medium Power Stations, checks need to be made such that any Electricity Storage Module which forms part of a Licence Exempt Embedded Medium Power Station is included in the Distribution Code Definitions. This specific issue was raised as a consultation question.

Definitions

Electricity Storage vs. Energy Storage

The Workgroup considered two possible definitions (for 'Electricity' and 'Energy' Storage). The Workgroup agreed that specific attention should be given to 'Electricity' Storage technologies, rather than to 'Energy' Storage technologies.

The latter category is widely accepted to be the consumption of power for temporary Storage, to then convert into another form of energy (but not electricity) such as heat. This means any conversion process is 'one way' in respect of electrical flow. It was noted that 'Energy' Storage, in this context, has existed on the GB electricity system for many decades, often in the form of domestic Storage heaters which have often been activated in an aggregate manner (in response to signals sent to individual units) and priced in the market accordingly.

The Workgroup therefore concluded that 'Energy' Storage (that is 'one way' and not 'bi-directional') could reasonably be defined as 'Demand' in the Grid Code. These technologies do not therefore require any specific attention from this GC0096 Modification.

Defining 'Electricity Storage'

The general understanding that the Workgroup took was categorising technologies which import (charge) and export (discharge) power onto the NETS, would be helpful and therefore considered what definitions were already being used by the Storage sector.

It was noted that the Electricity Storage Network Trade Association as their working definition for Electricity Storage which the GC0096 Workgroup agreed to consider as a starting point:

"Electricity Storage" in the electricity system is the conversion of electrical energy into a form of energy which can be stored, the storing of that energy, and the subsequent reconversion of that energy back into electrical energy".

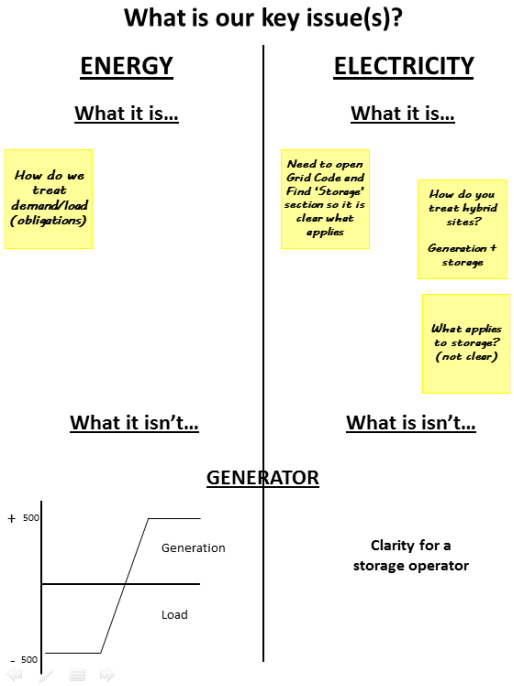
At the first GC0096 Workgroup, the discussion focused on agreeing a Grid Code definition for Storage. A Workgroup member set out his view that there are already, in his view, clear provisions in the Grid Code for the treatment of transmission connected 'Storage' by simple reference to 'Pump Storage' which exhibits all the same characteristics as the proposed GC0096 definition[9]. Applying a harmonised approach should ensure a level playing field is achieved. However, the Proposer noted that whilst the current Grid Code is clear on its treatment of Pumped Storage, the Proposer noted that this was specific to a small number of stations which utilise Synchronous Generation technology and therefore did not represent the growth in hybrid and battery storage applications which had been witnessed in quite high volumes witnessed over the last few years. The Proposer went on to advise that these specific issues and requirements needed to be reflected in the Grid Code which is what the workgroup is aiming to achieve.

A Workgroup member did conversely note that introducing a 'new' definition of 'Storage' as part of GC0096, would seem to introduce discriminatory treatment – as in treating similar situations differently (as both are transmission connected and both involve the "the conversion of electrical energy into a form of energy which can be stored, the storing of that energy, and the subsequent reconversion of that energy back into electrical energy").

It was noted by the Proposer that at the two workshops in August 2016, industry developed an initial thought on a definition for Electricity/Energy Storage which can be seen in figure 2 below. Following a Workgroup debate, the Workgroup determined that the correct definition to use was 'Electricity Storage' and that any definition should be technology neutral and setting a minimum standard noting that users can exploit their full

[9] "Is the conversion of electrical energy into a form of energy which can be stored, the storing of that energy, and the subsequent reconversion of that energy back into electrical energy"

operational flexibility services arrangements/ Enhanced Frequency



through commercial markets (e.g. Response).

Figure 2

At the third Workgroup meeting, a Workgroup member voiced an important clarification. Added to the definition for Electricity Storage was the ability for the Storage Facility Owner to be able to *control* the 'conversion' and 'reconversion' of that electrical energy – an important clarification to ensure a sufficient level of response to system-need for the technologies in question.

Therefore, the proposed agreed GC0096 definition for Electricity Storage was updated to become:

Electricity Storage *is the conversion of electrical energy into a form of energy which can be stored, the storing of that energy, and the subsequent reconversion of that energy back into electrical energy in a controllable manner.*

The addition of "in a controllable manner" was added to exclude certain technologies such as Synchronous Compensators, Synchronous flywheels and Regenerative Braking Systems which would otherwise struggle to meet the proposed technical requirements. It is also worth noting that storage technologies would only be required to meet the proposed technical requirements when they have sufficient capability – e.g. a battery is sufficiently charged or other storage device is sufficiently fuelled. In other words, if a storage device was completely discharged, there would be no requirement for it to satisfy any of the exporting requirements although the requirements for import would still apply - in just the same way as a generator which had no fuel would have no requirement to satisfy those same exporting requirements.

In Ofgem's recent consultation on 'Clarifying the regulatory framework for electricity storage: licensing' Ofgem have highlighted their request to maintain the Electricity Storage definition as that originally proposed (i.e. without reference to "in a controllable manner"). To address this issue, the legal text in the code has been modified to have specific definitions for Synchronous Compensation equipment and Synchronous flywheels which would fall outside the encompassing definition of Electricity Storage. In addition, and to align with the Storage definition following Ofgem's Storage consultation on Licensing, the term "Electricity Storage" has the term "in a controllable manner" removed and new terms of Non-Controllable Electricity Storage Equipment, which includes equipment such as "Synchronous Flywheels", "Synchronous Compensation Equipment" and "Regenerative Braking" have been added to address this concern. The aim being that if a Flywheel or Synchronous Compensator (for example) is controllable, it would be treated as contributing to "Electricity Storage" and therefore have to meet the same requirements as an Electricity Storage Module. This change will be necessary to prevent such technologies from having to apply for derogations.

Understanding how Electricity Storage can be configured – Modules and Units

The primary discussions at the Workgroup focused around how developers could deploy Storage – be that as a new standalone connection, or co-located as part of a new or existing generation/demand scheme.

It became clear that any technical complexity was around co-location, so the focus was how existing Grid Code definitions could be enhanced to incorporate a Storage element. It became clear that definitions for Power Station (from which capacity size determines licence and other compliance obligations), Power Park Module and Power Generating Module were the primary means to do this. Below the Station and modular level, would be a new definition for a Storage Unit which becomes integrated into the definition of a Generating Unit– permitting developers' flexibility to incorporate Storage in the most efficient means possible. This approach, according to the Proposer, also facilitates co-located sites in the most efficient way. In terms of BMU configuration, (i.e. where a Generator chooses to select to operate a Power Generating Module with an Electricity Storage Module) the current BSC makes provision as to how the Generator wishes to register its BMU's.

There was some discussion over whether 'Power Station' could be used for standalone configurations as well, and this was the initial default proposal at the Workgroup.

However, there was some doubt as to whether this sufficiently distinguishes Storage from Generation, which was one of the objectives of the GC0096 proposal.

There was further consideration outside the Workgroup by the proposer to understand the consequences of using Power Station for standalone Storage connections, particularly in relation to network charging and the CUSC. It was felt, by the Proposer, that using Power Station in this way could cause unnecessary ambiguity and the potential for unforeseen consequences for generation Users in the Grid Code if adjustments were made to the definition of Power Station.

The initial view was to define stand alone Electricity Storage installations in their own right as an Electricity Storage Facility belonging to an Electricity Storage Facility Owner. The legal drafting was initially prepared on this basis but following the Workgroup meeting on 24 October and in view that Ofgem's minded to position (as noted above) on licensing, treated storage in the same way as Generation, it was agreed by the Proposer that Electricity Storage should be integrated under the envelope of Generation and therefore the use of Generator, Power Station, Power Generating Module and Generating Unit have been amended to include Electricity Storage.

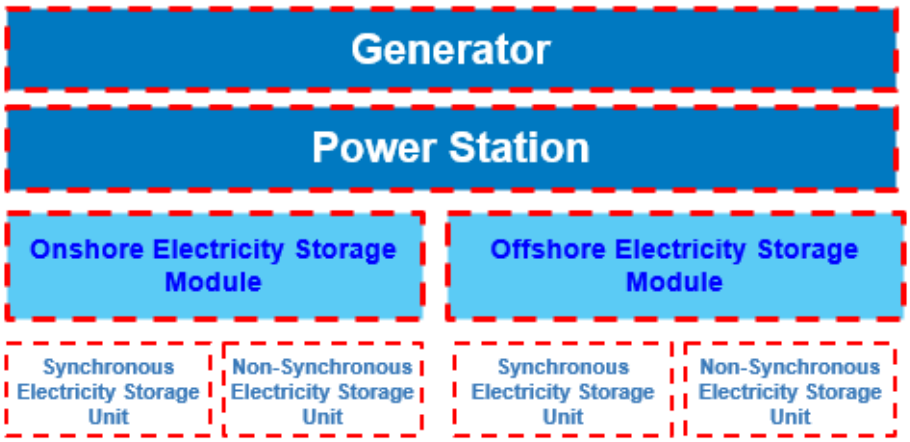
High level proposals for Storage definitions

The following hierarchy of definitions was constructed to explain the relationship and interdependency between the GC0096 new Storage definitions and existing Grid Code definitions to facilitate this.

Storage as a technology

The Proposer agreed with the Workgroup that a definition to clarify the specific activity for Storage would be useful. The Proposer also agreed with the Workgroup that a definition for 'Energy Storage' – the means of consuming electricity and converting for alternative uses (such as heat) is akin to 'Demand' – is already understood and, therefore, there would be no definition for 'Energy Storage' (as opposed to 'Electricity Storage') taken forward as part of this GC0096 Modification.

<u>Standalone Electricity Storage Facility</u>



Standalone Storage

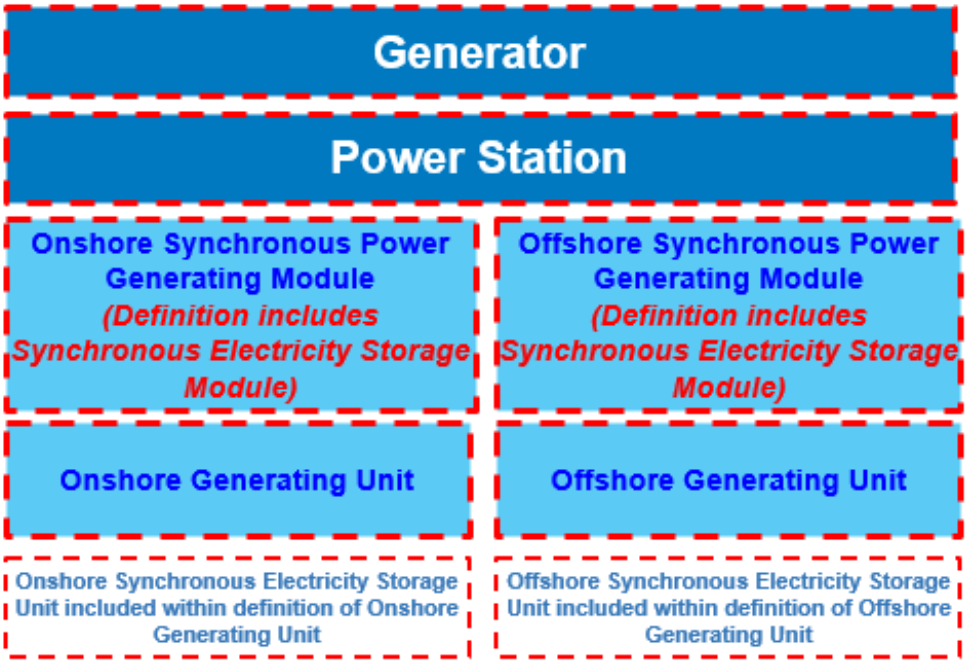
The Workgroup considered if using 'Power Station' as a catch-all for both standalone and co-located Storage would be appropriate. This was the basis of much of the discussions.

The Proposer sought further guidance outside GC0096 to understand the possible unforeseen consequences of using 'Power Station' in this way, and was made aware of several potential risks – not least network charging (for those also bound by the CUSC) and licencing (where there is no clarity on Storage outside Generation). These CUSC and licencing factors are out of the scope of GC0096 to consider.

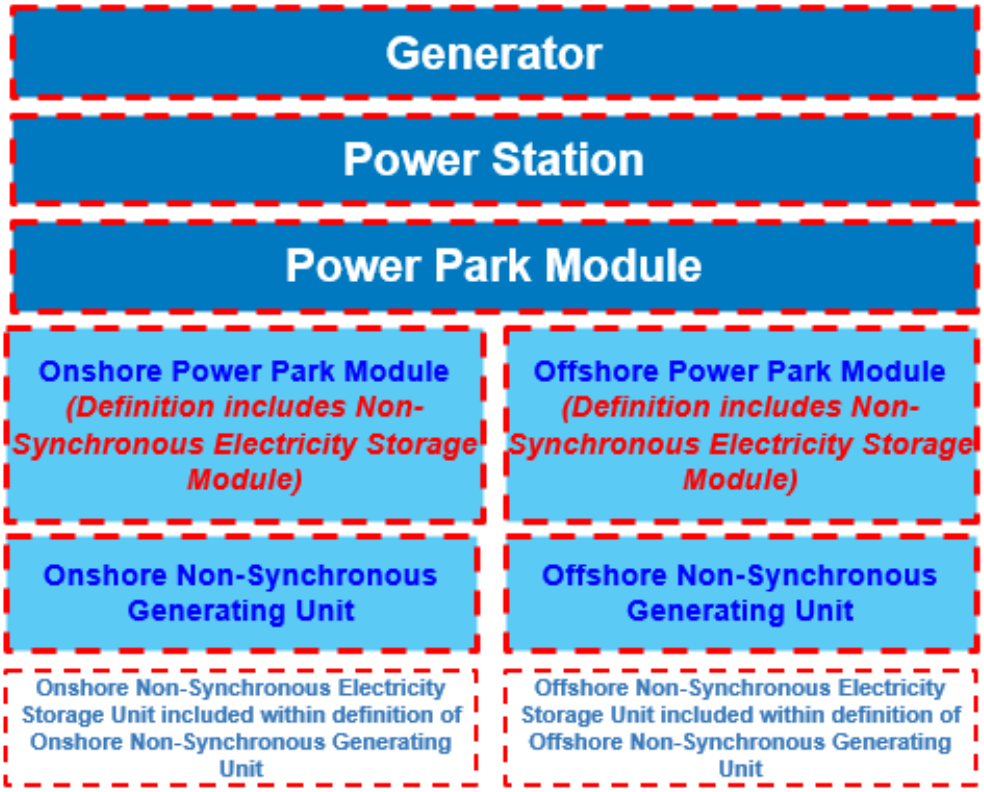
The initial view of the Proposer was to define a collection of standalone Electricity Storage Modules as an Electricity Storage Facility owned by an Electricity Storage Facility Owner.

However, as the debate continued and following Ofgem's minded to position on the licensing arrangements for storage, this being that it should be treated in the same way as for generation, it was considered late on as part of the Workgroup discussions that Storage should be treated in the same way as Generation, being part of a Power Station and owned by a Generator. This also has the advantage of significantly simplifying the code and minimises subsequent changes to other industry codes such as the CUSC.

<u>Co-located in a Synchronous Generator</u>



Co-located in a Non-Synchronous Generator



New definitions

The new / amended definitions are noted below and are direct extracts from the proposed Glossary and Definitions changes arising from GC0096. In summary, the important definitions are “Electricity Storage”, “Electricity Storage Module”, “Electricity Storage Unit” and “Storage User”. The conscript of these definitions follows that as outlined in the Definitions Section of the Proposers Solution as outlined earlier in this report.

Putting this another way, the definition of Generating Unit and Power Generating Module has been updated to include Electricity Storage Units and Electricity Storage Modules such that any obligation that applies to a Generating Unit or Power Generating Module will also include storage. Where there are specific requirements within the main body of the Grid Code which explicitly apply to storage these are explicitly defined for example in OC.6.6.6.

In terms of classification, and to ensure consistency with Ofgem’s Licensing proposals, storage is being treated in the same way as Generation. It is proposed that these requirements would apply going forward and not retrospectively. Whilst Storage has specifically been excluded from the requirements of the three European Connection Network Codes (Requirements for Generators (RfG), HVDC Code and Demand Connection Code (DCC)), the Proposers view and that of Ofgem, agree that any new requirements going forward should be consistent with the European Connection Conditions (ECC’s) and not the CC’s whilst specifically noting that in doing so, Generators who own and operate Electricity Storage Modules would not be bound by the requirements of the EU Connection Codes as they are not enforceable under EU law. This issue has been addressed through the definition of Storage User and how it sits within the definition of an EU Code User.

The main changes to the Glossary and Definitions as a result of these proposals are summarised below in the following table.

Block Load Capability	The incremental **Active Power** steps, from no load to **Rated MW**, which a ~~generator~~ **Generating Unit** or **Power Generating Module** or **Power Park Module** or **HVDC System** can instantaneously supply without causing it to trip or go outside the **Frequency** range of 47.5 – 52Hz (or an otherwise agreed **Frequency** range). The time between each incremental step shall also be provided.

Compliance Statement	A statement completed by the relevant **User** confirming compliance with each of the relevant Grid Code provisions, and the supporting evidence in respect of such compliance, of its: **Generating Unit(s)**; or, **Power Generating Modules** (including **DC Connected Power Park Modules** and/or **Electricity Storage Modules**); or, **CCGT Module(s)**; or, **Power Park Module(s)**; or, **DC Converter(s);** or **HVDC Systems; or** **Plant** and **Apparatus** at an **EU Grid Supply Point** owned or operated by a **Network Operator**; or **Network Operator's** entire distribution **System** where such **Network Operator's** distribution **System** comprises solely of **Plant** and **Apparatus** procured on or after 7 September 2018 and was connected to the **National Electricity Transmission System** on or after 18 August 2019. In this case, all connections to the **National Electricity Transmission System** would comprise only of **EU Grid Supply Points**; or **Plant** and **Apparatus** at an **EU Grid Supply Point** owned or operated by a **Non-Embedded Customer** where such **Non-Embedded Customer** is defined as an **EU Code User**; in the form provided by **The Company** to the relevant **User** or another format as agreed between the **User** and **The Company**.
Electricity Storage	The conversion of electrical energy into a form of energy which can be stored, the storing of that energy, and the subsequent reconversion of that energy back into electrical energy.
Electricity Storage Module	Is either one or more **Synchronous Electricity Storage Unit**(s) or **Non-Synchronous Electricity Storage Unit**(s) which could also be part of a **Power Generating Module**. For the avoidance of doubt, **Non-Controllable Electricity Storage Equipment** would not be considered to be classed as an **Electricity Storage Module** or as an **Electricity Storage Unit**.
Electricity Storage Unit	A **Synchronous Electricity Storage Unit** or **Non-Synchronous Electricity Storage Unit**.

EU Code User	A **User** who is any of the following:- (a) A **Generator** in respect of a **Power Generating Module** (excluding a **DC Connected Power Park Module**) or **OTSDUA** (in respect of an AC **Offshore Transmission System**) whose **Main Plant and Apparatus** is connected to the **System** on or after 27 April 2019 and who concluded **Purchase Contracts** for its **Main Plant and Apparatus** on or after 17 May 2018 (b) A **Generator** in respect of any **Type C** or **Type D Power Generating Module** which is the subject of a **Substantial Modification** which is effective on or after 27 April 2019. (c) A **Generator** in respect of any **DC Connected Power Park Module** whose **Main Plant and Apparatus** is connected to the **System** on or after 8 September 2019 and who had concluded **Purchase Contracts** for its **Main Plant and Apparatus** on or after 28 September 2018. (d) A **Generator** in respect of any **DC Connected Power Park Module** which is the subject of a **Substantial Modification** which is effective on or after 8 September 2019. (e) An **HVDC System Owner** or **OTSDUA** (in respect of a DC **Offshore Transmission System** including a **Transmission DC Converter**) whose **Main Plant and Apparatus** is connected to the **System** on or after 8 September 2019 and who had concluded **Purchase Contracts** for its **Main Plant and Apparatus** on or after 28 September 2018. (f) An **HVDC System Owner** or **OTSDUA** (in respect of a DC **Offshore Transmission System** including a **Transmission DC Converter**) whose **HVDC System** or DC **Offshore Transmission System** including a **Transmission DC Converter**) is the subject of a **Substantial Modification** on or after 8 September 2019. (g) A **User** which the **Authority** has determined should be considered as an **EU Code User**. (h) A **Network Operator** whose entire distribution **System** was first connected to the **National Electricity Transmission System** on or after 18 August 2019 and who had placed **Purchase Contracts** for its **Main Plant** and **Apparatus** in respect of its entire distribution **System** on or after 7 September 2018. For the avoidance of doubt, a **Network Operator** will be an **EU Code User** if its entire distribution **System** is connected to the **National Electricity Transmission System** at **EU Grid Supply Points** only. (i) A **Non Embedded Customer** whose **Main Plant and Apparatus** at each **EU Grid Supply Point** was first connected to the **National Electricity Transmission System** on or after 18 August 2019 and who had placed **Purchase Contracts** for its **Main Plant and Apparatus** at each **EU Grid Supply Point** on or after 7 September 2018 or is the subject of a **Substantial Modification** on or after 18 August 2019. *(j)* A **Storage User** in respect of an **Electricity Storage Module** whose **Main Plant and Apparatus** is connected to the **System** on or after DDMMYY 2019 and who concluded **Purchase Contracts** for its **Main Plant and Apparatus** on or after

	DDMMYY 2018. ~~(a)~~
~~Exisiting~~ Pumped Storage Plant	The Dinorwig, Ffestiniog, Cruachan and Foyers **Power Stations**.
~~Exisiting~~ Pumped Storage Unit	A **Generating Unit** within an **Exisiting Pumped Storage Plant**.
~~**Fault Current Interruption Time**~~	~~The time interval from fault inception until the end of the break time of the circuit breaker (as declared by the manufacturers).~~
~~**Fault Ride Through**~~	~~The capability of **Power Generating Modules** (including **DC Connected Power Park Modules**) and **HVDC Systems** to be able to be able to remain connected to the **System** and operate through periods of low voltage at the **Grid Entry Point** or **User System Entry Point** caused by secured faults~~
Fault Current Interruption Time	The time interval from fault inception until the end of the break time of the circuit breaker (as declared by the manufacturers).
Fault Ride Through	The capability of **Power Generating Modules** (including **DC Connected Power Park Modules**) and **HVDC Systems** to be able to be able to remain connected to the **System** and operate through periods of low voltage at the **Grid Entry Point** or **User System Entry Point** caused by secured faults
~~**Governor Deadband**~~	~~An interval used intentionally to make the frequency control unresponsive~~ ~~In the case of mechanical governor systems the **Governor Deadband** is the same as **Frequency Response Insensitivity**~~
~~**Governor Insensitivity**~~	~~The inherent feature of the control system specified as the minimum magnitude of change in the frequency or input signal that results in a change of output power or output signal~~
Generator	A person who generates electricity or undertakes **Electricity Storage** under licence or exemption under the **Act** acting in its capacity as a generator in **Great Britain** or **Offshore**. The term **Generator** includes a **EU Generator** and a **GB Generator**.
Governor Deadband	An interval used intentionally to make the frequency control unresponsive. In the case of mechanical governor systems the **Governor Deadband** is the same as **Frequency Response Insensitivity**.
Governor Insensitivity	The inherent feature of the control system specified as the minimum magnitude of change in the frequency or input signal that results in a change of output power or output signal.

High Frequency Response	An automatic reduction in **Active Power** output in response to an increase in **System Frequency** above the **Target Frequency** (or such other level of **Frequency** as may have been agreed in an **Ancillary Services Agreement**). This reduction in **Active Power** output must be in accordance with the provisions of the relevant **Ancillary Services Agreement** which will provide that it will be released increasingly with time over the period 0 to 10 seconds from the time of the **Frequency** increase on the basis set out in the **Ancillary Services Agreement** and fully achieved within 10 seconds of the time of the start of the **Frequency** increase and it must be sustained at no lesser reduction thereafter. The interpretation of the **High Frequency Response** to a + 0.5 Hz frequency change is shown diagrammatically in Figure CC.A.3.3 and Figure ECC.A.3.3.
Intermittent Power Source	The primary source of power for a **Generating Unit** or **Power Generating Module** that can not be considered as controllable, e.g. wind, wave or solar. For the avoidance of doubt, the input to an **Electricity Storage Module** would not be considered to be from an **Intermittent Power Source**.
Main Plant and Apparatus	In respect of a **Power Station** (including **Power Stations** comprising of **DC Connected Power Park Modules** and **Electricity Storage Modules**) is one or more of the principal items of **Plant** or **Apparatus** required to convert or re-convert the primary source of energy into electricity. In respect of **HVDC Systems** or **DC Converters** or **Transmission DC Converters** is one of the principal items of **Plant** or **Apparatus** used to convert high voltage direct current to high voltage alternating current or vice versa. In respect of a **Network Operator's** equipment or a **Non-Embedded Customer's** equipment, is one of the principal items of **Plant** or **Apparatus** required to facilitate the import or export of **Active Power** or **Reactive Power** to or from a **Network Operator's** or **Non Embedded Customer's System**.
Maximum Capacity or P_{max}	The maximum continuous **Active Power** which a **Power Generating Module** can supply to the **Total System** ~~produce~~, less any demand associated solely with facilitating the operation of that **Power Generating Module** and not fed into the **System**. In the case of an **Electricity Storage Module** the **Maximum Capacity** is the maximum continuous **Active Power** which an **Electricity Storage Module** can export to the **Total System** less any demand associated with facilitating the operation of that **Electricity Storage Module** when fully charged and operating in a mode analogous to **Generation** or the maximum continuous **Active Power** which an **Electricity Storage Module** can import from the **Total System** less any demand associated with facilitating the operation of that **Electricity Storage Module** when fully discharged and operating in a mode analogous to **Demand**.

National Demand	The amount of electricity supplied from the **Grid Supply Points** plus:- • that supplied by **Embedded Large Power Stations**, and • **National Electricity Transmission System Losses**, minus:- • the **Demand** taken by **Station Transformers**, **Existing Pumped Storage Units'** and **Pumped Storage Units'** and, for the purposes of this definition, does not include:- • any exports from the **National Electricity Transmission System** across **External Interconnections**.
National Electricity Transmission System Demand	The amount of electricity supplied from the **Grid Supply Points** plus:- • that supplied by **Embedded Large Power Stations**, and • exports from the **National Electricity Transmission System** across **External Interconnections**, and • **National Electricity Transmission System Losses**, and, for the purposes of this definition, includes:- • the **Demand** taken by **Station Transformers**, **Existing Pumped Storage Units'** and **Pumped Storage Units**.
Non-Controllable Electricity Storage Equipment	An item of storage **Plant**, including but not limited to a **Synchronous Flywheel** or **Synchronous Compensation Equipment** or **Regenerative Braking** whose active output power cannot be independently controlled.
Non-Synchronous Electricity Storage Module	A **Power Park Module** comprising solely of one or more **Non-Synchronous Electricity Storage Units**.
Non-Synchronous Electricity Storage Unit	A **Power Park Unit** which can produce electrical energy by converting or re-converting another source of energy such that the frequency of the generated voltage is not inherently in synchronism with the frequency of the **System**.
Offshore Generating Unit	Unless otherwise provided in the Grid Code, any **Apparatus** located **Offshore** which produces electrical energy by converting or re-converting another source of energy, including, an **Offshore Synchronous Generating Unit** or **Offshore Non-Synchronous Generating Unit** which could also be part of a **Power Generating Module** or **Electricity Storage Module**
Offshore Non-Synchronous Generating Unit	An **Offshore Generating Unit** that is not an **Offshore Synchronous Generating Unit** including for the avoidance of doubt a **Power Park Unit** or **Non-Synchronous Electricity Storage Unit** located **Offshore**.
Offshore Power Park String	A collection of **Offshore Generating Units** or **Power Park Units** or **Non-Synchronous Electricity Storage Units**, joined together by cables forming part of a **User System** with a single point of connection to an **Offshore Transmission System**. The connection to an **Offshore Transmission System** may include a **DC Converter** or **HVDC Converter**.

Offshore Synchronous Generating Unit	A~~n **Offshore**~~ **Generating Unit** or **Synchronous Electricity Storage Unit** located **Offshore** which could be part of an **Offshore Synchronous Power Generating Module** in which, under all steady state conditions, the rotor rotates at a mechanical speed equal to the electrical frequency of the **National Electricity Transmission System** divided by the number of pole pairs of the **Generating Unit**.
Offshore Synchronous Power Generating Module	A **Synchronous Power Generating Module** or **Synchronous Electricity Storage Module** located **Offshore**.
Onshore Generating Unit	Unless otherwise provided in the Grid Code, any **Apparatus** located **Onshore** which produces electrical energy by converting or re-converting another source of energy~~ity~~, including, an **Onshore Synchronous Generating Unit** or ~~and~~ **Onshore Non-Synchronous Generating Unit** which could also be part of a **Power Generating Module** or an **Electricity Storage Module**.
Onshore Grid Entry Point	A point at which a **Onshore Generating Unit** or a **CCGT Module** or a **CCGT Unit** or an **Onshore Power Generating Module** or a **Onshore DC Converter** or an **Onshore HVDC Converter** or a **Onshore Power Park Module** or an **Onshore Electricity Storage Module** or an **External Interconnection**, as the case may be, which is directly connected to the **Onshore Transmission System** connects to the **Onshore Transmission System**.
Onshore Non-Synchronous Generating Unit	A **Generating Unit** located **Onshore** that is not a **Synchronous Generating Unit** or **Synchronous Electricity Storage Unit** including for the avoidance of doubt a **Power Park Unit** or **Non-Synchronous Electricity Storage Unit** located **Onshore**.
Onshore Power Park Module	A collection of **Non-Synchronous Generating Units** ~~(registered as a **Power Park Module** under the **PC**)~~ that are powered by an **Intermittent Power Source** or connected through power electronic conversion technology or **Non-Synchronous Electricity Storage Units**, joined together by a **System** (registered as a **Power Park Module** under the **PC**) with a single electrical point of connection directly to the **Onshore Transmission System** (or **User System** if **Embedded**) with no intermediate **Offshore Transmission System** connections. The connection to the **Onshore Transmission System** (or **User System** if **Embedded**) may include a **DC Converter** or **HVDC Converter**.
Onshore Synchronous Generating Unit	An **Onshore Generating Unit** or **Onshore Synchronous Electricity Storage Unit** (which could also be part of an **Onshore Power Generating Module**) including, for the avoidance of doubt, a **CCGT Unit** or **Synchronous Electricity Storage Unit** in which, under all steady state conditions, the rotor rotates at a mechanical speed equal to the electrical frequency of the **National Electricity Transmission System** divided by the number of pole pairs of the **Generating Unit**.
Onshore Synchronous Power Generating Module	A **Syn~~n~~chronous Power Generating Module** or **Synchronous Electricity Storage Module** located **Onshore**.

Operational Intertripping	The automatic tripping of circuit-breakers to prevent abnormal system conditions occurring, such as over voltage, overload, **System** instability, etc. after the tripping of other circuit-breakers following power **System** fault(s) which includes **System** to **Generating Unit**, **System** to **CCGT Module**, **System** to **Power Park Module**, **System** to **Electricity Storage Module**, **System** to **DC Converter, System** to **Power Generating Module**, **System** to **HVDC Converter** and **System** to **Demand** intertripping schemes.
Power Available	A signal prepared in accordance with good industry practice, representing the instantaneous sum of the potential **Active Power** available from each individual **Power Park Unit** within the **Power Park Module** calculated using any applicable combination of ~~meteorological (including wind speed)~~, electrical or mechanical or meteorological data (including wind speed) measured at each **Power Park Unit** at a specified time. **Power Available** shall be a value between 0MW and **Registered Capacity** or **Maximum Capacity** which is the sum of the potential **Active Power** available of each **Power Park Unit** within the **Power Park Module.** A unit~~turbine~~ that is not generating or supplying power will be considered as not available. For the avoidance of doubt, the **Power Available** signal would be the **Active Power** output that a **Power Park Module** could reasonably be expected to export at the **Grid Entry Point** or **User System Entry Point** taking all the above criteria into account including **Power Park Unit** constraints such as optimisation modes but would exclude a reduction in the **Active Power** export of the **Power Park Module** instructed by **The Company** (for example) for the purposes selecting a **Power Park Module** to operate in **Frequency Sensitive Mode** or when an **Emergency Instruction** has been issued.
Power-Generating Module	Either a **Synchronous Power ~~-~~Generating Module**, a **Synchronous Electricity Storage Module**, ~~or~~ a **Power Park Module** or a **Non-Synchronous Electricity Storage Module** owned or operated by an **EU Generator**.
Power Station	An installation comprising one or more **Generating Units** or **Power Park Modules** or **Power Generating Modules** or **Electricity Storage Modules** (even where sited separately) owned and/or controlled by the same **Generator**, which may reasonably be considered as being managed as one **Power Station**.
Pumped Storage	A ~~a~~ hydro unit in which water can be raised by means of pumps and stored to be used for the generation of electrical energy;
Pumped Storage Generator	A **Generator** which owns and/or operates any **Pumped Storage Plant** including an **Exisiting Pumped Storage Plant**.
Pumped Storage Plant	~~The Dinorwig, Ffestiniog, Cruachan and Foyers~~ A **Power Station~~s~~**.comprising **Pumped Storage Generating Units** excluding an **Exisiting Pumped Storage Plant**.

Rated MW	The "rating-plate" MW output of a **Power Generating Module**, **Generating Unit**, **Power Park Module**, **Electricity Storage Module**, **HVDC Converter** or **DC Converter**, being: (a) that output up to which the **Generating Unit** or **Synchronous Electricity Storage Unit** was designed to operate (Calculated as specified in **British Standard BS** EN 60034 – 1: 1995); or (b) the nominal rating for the MW output of a **Power Park Module** or **Power Generating Module** being the maximum continuous electric output power which the **Power Park Module** or **Power Generating Module** or **Electricity Storage Module** was designed to achieve under normal operating conditions; or (c) the nominal rating for the MW import capacity and export capacity (if at a **DC Converter Station** or **HVDC Converter Station**) of a **DC Converter** or **HVDC Converter**.
Regenerative Braking	A method of braking in which energy is extracted from the parts braked, to be stored and reused.

Registered Capacity	(a) In the case of a **Generating Unit** other than that forming part of a **CCGT Module** or **Power Park Module** or **Power Generating Module**, the normal full load capacity of a **Generating Unit** as declared by the **Generator**, less the MW consumed by the **Generating Unit** through the **Generating Unit's Unit Transformer** when producing the same (the resultant figure being expressed in whole MW, or in MW to one decimal place). (b) In the case of a **CCGT Module** or **Power Park Module** owned or operated by a **GB Generator**, the normal full load capacity of the **CCGT Module** or **Power Park Module** (as the case may be) as declared by the **GB Generator**, being the **Active Power** declared by the **GB Generator** as being deliverable by the **CCGT Module** or **Power Park Module** at the **Grid Entry Point** (or in the case of an **Embedded CCGT Module** or **Power Park Module**, at the **User System Entry Point**), expressed in whole MW, or in MW to one decimal place. For the avoidance of doubt **Maximum Capacity** would apply to **Power Generating Modules** which form part of a **Large**, **Medium** or **Small Power Stations**. (c) In the case of a **Power Station**, the maximum amount of **Active Power** deliverable by the **Power Station** at the **Grid Entry Point** (or in the case of an **Embedded Power Station** at the **User System Entry Point**), as declared by the **Generator**, expressed in whole MW, or in MW to one decimal place. The maximum **Active Power** deliverable is the maximum amount deliverable simultaneously by the **Power Generating Modules** and/or **Generating Units** and/or **CCGT Modules** and/or **Power Park Modules** less the MW consumed by the **Power Generating Modules** and/or **Generating Units** and/or **CCGT Modules** in producing that **Active Power** and forming part of a **Power Station**. (d) In the case of a **DC Converter** at a **DC Converter Station** or **HVDC Converter** at an **HVDC Converter Station**, the normal full load amount of **Active Power** transferable from a **DC Converter** or **HVDC Converter** at the **Onshore Grid Entry Point** (or in the case of an **Embedded DC Converter Station** or an **Embedded HVDC Converter Station** at the **User System Entry Point**), as declared by the **DC Converter Station** owner or **HVDC System Owner**, expressed in whole MW, or in MW to one decimal place. (e) In the case of a **DC Converter Station** or **HVDC Converter Station**, the maximum amount of **Active Power** transferable from a **DC Converter Station** or **HVDC Converter Station** at the **Onshore Grid Entry Point** (or in the case of an **Embedded DC Converter Station** or **Embedded HVDC Converter Station** at the **User System Entry Point**), as declared by the **DC Converter Station** owner or **HVDC System Owner**, expressed in whole MW, or in MW to one decimal place. (f) In the case of an **Electricity Storage Module**, the normal full load amount of **Active Power** transferable (in both an importing and exporting mode of operation) from an **Electricity Storage Module** at the **Grid Entry Point** (or in the case of an **Embedded Electricity Storage Module** at the **User System Entry Point**), as declared by the **Generator**, expressed in whole MW, or in MW to one decimal place.

Self-Governance Criteria	A proposed **Modification** that, if implemented, (a) is unlikely to have a material effect on: (i) existing or future electricity consumers; and (ii) competition in the generation, storage, distribution, or supply of electricity or any commercial activities connected with the generation, storage, distribution or supply of electricity; and (iii) the operation of the **National Electricity Transmission System**; and (iv) matters relating to sustainable development, safety or security of supply, or the management of market or network emergencies; and (v) the **Grid Code**'s governance procedures or the **Grid Code**'s modification procedures, and (b) is unlikely to discriminate between different classes of Users.
Storage User	A **Generator** who owns or operates one or more **Electricity Storage Modules**. For the avoidance of doubt: (a) **European Regulation** (EU) 2016/631, **European Regulation** 2016/1388 and **European Regulation** 2016/1485 shall not apply to **Storage Users**; and (b) the **European Connection Conditions (ECC's)** shall apply to **Storage Users** on the basis set out in Paragraph ECC1.1(d) .
Synchronising Generation	The amount of MW (in whole MW) produced at the moment of synchronising.
Synchronous Compensation Equipment	**Apparatus** which has the function of providing **Synchronous Compensation**. For the avoidance of doubt, one or more **Synchronous Compensation** units would not constitute an **Electricity Storage Module** unless it could be operated in a controllable manner.
Synchronous Electricity Storage Module	A **Synchronous Power Generating Module** which can convert or re-convert electrical energy from another source of energy such that the frequency of the generated voltage, the rotor speed and the frequency of network voltage are in a constant ratio and thus in synchronism. For the avoidance of doubt a **Synchronous Electricity Storage Module** could comprise of one or more **Synchronous Electricity Storage Units**.
Synchronous Electricity Storage Unit	A**Synchronous Generating Unit** which can supply or absorb electrical energy such that the frequency of the generated voltage, the rotor speed and the frequency of the equipment are in constant ratio and thus in synchronism with the network.
Synchronous Flywheel	An item of synchronously rotating **Plant** for the specific purpose of contributing inertia to the **System**. One or more **Synchronous Flywheels** would not be considered to form an **Electricity Storage Module** unless it could be operated in a controllable manner for its AC input and output power.

Synchronous Power-Generating Module	An indivisible set of installations which can ~~generate~~ convert or re-convert electrical energy from another source of energy such that the frequency of the supplied~~generated~~ voltage, the rotor ~~generator~~ speed and the frequency of network voltage are in a constant ratio and thus in synchronism. For the avoidance of doubt, a **Synchronous Power Generating Module** could comprise of one or more **Synchronous Generating Units** or one or more **Synchronous Electricity Storage Units**.
System to Generator Operational Intertripping Scheme	A **System** to **Generating Unit** or **System** to **CCGT Module** or **System** to **Power Park Module** or **System** to **Power Generating Module** or **System to Electricity Storage Module** **Intertripping Scheme** forming a condition of connection and specified in Appendix F3 of the relevant **Bilateral Agreement**, being either a **Category 1 Intertripping Scheme**, **Category 2 Intertripping Scheme**, **Category 3 Intertripping Scheme** or C**ategory 4 Intertripping Scheme**.
Total Shutdown	The situation existing when all generation and/or storage has ceased and there is no electricity supply from **External Interconnections** and, therefore, the **Total System** has shutdown with the result that it is not possible for the **Total System** to begin to function again without **The Company's** directions relating to a **Black Start**.
Type A Power Generating Module	A **Power-Generating Module** (including an **Electricity Storage Module**) with a **Grid Entry Point** or **User System Entry Point** below 110 kV and a **Maximum Capacity** of 0.8 kW or greater but less than 1MW;
Type B Power Generating Module	A **Power-Generating Module** (including an **Electricity Storage Module**) with a **Grid Entry Point** or **User System Entry Point** below 110 kV and a **Maximum Capacity** of 1MW or greater but less than 10MW;
Type C Power Generating Module	A **Power-Generating Module** (including an **Electricity Storage Module**) with a **Grid Entry Point** or **User System Entry Point** below 110 kV and a **Maximum Capacity** of 10MW or greater but less than 50MW;
Type D Power Generating Module	A **Power-generating Module** (including an **Electricity Storage Module**): with a **Grid Entry Point** or **User System Entry Point** at, or greater than, 110 kV; or with a **Grid Entry Point** or **User System Entry Point** below 110 kV and with **Maximum Capacity** of 50MW or greater
User System Entry Point	A point at which a **Power Generating Module**, **Generating Unit**, a **CCGT Module** or a **CCGT Unit** or a **Power Park Module**, or an **Electricity Storage Module** or a **DC Converter** or an **HVDC Converter**, as the case may be, which is **Embedded** connects to the **User System**.

Assigning appropriate technical requirements

The Workgroup reviewed the existing suite of Grid Code Connection Conditions (CCs) and subsequently the European Connection Conditions (ECC's) to determine which would be applicable to Electricity Storage, Modules or Units. The Workgroup's priorities when assigning technical requirements was to ensure consistency and non discriminatory

treatment to other Grid Code Users, whilst not limiting the potential capability to do more. In this respect, it is expected that Storage providers will need to satisfy a minimum level of capability to make a connection, and would be encouraged to surpass these through participation in Ancillary Services.

In the majority of cases, it is expected that Storage would meet the same requirements as Generation and HVDC technologies. The one notable point mentioned was that storage should have a requirement to cater for power output with falling frequency and power output with rising frequency. With storage operating in a mode analogous to Generation, this would be covered through ECC.6.3.3 (Limited Power Output reductions with falling frequency) and ECC.6.3.7.1 (the Limited Frequency Sensitive Mode – Overfrequency (LFSM-O). When the Storage plant is in a mode analogous to demand it should trip off the demand at pre-defined frequency levels in the same way as a pumped storage plant when operating in a pumping mode. The legal text in OC6.6 has been updated to address this issue. However, the Proposer notes there are wider issues associated with this issue which are described in the Future Work section below.

So far as the Grid Code is concerned, most of the changes are reflected through the Glossary and Definitions with the rest of the code remining more or less unchanged other than in respect of specific items relating to storage. The key point here is that by amending the definitions such that Electricity Storage is now incorporated into the definition of a Power Generating Module and Generating Unit means that the obligation on Generators will also include storage. In summary, and in view of the intention to align storage to Power Generating Modules (as introduced under RfG), a Generator who owns an Electricity Storage Module would be classified as an EU Code User.

A full table of the proposed requirements and their applicability to Storage is shown in Section 8 (legal text) of this report.

Onshore and Offshore Considerations

The Workgroup considered whether there were important distinctions to be made between onshore and offshore requirements, particularly in the case of Storage co-located with wind generation. It was then agreed that the modular equivalents – e.g. onshore Generation vs. onshore Storage; offshore generation vs. offshore Storage – should be consistent, given the differing circumstances/topologies between the connecting TOs (OFTOs). The Workgroup agreed that any consideration of Storage being deployed within an OFTO network, owned by an OFTO, was not being considered, as part of GC0096, due to the licence implications.

This principle was accepted by the Workgroup and was factored into the determination of technical requirements accordingly meaning that onshore Storage technologies will be treated in the same way as Onshore Power Generating Modules and Offshore Generation should be treated in the same way as Offshore Power Generating Modules. It was however noted that in GB, there is an Offshore Transmission Regime which results in slightly different requirements between Offshore Generation and Onshore Generation.

Wider requirements

As highlighted above, the view of the Proposer was to initially include a standalone Storage definition which approximates to 'Power Station', namely an Electricity Storage Facility being owned by an Electricity Storage Facility Owner. Although an earlier version of the legal drafting was prepared to explicitly define an Electricity Storage Facility owned by an Electricity Storage Facility Owner, this was subsequently dropped following a Workgroup discussion on 24 October 2018 on the basis of simplifying the code and to ensure consistency with Ofgem's licensing arrangements in which storage should be treated in the same way as generation. The decision was taken at that meeting to simplify the legal drafting such that the definition of Electricity Storage was contained within the definition of Generator, Power Station and Power Generating Module. Whilst it is acknowledged that the code is not as clear as explicitly defining storage on a case by case basis, it does have the advantage that it significantly reduces the amount of Grid Code changes and the subsequent changes to other related Industry Codes.

For the purposes of this Workgroup, the main focus has concentrated on the Glossary and Definitions, European Connection Conditions and European Compliance Processes, with additional consequential amendments being made to the remaining sections of the code as the need arises.

Future Work

In the view of the Proposer, these elements represent the minimum set of definitions and requirements needed to facilitate parties who own Storage to connect to the transmission network in so far that they reflect equivalent definitions used for synchronous and non-synchronous generation technologies or demand where necessary.

In general, the updates to remining parts of the code are simply consequential changes as a result of changes to the Glossary and Definitions. In summary, the approach adopted is similar to that of Pumped Storage in which a Pumped Storage Generator has to meet all the specific requirements of a Generating Unit with specific requirements specified in respect of Pumped Storage where they are necessary.

In respect of Compliance, a Workgroup Member did raise the point as to how compliance would be demonstrated where you have a 'co-located' site (with, for example, both generation and storage or demand and storage at one site) and the Grid Code requirements were satisfied by a combination of the storage and generation. This issue has been addressed in the ECP's by specifically stating that compliance can be demonstrated through the combined capability of the storage and generating plant though demonstration on an individual basis (through their own capabilities) would be required where either the storage plant or generating plant was out of service if the party so wished to operate the co-located plant in that mode of operation. In addition, following the consultation, a question was raised with regard to the treatment of a pumped storage unit where the pumping function is completely independent of the generating function. Under the revised legal drafting the European Compliance Processes have been updated to

address this issue where the pumps will be treated as demand and the generation treated as generation.

In addition, one workgroup member noted that in a co-located site there were many permutations and combinations which could affect compliance, for example, where you have an existing Generator which had a Power Station comprising Generating Units or Power Park Modules which are caught by the requirements of the CC's and CP's and that Generator then wishes to connect a new Electricity Storage Module within that Power Station. In this case the Electricity Storage Module would be caught by the requirements of the ECC's and ECP's and compliance would have to assessed from this perspective. As a general point, NGESO would not wish to see new requirements applied to existing plant where there is no change to their plant and apparatus.

An example of these permutations and combinations are shown below in the following table.

ESS co-location cases	Requirement to meet ECC and ECP	Requirement to meet CC and CP
New Power Generating module and New ESS Module connected in a parallel connection	Both PGM and ESS have to demonstrate compliance cumulatively and individually if the plants are expected to operate independently	Not applicable
New Power Generating module and New ESS Module connected in a consolidated connection	Both PGM and ESS have to demonstrate compliance cumulatively and individually if the plants are expected to operate independently	Not applicable
Existing Power Generating Module with ION/FON and New ESS Module in a parallel connection[10]	Only new ESS based on its MW output (Type A, Type B, Type C or Type D) to demonstrate compliance individually	Existing Power Generating Module
Existing Power Generating Module with ION/FON and New ESS Module in a consolidated connection[11]	Only new ESS based on its MW output (Type A, Type B, Type C or Type D) to demonstrate compliance individually	Existing Power Generating Module

[10] Demonstration of cumulative compliance is dependent on market participation of ESSM e.g. capacity market or Firm Frequency Response

[11] Demonstration of cumulative compliance is dependent on market participation of ESSM e.g. capacity market or Firm Frequency Response

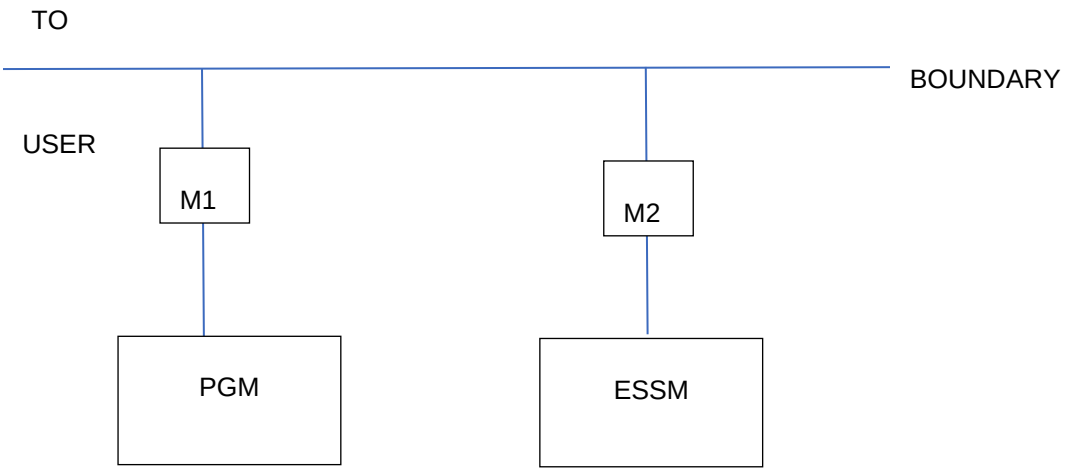


Figure 1. Consolidated connection

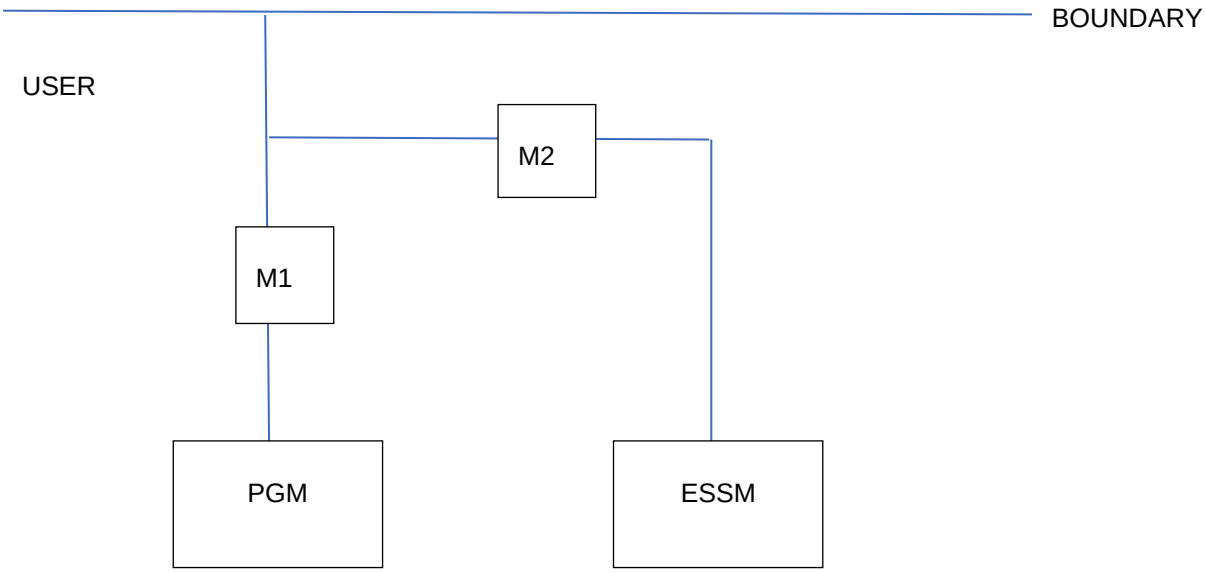


Figure 2. Parallel connection

As part of the Workgroup discussions, one Workgroup member noted that storage should have a requirement to cater for limiting power input with falling frequency and limiting power output with rising frequency and proposed the use of the following graph.

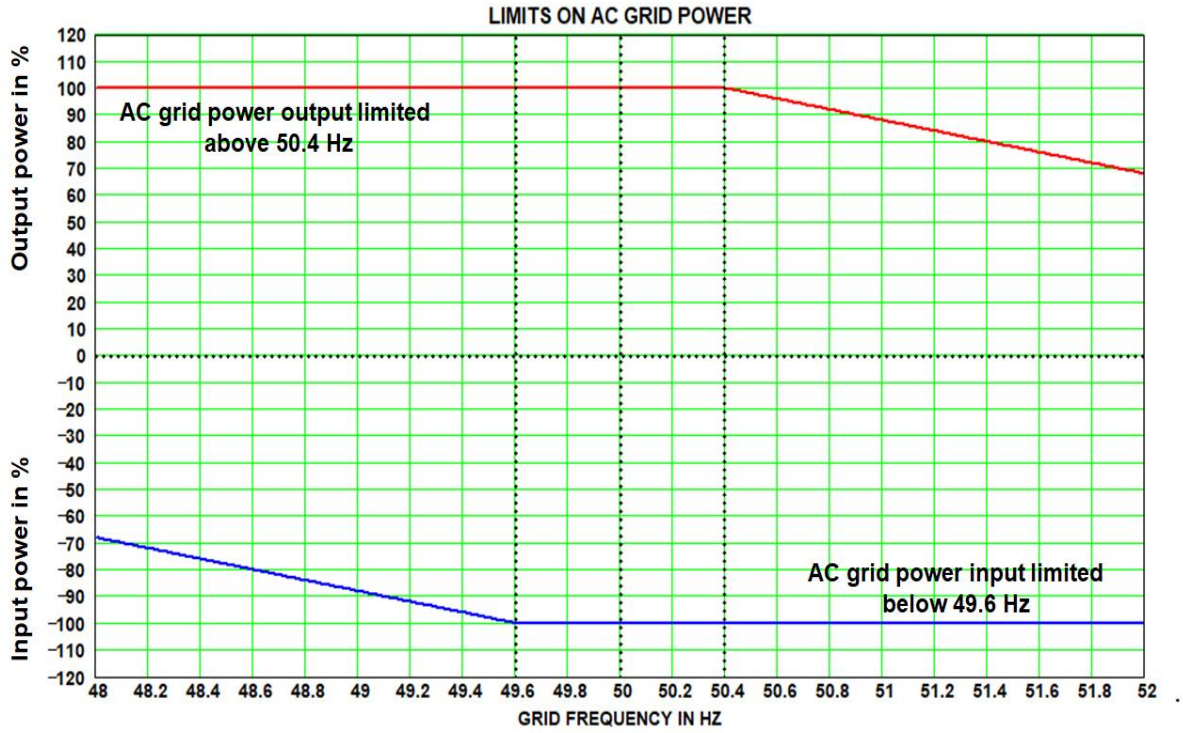


Figure 2.0

In addition, a Workgroup Member noted that as part of a future co-located site that it was entirely likely that an energy storage technology could be integrated as part of a solar park, wind farm or synchronous plant. Figure 3.0(a) and Figure 3.0(b) below (which have been re-produced in this report with the kind permission of ENTSO-E) illustrate this example for a wind farm or solar park.

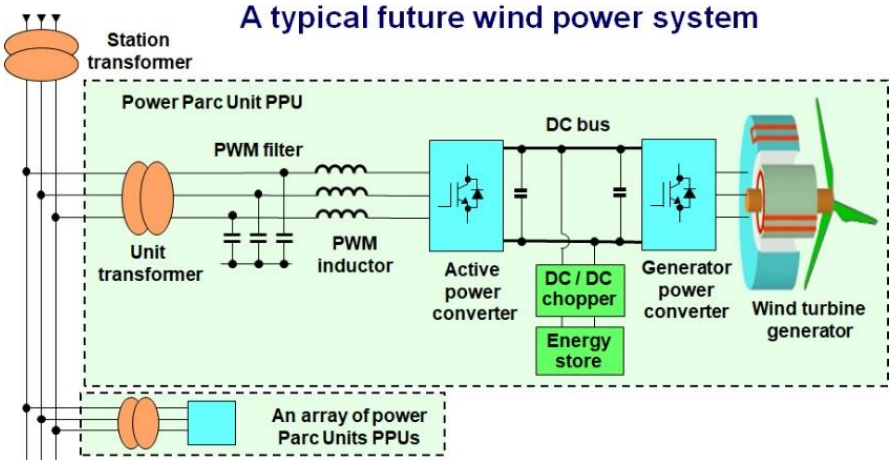


Figure 3.0 (a)

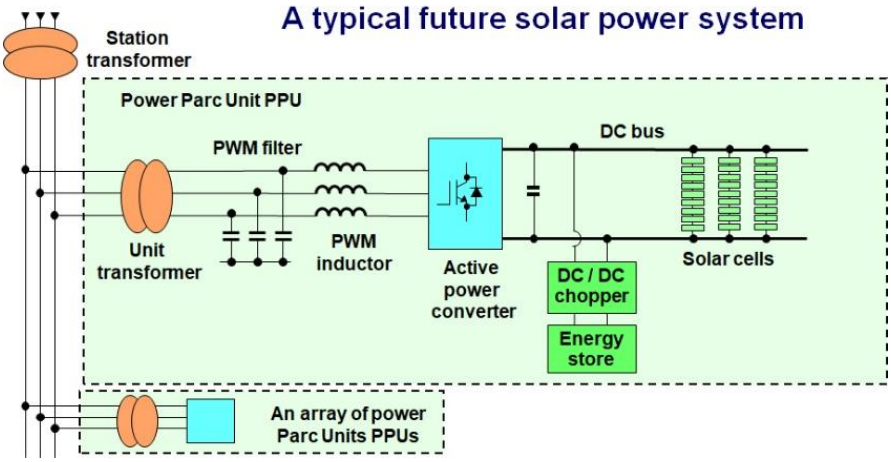


Figure 3.0 (b)

One Workgroup member noted that for wind farms and solar parks, the storage elements are not directly connected to the AC system and raised concern that they would not be required to satisfy the requirements of the GC0096 proposals. It was also noted that for rotating synchronous generators this is not so much of an issue.

In response, the Proposer would note that where you have a Power Station comprising of Power Park Modules and/or Electricity Storage Modules, the Grid Code applies to the Power Park Modules and Electricity Storage Modules within that Power Station.

In addition, the Proposer would note that as part of the GC0096 proposals, that when a storage element is operating in a condition analogous to demand, then there is a requirement for this demand to be reduced as frequency falls as defined under OC6.6, in just the same way as pump tripping as part of a pumped storage plant.

The Proposer would however note that the characteristic shown in Figure 2.0 may be more appropriate however as also pointed out by a workgroup member this requirement applies to generation equally as it applies to Storage. As such, and as the aim of the workgroup is to ensure consistent treatment between different classes of User's, this is an issue that should be highlighted as a future area of work as the implications of a change to generation affects a much greater audience.

As noted above, the three EU Network Codes (RfG, HVDC and DCC) specifically exclude storage, however it is unclear if Storage may be introduced as part of a future update to the suite of European Codes. Whilst the issues of Brexit may have an issue here, The Proposer is actively engaged with an Expert Group established by the European Stakeholder Committee for Grid Connection and advising them of the approach to storage adopted in GB. It is hoped this approach will reduce any European changes that may arise in the future.

Furthermore, data exchange requirements for Storage may need to be reviewed in order to consider changes needed to implement the System Operation Guideline (SOGL) the details of which are being addressed in a separate Grid Code modification proposal

(GC0106[12]). At this point, it is worth noting that as part of the EU Storage Connection Expert Group, the issues of SOGL are also outside the scope of that is group and would need be picked up at some future date.

Workgroup Consultation Question Review:

The Workgroup met to review the responses from the Workgroup Consultation. Below are the discussions that took place in relation to each question.

The full consultation responses can be found at Annex 4.

Q1 – Do you believe that GC0096 Original proposal or any potential alternative that you may wish to suggest better facilitates the Grid Code Objectives?

SSE's response stated that if the definitions are changed then the legal text could be simplified and therefore much of the additional draft legal text changes would be unnecessary. The Proposer highlighted that the definitions have been changed and potentially a mis-understanding has been made about the version used to provide the consultation response or the intention of what the draft legal text is looking to achieve. It was confirmed that there has not been a mis-understanding and the response provided is correct. What is important is to ensure that there is a level playing field and no discrimination between industry participants.

The Workgroup noted that the Authority had previously stated that Storage should be treated in the same way as Generation.

A Workgroup member highlighted that there are three conventional differences between storage and electrical generation. A different Workgroup member stated that Pump Storage is already in use today, so the technologies captured by GC0096 should be treated in the same way as Pump Storage is currently treated in the Grid Code.

The Proposer stated that the Grid Code as currently written, meant that some elements of Pump Storage would not apply to Electricity Storage. Given this, simply including Electricity Storage within the definition of Pump Storage would not be appropriate.

The Workgroup noted the responses and highlighted that the Proposer needs to make changes to the definitions to be clearer, and provide more transparency.

[12] https://www.nationalgrid.com/uk/electricity/codes/grid-code/modifications/data-exchange-requirements-accordance-regulation-eu-0

Q2 - Do you support the proposed implementation approach?

The Workgroup noted the consultation responses received in relation to how the proposed modification should be implemented. A Workgroup member raised that there needed to be a transitional period for the implementation of GC0096 given that this modification would affect projects that are currently live. The Proposer stated that the proposed implementation date was suggested earlier in the process and now it is clear this is unrealistic. A Workgroup member stated that they feel the Grid Code implementation date should be 10 working days after a decision is received from the Authority.

The Workgroup then discussed how GC0096 could be implemented practically. The Workgroup agreed that any party connecting to the transmission network should have a period in which to sign any main plant contracts, followed by a defined period to notify NGESO in order to be considered to have the existing Grid Code requirements apply to their site. The example used in the Workgroup was 10 working days from the Ofgem decision to sign any main plant contracts, followed by 20 working days to notify NGESO.

The Workgroup discussed having a period of 1 year from the Authority decision date (ie the date upon which contracts for main plant are signed and 1 year later when that plant connects to the NETS). This will allow parties to connect to the transmission network with little impact on existing or current projects.

It was proposed that industry parties that do not sign their main plant contract or notify NGESO within the time period (10 plus 20 (=30) working days after an Authority decision) or connect to the network with the defined period would be caught by the new requirements set out in GC0096.

A Workgroup member highlighted that a separate Workgroup is currently working on Fast Fault Current Injection (Grid Code modification GC0111). This Workgroup is looking to provide updated legal text to the European Connection Conditions. It was observed that a Battery provider may struggle to comply with the Fast Fault Current Injection requirements but it was noted that this modification applies to parties affected by the new GC0096 requirements. Since the GC0096 Consultation was held, there have been substantial updates to the GC0111 proposed text so there is not envisaged to be a conflict between the requirements on battery storage providers and the revised GC0111 requirements.

Q3 - Do you have any other comments?

The Workgroup reviewed the consultation responses. In particular, in relation to Drax's consultation response, the Proposer highlighted that with Storage there is finite capability.

It was highlighted by a Workgroup member that there may be an opportunity for industry participants to avoid GC0096 requirements depending upon the location of the storage on the site. The Workgroup member emphasised the importance that all storage is treated equally, regardless of how the site is configured.

The Workgroup discussed the definition of Intermittent Power Source and the Proposer agreed that clarification is required on the definition. The legal text has been updated to address this issue.

It was highlighted by a Workgroup member that there are concerns over the practicality of the draft solution and the participation from NETS Users. They queried how will GC0096 deal with mixed sites? It was agreed that the Proposer will clarify this and report back to the Workgroup which has been addressed for example through the treatment of pumped storage plant where the pumping elements are separate from the generating elements.

Q4 - Do you wish to raise a Workgroup Consultation Alternative request for the Workgroup to consider?

The Workgroup noted that there were no responses that stated they wished to raise a Workgroup Alternative Grid Code Modification.

Q5 – Do you agree with the proposed '<u>Electricity</u> Storage' definitions? Please provide your reasoning for your answer to this question. If you answered no, what would you include / amend / remove?

A Workgroup member noted that there have been amendments to the definition of Electricity Storage, including Pump Storage. It was agreed that for avoidance of doubt, Electricity Storage would have to comply with all other relevant aspects of the Grid Code.

It was noted by the Workgroup that there was a minor error in relation to the use of 'in a controllable manner'. The Proposer agreed to amend the draft legal text.

The Workgroup discussed amending the Offshore and Onshore Generating Unit definitions. The reason this change was suggested relates to the fact that under the current draft definition, suppliers may not be caught in all circumstances by the definition. However, the Workgroup suggested a change that will ensure all suppliers are caught as intended by GC0096.

Q6 – Do you agree with the decision to not define 'Energy Storage'? Please provide your reasoning for your answer to this question.

The Workgroup noted the consultation responses and agreed with the respondents that Energy Storage should not be defined.

Q7 – Do the proposed changes provide suitable flexibility for viable 'Electricity Storage' technologies and topologies? Or, do you feel these proposed changes limit the development of 'Electricity Storage' in any way or present barriers to entry (please provide supporting justification / evidence)?

The Workgroup noted the responses received and in particular in relation to ensuring that a level playing field is created.

Q8 - Do you believe new Pump Storage schemes should be incorporated into the proposed approach on 'Electricity Storage'? Please provide your reasoning for your answer to this question.

A Workgroup member highlighted that Pump Storage is included in the RfG and stated that any changes proposed through GC0096 need to ensure no further requirements are added in addition to the European Connection Codes. The Proposer agreed with this suggestion.

Q9 – Do you believe existing Pump Storage schemes should be incorporated into the proposed approach on 'Electricity Storage'. Please provide your reasoning for your answer to this question.

The Workgroup noted the consultation responses. The Workgroup agreed that existing plant should not be caught by the new proposals. The Proposer explained that if the proposal was applied to existing plant it was felt that this may be disadvantageous to the existing plant owners as they may suddenly have additional requirements to meet in order to be compliant. Therefore, GC0096 will not be retrospectively applied.

Q10 – Do you believe if the definition of Pumped Storage should be included within the definition of Electricity Storage. Please provide your reasoning for your answer to this question.

The Workgroup noted the consultation responses received which overall supported having Pumped Storage included within the definition of Electricity Storage. The Proposer agreed to update the draft legal text to reflect this, however as noted in the report, Pumped Storage is caught by the requirements of RfG whereas Electricity Storage is not. As a result, Pumped Storage has not been included in the definition of Electricity Storage but

the legal drafting has been clarified to ensure the requirements for pumped storage are equitable to Electricity Storage.

Q11 – Do you believe there are any unintended consequences behind these proposed changes, either within the Grid Code/D-Code, CUSC, BSC or elsewhere? Please provide your reasoning for your answer to this question.

The Workgroup noted that it was felt that there was a need for a Distribution Code change to be made in consequence of GC0096. A Workgroup member highlighted that the ENA have already created a Workgroup to address the required Distribution Code change.

A Workgroup member highlighted Northern Powergrid's response, which highlights an inconsistency between the Grid Code and Distribution Code. The Proposer stated that they believed the wording between the two codes is similar. It was agreed that the Proposer will contact Northern Powergrid to discuss this further.

Q12 – Do you believe that it is appropriate to apply the same approach to Storage Providers as adopted for Power Generating Modules? Please provide your reasoning for your answer to this question, in particular, if you answered no, please state why and what different approach should be adopted.

The Workgroup noted the consultation responses, which stated unanimously that they supported applying the same approach to Storage Providers as adopted for Power Generating Modules.

Q13 – Do you agree that it is appropriate to include Electricity Storage within the definition of Generation and its related terms. Please provide your reasoning for your answer to this question, in particular, if you answered no, please state why and what different approach should be explored.

The Workgroup noted the consultation responses, which unanimously agreed that Electricity Storage should be included within the definition of Generation and its related terms.

Q14 – Do you believe there are any other unintended consequences behind these proposed changes? Please provide your reasoning for your answer to this question.

The Workgroup noted the consultation responses, which stated that there were no unintended consequences behind the changes beyond the already highlighted Distribution Code change in question 11.

Q15 – Do you believe that it is appropriate to classify storage as an EU Code User with the premise that Generators who own or operate Electricity Storage Modules are explicitly excluded from satisfying the requirements of the EU Connection Codes and that they would not be enforceable under EU law. Please provide your

reasoning for your answer to this question. Do you believe that this exclusion is adequately defined in the proposed draft changes to the Grid Code legal text?

The Workgroup noted the responses and discussed this question. The Proposer agreed to confirm the position with the NGESO legal team and respond back to the Workgroup.

Q16 – Do you agree that it is appropriate to specify that these requirements are applicable from the date on which main plant items are procured rather than the Completion Date. Please provide your reasoning for your answer to this question, in particular, if you answered no, please state why you feel this is the case and if you believe there is a more appropriate solution.

The Workgroup noted the consultation responses, which stated that it is appropriate to specify that requirements are applicable from the date of which main plant items are procured and the date upon which the storage plant connects to the System. The Workgroup discussed when the requirements would be applicable during question 2, implementation and these comments have been reflected in the revised Legal drafting

Q17 – The current legal drafting is based on the proposed requirements being applicable based on a Storage User who had concluded Purchase Contracts for its Main Plant and Apparatus on or after 1 January 2019. This assumes implementation is based on the date main plant items are procured as noted in question 16, but do you have any preference for an implementation date. Bearing in mind the proposed changes are unlikely to be approved until mid 2019, a more appropriate date may be 1 January 2020. Do you support this implementation date? If not please state why and what alternative you believe would be more appropriate.

The Workgroup noted the consultation responses and referred back to the discussion in relation to question 2, implementation. An Authority decision for GC0096 would be anticipated in mid-2019.

Q18 – Do you believe that Electricity Storage Modules which form part of a License Exempt Embedded Medium Power Station (LEEMPS) are adequately catered for in these provisions and it is clear that a License Exempt Embedded Medium Power Station comprising of storage would be caught by the requirements in the Grid Code from the obligations in the Distribution Code.

The Workgroup has noted the consultation responses and believed this would not cause a major issue.

Q19 – Do you believe that the list of storage technologies shown in Annex 3 is sufficient or should some technologies be added or subtracted? Please provide your reasons for your answer to this question.

One Workgroup member highlighted they didn't find the list of storage options provided as part of the consultation was clear that it will be included in the Grid Code. The Proposer confirmed they would ensure it is clear that the list of storage options will be included into the Grid Code as part of GC0096 which has been included in the latest legal text based on the list provided by EASE (European Association for Storage of Energy).

The Proposer confirmed GC0096 is looking at active and reactive equipment, so in response to SSE's suggestion for StatCom and Static Synchronous Series Compensators to be included, the Proposer and Workgroup confirmed this shouldn't be included.

Legal Text Comments:

The Workgroup noted that a number of stakeholders included suggestions for amending the legal text. The Workgroup reviewed these suggested amendments. The Proposer confirmed that they had contacted stakeholders to discuss the outcome of this review. The Proposer confirmed he will then update the legal text for the Workgroup to review incorporating all of the changes that had been discussed.

5 Workgroup Consultation

The GC0096 Workgroup Consultation was issued on 07 December 2018 for 23 Working Days, with a close date of 11 January 2019. Fifteen additional questions to the four standard Workgroup consultation questions were asked, and the Workgroup reviewed these in Section 4.

Eight responses were received to the Workgroup Consultation which can be found in Annex 4.

6 Workgroup Vote

The Workgroup believe that the Terms of Reference have been fulfilled and GC0096 has been fully considered.

The Workgroup met on 13 March 2019 and voted on whether the Original would better facilitate the Applicable Grid Code Objectives than the baseline and what option was best overall.

The Workgroup voted against the Applicable Grid Code Objectives for the Original Proposal. The Workgroup agreed unanimously that the Original was better that the baseline. The voting record is detailed below.

Workgroup Member	**Better facilitates AGCO (i)**	**Better facilitates AGCO (ii)?**	**Better facilitates AGCO (iii)?**	**Better facilitates AGCO (vi)?**	**Better facilitates AGCO (v)?**	**Overall (Y/N)**
Garth Graham						
Original	Y	Y	Y	-	-	Y
Voting Statement: Including arrangements for Storage within the Grid Code will facilitate the development of the transmission system by allowing for that technology to know what is required of them when connecting. It will also, as a result, facilitate competition by allowing for more parties (in this case Storage) to offer services. Finally, it will facilitate the promotion of security and efficiency of the system.						
Antony Johnson						
Original	Y	Y	Y	Y	Y	Y
Voting Statement: Supportive on the basis that it provides clarity to developers, treats storage equitably with other users and contributes to the safe, secure and economic design and operation of the Transmission System						
Andy Vaudin						
Original	Y	Y	Y	-	Y	Y
Voting Statement: The Original Proposal facilitates the Grid Code objectives						
Nick Rubin						

Original	Abstained from voting					
Voting Statement: ** ABSTAINED**						
Isaac Gutierrez						
Original	Y	Y	Y	Y	Y	Y
Voting Statement: This modification defines clearly the technical requirements for electricity storage systems.						
Ahmed Shafiu						
Original	Y	Y	Y	-	Y	Y
Voting Statement: The RFG excludes storage and hence my decision to vote neutral on objective 4. It is however noted that OFGEM and NGET have given clarification of their views (from a legal point of view) on this point to the work group members. The proposal overall achieves the objective set forth for the working group.						
Eric Lewis						
Original	Y	Y	Y	Y	Y	Y
Voting Statement: I fully support the results of the GC0096 Workgroup. In the future storage facilities, can be included with **Generation** equipment in ways that are not covered by GC0096 as these storage facilities do not have a direct grid connection. The effect of this can result in **Generation** equipment that is dominantly exporting power but that can also operate to import power. Due to this Enstore considers that a change is needed to the Generation grid code that makes the following change “For the avoidance of doubt Generators are also required to satisfy the requirements of OC.6.6.6”.						

Vote 2: Which option is best?

Workgroup Member	BEST Option?
Garth Graham – SSE	Original
Antony Johnson - NGESO	Original
Andy Vaudin – EDF	Original
Nick Rubin – Elexon	Abstained
Isaac Gutierrez – Scottish Power	Original
Ahmed Shafiu - Siemens	Original
Eric Lewis - Enstore	Original

7 Relevant Objectives

Below sets out the Proposer's view in relation to how the proposed modification impacts on the Applicable Grid Code Objectives:

Impact of the modification on the Applicable Grid Code Objectives:

Relevant Objective	Identified impact
(a) To permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity	Positive
(b) 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);	Positive
(c) 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;	Positive
(d) 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	Neutral
(e) To promote efficiency in the implementation and administration of the Grid Code arrangements	Neutral

8 Implementation

The Workgroup discussed how GC0096 could be implemented practically. The Workgroup agreed that any party connecting to the Transmission System should have a period in which to sign any main plant contracts, followed by a defined period to notify NGESO in order to be considered to have the existing Grid Code requirements apply to their site.

The Workgroup therefore agreed that the implementation for GC0096 would be ten (10) working days after an Authority decision to approve. From that date, parties would also have needed to sign any main plant contracts. Having signed those contracts parties would have the following twenty (20) working days to notify NGESO of those said contracts.

The Workgroup agreed that a period of 1 year; from the Authority decision date on GC0096; would be allowed for the affected parties to bear required to have connected to the (NETS) for the existing (baseline, pre GC0096) Grid Code requirements to apply.

It was agreed that industry parties that do not sign their main plant contract within ten (10) working days of an Authority decision to approve GC0096, or fail to notify NGESO within thirty (30) working days from the Authority decision, or fail to connect to the network within 1 year of the Authority decision would be caught by the new requirements set out in GC0096.

The Workgroup agreed for the implementation of GC0096 to be clear, they ask the Authority to instruct the Code Administrator to input their decision date and 1 year thereafter for connection to replace DDMMYY in the definition of EU Code User to ensure it is clear for Users to understand when the requirements of GC0096 would apply.

For the avoidance of doubt, the actual legal text changes arising from GC0096 would be implemented into the Grid Code ten working days after an Authority decision to approve GC0096.

8 Legal Text

The proposed legal text weblink can be found in Annex 1 below.

Annex 1 - Legal Text

The legal text can be found at the following link:

https://www.nationalgrideso.com/codes/grid-code/modifications/gc0096-energy-storage

Annex 2 – Terms of Reference

nationalgrid

Workgroup Terms of Reference and Membership

TERMS OF REFERENCE FOR GC0096 WORKGROUP

This proposal seeks to modify the Grid Code to define the appropriate technical requirements for Storage technologies connecting to the Transmission system and associated changes to the Grid Code requirements for making a connection.

Responsibilities

1. The Workgroup is responsible for assisting the Grid Code Review Panel in the evaluation of Grid Code Modification Proposal **GC0096 – Energy Storage,** submitted by Patrick Cassels (Robert Wilson Alternate Proposer) at the Grid Code Review Panel meeting on 18 May 2016.

2. The proposal must be evaluated to consider whether it better facilitates achievement of the Grid Code Objectives. These can be summarised as follows:

   (i) To permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity;

   (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);

   (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; and

   (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. In conducting its business, the Workgroup will at all times endeavour to operate in a manner that is consistent with the Code Administration Code of Practice principles.

Scope

3. The Workgroup must consider the issues raised by the Modification Proposal and consider if the proposal identified better facilitates achievement of the Grid Code Objectives.

4. In addition to the overriding requirement of point 3 above, the Workgroup **shall** consider and report on the following specific issues:

   a) Workgroup meeting one: “Definitions” We will determine which Storage categories shall be the focus of the workgroup; either “Energy Storage” or “Electricity Storage”, or both. Once agreed, we will form a high-level working definition (noting the link to the BEIS/Ofgem call for evidence) to set the context for delivering the next workgroup deliverables. We will also consider how this definition links with existing Transmission Generation or Demand users looking to co-locate with Storage.

b) Workgroup meeting two-to-three – "Technical and Planning Requirements" We will form the minimum Grid Code technical requirements applicable to Storage equipment defined above - either via a stand-alone connection or co-located with an existing user, ensuring consistency and transparency with other classes of Transmission System user.
c) Workgroup meeting four – "Structure" consideration of how (or if), the outcomes from the previous workgroup meetings need to be structured in the Grid Code via legal text changes.
d) Workgroup meeting five – "Next steps" this will be an open attendance meeting allowing a full review of the outputs from the previous workgroups to confirm what will be written up in reports/consultations to progress any Grid Code mod proposals. It will also check the outcomes of GC0096 against the BEIS/Ofgem call for evidence published outcomes (if available) This meeting will also set out what additional arrangements (see 'Out of Scope' below) may need to be considered in other GB frameworks to support Storage, and recommend items for escalation if not currently being considered.

The scope of the Workgroup **shall not** include:

a) Charging arrangements for Storage; network charging is defined in other GB codes
b) Commercial services for Storage; whilst the Grid Code sets certain technical requirements to deliver response services, the delivery of services is discharged via contractual agreements. This includes procedures to facilitate Aggregation and virtual Power Plants
c) Connection requirements for Distribution Code; however, we will coordinate with the DCRP and our DNO colleagues to ensure that GC0096 proposals are compatible

5. As per Grid Code GR20.8 (a) and (b) the Workgroup should seek clarification and guidance from the Grid Code Review Panel when appropriate and required.

6. The Workgroup is responsible for the formulation and evaluation of any Workgroup Alternative Grid Code Modifications arising from Group discussions which would, as compared with the Modification Proposal or the current version of the Grid Code, better facilitate achieving the Grid Code Objectives in relation to the issue or defect identified.

7. The Workgroup should become conversant with the definition of Workgroup Alternative Grid Code Modification (WACM) which appears in the Governance Rules of the Grid Code. The definition entitles the Group and/or an individual member of the Workgroup to put forward a Workgroup Alternative Code Modification proposal if the member(s) genuinely believes the alternative proposal compared with the Modification Proposal or the current version of the Grid Code better facilitates the Grid Code objectives The extent of the support for the Modification Proposal or any Workgroup Alternative Modification (WACM) proposal WACM arising from the Workgroup's discussions should be clearly described in the final Workgroup Report to the Grid Code Review Panel.

8. Workgroup members should be mindful of efficiency and propose the fewest number of WACM proposals as possible. All new alternative proposals need to be proposed using the Alternative request Proposal form ensuring a reliable source of information for the Workgroup, Panel, Industry participants and the Authority.

9. All WACM proposals should include the Proposer(s)'s details within the final Workgroup report, for the avoidance of doubt this includes WACM proposals which are proposed by the entire Workgroup or subset of members.

10. There is an option for the Workgroup to undertake a period of Consultation in accordance with Grid Code GR. 20.11, if defined within the timetable agreed by the Grid Code Panel.

Should the Workgroup determine that they see the benefit in a Workgroup Consultation being issued they can recommend this to the Grid Code Review Panel to consider.

11. Following the Consultation period the Workgroup is required to consider all responses including any Workgroup Consultation Alternative Requests. In undertaking an assessment of any Workgroup Consultation Alternative Request, the Workgroup should consider whether it better facilitates the Grid Code Objectives than the current version of the Grid Code.

12. As appropriate, the Workgroup will be required to undertake any further analysis and update the appropriate sections of the original Modification Proposal and/or WACM proposals (Workgroup members cannot amend the original text submitted by the Proposer of the modification) All responses including any Workgroup Consultation Alternative Requests shall be included within the final report including a summary of the Workgroup's deliberations and conclusions. The report should make it clear where and why the Workgroup chairman has exercised their right under the Grid Code to progress a Workgroup Consultation Alternative Request or a WACM proposal against the majority views of Workgroup members. It should also be explicitly stated where, under these circumstances, the Workgroup chairman is employed by the same organisation who submitted the Workgroup Consultation Alternative Request.

13. The Workgroup is to submit its final report to the Modifications Panel Secretary on 09 October 2018 for circulation to Panel Members. The final report conclusions will be presented to the Grid Code Review Panel meeting on 17 October 2018.

Membership

It is recommended that the Workgroup has the following members:

Role	Name	Representing (User nominated)
Chair	Christine Brown/ Teresa Thompson	Code Administrator
Technical Secretary	Lurrentia Walker	Code Administrator
National Grid Representative/Proposer	Robert Wilson	National Grid Electricity Transmission
Industry Representative	Anthony Johnson	National Grid
Industry Representative	Ahmed Shafiu	Siemens
Industry Representative	Ander Madariaga	Offshore Renewable Energy Catapult
Industry Representative	Chinglai Hor	Fitchner Consulting Engineers
Industry Representative	Chris Smith	Innogy
Industry Representative	David Lyon	Frontier Power
Industry Representative	David Spillett	ENA
Industry Representative	Eric Lewis	Enstore
Industry Representative	Garth Graham	SSE
Industry Representative	Harry Vickers	Camborne Energy Storage
Industry Representative	Herve Biellmann	GE
Industry Representative	Hui Heng	SSE
Industry Representative	Lisa Waters	Waterswye
Industry Representative	Marc Smeed	Xero Energy
Industry Representative	Matthew White	UK Power Networks
Industry Representative	Mick Barlow	S & C
Industry Representative	Paul Graham	UK Power Reserve
Industry Representative	Razvan Pabat	SP Energy Network
Industry Representative	Rui Rui	Scottish Power
Authority Representative	Shilen Shah	Ofgem
Industry Representative	Sridhar Sahukari	DONG
Industry Representative	Tim Ellingham	RWE

14. A (*) Workgroup must comprise at least 5 members (who may be Panel Members). The roles identified with an asterisk(*) in the table above contribute toward the required quorum, determined in accordance with paragraph 15 below.

15. The Grid Code Review Panel must agree a number that will be quorum for each Workgroup meeting. The agreed figure for GC0096 is that at least 5 Workgroup members must participate in a meeting for quorum to be met.

16. A vote is to take place by all eligible Workgroup members on the Modification Proposal and each WACM proposal and Workgroup Consultation Alternative Request based on their assessment of the Proposal(s) against the Grid Code objectives when compared against the current Grid Code baseline.

    - Do you support the Original or any of the alternative Proposals?
    - Which of the Proposals best facilitates the Grid Code Objectives?

    The Workgroup chairman shall not have a vote, casting or otherwise.

    The results from the vote and the reasons for such voting shall be recorded in the Workgroup report in as much detail as practicable.

17. It is expected that Workgroup members would only abstain from voting under limited circumstances, for example where a member feels that a proposal has been insufficiently developed. Where a member has such concerns, they should raise these with the Workgroup chairman at the earliest possible opportunity and certainly before the Workgroup vote takes place. Where abstention occurs, the reason should be recorded in the Workgroup report.

18. Workgroup members or their appointed alternate are required to attend a minimum of 50% of the Workgroup meetings to be eligible to participate in the Workgroup vote.

19. The Technical Secretary shall keep an Attendance Record for the Workgroup meetings and circulate the Attendance Record with the Action Notes after each meeting. This will be attached to the final Workgroup report.

20. The Workgroup membership can be amended from time to time by the Grid Code Review Panel and the Chairman of the Workgroup.

Annex 3 – List of Storage Technologies

- Chemical
    - Ammonia
    - Hydrogen
    - Synthetic Fuels
    - Drop-in Fuels
    - Methanol
    - Synthetic Natural Gas
- Electrical
    - Supercapacitors
    - Superconducting Magnetic ES (SMES)
    - Mechanical
        - Adiabatic Compressed Air
        - Diabatic Compressed Air
        - Liquid Air Energy Storage
        - Pumped Hydro
        - Flywheels
    - Thermal
        - Latent Heat Storage
        - Thermochemical Storage
        - Sensible Heat Storage
    - Electrochemical
        - Classic Batteries
            - Lead Acid
            - Lithium Polymer (Li-Polymer)
            - Metal Air
            - Nickle Cadmium (Ni-Cd)
            - Sodium Nickle Chloride (Na-$NiCl_2$)
            - Lithium Ion (Li–ion)
            - Sodium Ion (Na–ion)
            - Lithium Sulphur (Li-S)
            - Sodium Sulphur (Na-S
            - Nickle – Metal Hydride (Ni-MH)

Flow Batteries

- Vanadium Red- Oxide
- Zinc – Iron (Zn – Fe)
- Zinc – Bromine (Zn – Br)

Other

Annex 4 – Workgroup Consultation Responses

VGrid Code Workgroup Consultation Response Proforma

GC0096 - Storage

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 by **5pm** on **11 January 2019** to grid.code@nationalgrid.com. Please note that any responses received after the deadline or sent to a different email address may not receive due consideration by the Workgroup.

Any queries on the content of the consultation should be addressed to Emma Hart at Emma.Hart@nationalgrid.com

Respondent:	*Gregory Heavens*
Company Name:	*National Grid Electricity Transmission plc*
Please express your views regarding the Workgroup Consultation, including rationale. **(Please include any issues, suggestions or queries)**	As the proposer, we support this modification. The inclusion of storage in the Grid Code will provide certainty to Users as to the necessary technical requirements for new storage plant and apparatus.

Standard Workgroup Consultation questions

Q	Question	Response
1	Do you believe that GC0096 Original proposal or any potential alternative that you may wish to suggest better facilitates the Grid Code Objectives?	We believe that this modification proposal is positive against objectives i, ii, iii and v, and is neutral against objective iv.
2	Do you support the proposed implementation approach?	Yes. The addition of a date in bullet (j) of EU Code user, which we note will change from 01/01/19 (possibly as a result of the governance process as noted in Question 17 below), will give certainty to parties connecting new storage apparatus as to when the requirements become binding.
3	Do you have any other comments?	No

4	Do you wish to raise a Workgroup Grid Code Alternative Request for the Workgroup to consider?	No

Specific GC00096 questions

Q	Question	Response
5	Do you agree with the proposed 'Electricity Storage' definitions? Please provide your reasoning for your answer to this question. If you answered no, what would you include / amend / remove?	Yes, the definitions of Electricity Storage proposed should ensure that the modification applies to the correct technologies. This aligns with the definition of Storage that Ofgem use in the consultation on Storage Licensing: https://www.ofgem.gov.uk/publications-and-updates/clarifying-regulatory-framework-electricity-storage-licensing
6	Do you agree with the decision to not define 'Energy Storage'? Please provide your reasoning for your answer to this question.	Yes, the attempt to define this term could introduce unforeseen consequences and capture more Plant and Apparatus than the modification intends. E.g. energy converted into heat that is not intended to be converted back into electricity.
7	Do the proposed changes provide suitable flexibility for viable 'Electricity Storage' technologies and topologies? Or, do you feel these proposed changes limit the development of 'Electricity Storage' in any way or present barriers to entry (please provide supporting justification / evidence)?	Yes, by defining in terms of energy conversion the definitions are future proof against innovations for new configurations.
8	Do you believe new Pump Storage schemes should be incorporated into the proposed approach on 'Electricity Storage'? Please provide your reasoning for your answer to this question.	Yes, as far as possible the Grid Code should aim for consistent treatment of alike technologies.

9	Do you believe existing Pump Storage schemes should be incorporated into the proposed approach on 'Electricity Storage'. Please provide your reasoning for your answer to this question.	The modification has not considered retrospectivity, will only apply to new equipment from a certain date. As it is unlikely that changing the technical requirements upon existing pumped storage hydro plant could demonstrate a positive cost benefit, we do not believe this would be appropriate.
10	Do you believe if the definition of Pumped Storage should be included within the definition of Electricity Storage. Please provide your reasoning for your answer to this question.	Yes, as far as possible the Grid Code should aim for consistent treatment of alike technologies going forward.
11	Do you believe there are any unintended consequences behind these proposed changes, either within the Grid Code/D-Code, CUSC, BSC or elsewhere? Please provide your reasoning for your answer to this question.	No, the definition of Electricity storage as part of a power station should mitigate the need for a CUSC modification. We note the in progress BSC modifications P363364, the proposed solution of which (at the time of writing) will enable Electricity Storage as defined here to participate in the BM as standard BMUs.
12	Do you believe that it is appropriate to apply the same approach to Storage providers as adopted for Power Generating Modules? Please provide your reasoning for your answer to this question, in particular, if you answered no, please state why and what different approach should be adopted.	Yes, as far as possible the Grid Code should aim for consistent treatment of alike technologies.
13	Do you agree that it is appropriate to include Electricity Storage within the definition of Generation and its related terms. Please provide your reasoning for your answer to this question, in particular, if you answered no, please state why and what different approach should be explored.	Yes, the definition of Electricity Storage as part of a power station should mitigate the need for a CUSC modification.

14	Do you believe there are any other unintended consequences behind these proposed changes? Please provide your reasoning for your answer to this question.	No
15	Do you believe that it is appropriate to classify storage as an EU Code User with the premise that Generators who own or operate Electricity Storage Modules are explicitly excluded from satisfying the requirements of the EU Connection Codes and that they would not be enforceable under EU law. Please provide your reasoning for your answer to this question. Do you believe that this exclusion is adequately defined in the proposed draft changes to the Grid Code legal text?	Yes, as far as possible the Grid Code should aim for consistent treatment of alike technologies. The Grid Code reflects the obligations from the European Network Codes due to previous Modifications GC100-102; but applies because the NETSO is required to have a Grid Code as part of the transmission licence, and CUSC parties are required to follow the relevant parts of the Grid Code as part of their Contract/Licenses. The obligations of the Grid Code are enforceable via the Electricity Act 1989 as non-compliance can be considered as a breach of license. Though we expect a forthcoming European Network Code on Storage, we believe it is right to include storage in the Grid Code ahead of this as it allows for Consistent and Transparent connection offers sooner.
16	Do you agree that it is appropriate to specify that these requirements are applicable from the date on which main plant items are procured rather than the Completion Date. Please provide your reasoning for your answer to this question, in particular, if you answered no, please state why you feel this is the case and if you believe there is a more appropriate solution.	Yes. Specifying when these requirements are applicable from will give certainty to parties connecting new storage apparatus as to when the requirements become binding.
17	The current legal drafting is based on the proposed requirements being applicable based on a Storage User who had concluded Purchase Contracts for its Main Plant and Apparatus on or after 1 January 2019. This assumes implementation is based on the date main plant items are procured as noted in question	Yes, we support an implementation date of 01/01/2020. We are also willing to consider a different implementation date that can be determined as suitable and included in the Code Administrator consultation. Parties connecting before this time can be given the choice to follow the Grid Code as published when they concluded Purchase Contracts or the Grid Code as modified by this solution.

	16, but do you have any preference for an implementation date. Bearing in mind the proposed changes are unlikely to be approved until mid 2019, a more appropriate date may be 1 January 2020. Do you support this implementation date? If not please state why and what alternative you believe would be more appropriate.	
18	Do you believe that Electricity Storage Modules which form part of a License Exempt Embedded Medium Power Station (LEEMPS) are adequately catered for in these provisions and it is clear that a License Exempt Embedded Medium Power Station comprising of storage would be caught by the requirements in the Grid Code from the obligations in the Distribution Code.	Yes, there is no change in the applicability of the Grid Code. Those who must, or choose, to follow the requirements of the Grid Code must still comply with its appropriate provisions. While those stations who are not required to follow the Grid Code, by capacity, connection point or license, are not obligated to by this modification.
19	Do you believe that the list of storage technologies shown in Annex 3 is sufficient or should some technologies be added or subtracted? Please provide your reasons for your answer to this question.	We believe that the list of technologies set out in Annex 3 is sufficient for the consultation. We do not believe that this list should be referenced or replicated in the Grid Code as it could be perceived to limit innovation or require updating, instead the proposed definition of Electricity Storage should be relied upon.
	Legal text comments	
	If you believe there are issues in the legal text, can you please bring these to our attention by using the space provided on the response proforma. These will then be discussed at the next Workgroup, following the closure of this Consultation.	

Grid Code Workgroup Consultation Response Proforma

GC0096 - Storage

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 by **5pm** on **11 January 2019** to grid.code@nationalgrid.com. Please note that any responses received after the deadline or sent to a different email address may not receive due consideration by the Workgroup.

Any queries on the content of the consultation should be addressed to Emma Hart at Emma.Hart@nationalgrid.com

Respondent:	*Alan Creighton*
Company Name:	*Northern Powergrid*
Please express your views regarding the Workgroup Consultation, including rationale. **(Please include any issues, suggestions or queries)**	

Standard Workgroup Consultation questions

Q	Question	Response
1	Do you believe that GC0096 Original proposal or any potential alternative that you may wish to suggest better facilitates the Grid Code Objectives?	*For reference the applicable Grid Code objectives are:* *(i) to permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity;* Positive *(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);*

		Positive *(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;* Positive *(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; and* Neutral *(v) To promote efficiency in the implementation and administration of the Grid Code arrangements.* Neutral
2	Do you support the proposed implementation approach?	Yes
3	Do you have any other comments?	Our comments are provided below.
4	Do you wish to raise a Workgroup Grid Code Alternative Request for the Workgroup to consider?	No

Specific GC00096 questions

Q	Question	Response
5	Do you agree with the proposed 'Electricity Storage' definitions? Please provide your reasoning for your answer to this question. If you answered no, what would you include / amend / remove?	Yes, in principle, although the definitions do seem to be more confusing than they need to be. Our view is that these definitions could probably be simplified in such a way as to add clarity and reduce confusion. We have included examples and suggested text in the version of the Glossary and Definitions which forms part of our consultation response.
6	Do you agree with the decision to not define 'Energy	Yes. The technical requirements that the GCode relate to electrical energy.

	Storage'? Please provide your reasoning for your answer to this question.	
7	Do the proposed changes provide suitable flexibility for viable 'Electricity Storage' technologies and topologies? Or, do you feel these proposed changes limit the development of 'Electricity Storage' in any way or present barriers to entry (please provide supporting justification / evidence)?	The proposed changes currently seem appropriate.
8	Do you believe new Pump Storage schemes should be incorporated into the proposed approach on 'Electricity Storage'? Please provide your reasoning for your answer to this question.	Possibly, depending on whether the EU requirements for Electricity Storage, being developed the EU expert group, are expected to align with the existing requirements for Pumped Storage.
9	Do you believe existing Pump Storage schemes should be incorporated into the proposed approach on 'Electricity Storage'. Please provide your reasoning for your answer to this question.	It seems unreasonable for an existing Pump Storage scheme to be required to comply with any retrospectively requirements unless demonstrated to be reasonable via a CBA.
10	Do you believe if the definition of Pumped Storage should be included within the definition of Electricity Storage. Please provide your reasoning for your answer to this question.	See our response to Question 8.
11	Do you believe there are any unintended consequences behind these proposed changes, either within the Grid Code/D-Code, CUSC, BSC or elsewhere? Please provide your reasoning for your answer to this question.	There are consequences for the DCode that will need to be addressed by the DCRP in due course. 1. A DCode modification will be required to collect, for new Electricity Storage connections, the information that NGET propose is included in our Week 24 submission. This information is not currently collected for existing storage facilities and the GCode needs to be drafted to reflect this. 2. The GCode proposal is to require Electricity Storage Modules to comply with EU codes,

		whereas whilst the DCode specifically includes storage in the definition of generation, it excludes the need to comply with some of the EU code requirements. Hence there would be an inconsistency re the technical requirements for transmission and distribution connected storage facilities which needs to be addressed.
12	Do you believe that it is appropriate to apply the same approach to Storage providers as adopted for Power Generating Modules? Please provide your reasoning for your answer to this question, in particular, if you answered no, please state why and what different approach should be adopted.	Yes. Storage is either generation or demand at an instant in time. It cannot be both together. Therefore it should treated, as far as possible, with complete parity in respect of technical requirements in the GCode with the existing requirement for generation and demand. However we note that there are some aspects of the ECC where Electricity Storage Modules seem to be treated as an importing HVDC module rather than demand – clarity in this area would be beneficial.
13	Do you agree that it is appropriate to include Electricity Storage within the definition of Generation and its related terms. Please provide your reasoning for your answer to this question, in particular, if you answered no, please state why and what different approach should be explored.	Yes. Same reason as Q12 above.
14	Do you believe there are any other unintended consequences behind these proposed changes? Please provide your reasoning for your answer to this question.	Please see our response to Question 11.
15	Do you believe that it is appropriate to classify storage as an EU Code User with the premise that Generators who own or operate Electricity Storage Modules are explicitly excluded from satisfying the requirements of the EU Connection Codes and that they would not be enforceable under EU law. Please provide	This is probably reasonable as the ECCs generally relate to new connections, although as the consultation makes clear, at the moment Electricity Storage Modules do not need to comply with EU Code requirements. We recognise that there is a point of view that this was an oversight in the EU drafting process that is being reviewed. However by drafting the GCode as proposed Electricity Storage Modules will need to comply with the ECCs and hence the EU Codes.

	your reasoning for your answer to this question. Do you believe that this exclusion is adequately defined in the proposed draft changes to the Grid Code legal text?	The WG report should explain why this approach is reasonable if only because it is different to the approach in the DCode, where an Electricity Storage Modules does not need to comply with all the EU Code requirements. It might be helpful to clarify those ECC requirements that wouldn't be enforceable by EU law.
16	Do you agree that it is appropriate to specify that these requirements are applicable from the date on which main plant items are procured rather than the Completion Date. Please provide your reasoning for your answer to this question, in particular, if you answered no, please state why you feel this is the case and if you believe there is a more appropriate solution.	Yes – developers of Electricity Storage Modules need clarity and sufficient time to implement the requirements. Depending on the progress of this Modification Proposal, we agreed that the suggested 1 Jan 2019 date may need to be deferred. At the moment the definition of Main Plant and Apparatus does not relate to Electricity Storage Modules; this needs to be addressed.
17	The current legal drafting is based on the proposed requirements being applicable based on a Storage User who had concluded Purchase Contracts for its Main Plant and Apparatus on or after 1 January 2019. This assumes implementation is based on the date main plant items are procured as noted in question 16, but do you have any preference for an implementation date. Bearing in mind the proposed changes are unlikely to be approved until mid 2019, a more appropriate date may be 1 January 2020. Do you support this implementation date? If not please state why and what alternative you believe would be more appropriate.	Please see our response to Question 16.
18	Do you believe that Electricity Storage Modules which form	LEEMPS are covered explicitly in section 2.8 of EREC G99 and EREC G99 already also explicitly

	part of a Licence Exempt Embedded Medium Power Station (LEEMPS) are adequately catered for in these provisions and it is clear that a Licence Exempt Embedded Medium Power Station comprising of storage would be caught by the requirements in the Grid Code from the obligations in the Distribution Code.	includes electricity storage as generation. There would be a need to check that that proposed GCode definitions don't affect this existing linkage.
19	Do you believe that the list of storage technologies shown in Annex 3 is sufficient or should some technologies be added or subtracted? Please provide your reasons for your answer to this question.	It is probably sufficient for the time being. To be consistent with the rest of this list each battery technology should be listed as a separate line. However, as mentioned in our response to Qun 11 DNOs would be unable to comply with the requirement as drafted. We have included suggested text in the version of the Planning Code which forms part of our consultation response.
	Legal text comments	
	If you believe there are issues in the legal text, can you please bring these to our attention by using the space provided on the response proforma. These will then be discussed at the next Workgroup, following the closure of this Consultation.	Please see the attached versions of the proposed legal text which form an integral part of our consultation response: Glossary and Definitions Planning Code European Connection Conditions European Compliance Process Operating Code 6 Operating Code 9

Grid Code Workgroup Consultation Response Proforma

GC0096 - Storage

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 by **5pm** on **11 January 2019** to grid.code@nationalgrid.com. Please note that any responses received after the deadline or sent to a different email address may not receive due consideration by the Workgroup.

Any queries on the content of the consultation should be addressed to Emma Hart at Emma.Hart@nationalgrid.com

Respondent:	Alastair Frew Alastair.Frew@drax.com
Company Name:	Drax Generation Enterprise Ltd
Please express your views regarding the Workgroup Consultation, including rationale. **(Please include any issues, suggestions or queries)**	

Standard Workgroup Consultation questions

Q	Question	Response
1	Do you believe that GC0096 Original proposal or any potential alternative that you may wish to suggest better facilitates the Grid Code Objectives?	*For reference the applicable Grid Code objectives are:* *(i) to permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity;* *(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); *(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;* *(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; and* *(v) To promote efficiency in the implementation and administration of the Grid Code arrangements.*
2	Do you support the proposed implementation approach?	Yes in principle but this appear to be adding lots of similar definitions, but this can be dealt with see answer 5. Also there is an assumption a storage unit and a generating unit will always be the same plant item
3	Do you have any other comments?	The definition of Intermittent Power Source is being changed to include "(excluding Electricity Storage Modules)", does this mean that adding a battery to an Intermittent Power Source immediately removes any relaxation on this plant response requirements, although the battery may be of limited size? Also in the ECC and ECP at various places the phrase "and in the case of an Electricity Storage Module allowance will be made for the storage capability of the Electricity Storage Module." is used, the question is what allowance will be made and does this need to be made more explicit.
4	Do you wish to raise a Workgroup Grid Code Alternative Request for the Workgroup to consider?	
5	Do you agree with the proposed 'Electricity Storage' definitions? Please provide your reasoning for your answer to this question. If you answered no, what would you include / amend / remove?	No, this proposal appears to be taking 2 parallel approaches which a leading to multiple definitions covering the same item, on one hand the existing generator definitions are being modified to include storage units, and on the one hand new storage definitions are being added in parallel to the existing generator definitions which have just been modified. To demonstrate this table 1 shows how

		the proposed definitions interact with each other and the existing definitions. The table starts at the left with a Genset and then moves to the right with the definition of a Genset broken down into its constituent parts in each box, it then continues across breaking each subsequent definition into its constituent parts. As can be seen there are numerous entries next to each other where the same storage are being covered and it is not clear what the benefit of adding all these entries and definitions are. It appear that the work group wish to ensure that storage units continue to meet the appropriate generating requirements whilst they are producing electricity, so it would be simpler just modify the very basic generator definitions which are an Onshore Generating Unit and an Offshore Generating Unit to allow them to be part of a storage unit. Also additional storage requirements need to be defined by an additional set off storage definitions. Given that all generating unit produce electricity by converting another energy source into electrical energy this is no different for a storage unit producing electricity so potential definitions for an Onshore Generating Unit and an Offshore Generating Unit are:- **Onshore Generating Unit** Unless otherwise provided in the Grid Code, Apparatus located Onshore which produces ~~electricity~~ electrical energy by converting another source of energy, including an Onshore Synchronous Generating Unit, an Onshore Non-Synchronous Generating Unit which could also be part of a Generating Module or Electricity Storage Module. **Offshore Generating Unit** Unless otherwise provided in the Grid Code, Apparatus located Offshore which produces ~~electricity~~ electrical energy by converting another source of energy, including an Onshore Synchronous Generating Unit, an Onshore Non-Synchronous Generating Unit which could also be part of a Generating Module or Electricity Storage Module. With these definitions all existing generating

		definitions apply whilst generating. Definitions for when operating in storage mode are also required, whilst looking at the proposed legal text there appear to be only 3 storage definitions used in the rest of the changes being Electricity Storage Module, Synchronous Electricity Storage Module and Non-Synchronous Electricity Storage Module. **Electricity Storage Module** Is either a Synchronous Electricity Storage Unit or a Non-Synchronous Electricity Storage Unit, which could also be part of a Generating Module. **Synchronous Electricity Storage Unit** Apparatus which whilst absorbing electrical energy to convert to another source of energy for storage has a steady state operating frequency of the Apparatus which is in constant ratio of the network frequency and are thus in synchronism, which could also be part of an Onshore Generating Unit or Onshore Generating Unit. **Non-Synchronous Electricity Storage Unit** Apparatus which whilst absorbing electrical energy to convert to another source of energy for storage has a steady state operating frequency of the Apparatus which is not in constant ratio of the network frequency and are thus not in synchronism, which could also be part of an Onshore Generating Unit or Onshore Generating Unit. This arrangement of definitions also allows for the possibility that generation is synchronous and absorption is non-synchronous and vice versa.

Specific GC00096 questions

Q	Question	Response
6	Do you agree with the decision to not define 'Energy Storage'? Please provide your	Yes

	reasoning for your answer to this question.	
7	Do the proposed changes provide suitable flexibility for viable 'Electricity Storage' technologies and topologies? Or, do you feel these proposed changes limit the development of 'Electricity Storage' in any way or present barriers to entry (please provide supporting justification / evidence)?	This is a basic assumption that the generating unit and the storage unit are the same item operating in reverse, there is the possibility they are different and even at different locations eg a pump storage arrangement could be pumping at one location and generating at a completely different location. Questions in terms of what all are considered to be storage units are; does a storage unit need to import electricity through the connection point? How would the situation be treated if for example a solar plant installed a battery connected to the DC side of the converter which only stored energy from the solar plant and used it on-site before the connection and never imported electricity for storage, is this an electricity storage module? And does it need to provide storage unit services? Similarly with a windfarm or something else only using internal generated power for storage and not importing for storage is that required to meet storage unit requirements?
8	Do you believe new Pump Storage schemes should be incorporated into the proposed approach on 'Electricity Storage'? Please provide your reasoning for your answer to this question.	In principle it would appear sensible but current pump storage plant designs may not be able to comply with ECC.6.3.7.16 as varying pump loading with frequency using guide vanes control will very likely cause control system instabilities. Whilst there a trial designs using converter drives for variable speed pump drives this is a major increase in complexity and given there will always be excess generation is there actually a requirement for this?
9	Do you believe existing Pump Storage schemes should be incorporated into the proposed approach on 'Electricity Storage'. Please provide your reasoning for your answer to this question.	Would they be required to meet all the ECC requirements as opposed to their current requirements to only meet the CC. Again existing plants may not be able to comply with ECC.6.3.7.16 as varying pump loading with frequency using guide vanes control will very likely cause control system instabilities.
10	Do you believe if the definition of Pumped Storage should be included within the definition of Electricity Storage. Please	It would appear sensible to treat all storage devices similarly. It should be noted that the proposed changes to the pump storage definitions by removing the station

	provide your reasoning for your answer to this question.	names ends up with no real definition and just 2 circular definitions which just refer back to each and do not actual state an independent definition.
11	Do you believe there are any unintended consequences behind these proposed changes, either within the Grid Code/D-Code, CUSC, BSC or elsewhere? Please provide your reasoning for your answer to this question.	There will need to be D-Code changes to implement similar requirements to embedded storage. In terms of other codes provided trading arrangements are unaltered there should be no obvious issues.
12	Do you believe that it is appropriate to apply the same approach to Storage providers as adopted for Power Generating Modules? Please provide your reasoning for your answer to this question, in particular, if you answered no, please state why and what different approach should be adopted.	Yes the approach should be the same as they are to all providing the same services into the same market place.
13	Do you agree that it is appropriate to include Electricity Storage within the definition of Generation and its related terms. Please provide your reasoning for your answer to this question, in particular, if you answered no, please state why and what different approach should be explored.	Partially if the Apparatus performing the storage function is also the same Apparatus which is performing the generating function then yes, however if the Apparatus performing the storage function is different from the generation apparatus then these need to be treated differently. A possible example of this would an existing hydro station which wanted to be converted to a pumped storage station by the addition of a pumping unit to do the storage only, whilst all the generation was carried out by the existing generating units. In this case there are generating and storage units but none of them perform both tasks. Possible way forward see answer to question 5.
14	Do you believe there are any other unintended consequences behind these proposed changes? Please provide your reasoning for your answer to this question.	
15	Do you believe that it is	Apparatus which is carrying out generating needs

	appropriate to classify storage as an EU Code User with the premise that Generators who own or operate Electricity Storage Modules are explicitly excluded from satisfying the requirements of the EU Connection Codes and that they would not be enforceable under EU law. Please provide your reasoning for your answer to this question. Do you believe that this exclusion is adequately defined in the proposed draft changes to the Grid Code legal text?	to comply with EU Law whilst generating, however it needs to be noted that large sections of the Grid Code are only enforced by Contract Law and licences so areas which are not EU law can still be enforced using current arrangements.
16	Do you agree that it is appropriate to specify that these requirements are applicable from the date on which main plant items are procured rather than the Completion Date. Please provide your reasoning for your answer to this question, in particular, if you answered no, please state why you feel this is the case and if you believe there is a more appropriate solution.	This does appear to be a better suggestion than the current arrangement where parties can be caught out by changes made after they have ordered their equipment.
17	The current legal drafting is based on the proposed requirements being applicable based on a Storage User who had concluded Purchase Contracts for its Main Plant and Apparatus on or after 1 January 2019. This assumes implementation is based on the date main plant items are procured as noted in question 16, but do you have any preference for an implementation date. Bearing in mind the proposed changes are unlikely to be approved until mid 2019, a more appropriate date may be 1 January 2020. Do you	If application is based on purchase date then the implementation date is less of an issue. It should be noted that NGET when they originally raised this modification indicated it was needed as parties were applying and were being treated as special cases, there might be an argument for implementation as soon as possible.

	support this implementation date? If not please state why and what alternative you believe would be more appropriate.	
18	Do you believe that Electricity Storage Modules which form part of a License Exempt Embedded Medium Power Station (LEEMPS) are adequately catered for in these provisions and it is clear that a License Exempt Embedded Medium Power Station comprising of storage would be caught by the requirements in the Grid Code from the obligations in the Distribution Code.	Not sure
19	Do you believe that the list of storage technologies shown in Annex 3 is sufficient or should some technologies be added or subtracted? Please provide your reasons for your answer to this question.	Yes
	Legal text comments	
	If you believe there are issues in the legal text, can you please bring these to our attention by using the space provided on the response proforma. These will then be discussed at the next Workgroup, following the closure of this Consultation.	

Table 1 showing hierarchy of definitions as proposed by GC0066
Starting on the left column with Genset the next column gives the definition of a Genset broken down to individual items,
then each subsequent column give the definition of the previous column.
Text in red is the proposed GC0066 changes.
Note some definitions have been adjusted slight to fit into the table for full definitions see the GC0066 report

Genset	Generating Unit... (& see below)	Synchronous Power-Generating Module	Synchronous Generating Unit	Onshore Synchronous Generating Unit	Onshore Generating Unit (& see below)	...Apparatus located Onshore which produces/ stores electricity, including an Onshore Synchronous Generating Unit/or Onshore Synchronous Electricity Storage Unit/or Onshore Non-Synchronous Generating Unit/or Onshore Non-Synchronous Electricity Storage Unit which could also be part of a Generating Module			
					Onshore Synchronous Electricity Storage Unit (& see below)	Synchronous Electricity Storage Unit located onshore	Single item of Electricity Storage equipment which can supply or absorb electrical energy such that the frequency of the generated voltage, the generator speed and frequency of the network voltage are in constant ratio and thus in synchronism		
					CCGT Unit (& see below)	A Generating Unit within a CCGT Module			
					Synchronous Electricity Storage Unit (& see below)	Single item of Electricity Storage equipment which can supply or absorb electrical energy such that the frequency of the generated voltage, the generator speed and frequency of the network voltage are in constant ratio and thus in synchronism			
					...in which under all steady state conditions the rotor rotates at a mechanical speed equal to the electrical frequency of the NETS divided by the number of pole pairs of the Generating Unit				
				Offshore Synchronous Generating Unit	Offshore Generating Unit... (& see below)	...Apparatus located Offshore which produces/ stores electricity, including an Offshore Synchronous Generating Unit/or Offshore Synchronous Electricity Storage Unit/an Offshore Non-Synchronous Generating Unit/or Offshore Non-Synchronous Electricity Storage Unit which could also be part of a Generating Module			
					Offshore Synchronous Electricity Storage Unit... (& see below)	Synchronous Electricity Storage Unit located offshore	Single item of Electricity Storage equipment which can supply or absorb electrical energy such that the frequency of the generated voltage, the generator speed and frequency of the network voltage are in constant ratio and thus in synchronism		
					...in which under all steady state conditions the rotor rotates at a mechanical speed equal to the electrical frequency of the NETS divided by the number of pole pairs of the Generating Unit				
			Synchronous Electricity Storage Unit	Single item of Electricity Storage equipment which can supply or absorb electrical energy such that the frequency of the generated voltage, the generator speed and frequency of the network voltage are in constant ratio and thus in synchronism					
		Synchronous Electricity Storage Module	Synchronous Electricity Storage Unit	Single item of Electricity Storage equipment which can supply or absorb electrical energy such that the frequency of the generated voltage, the generator speed and frequency of the network voltage are in constant ratio and thus in synchronism					
		Power Park Module	Onshore Power Park Module	A Collection of Non-Synchronous Generating Units powered by an intermittent Power Source or connected through power electronic conversion technology... (& see below)	Onshore Non-Synchronous Generating Unit... (& see below)	Onshore Generating Unit ... (& see below)	...Apparatus located Onshore which produces/ stores electricity, including an Onshore Synchronous Generating Unit/or Onshore Synchronous Electricity Storage Unit/an Onshore Non-Synchronous Generating Unit/ Onshore Non-Synchronous Electricity Storage Unit which could also be part of a Generating Module		
						...that is not a Synchronous Generating Unit dy/synchronous Electricity Storage Unit/including for he avoidance of doubt Power Park Units/or Non-Synchronous Electricity Storage Unit/located onshore			
					Onshore Non-Synchronous Electricity Storage Unit... (& see below)	A Non-Synchronous Electricity Storage Unit located onshore	A single item of Electricity Storage equipment which can supply or absorb electrical energy which is not a Synchronous Electricity Storage Unit		
					...could form part of Power Generating Module				
				Non-Synchronous Electricity Storage Units... (& see below)	A single item of Electricity Storage equipment which can supply or absorb electrical energy which is not a Synchronous Electricity Storage Unit				
				... joined together by a System with a single electrical point of connection to the Onshore Transmission System (or User System if Embedded) with no intermediate Offshore Transmission System connections. The connection to the Onshore Transmission System may include a DC Converter or HVDC Convertor.					
			Offshore Power Park Module	A collection of one or more Offshore Power Park Strings... (& see below)	A collection of Offshore Generating Units... (& see below)	Offshore Synchronous Generating Unit... (& see below)	Offshore Generating Unit... (& see below)	...Apparatus located Offshore which produces/ stores electricity, including an Offshore Synchronous Generating Unit/or Offshore Synchronous Electricity Storage Unit/ an Offshore Non-Synchronous Generating Unit/ Offshore Non-Synchronous Electricity Storage Unit which could also be part of a Generating Module		
							Offshore Synchronous Electricity Storage Unit... (& see below)	Synchronous Electricity Storage Unit located offshore	Single item of Electricity Storage equipment which can supply or absorb electrical energy such that the frequency of the generated voltage, the generator speed and frequency of the network voltage are in constant ratio and thus in synchronism
							...in which under all steady state conditions the rotor rotates at a mechanical speed equal to the electrical frequency of the NETS divided by the number of pole pairs of the Generating Unit		
						Offshore Non-Synchronous Generating Unit... (& see below)	Offshore Synchronous Electricity Storage Unit... (& see below)	A Synchronous Electricity Storage Unit located Offshore	Single item of Electricity Storage equipment which can supply or absorb electrical energy such that the frequency of the generated voltage, the generator speed and frequency of the network voltage are in constant ratio and thus in synchronism
							Offshore Generating Unit... (& see below)	...Apparatus located Offshore which produces/ stores electricity, including an Offshore Synchronous Generating Unit/or Offshore Synchronous Electricity Storage Unit/ an Offshore Non-Synchronous Generating Unit/ Offshore Non-Synchronous Electricity Storage Unit which could also be part of a Generating Module	
							... that is not an Offshore Synchronous Generating Unit including for he avoidance of doubt Power Park Units/or Non-Synchronous Electricity Storage Unit/located Offshore		
							Offshore Non-Synchronous Electricity Storage Unit... (& see below)	Non-Synchronous Electricity Storage Unit located Offshore	A single item of Electricity Storage equipment which can supply or absorb electrical energy which is not a Synchronous Electricity Storage Unit
						...could also be part of Power Generating Module			
					Power Park Units... (& see below)	A Generating Unit within a Power Park	Not clear what this definition covers which is not covered in Offshore Generating Units in row above, but you could go to Generating Unit chain earlier if you think you want to look further		
					Non-Synchronous Electricity Storage Units... (& see below)	A single item of Electricity Storage equipment which can supply or absorb electrical energy which is not a Synchronous Electricity Storage Unit			
				... joined together by cables forming part of a User System with a single point of connection to an Offshore Transmission System. The connection to an Offshore Transmission System may include a DC Converter or HVDC Converter.					
				... connected to the same busbar which cannot be electrically split or connect to a collection of directly electrically connected busbars of the same nominal voltage and are configured in accordance with the operating arrangements set out in the BCA					
			A Power Park Module may also						
		Non-synchronous Electricity Storage Module	Non-synchronous Electricity Storage Unit	Electricity Storage equipment which is not a Synchronous Electricity Storage Unit					
		Onshore Generating Unit... (& see below)	Onshore Synchronous Generating Unit... (& see below)	Onshore Generating Unit (& see below)	...Apparatus located Onshore which produces/ stores electricity, including an Onshore Synchronous Generating Unit/or Onshore Synchronous Electricity Storage Unit/an Onshore Non-Synchronous Generating Unit/ Onshore Non-Synchronous Electricity Storage Unit which could also be part of a Generating Module				
				Onshore Synchronous Electricity Storage Unit (& see below)	Synchronous Electricity Storage Unit located onshore	Single item of Electricity Storage equipment which can supply or absorb electrical energy such that the frequency of the generated voltage, the generator speed and frequency of the network voltage are in constant ratio and thus in synchronism			
				CCGT Unit (& see below)	A Generating Unit within a CCGT Module				
				Synchronous Electricity Storage Unit (& see below)	Single item of Electricity Storage equipment which can supply or absorb electrical energy such that the frequency of the generated voltage, the generator speed and frequency of the network voltage are in constant ratio and thus in synchronism				
				... in which under all steady state conditions the rotor rotates at a mechanical speed equal to the electrical frequency of the NETS divided by the number of pole pairs of the Generating Unit					
			Onshore Synchronous Electricity Storage Unit... (& see below)	Synchronous Electricity Storage Unit located onshore	Single item of Electricity Storage equipment which can supply or absorb electrical energy such that the frequency of the generated voltage, the generator speed and frequency of the network voltage are in constant ratio and thus in synchronism				
			Onshore Non-synchronous Generating Unit... (& see below)	Onshore Generating Unit ... (& see below)	...Apparatus located Onshore which produces/ stores electricity, including an Onshore Synchronous Generating Unit/or Onshore Synchronous Electricity Storage Unit/an Onshore Non-Synchronous Generating Unit/ Onshore Non-Synchronous Electricity Storage Unit which could also be part of a Generating Module				
				...that is not a Synchronous Generating Unit dy/synchronous Electricity Storage Unit/including for he avoidance of doubt Power Park Units/or Non-Synchronous Electricity Storage Unit/located onshore					
			Onshore Non-synchronous Electricity Storage Unit... (& see below)	A Non-Synchronous Electricity Storage Unit located onshore	A single item of Electricity Storage equipment which can supply or absorb electrical energy which is not a Synchronous Electricity Storage Unit				
			...could also be part of Power Generating Module						
		Offshore Generating Unit... (& see below)	Offshore Synchronous Generating Unit... (& see below)	Offshore Generating Unit... (& see below)	...Apparatus located Offshore which produces/ stores electricity, including an Offshore Synchronous Generating Unit/or Offshore Synchronous Electricity Storage Unit/an Offshore Non-Synchronous Generating Unit/ Offshore Non-Synchronous Electricity Storage Unit which could also be part of a Generating Module				
				Offshore Synchronous Electricity Storage Unit... (& see below)	Synchronous Electricity Storage Unit located offshore	Single item of Electricity Storage equipment which can supply or absorb electrical energy such that the frequency of the generated voltage, the generator speed and frequency of the network voltage are in constant ratio and thus in synchronism			
				... in which under all steady state conditions the rotor rotates at a mechanical speed equal to the electrical frequency of the NETS divided by the number of pole pairs of the Generating Unit					
			Offshore Synchronous Electricity Storage Unit... (& see below)	A Synchronous Electricity Storage Unit located Offshore	Single item of Electricity Storage equipment which can supply or absorb electrical energy such that the frequency of the generated voltage, the generator speed and frequency of the network voltage are in constant ratio and thus in synchronism				
			Offshore Non-Synchronous Generating Unit... (& see below)	Offshore Generating Unit... (& see below)	...Apparatus located Offshore which produces/ stores electricity, including an Offshore Synchronous Generating Unit/or Offshore Synchronous Electricity Storage Unit/an Offshore Non-Synchronous Generating Unit/ Offshore Non-Synchronous Electricity Storage Unit which could also be part of a Generating Module				
				... that is not an Offshore Synchronous Generating Unit including for he avoidance of doubt Power Park Units/or Non-Synchronous Electricity Storage Unit/located Offshore					
			Offshore Non-Synchronous Electricity Storage Unit... (& see below)	Non-Synchronous Electricity Storage Unit located Offshore	A single item of Electricity Storage equipment which can supply or absorb electrical energy which is not a Synchronous Electricity Storage Unit				
			...could also be part of Power Generating Module						
		Onshore Power Park Module	A Collection of Non-Synchronous Generating Units powered by an intermittent Power Source or connected through power electronic conversion technology... (& see below)	Onshore Non-Synchronous Generating Unit... (& see below)	Onshore Generating Unit ... (& see below)	...Apparatus located Onshore which produces/ stores electricity, including an Onshore Synchronous Generating Unit/or Onshore Synchronous Electricity Storage Unit/an Onshore Non-Synchronous Generating Unit/ Onshore Non-Synchronous Electricity Storage Unit which could also be part of a Generating Module				
					...that is not a Synchronous Generating Unit dy/synchronous Electricity Storage Unit/including for he avoidance of doubt Power Park Units/or Non-Synchronous Electricity Storage Unit/located onshore				
				Onshore Non-Synchronous Electricity Storage Unit... (& see below)	A Non-Synchronous Electricity Storage Unit located onshore	A single item of Electricity Storage equipment which can supply or absorb electrical energy which is not a Synchronous Electricity Storage Unit			
				...could form part of Power Generating Module					
			Non-Synchronous Electricity Storage Units... (& see below)	A single item of Electricity Storage equipment which can supply or absorb electrical energy which is not a Synchronous Electricity Storage Unit					
			... joined together by a System with a single electrical point of connection to the Onshore Transmission System (or User System if Embedded) with no intermediate Offshore Transmission System connections. The connection to the Onshore Transmission System may include a DC Converter or HVDC Convertor.						
	Power Park Module... (& see below)	Offshore Power Park Module	A collection of one or more Offshore Power Park Strings... (& see below)	A collection of Offshore Generating Units... (& see below)	Offshore Synchronous Generating Unit... (& see below)	Offshore Generating Unit... (& see below)	...Apparatus located Offshore which produces/ stores electricity, including an Offshore Synchronous Generating Unit/or Offshore Synchronous Electricity Storage Unit/an Offshore Non-Synchronous Generating Unit/ Offshore Non-Synchronous Electricity Storage Unit which could also be part of a Generating Module			
						Offshore Synchronous Electricity Storage Unit... (& see below)	Synchronous Electricity Storage Unit located offshore	Single item of Electricity Storage equipment which can supply or absorb electrical energy such that the frequency of the generated voltage, the generator speed and frequency of the network voltage are in constant ratio and thus in synchronism	
						... in which under all steady state conditions the rotor rotates at a mechanical speed equal to the electrical frequency of the NETS divided by the number of pole pairs of the Generating Unit				
					Offshore Synchronous Electricity Storage Unit... (& see below)	A Synchronous Electricity Storage Unit located Offshore	Single item of Electricity Storage equipment which can supply or absorb electrical energy such that the frequency of the generated voltage, the generator speed and frequency of the network voltage are in constant ratio and thus in synchronism		
					Offshore Non-Synchronous Generating Unit... (& see below)	Offshore Generating Unit... (& see below)	...Apparatus located Offshore which produces/ stores electricity, including an Offshore Synchronous Generating Unit/or Offshore Synchronous Electricity Storage Unit/an Offshore Non-Synchronous Generating Unit/ Offshore Non-Synchronous Electricity Storage Unit which could also be part of a Generating Module		
						... that is not an Offshore Synchronous Generating Unit including for he avoidance of doubt Power Park Units/or Non-Synchronous Electricity Storage Unit/located Offshore			
					Offshore Non-Synchronous Electricity Storage Unit... (& see below)	Non-Synchronous Electricity Storage Unit located Offshore	A single item of Electricity Storage equipment which can supply or absorb electrical energy which is not a Synchronous Electricity Storage Unit		
					...could also be part of Power Generating Module				
				Power Park Units... (& see below)	A Generating Unit within a Power Park	Not clear what this definition covers which is not covered in Offshore Generating Units in row above, but you could go to Generating Unit chain earlier if you think you want to look further			
				Non-Synchronous Electricity Storage Units... (& see below)	A single item of Electricity Storage equipment which can supply or absorb electrical energy which is not a Synchronous Electricity Storage Unit				
				... joined together by cables forming part of a User System with a single point of connection to an Offshore Transmission System. The connection to an Offshore Transmission System may include a DC Converter or HVDC Converter.					
			... connected to the same busbar which cannot be electrically split or connect to a collection of directly electrically connected busbars of the same nominal voltage and are configured in accordance with the operating arrangements set out in the BCA						
	CCGT Module... (& see below)	Generating Units (registered as CCGT module could be within a Power Generating Module)							
		Gas Turbine Units	Generating Unit within a CCGT Module						
		Steam Turbine Units	Generating Unit who's prime mover converts the heat energy in steam into mechanical energy						
	...Large Power Stations and NETS connections								

Grid Code Workgroup Consultation Response Proforma

GC0096 - Storage

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 by **5pm** on **11 January 2019** to grid.code@nationalgrid.com. Please note that any responses received after the deadline or sent to a different email address may not receive due consideration by the Workgroup.

Any queries on the content of the consultation should be addressed to Emma Hart at Emma.Hart@nationalgrid.com

Respondent:	*Andy Vaudin* *andrew.vaudin@edfenergy.com*
Company Name:	*EDF ENERGY*
Please express your views regarding the Workgroup Consultation, including rationale. **(Please include any issues, suggestions or queries)**	

Standard Workgroup Consultation questions

Q	Question	Response
1	Do you believe that GC0096 Original proposal or any potential alternative that you may wish to suggest better facilitates the Grid Code Objectives?	*For reference the applicable Grid Code objectives are:* *(i) to permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity;* *Yes* *(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);*

		(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; *Yes* *(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; and* *n/a* *(v) To promote efficiency in the implementation and administration of the Grid Code arrangements.* *n/a*
2	Do you support the proposed implementation approach?	Yes
3	Do you have any other comments?	No
4	Do you wish to raise a Workgroup Grid Code Alternative Request for the Workgroup to consider?	No

Specific GC00096 questions

Q	Question	Response
5	Do you agree with the proposed 'Electricity Storage' definitions? Please provide your reasoning for your answer to this question. If you answered no, what would you include / amend / remove?	Yes The definition is consistent with the Ofgem 2018 consultation on 'Clarifying the regulatory framework for electricity storage: licensing'.
6	Do you agree with the decision to not define 'Energy Storage'? Please provide your reasoning for your answer to this question.	Yes. Energy storage is not within this modification scope.
7	Do the proposed changes provide suitable flexibility for	Yes The proposal notes the importance that the specific

	viable 'Electricity Storage' technologies and topologies? Or, do you feel these proposed changes limit the development of 'Electricity Storage' in any way or present barriers to entry (please provide supporting justification / evidence)?	characteristics of co-located sites are recognized, for example as per the proposed ECP.10.7.
8	Do you believe new Pump Storage schemes should be incorporated into the proposed approach on 'Electricity Storage'? Please provide your reasoning for your answer to this question.	This shouldn't be required because the EU Network Codes and the consequent Grid Code requirements already include pumped storage.
9	Do you believe existing Pump Storage schemes should be incorporated into the proposed approach on 'Electricity Storage'. Please provide your reasoning for your answer to this question.	No – see above and also the approach should not be applied retrospectively
10	Do you believe if the definition of Pumped Storage should be included within the definition of Electricity Storage. Please provide your reasoning for your answer to this question.	No –see above
11	Do you believe there are any unintended consequences behind these proposed changes, either within the Grid Code/D-Code, CUSC, BSC or elsewhere? Please provide your reasoning for your answer to this question.	No unintended consequences known of at present. As noted in the workgroup report Distribution Code changes will be consequential from GC0096, using the proposed solution as a basis.
12	Do you believe that it is appropriate to apply the same approach to Storage providers as adopted for Power Generating Modules? Please provide your reasoning for your answer to this question, in particular, if you answered no, please state why and what different approach should be	Yes. As noted in the workgroup report, Ofgem will implement changes to the generation licence to include storage as a subset of generation. In addition, the Government will define storage in primary legislation when Parliamentary time allows.

	adopted.	
13	Do you agree that it is appropriate to include Electricity Storage within the definition of Generation and its related terms. Please provide your reasoning for your answer to this question, in particular, if you answered no, please state why and what different approach should be explored.	Yes As noted in the workgroup report, Ofgem will implement changes to the generation licence to include storage as a subset of generation. In addition, the Government will define storage in primary legislation when Parliamentary time allows. In addition, the additional Grid Code legal text would significantly simpler with this approach.
14	Do you believe there are any other unintended consequences behind these proposed changes? Please provide your reasoning for your answer to this question.	None known at present.
15	Do you believe that it is appropriate to classify storage as an EU Code User with the premise that Generators who own or operate Electricity Storage Modules are explicitly excluded from satisfying the requirements of the EU Connection Codes and that they would not be enforceable under EU law. Please provide your reasoning for your answer to this question. Do you believe that this exclusion is adequately defined in the proposed draft changes to the Grid Code legal text?	Yes Consistent with the EU Connection Codes.
16	Do you agree that it is appropriate to specify that these requirements are applicable from the date on which main plant items are procured rather than the Completion Date. Please provide your reasoning for your answer to this question, in particular, if you answered no, please state why you feel this is the case and if you	Yes Developers require a period of time to contract for plant with the modified Grid Code requirements.

	believe there is a more appropriate solution.	
17	The current legal drafting is based on the proposed requirements being applicable based on a Storage User who had concluded Purchase Contracts for its Main Plant and Apparatus on or after 1 January 2019. This assumes implementation is based on the date main plant items are procured as noted in question 16, but do you have any preference for an implementation date. Bearing in mind the proposed changes are unlikely to be approved until mid 2019, a more appropriate date may be 1 January 2020. Do you support this implementation date? If not please state why and what alternative you believe would be more appropriate.	A 1 January 2020 date implementation is more appropriate based on a mid-2019 approval date, but it should actually this be set at approval as, say, approval date plus six months.
18	Do you believe that Electricity Storage Modules which form part of a License Exempt Embedded Medium Power Station (LEEMPS) are adequately catered for in these provisions and it is clear that a License Exempt Embedded Medium Power Station comprising of storage would be caught by the requirements in the Grid Code from the obligations in the Distribution Code.	Yes
19	Do you believe that the list of storage technologies shown in Annex 3 is sufficient or should some technologies be added or subtracted? Please provide your reasons for your answer to this question.	The relevance of this list is not clear. It is not included within the proposed modification, e.g. within storage definition.

	Legal text comments	
	If you believe there are issues in the legal text, can you please bring these to our attention by using the space provided on the response proforma. These will then be discussed at the next Workgroup, following the closure of this Consultation.	None known of at present

Grid Code Workgroup Consultation Response Proforma

GC0096 - Storage

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 by **5pm** on **11 January 2019** to grid.code@nationalgrid.com. Please note that any responses received after the deadline or sent to a different email address may not receive due consideration by the Workgroup.

Any queries on the content of the consultation should be addressed to Emma Hart at Emma.Hart@nationalgrid.com

Respondent:	*Garth Graham (garth.graham@sse.com)*
Company Name:	*SSE*
Please express your views regarding the Workgroup Consultation, including rationale. **(Please include any issues, suggestions or queries)**	

Standard Workgroup Consultation questions

Q	Question	Response
1	Do you believe that GC0096 Original proposal or any potential alternative that you may wish to suggest better facilitates the Grid Code Objectives?	*For reference the applicable Grid Code objectives are:* *(i) to permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity;* *(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);* *(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; *(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; and* *(v) To promote efficiency in the implementation and administration of the Grid Code arrangements.* **Negative**. This Original Proposal will <u>not</u> promote the efficient implementation and administration of the Grid Code as it is 'over the top' in seeking to make large swaths of changes to many pages of the Grid Code when the vast majority of those changes (as they often involve duplication of existing text) are not required. The achievement of what GC0096 seeks to do could be achieved much more easily, more comprehensively and in a non-discriminatory manner by simply changing the Glossary and Definitions to bring Electricity Storage within the remit of Generation (as Ofgem has outlined in its minded to position).
2	Do you support the proposed implementation approach?	We note that the Workgroup has yet to conclude what the implementation approach should be. The Proposer suggests ten Working Days which, assuming there is no requirement for transition to the new approach, would seem appropriate (unless a period of transition is required).
3	Do you have any other comments?	
4	Do you wish to raise a Workgroup Grid Code Alternative Request for the Workgroup to consider?	Not at this time.

Specific GC00096 questions

Q	Question	Response
5	Do you agree with the proposed 'Electricity Storage' definitions? Please provide your reasoning for your answer to this question. If you answered no, what would you include / amend / remove?	We note the proposed definition (Footnote 1, page 4) as being: "'Is the conversion of electrical energy into a form of energy which can be stored, the storing of that energy, and the subsequent reconversion of that energy back into electrical energy in a controllable manner'" We agree with this definition and note that it will need to be applied consistently to all storage situations in GB, including Pump Storage, to avoid any discrimination in how the Grid Code is applied and / or how the TSO treat different parties.
6	Do you agree with the decision to not define 'Energy Storage'? Please provide your reasoning for your answer to this question.	Our understanding is that 'Energy Storage' differs from the definition of 'Electricity Storage' in that with Energy Storage there is no "subsequent reconversion of that energy back into electrical energy". This being the case then Energy Storage would be; for the purposes of the Transmission (and Distribution) Network; simply demand (as we have had on the Network for many years in the form of, for example, 'Economy 7' type storage heaters). As such we agree that there is no need to formally define 'Energy Storage' within the Grid Code – it's already included via 'Demand' and it's associated definitions.
7	Do the proposed changes provide suitable flexibility for viable 'Electricity Storage' technologies and topologies? Or, do you feel these proposed changes limit the development of 'Electricity Storage' in any way or present barriers to entry (please provide supporting justification / evidence)?	It is important to ensure that a level playing field (that is where all parties offering or doing the same thing are treated the same in all circumstances) exists for all Users including all Electricity Storage providers, which (given Ofgem's minded to position as regards treating storage as generation) includes Pump Storage. It would be detrimental to competition (and thus detrimental to end consumers) if certain Electricity Storage providers were to be treated (on the false application of the word 'flexibility') in a discriminatory way to other Electricity Storage providers (including Pump Storage providers).
8	Do you believe new Pump Storage schemes should be incorporated into the proposed approach on 'Electricity Storage'? Please provide your	In order to ensure both a level playing field and to avoid discriminatory treatment, we believe that new Pump Storage schemes should be treated in the same way as other new Electricity Storage schemes. Furthermore, whilst we note the discussion in the

	reasoning for your answer to this question.	Workgroup Consultation around the application of this proposed change to the ECCs (thus to 'new' projects going forward) we also note the RfG Article 4 procedure; as regards the modernisation of a plant or the replacement of equipment etc.; which means that the GC0096 solution (if approved) could also apply to existing Pump Storage schemes.
9	Do you believe existing Pump Storage schemes should be incorporated into the proposed approach on 'Electricity Storage'. Please provide your reasoning for your answer to this question.	In principle yes, to ensure a level playing field and avoid any discriminatory treatment.
10	Do you believe if the definition of Pumped Storage should be included within the definition of Electricity Storage. Please provide your reasoning for your answer to this question.	In principle yes, to ensure a level playing field and avoid any discriminatory treatment.
11	Do you believe there are any unintended consequences behind these proposed changes, either within the Grid Code/D-Code, CUSC, BSC or elsewhere? Please provide your reasoning for your answer to this question.	It is possible that unintended consequences may arise if a non-level playing field or a discriminatory approach is followed whereby some forms of storage are treated differently to others when both are converting electrical energy into another energy form and then, subsequently, reconverting that stored form of energy back into electrical energy.
12	Do you believe that it is appropriate to apply the same approach to Storage providers as adopted for Power Generating Modules? Please provide your reasoning for your answer to this question, in particular, if you answered no, please state why and what different approach should be adopted.	Given Ofgem's stated position as regards the regulatory (i.e. Licence) treatment of generation and storage then, in principle, we believe that if this is the case then it is appropriate to apply the same approach; to Storage providers as adopted for Power Generating Modules; to ensure a level playing field and avoid any discriminatory treatment.
13	Do you agree that it is appropriate to include Electricity Storage within the definition of Generation and its related terms. Please provide your reasoning for your answer to this question, in	Given Ofgem's stated position as regards the regulatory (i.e. Licence) treatment of generation and storage then, in principle, we believe that if this is the case then it is appropriate to include Electricity Storage within the definition of Generation and its related terms as set out in the Glossary and

	particular, if you answered no, please state why and what different approach should be explored.	Definitions Section of the Grid Code. Therefore the quantity of proposed changes to the Grid Code that arise from GC0096 should be substantially less than those shown in the draft legal text that forms part of this Workgroup Consultation. We are concerned that the current draft legal text, which seeks to introduce a whole new classification, does not conform with Ofgem's minded to position as regards the regulatory (i.e. Licence) treatment of generation and storage. Instead it undermines and impedes Ofgem's minded to position. In our view the simplest thing would be to make the minimum necessary changes to the Glossary and Definitions section of the Grid Code only and (as per Ofgem's minded to position) as Storage is to be treated the same as Generation then all the current Generation references elsewhere in the Grid Code are 'fit for purpose' in the context of GC0096.
14	Do you believe there are any other unintended consequences behind these proposed changes? Please provide your reasoning for your answer to this question.	
15	Do you believe that it is appropriate to classify storage as an EU Code User with the premise that Generators who own or operate Electricity Storage Modules are explicitly excluded from satisfying the requirements of the EU Connection Codes and that they would not be enforceable under EU law. Please provide your reasoning for your answer to this question. Do you believe that this exclusion is adequately defined in the proposed draft changes to the Grid Code legal text?	
16	Do you agree that it is appropriate to specify that these requirements are applicable from the date on which main plant items are procured rather than the Completion Date. Please	

	provide your reasoning for your answer to this question, in particular, if you answered no, please state why you feel this is the case and if you believe there is a more appropriate solution.	
17	The current legal drafting is based on the proposed requirements being applicable based on a Storage User who had concluded Purchase Contracts for its Main Plant and Apparatus on or after 1 January 2019. This assumes implementation is based on the date main plant items are procured as noted in question 16, but do you have any preference for an implementation date. Bearing in mind the proposed changes are unlikely to be approved until mid 2019, a more appropriate date may be 1 January 2020. Do you support this implementation date? If not please state why and what alternative you believe would be more appropriate.	See our answer to Question 2 above.
18	Do you believe that Electricity Storage Modules which form part of a License Exempt Embedded Medium Power Station (LEEMPS) are adequately catered for in these provisions and it is clear that a License Exempt Embedded Medium Power Station comprising of storage would be caught by the requirements in the Grid Code from the obligations in the Distribution Code.	
19	Do you believe that the list of storage technologies shown in Annex 3 is sufficient or should	This list should include all known technologies that involves converting electrical energy into another energy form and then, subsequently, reconverting

	some technologies be added or subtracted? Please provide your reasons for your answer to this question.	that stored form of energy back into electrical energy to avoid any purported uncertainty on the part of the parties concerned. There is a helpful list provided by the European Energy Storage Association at: http://ease-storage.eu/energy-storage/technologies/ Looking at that list, there appear to be omissions from the list shown in Annex 3, such as around storage via chemical means – it would seem, for example, that converting electricity into hydrogen and then reconverting that hydrogen back to electricity via a fuel cell (or using the hydrogen in a gas engine?) would not form part of GC0096. This could provide a perverse incentive to build these types of electricity storage projects rather than, for example, a battery based or compressed air based storage project. In addition, should, for example, the list in Annex 3 also include 'StatCom' and 'Static synchronous series compensator'?
	Legal text comments	
	If you believe there are issues in the legal text, can you please bring these to our attention by using the space provided on the response proforma. These will then be discussed at the next Workgroup, following the closure of this Consultation.	See our comments above as to the need to consolidate the changes into just the Glossary and Definitions part of the Grid Code in order to avoid both duplication of work as well as the TSO discriminating in discharging their duties.

Grid Code Workgroup Consultation Response Proforma

GC0096 - Storage

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 by **5pm** on **11 January 2019** to grid.code@nationalgrid.com. Please note that any responses received after the deadline or sent to a different email address may not receive due consideration by the Workgroup.

Any queries on the content of the consultation should be addressed to Emma Hart at Emma.Hart@nationalgrid.com

Respondent:	*Thorsten Bülo, Claus Allert*
Company Name:	*SMA Solar Technology AG*
Please express your views regarding the Workgroup Consultation, including rationale. **(Please include any issues, suggestions or queries)**	It's a very transparent process with lots of information.

Standard Workgroup Consultation questions

Q	Question	Response
1	Do you believe that GC0096 Original proposal or any potential alternative that you may wish to suggest better facilitates the Grid Code Objectives?	*For reference the applicable Grid Code objectives are:* *(i) to permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity;* *(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);* *(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; *(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; and* *(v) To promote efficiency in the implementation and administration of the Grid Code arrangements.* *NO*
2	Do you support the proposed implementation approach?	YES
3	Do you have any other comments?	Instead of the purchase date of the main components, the date of grid connection application would be a more appropriate, since it's a well defined single date.
4	Do you wish to raise a Workgroup Grid Code Alternative Request for the Workgroup to consider?	NO

Specific GC00096 questions

Q	Question	Response
5	Do you agree with the proposed 'Electricity Storage' definitions? Please provide your reasoning for your answer to this question. If you answered no, what would you include / amend / remove?	YES – main aspect is electrical behaviour (power, voltage, current…) and not means of storing energy
6	Do you agree with the decision to not define 'Energy Storage'? Please provide your reasoning for your answer to this question.	YES – see 5.
7	Do the proposed changes provide suitable flexibility for viable 'Electricity Storage'	YES – see 5.

	technologies and topologies? Or, do you feel these proposed changes limit the development of 'Electricity Storage' in any way or present barriers to entry (please provide supporting justification / evidence)?	
8	Do you believe new Pump Storage schemes should be incorporated into the proposed approach on 'Electricity Storage'? Please provide your reasoning for your answer to this question.	YES – for clarification
9	Do you believe existing Pump Storage schemes should be incorporated into the proposed approach on 'Electricity Storage'. Please provide your reasoning for your answer to this question.	NO – not necessary, but can be
10	Do you believe if the definition of Pumped Storage should be included within the definition of Electricity Storage. Please provide your reasoning for your answer to this question.	YES – in order to be technology neutral
11	Do you believe there are any unintended consequences behind these proposed changes, either within the Grid Code/D-Code, CUSC, BSC or elsewhere? Please provide your reasoning for your answer to this question.	NO
12	Do you believe that it is appropriate to apply the same approach to Storage providers as adopted for Power Generating Modules? Please provide your reasoning for your answer to this question, in particular, if you answered no, please state why and what different approach should be adopted.	YES

13	Do you agree that it is appropriate to include Electricity Storage within the definition of Generation and its related terms. Please provide your reasoning for your answer to this question, in particular, if you answered no, please state why and what different approach should be explored.	YES – but may require some additional word regarding load behaviour (during charging), as some requirements during generation (e.g. reactive power behaviour) may not be appropriately or exhaustively defined
14	Do you believe there are any other unintended consequences behind these proposed changes? Please provide your reasoning for your answer to this question.	NO
15	Do you believe that it is appropriate to classify storage as an EU Code User with the premise that Generators who own or operate Electricity Storage Modules are explicitly excluded from satisfying the requirements of the EU Connection Codes and that they would not be enforceable under EU law. Please provide your reasoning for your answer to this question. Do you believe that this exclusion is adequately defined in the proposed draft changes to the Grid Code legal text?	YES – as long as RfG applies to generation mode only
16	Do you agree that it is appropriate to specify that these requirements are applicable from the date on which main plant items are procured rather than the Completion Date. Please provide your reasoning for your answer to this question, in particular, if you answered no, please state why you feel this is the case and if you believe there is a more	In principle, YES – in order to minimize risks to all participants, but the date of connection application would be even more appropriate

	appropriate solution.	
17	The current legal drafting is based on the proposed requirements being applicable based on a Storage User who had concluded Purchase Contracts for its Main Plant and Apparatus on or after 1 January 2019. This assumes implementation is based on the date main plant items are procured as noted in question 16, but do you have any preference for an implementation date. Bearing in mind the proposed changes are unlikely to be approved until mid 2019, a more appropriate date may be 1 January 2020. Do you support this implementation date? If not please state why and what alternative you believe would be more appropriate.	In principle, YES, but the date of connection application would be even more appropriate
18	Do you believe that Electricity Storage Modules which form part of a License Exempt Embedded Medium Power Station (LEEMPS) are adequately catered for in these provisions and it is clear that a License Exempt Embedded Medium Power Station comprising of storage would be caught by the requirements in the Grid Code from the obligations in the Distribution Code.	YES
19	Do you believe that the list of storage technologies shown in Annex 3 is sufficient or should some technologies be added or subtracted? Please provide your reasons for your answer to this question.	YES

	Legal text comments	
	If you believe there are issues in the legal text, can you please bring these to our attention by using the space provided on the response proforma. These will then be discussed at the next Workgroup, following the closure of this Consultation.	NO

Grid Code Workgroup Consultation Response Proforma

GC0096 - Storage

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 by **5pm** on **11 January 2019** to grid.code@nationalgrid.com. Please note that any responses received after the deadline or sent to a different email address may not receive due consideration by the Workgroup.

Any queries on the content of the consultation should be addressed to Emma Hart at Emma.Hart@nationalgrid.com

Respondent:	*Graeme Vincent* *graeme.vincent@spenergynetworks.co.uk*
Company Name:	*SP Energy Networks*
Please express your views regarding the Workgroup Consultation, including rationale. **(Please include any issues, suggestions or queries)**	

Standard Workgroup Consultation questions

Q	Question	Response
1	Do you believe that GC0096 Original proposal or any potential alternative that you may wish to suggest better facilitates the Grid Code Objectives?	*For reference the applicable Grid Code objectives are:* *(i) to permit the development, maintenance and operation of an efficient, coordinated and economical system for the transmission of electricity;* *(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);*

		(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; *(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; and* *(v) To promote efficiency in the implementation and administration of the Grid Code arrangements.*
2	Do you support the proposed implementation approach?	
3	Do you have any other comments?	No
4	Do you wish to raise a Workgroup Grid Code Alternative Request for the Workgroup to consider?	No

Specific GC00096 questions

Q	Question	Response
5	Do you agree with the proposed 'Electricity Storage' definitions? Please provide your reasoning for your answer to this question. If you answered no, what would you include / amend / remove?	Please note there seems to be a difference between the WG Report and the proposed legal text. The words 'in a controllable manner' have been struck through in the G&D, and therefore we understand that these words will not be included in the definition going forward so should be removed from the consultation text on page 9 to avoid any confusion. We understand the rationale behind removing these words
6	Do you agree with the decision to not define 'Energy Storage'? Please provide your reasoning for your answer to this question.	Yes – from our understanding energy storage can cover a much wider set of technologies than are being considered under this particular modification
7	Do the proposed changes provide suitable flexibility for viable 'Electricity Storage' technologies and topologies?	No response

	Or, do you feel these proposed changes limit the development of 'Electricity Storage' in any way or present barriers to entry (please provide supporting justification / evidence)?	
8	Do you believe new Pump Storage schemes should be incorporated into the proposed approach on 'Electricity Storage'? Please provide your reasoning for your answer to this question.	Yes but only in so far as is needed to avoid undue discrimination between these differing types of storage technology.
9	Do you believe existing Pump Storage schemes should be incorporated into the proposed approach on 'Electricity Storage'. Please provide your reasoning for your answer to this question.	Yes but only in so far as to avoid discrimination. It would not be appropriate to place new obligations and costs on existing technology which has previously been shown to be Grid Code compliant
10	Do you believe if the definition of Pumped Storage should be included within the definition of Electricity Storage. Please provide your reasoning for your answer to this question.	
11	Do you believe there are any unintended consequences behind these proposed changes, either within the Grid Code/D-Code, CUSC, BSC or elsewhere? Please provide your reasoning for your answer to this question.	Not that we have identified though we do appreciate that there is a corresponding DCode review being undertaken.
12	Do you believe that it is appropriate to apply the same approach to Storage providers as adopted for Power Generating Modules? Please provide your reasoning for your answer to this question, in particular, if you answered no, please state why and what different approach should be adopted.	Yes – storage is only a subset of generation and therefore can have a similar impact on the operation/design of the network as conventional power generating modules.

13	Do you agree that it is appropriate to include Electricity Storage within the definition of Generation and its related terms. Please provide your reasoning for your answer to this question, in particular, if you answered no, please state why and what different approach should be explored.	Yes – storage has been identified as a subset of generation and therefore should be included within the overall definition of generation.
14	Do you believe there are any other unintended consequences behind these proposed changes? Please provide your reasoning for your answer to this question.	Not that we are aware of or have identified.
15	Do you believe that it is appropriate to classify storage as an EU Code User with the premise that Generators who own or operate Electricity Storage Modules are explicitly excluded from satisfying the requirements of the EU Connection Codes and that they would not be enforceable under EU law. Please provide your reasoning for your answer to this question. Do you believe that this exclusion is adequately defined in the proposed draft changes to the Grid Code legal text?	Whilst it is appropriate to classify storage as an EU Code User it is also important to note that they were specifically excluded from the scope of the EU Connection Codes and as such it is appropriate that they are excluded from specific requirements arising directly from these codes
16	Do you agree that it is appropriate to specify that these requirements are applicable from the date on which main plant items are procured rather than the Completion Date. Please provide your reasoning for your answer to this question, in particular, if you answered no, please state why you feel this is the case and if you believe there is a more appropriate solution.	It is appropriate and consistent with the process adopted during the introduction of the RfG requirements.

17	The current legal drafting is based on the proposed requirements being applicable based on a Storage User who had concluded Purchase Contracts for its Main Plant and Apparatus on or after 1 January 2019. This assumes implementation is based on the date main plant items are procured as noted in question 16, but do you have any preference for an implementation date. Bearing in mind the proposed changes are unlikely to be approved until mid 2019, a more appropriate date may be 1 January 2020. Do you support this implementation date? If not please state why and what alternative you believe would be more appropriate.	This may lead to practical differences given that the modification proposal has not concluded and the enduring solution has not been finalised therefore there may be some projects which would require to apply additional technical requirements retrospectively. Therefore an appropriate length of time to allow manufacturers and developers to meet any new requirements whilst acknowledging that there is an increasing benefit for giving the additional clarity should be provided. Though a date in January 2020 does seem distant given the length of time that this modification has been in progression.
18	Do you believe that Electricity Storage Modules which form part of a License Exempt Embedded Medium Power Station (LEEMPS) are adequately catered for in these provisions and it is clear that a License Exempt Embedded Medium Power Station comprising of storage would be caught by the requirements in the Grid Code from the obligations in the Distribution Code.	Yes we believe so.
19	Do you believe that the list of storage technologies shown in Annex 3 is sufficient or should some technologies be added or subtracted? Please provide your reasons for your answer to this question.	Should regenerative braking on trains be captured in the list? Network Rail connections can spill energy back into the DNO or TO network. For recent applications Network Rail requested export capacity equipped with settlement metering. regenerative braking *noun* 1. a method of braking in which energy is extracted from the parts braked, to be stored

		and reused.
	Legal text comments	
	If you believe there are issues in the legal text, can you please bring these to our attention by using the space provided on the response proforma. These will then be discussed at the next Workgroup, following the closure of this Consultation.	**<u>Glossary & Definitions</u>** **EU Code User –** why is the 1 January significant for being treated as existing especially as there is not yet clarity for those who connect after this date (this consultation doesn't close until the 11 January 2019. It looks like they are some proposed housekeeping changes to reorder the definitions into alphabetical order. If this is the case then **GSP** (which follows Governor deadband and Governor Sensitivity (which are being moved) should also be moved from its current location. **Main Plant and Apparatus** – it is noted that there is a note saying ' Not required for Storage' however, the MP&A definition is used when defining Storage User under the EU Code User definition – so what MP&A is being referred to within the EU Code User part (e). **Registered capacity (Part C)** What the justification for adding 'auxiliary' into this definition? **European Connection Conditions** Under ECC.6.3.3.1, first paragraph should be **E**CC.6.3.3.1.1. (appreciate that this not strictly related to Storage but it does appear that there are more than just storage changes being made eg. ECC.6.3.3.1.1(d) where 'or an Embedded Power Station' has also been added. ECC.6.3.9.1 – is there is an extra space between 'capability' and 'of' in the text which has been added. ECC.6.6.2.2 - paragraph doesn't align with numbering **European Compliance Processes** ECP.A.6.4.6 – Company should be bold text

		Operating Code 11 – are the changes proposed strictly necessary to accommodate Energy Storage? BC2.A.3.2 – reference should be to GC.6 **Data Registration Code** Schedule 16 – add space between Electricity and Storage

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Code Administrator
National Grid ESO
Technology Park
Gallows Hill
Warwick
CV34 6DA

Our Ref: EN01-005762

10 January 2019

Dear Code Administrator,

Re: Response to Grid Code Consultation GC0096 Energy Storage

RES is a recognised global leader in electricity storage with 250MW constructed worldwide, including 80MW in GB and many more projects in construction and development. RES welcomes the opportunity to respond to this consultation.

Should you have any questions regarding RES consultation response (attached), please do not hesitate to contact me.

Yours sincerely,

Joe Duddy
Principal Electrical Engineer
E joe.duddy@res-group.com
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Respondent:	*Joe Duddy*
Company Name:	*RES Ltd.*
Please express your views regarding the Workgroup Consultation, including rationale. **(Please include any issues, suggestions or queries)**	RES welcomes the intent of National Grid to clarify the provisions of the Grid Code with respect to Energy Storage. A clear technical framework is essential to successful development and operation.

Standard Workgroup Consultation questions

Q	Question	Response
1	Do you believe that GC0096 Original proposal or any potential alternative that you may wish to suggest better facilitates the Grid Code Objectives?	Yes, the GC0069 original proposal described in the legal text included with the consultation better facilitates the Grid Code Objectives.
2	Do you support the proposed implementation approach?	Yes.
3	Do you have any other comments?	No.
4	Do you wish to raise a Workgroup Grid Code Alternative Request for the Workgroup to consider?	No.

Specific GC00096 questions

Q	Question	Response
5	Do you agree with the proposed 'Electricity Storage' definitions? Please provide your reasoning for your answer to this question. If you answered no, what would you include / amend / remove?	The definitions of Electricity Storage given in early parts of the consultation document and in the red-lined legal text are different. The former includes the addendum *"in a controllable manner".* RES agrees with the definition provided in the red-lined legal text i.e. *"The conversion of electrical energy into a*

Q	Question	Response
		form of energy which can be stored, the storing of that energy, and the subsequent reconversion of that energy back into electrical energy" provided that synchronously connected inertial machines are excluded from this definition (e.g. synchronous compensators and synchronously connected flywheels which exchange electrical and kinetic energy dependent on changes in the System frequency which are outside the direct control of the User).
6	Do you agree with the decision to not define 'Energy Storage'? Please provide your reasoning for your answer to this question.	Yes. Electrical energy could be converted into a form of energy which can be stored and then subsequently that energy could be used for a purpose other than reconversion back into electrical energy. This is energy storage and it is adequately covered by existing Grid Code provisions for Customers and Demand Facilities who may use electrical energy for this and other purposes.
7	Do the proposed changes provide suitable flexibility for viable 'Electricity Storage' technologies and topologies? Or, do you feel these proposed changes limit the development of 'Electricity Storage' in any way or present barriers to entry (please provide supporting justification / evidence)?	
8	Do you believe new Pump Storage schemes should be incorporated into the proposed approach on 'Electricity Storage'? Please provide your reasoning for your answer to this question.	Yes. This approach will eventually simplify the Grid Code when the CC section becomes redundant and only the ECC section will apply.
9	Do you believe existing Pump Storage schemes should be incorporated into the proposed approach on 'Electricity Storage'. Please provide your reasoning for your answer to this question.	No. Existing Pump Storage schemes should not be subject to the ECC section and existing requirements in the CC section are sufficient.
10	Do you believe if the definition of Pumped Storage should be included within the definition of Electricity Storage. Please provide your reasoning for your answer to this question.	Yes. This would avoid the risk of undue discrimination. There are no good reasons for excluding Pumped Storage from the relevant requirements which apply to Electricity Storage Modules.
11	Do you believe there are any unintended consequences behind these proposed changes, either	

Q	Question	Response
	within the Grid Code/D-Code, CUSC, BSC or elsewhere? Please provide your reasoning for your answer to this question.	
12	Do you believe that it is appropriate to apply the same approach to Storage providers as adopted for Power Generating Modules? Please provide your reasoning for your answer to this question, in particular, if you answered no, please state why and what different approach should be adopted.	Yes. It is the reconversion of stored energy back to electrical energy which distinguishes Electricity Storage from energy storage (which RES considers is a process which can apply to Customers and Demand Facilities, see response 6 above). A Power Generating Module, which converts a form of energy into electrical energy, therefore has a strong resemblance to an Electricity Storage Module which converts a form of stored energy (previously converted from electrical energy) back into electrical energy.
13	Do you agree that it is appropriate to include Electricity Storage within the definition of Generation and its related terms. Please provide your reasoning for your answer to this question, in particular, if you answered no, please state why and what different approach should be explored.	Yes. It is the reconversion of stored energy back to electrical energy which distinguishes Electricity Storage from energy storage (which RES considers is a process which can apply to Customers and Demand Facilities, see response 6 above). A Power Generating Module, which converts a form of energy into electrical energy, therefore has a strong resemblance to an Electricity Storage Module which converts stored energy back into electrical energy.
14	Do you believe there are any other unintended consequences behind these proposed changes? Please provide your reasoning for your answer to this question.	
15	Do you believe that it is appropriate to classify storage as an EU Code User with the premise that Generators who own or operate Electricity Storage Modules are explicitly excluded from satisfying the requirements of the EU Connection Codes and that they would not be enforceable under EU law. Please provide your reasoning for your answer to this question. Do you believe that this exclusion is adequately defined in the proposed draft changes to the Grid Code legal text?	Yes. This seems an efficient way to apply appropriate grid code requirements to Electricity Storage. The exclusion is appropriate and adequate.
16	Do you agree that it is appropriate to specify that these requirements are applicable from the date on which	Yes. This was a reasonable provision of RfG to limit the exposure of Generators to the risk of change in legislation.

Q	Question	Response
	main plant items are procured rather than the Completion Date. Please provide your reasoning for your answer to this question, in particular, if you answered no, please state why you feel this is the case and if you believe there is a more appropriate solution.	Such protection reduces the cost of generation schemes and therefore encourages competition and low priced energy for consumers. For the same reason, it would be a good idea to offer similar protection to the developers of Electricity Storage schemes.
17	The current legal drafting is based on the proposed requirements being applicable based on a Storage User who had concluded Purchase Contracts for its Main Plant and Apparatus on or after 1 January 2019. This assumes implementation is based on the date main plant items are procured as noted in question 16, but do you have any preference for an implementation date. Bearing in mind the proposed changes are unlikely to be approved until mid 2019, a more appropriate date may be 1 January 2020. Do you support this implementation date? If not please state why and what alternative you believe would be more appropriate.	On the assumption that the proposed changes would be approved around mid 2019, RES would support 1 January 2020 as the implementation date and the date from which the proposed changes should apply to a Storage User who had not yet concluded Purchase Contracts for its main plant items. If the proposed changes are approved at a later time, then the proposed threshold of 1 January 2020 should be postponed until at least 6 calendar months after such approval and not *"10 business days after an Authority decision"* as stated in the consultation document section 7.
18	Do you believe that Electricity Storage Modules which form part of a License Exempt Embedded Medium Power Station (LEEMPS) are adequately catered for in these provisions and it is clear that a License Exempt Embedded Medium Power Station comprising of storage would be caught by the requirements in the Grid Code from the obligations in the Distribution Code.	Yes
19	Do you believe that the list of storage technologies shown in Annex 3 is sufficient or should some technologies be added or subtracted? Please provide your reasons for your answer to this question.	Yes. Although there are other forms of Electricity Storage which are not specifically listed, the catchall phrase "Other" is comprehensive. The functional description of Electricity Storage allows "Other" to be classified when they are proposed by a User.

	Legal text comments	
	Glossary and Definitions *"Flywheel"*	The definition and its proposed usage are appropriate for synchronously connected flywheels only, they are unsuitable for inverter connected flywheels. Electricity Storage may be carried out by inverter connected high speed flywheels which may not contribute inertia to the System (unless they are connected by an inverter with Virtual Synchronous Generator control) and which may be fully controllable Electricity Storage Units. Therefore the definition and its usage should be amended accordingly to avoid confusion with high speed flywheel Electricity Storage Units e.g. *"Synchronous Flywheel: An item of synchronously rotating Plant for the specific purpose of contributing inertia to the System. One or more Synchronous Flywheels would not be considered to be an Electricity Storage Module unless it could be operated in a controllable manner for its AC input and output power."*
	Glossary and Definitions *"Non-Controllable Electricity Storage Equipment"*	Further to the above comment on "Flywheel" definition, this definition should be amended accordingly e.g. *"Non-Controllable Electricity Storage Equipment: An item of Electricity Storage Plant, including but not limited to a Synchronous Flywheel or Synchronous Compensation Equipment."* It would be clearer to move the latter part of this definition i.e. *"For the avoidance of doubt, Non-Controllable Electricity Storage Equipment would not be considered to be part of an Electricity Storage Module or classed as an Electricity Storage Unit"* from this definition and into the definitions for Electricity Storage Unit.
	Glossary and Definitions "*Electricity Storage Module"*	Further to the comment on *"Non-Controllable Electricity Storage Equipment"* above, amend this definition as follows "*Electricity Storage Module: A Synchronous Electricity Storage Unit or Non Synchronous Electricity Storage Unit. For the avoidance of doubt, Non-Controllable Electricity Storage Equipment would not be considered to be classed as an Electricity Storage Unit."*
	Glossary and Definitions *"Minimum Generation"*	It is not clear how this would apply to an Electricity Storage Module.
	Glossary and Definitions *"Registered Capacity"*	With respect to an Electricity Storage Module, it is not clear whether *"normal full load capacity"* refers to charging or discharging. Note that the charging capacity of an

	Legal text comments	
		Electricity Storage Module could differ from its charging capacity. Redraft to remove this ambiguity by referring to the *"normal full load discharging capacity"* of Electricity Storage Units. Also, while item (a) excludes Units *"forming part of a CCGT Module or Power Park Module or Power Generating Module or Electricity Storage Module"*, item (b) provides guidance with respect to CCGT Module and Power Park Module but not to Electricity Storage Module. This inconsistency should be addressed.
	Glossary and Definitions *"EU Code User"*	The proposed 1 January 2019 applicability date for Storage Users is impractical because it is before the approval of this grid code modification. It should be amended to no later than 6 months after this grid code modification is approved.
	PC.A.3.1.4(a)(ii)(2)(a)	It is not clear why the Network Operator should inform The Company about the types of batteries employed at each Embedded Small Power Station which includes battery Electricity Storage Units. This was not described in the consultation document. This requirement should be deleted in the absence of a clear and proportionate justification.
	PC.A.3.4.3	It is not clear why the Generator should inform The Company about the types of batteries employed at each of its battery Electricity Storage Units. This was not described in the consultation document. This requirement should be deleted in the absence of a clear and proportionate justification.
	PC.A.4.6	What does "Electricty Storage Module load" mean? The context suggests it means charging active power. This could be drafted more clearly.
	PC.A.4.7.1(a)	Delete "Storage" and substitute "Electricity Storage"
	Planning Code	Is The Company not interested in the amount of Electrical Energy which can be charged and discharged (or the maximum duration that Rated MW can be maintained)?
	ECC.6.3.1	Is it necessary to clarify three times *"Power Generating Modules (which includes Electricity Storage Modules)"*? Once is helpful, three times is excessive and hinders readability, particularly as this point is made clear by the

	Legal text comments	
		Glossary and Definitions.
	Figure ECC.6.3.2.4(c) and Figure ECC.6.3.2.6(b)	These figures do not explicitly indicate the reactive power capability required of Electricity Storage Modules when charging. They should be amended accordingly to ensure clarity. Specifically, the region bounded by -0.05 to 0.05 Q/Pmax which presently extends between 0.2 pu power and 0 pu active power should be extended to -1 pu active power (or some other expression denoting maximum charging power)
	Figure ECC.6.3.2.4(a) p29, second Figure ECC.6.3.2.4(a) p30	There are two figures ECC.6.3.2.4(a). They should be given unique references and the references should be updated in the body of the ECC.
	ECC.6.3.7.1.6	In a similar manner to the allowances made in ECC.6.3.3.1.1(c), allowances should be made for the finite charging energy capacity of Electricity Storage Modules. Please add *"In the case of an Electricity Storage Module, an allowance will be made for the storage capability of the Electricity Storage Module."*
	ECC.6.3.15.10(i)	*"In the case of a Power Park Module, the requirements in ECC.6.3.15.9 do not apply when the Power Park Module is operating at less than 5% of its Rated MW"* The definition of Rated MW refers to output and therefore charging (input) is less than any positive % of Rated MW. Is The Company content that Electricity Storage Modules are not required to remain connected in accordance with ECC.6.3.15.9 when they are charging?
	ECC.6.3.16.1 and sub-clauses	Refers to "reactive current", "maximum rated current", "rated Active Power", "Rated Active Power" and "rated Reactive Power" which are not defined terms. Amend to use defined terms.
	ECC.6.5.6.4(e)	A state of charge signal and a Power Available Signal will be of limited use if The Company does not know the size of the associated energy store (not collected in proposed Planning Data). An energy store at 50% state of charge could be exhausted in 5 minutes or 5 hours. "State of charge" is not a defined term in the Grid Code. State of charge (Coulombs or ampere hours) is frequently confused with state of energy (Joules or MWh). I expect that The Company is only interested in the latter. Is The Company only interested in the Power Available to

	Legal text comments	
		be discharged from an Electricity Storage Module and not the power available to be charged into it? The definition for Power Available refers to exported Active Power only.