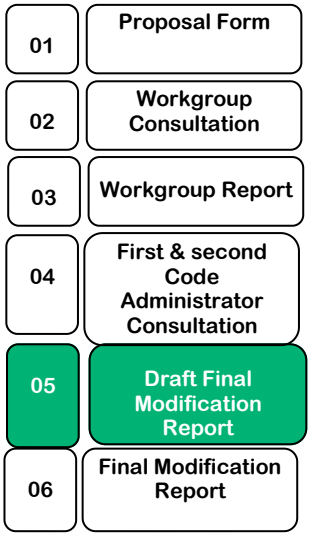
Stage 5: Draft Final Modification Report	At what stage is this document in the process?
# GC0096 ## Modification Title: Energy Storage	

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 Draft Final Modification Report has been prepared in accordance with the terms of the Grid Code. An electronic version of this document and all other GC0096 related documentation can be found on the National Grid ESO website via the following link: https://www.nationalgrideso.com/codes/grid-code/modifications/gc0096-energy-storage The purpose of this document is to assist the Grid Code Review Panel in making its recommendation on whether to implement GC0096.
	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	10 May 2019
Draft Final Modification Report presented to Panel	27 June 2019
Panel sent modification back to Workgroup	27 June 2019
Second Code Administrator Consultation (10 Working days)	4 November 2019
Second presentation of Draft Modification Report	28 November 2019

Any questions?

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Modification Panel decision	28 November 2019
Final Modification Report issued the Authority	9 December 2019
Decision implemented in Grid Code	January 2020

1 About this document

This document is the Draft Final Modification Report that contains the discussion of the Workgroup which formed in May 2016 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 March 2019 and the first Code Administrator Consultation responses. The Panel reviewed the Workgroup Report at their Grid Code Review Panel meeting on 25 April 2019 and agreed that the Workgroup had met its Terms of Reference and that the Workgroup could be discharged. This document also contains the responses to the second Code Administrator Consultation that closed on the 18 November 2019.

GC0096 was proposed by National Grid Electricity System Operator (NGESO) and was submitted to the Grid Code Review Panel for its consideration on May 2016. The Panel decided to send the Proposal to a Workgroup to be developed and assessed against the Grid Code Panel 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 eight responses were received. These responses can be viewed in Annex 4 of this Report.

Panel send back to Workgroup On the 27 June 2019 the Grid Code Review Panel reviewed the Draft Final Modification Report presented to them following the Code Administrator Consultation.

The Panel noted the following;

- A Panel member, following the Code Administrator Consultation, questioned whether it would be possible to amend the GC0096 Proposal in terms of the definitions of Pumped Storage Plant and Existing Pump Storage Plant;
- That a respondent also expressed the need for some amendments to the legal text (RES Ltd – the full response can be located in Annex 5)
- That they felt that there could be some improvements made to the readability of the Report

The Panel decided that, under Governance Rule 22.4 that they would be sending the modification back to the Workgroup to review these points and report back to them on whether amendments should be made.

Summary of amendments to Report following send back to Workgroup

The Proposer of GC0096 reviewed the feedback provided by both the Panel and the Code Administrator Consultation respondents and presented their proposed way

forward to the Workgroup on 12 September 2019. A summary of these amendments can be found below;

Glossary and Definitions (G&D)

1) References to Existing Pumped Storage Plant, Existing Pumped Storage Units and related terms removed. The definition of Pumped Storage Generator now has the references to Dinorwig, Ffestiniog, Cruachan and Foyers removed. The existing Pumped Storage Power Stations of Dinorwig, Ffestiniog, Cruachan and Foyers would still be protected from having to meet the requirements of the European Connection Conditions as they would be treated as GB Code User's (ie they were connected to the System and placed contracts for major plant items before the RfG cut off dates). The advantage of this approach is that there is no requirement to change related terms in the BSC or other documents whilst ensuring existing pumped storage plant are not caught by the RfG Requirements.
2) Definition of Registered Capacity and Registered Import Capability has been changed in respect of Electricity Storage Modules as per comments in the Code Administrator Consultation.
3) Definition of Maximum Capacity has been amended in respect of Electricity Storage Modules when in an exporting mode of operation. A new definition has been added "Maximum Import Power" to cater for the maximum Active Power an Electricity Storage Module would be capable of importing. This will be included as an additional data item as part of the Planning Code and Data Registration Code. This then addresses the issues that an Electricity Storage Module may have different levels between maximum import and maximum export.
4) EU Code User – Storage User – dates changed to 2020 (connection) and 2019 (contract date) respectively. When the mod is approved the XXX will be replaced by Ofgem's Approval Date.
5) Electricity Storage Module included within the definition of Genset. This is to ensure consistency with the definition of Minimum Generation.
6) Definitions of Synchronous Electricity Storage Module and Synchronous Electricity Storage Unit – minor amendment "…which can convert and or re-convert electrical energy from another source…." The word "or" is replaced by the word "and".
7) Definition of Regenerative Braking adjusted in line with Code Administrator comments.
8) Rated MW – Clarifications added to Rated MW in particular with respect to import and export capabilities.
9) Typographical errors and spelling corrected as notified as part of the Code Administrator Consultation.

Planning Code (PC)

1) Minor amendment to PC.1.7
2) Updates to PC.A.4.7.1(g) to reflect changes in Glossary and Definitions relating to Maximum Capacity, Registered Import Capability and Maximum Import Power.
3) PC.A.4.6 – Updated for the purposes of clarity
4) Typo's / Bolds corrected on new text

Connection Conditions (CC's)

1) CC.A.6.2.5.8 – "Existing" removed from Pumped Storage Unit as a result of the change to Pumped Storage in the Glossary and Definitions.

European Connection Conditions (ECC's)

1) Typographical errors corrected.
2) ECC.6.5.6.4 – State of charge changed to state of energy. Clarifications have also been added to "Power Available" when in an importing mode of operation.

European Compliance Processes (ECP)

1) No change

Operating Code 1 (OC1)

1) OC1.6.1(h) – Removal of "Existing Pumped Storage Unit" to reflect changes to the Glossary and Definitions

Operating Code 6 (OC6)

1) Clarification added to OC6.6.6 to state that LFDD data is only required from Pumped Storage Generators and Electricity Storage Modules when operating in a mode analogous to demand. There is no requirement for this capability when a Pumped Storage Generator or Electricity Storage Module is operating in a mode analogous to generation as detailed in section 3 (New Definitions) of this report.

Operating Code 9 (OC9)

1) No change other than a minor typo in OC9.4.1

Balancing Code 2 (BC2)

1) No change

Data Registration Code (DRC)

Minor amendments to ensure consistency with the Planning Code

There are some amendments to the Report. To show the amendments made to the legal text, these are highlighted for ease.

The Workgroup, on the 12 September 2019, concluded that they were happy with the amendments suggested by the Proposer and that these could be presented back to the Grid Code Review Panel for their review on next steps for the modification. The Panel agreed to a ten day second Code Administrator Consultation followed by a second Draft Final Modification Report being presented to them at the November 2019 Panel meeting.

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.

First Code Administrator Consultation responses

The first Code Administrator Consultation was issued on 10 May 2019 for 20 Working Days, with a close date of 10 June 2019. Eight responses were received. These can be located in Section 9 and Annex 5.

Second Code Administrator Consultation

The Code Administrator Consultation was issued on 18 October 2019 for one calendar month, with a close date of 18 November 2019. Two responses were received. Both respondents agreed that the modification better facilitates the Grid Code objectives. One respondent raised a concern around an omission to clarify testing for Electricity Storage Modules within OC5.7. The full responses can be located in Annex 6.

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-	Section 3 and 4

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.	
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[1]
HVDC	High Voltage Direct Current
RFG	Requirements for Generators[2]
NGET	National Grid Electricity Transmission (TO)
DCC	Demand Connection Code[3]

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

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

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

NGESO	National Grid Electricity System Operator (SO)
EFR	Enhanced Frequency Response
ECPs	European Connection Procedures
CUSC	Connection and Use of System Code

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 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[4] 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

[4] 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"

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.

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 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 ESO's Enhanced Frequency Response (EFR) tender in 2016.

Furthermore, BEIS and Ofgem have initiated 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[5].

3 Proposer's Solution

Section 3 (Proposer's solution) is sourced directly from the Proposer and any statements or assertions have not been altered or substantiated/supported or refuted by the Workgroup. Section 7 of the Workgroup contains the discussion by the Workgroup on the Proposal and the potential 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

[5] The Connection Application can be found at
https://www.nationalgrideso.com/document/91426/download

The Connection Offer document can be found at:
https://www.nationalgrideso.com/document/91431/download

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 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 Grid Code which explicitly apply to storage (for example in OC.6.6.6) these obligations are made explicitly clear. In the case of OC6.6.6 the requirement for Low Frequency Demand Disconnection would only apply when the Electricity Storage Module is in a mode analogous to Demand; i.e. the Electricity Storage Module would be expected to disconnect, or switch to Generation (discharge) mode, if it was in Demand (charging) mode, ahead of LFDD equipment being

activated. This capability would not be required when a storage module is acting in a mode analogous to Generation as the ESO would not want plant (which is essentially acting as a generator) to be tripped (ie disconnected) during a low frequency incident as this would reduce the amount of power infeed to the Total System and therefore result in a faster and more detrimental frequency fall, potentially resulting in the earlier operation of the first and subsequent stages of the low frequency demand disconnection scheme.

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 when the Proposer initially prepared this modification the opportunity was taken to amend the definition of Pumped Storage Plant to form Pumped Storage Plant and Existing Pumped Storage Plant. The intention being that the definition of 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" was changed to "Pumped Storage" and the definition of Existing Pump Storage Unit was updated so as not to cause any unintended consequences for existing Pumped Storage Stations.

Following the above change, 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. A Panel member, following the Code Administrator Consultation, questioned whether it would be possible to amend the GC0096 Proposal in terms of the definitions of Pumped Storage Plant and Existing Pump Storage Plant. The Proposer has since considered this issue and amended the definitions such that there is now only one definition of Pumped Storage Plant. This would prevent a consequential change being required to other Industry Codes whilst having the advantage of preventing Existing Pump Storage Plants from having to meet the requirements of the European Connection Conditions. This would be on the basis that RfG only applies to plant connected to the system on or after 27 April 2019 or placed the contract for its major plant items on or after 17 May 2018. As such, an Existing Pump Storage Generator would be treated as a GB Code User and a New Pump Storage Generator (or an Existing Pump Storage Generator that has been substantially modified it plant and apparatus) would be treated as a EU Code User.

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 should be 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 implemented via 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 ESO 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. It is envisaged that when changes are introduced to the Distribution Code similar arrangements are adopted.

At this point, it is worth noting that the EU Connection Stakeholder Committee have recently established several[6] 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

[6] 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).

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 ESO 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.

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 ESO website[7].

[7] The Connection Application can be found at
https://www.nationalgrideso.com/document/91426/download

The Connection Offer document can be found at:
https://www.nationalgrideso.com/document/91431/download

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).

The additional technical capability of Storage when co-located with renewable generation should also aid a User's ability to participate in the Ancillary Services market 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 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 that 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. 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 (CMP280/281) to better reflect Storage Users have been considered and the impact is low on the basis that that Storage is being treated as a subset of Generation in the same way as that of the Grid Code. Coordination between ESO representatives of the Grid Code and CUSC has taken place to ensure compatibility between the two codes. The approach adopted is that Storage will be treated in the same way in both the Grid Code and CUSC. The only slight difference is that the CUSC uses the term Electricity Storage Facility for the purposes of charging only and has no consequential impact on the Grid Code.

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). Under this modification, any Storage Plant forming part of a Licence Exempt Embedded Medium Power Station would have to meet

the same requirements of a Power Generating Module. As part of the Distribution Code Workgroup on Storage this issue will be discussed. A Workgroup member noted that this could lead to discriminatory treatment for similar storage plant in GB connected at Distribution compared to Transmission but it was noted that this issue is also applicable in terms of the treatment of embedded generation.

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 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[8]. 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 operational flexibility through commercial services arrangements/ markets (e.g. Enhanced Frequency Response).

[8] "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"

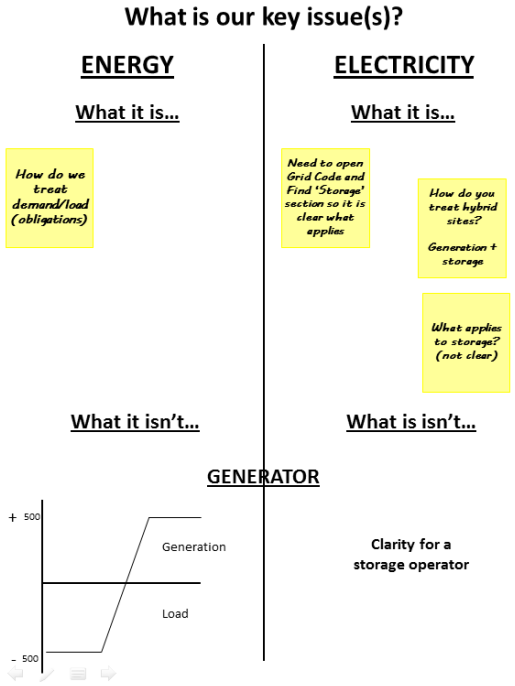


Figure 2

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 text "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 October 2017consultation 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 proposed legal text was modified to have specific definitions for Synchronous Compensation equipment and Synchronous flywheels which would fall outside the encompassing definition of Electricity Storage. 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 2018 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 (i.e. the Party owning the Storage Plant) and therefore the use of Power Station, Power Generating Module and Generating Unit have been amended to include Electricity Storage.

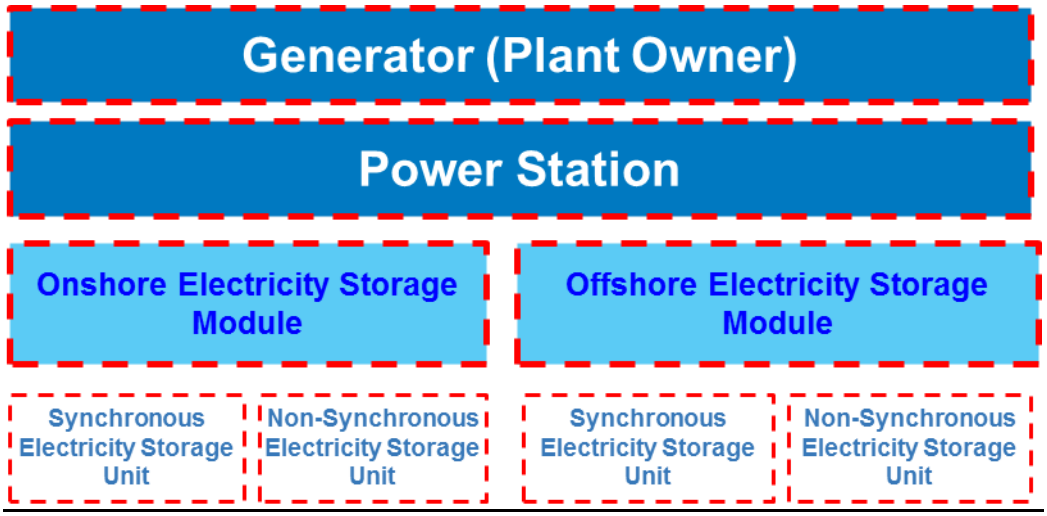
High level proposals for Storage definitions

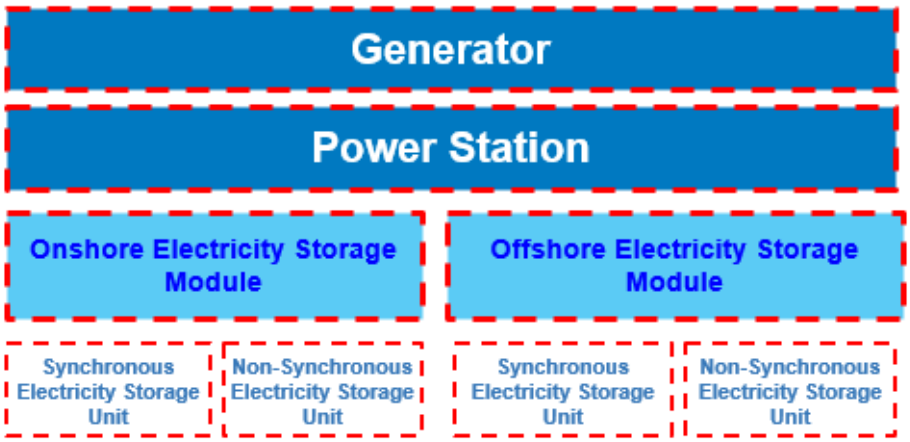
The following hierarchy of definitions was constructed to explain the relationship and interdependency between the GC0096 new Storage definitions and existing Grid Code definitions to facilitate this.

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.

Standalone Electricity Storage Facility





Standalone Storage

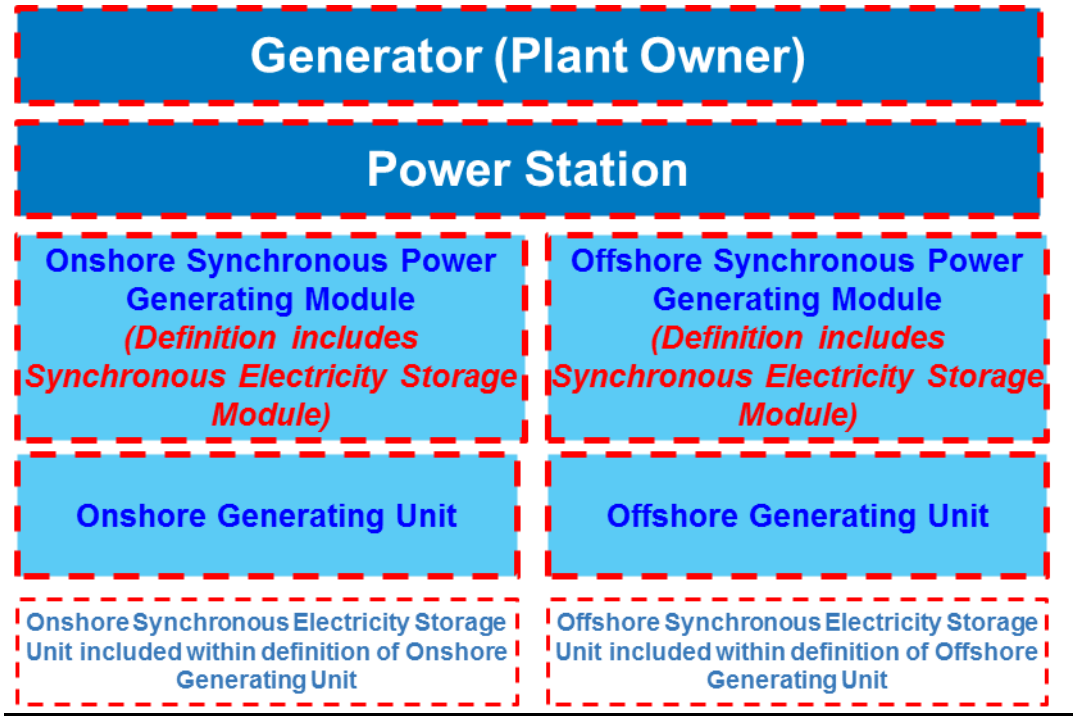
The Workgroup considered if using 'Power Station' as a catch-all for both standalone and co-located Storage would be appropriate. This was the basis of much of the discussions.

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.

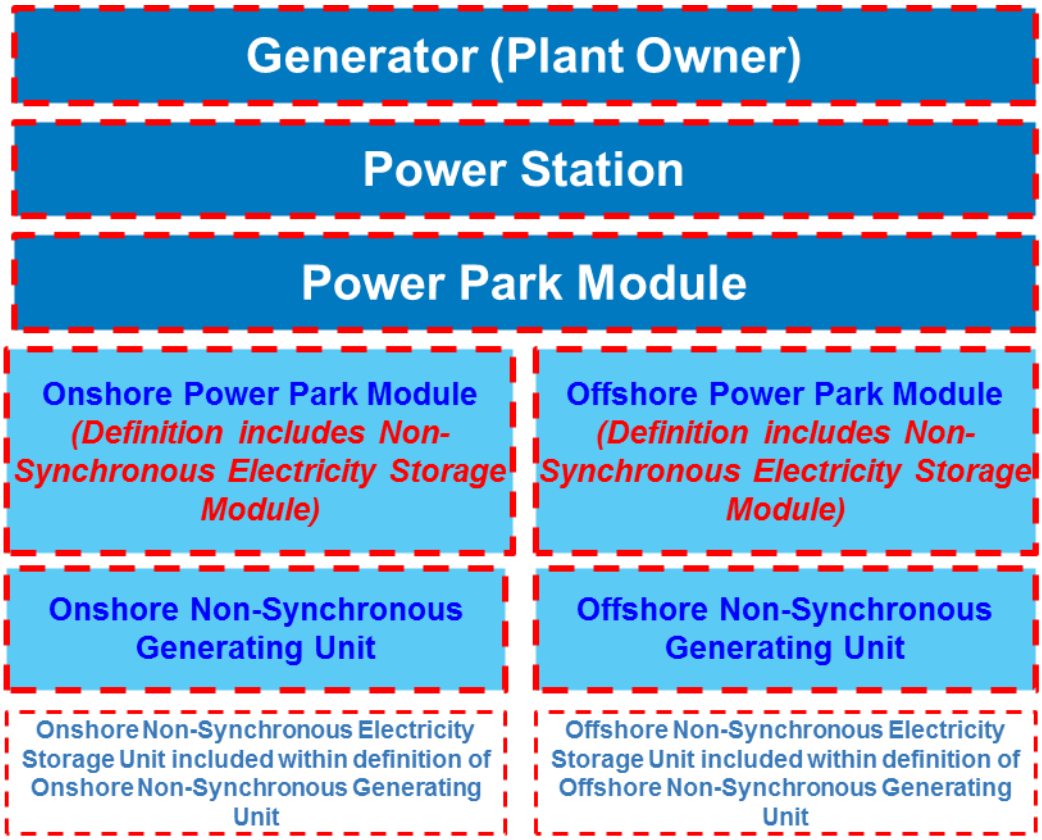
The initial view of the Proposer was to define a collection of standalone Electricity Storage Modules as an Electricity Storage Facility owned by an Electricity Storage Facility Owner.

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, is 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 detailed in the “about this document” section at the start of this document.

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 other issues 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.

Other issues

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 remaining 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.

Electricity Storage System (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[9]	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[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

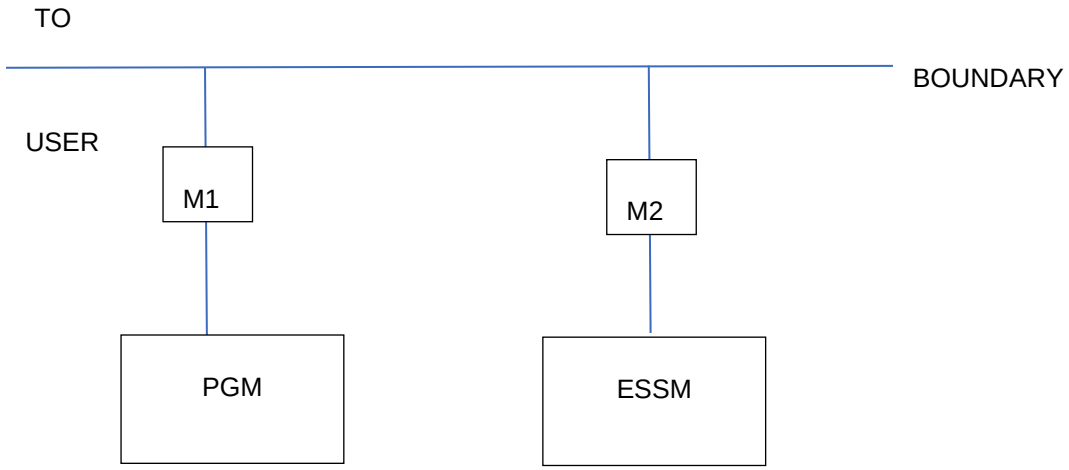


Figure 1. Consolidated connection

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

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

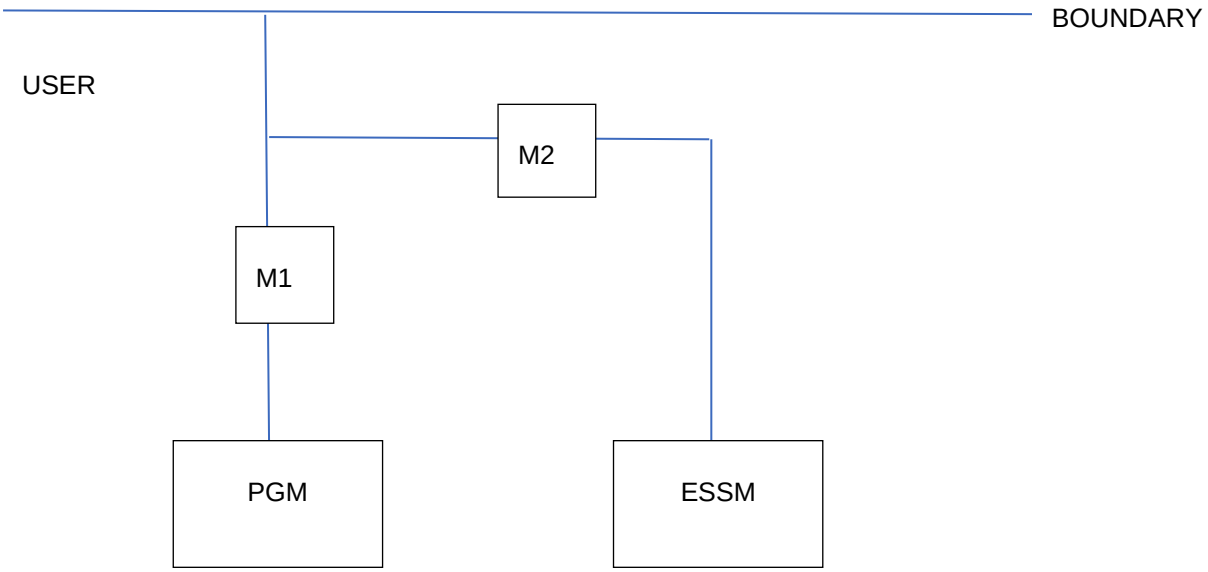


Figure 2. Parallel connection

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.

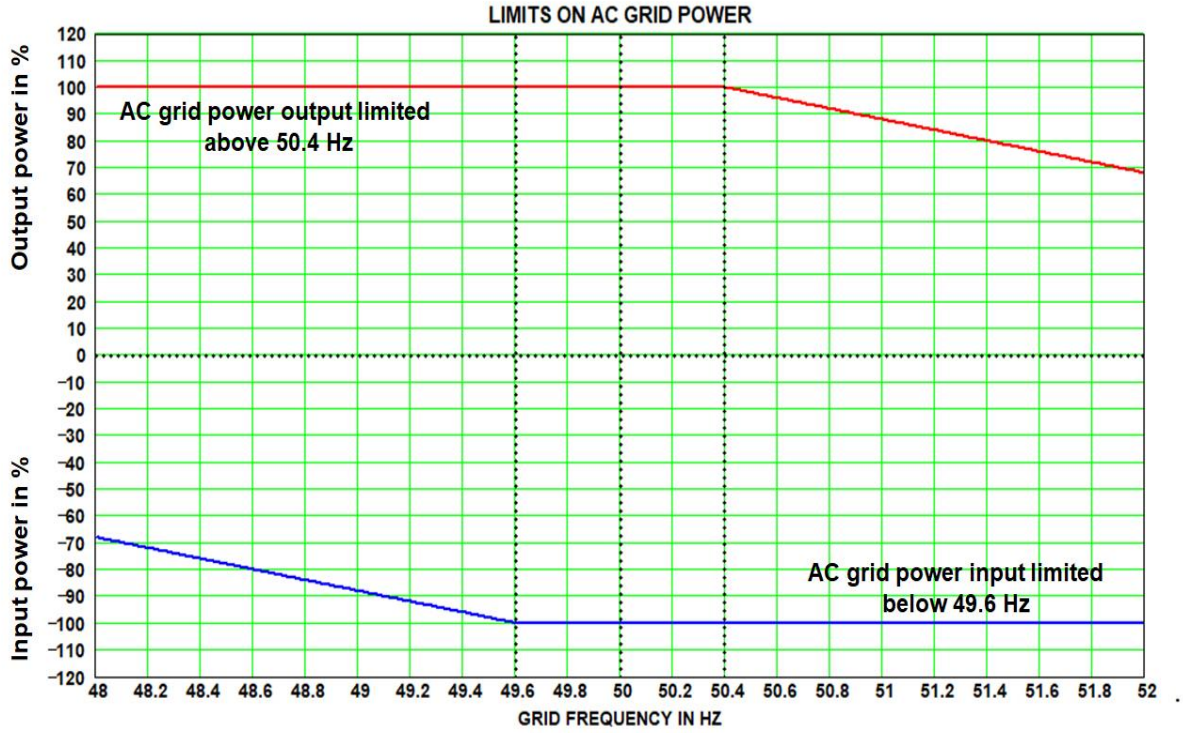


Figure 2.0

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.

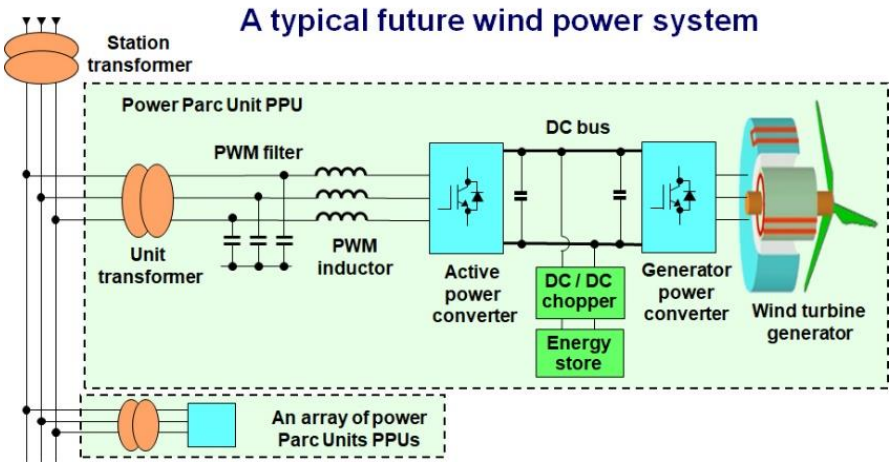


Figure 3.0 (a)

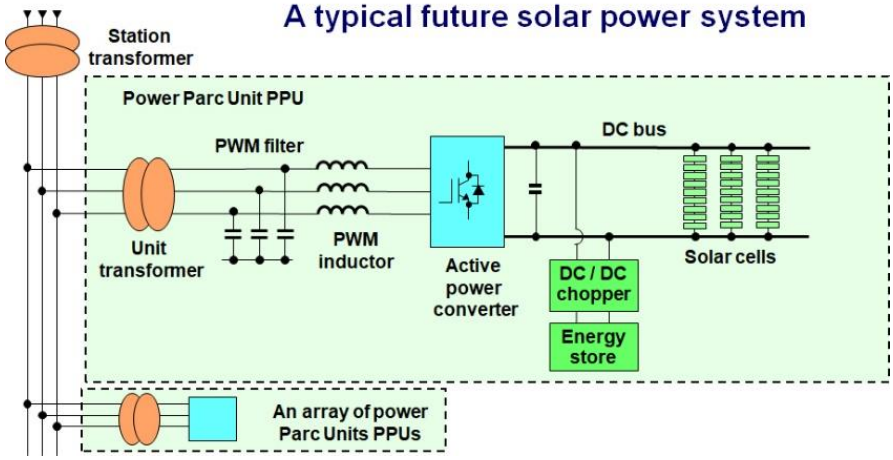


Figure 3.0 (b)

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[11]). 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

[11] https://www.nationalgrideso.com/codes/grid-code/modifications/gc0106-data-exchange-requirements-accordance-regulation-eu-20171485

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.

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 22 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	Positive

electricity transmission system operator area taken as a whole;	
(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.

10 Costs

Code administration costs	
Resource costs	**£ 23,595**- 13 Workgroup meetings **£ 2,501** - Catering
Total Code Administrator costs	**£26,096**

Industry costs	
Resource costs	**£412,913**- 13 Workgroup meetings **£16,335** – 3 Consultations • 13 Workgroup meetings • 35 Workgroup members • 1.5 man days effort per meeting • 1.5 man days effort per consultation response • 6 consultation respondents (average over three consultations)
Total Code Administrator costs	**£26,096**
Total Industry Costs	**£455,344**

9 Code Administrator Consultation Response Summary

The Code Administrator Consultation was issued on 10 May 2019 for 20 Working Days, with a close date of 10 June 2019.

Eight responses were received to the Code Administrator Consultation and are detailed in the table below

Respondent	Do you believe that GC0096 better facilitates the Applicable Grid Code objectives?	Do you support the proposed implementation approach?	Do you have any other comments?
UK Power Reserve	By explicitly defining Storage within the Grid Code this modification, and associated Consultation, assists in facilitating effective competition in the generation of electricity, by enabling the deployment of additional balancing assets alongside traditional generation only assets. Storage assets will also assist in increasing network security at both transmission and distribution system levels.	Yes, we support the proposed implementation approach – particularly given that it has come as the result of an extended period of consultation and review.	It is disappointing that the original 'fast track' approach was significantly delayed. The changing of personnel, as well as lack of resource within NG TSO would appear to be the major factors in this.

National Grid ESO Electricity System Operator	We believe that this modification proposal is positive against objectives a), b), c), and d) and is neutral against objective e). We therefore fully support this modification.	Yes – We support the implementation approach, based on the conditional criteria of the date upon which the contract for plant items is placed and the date upon which the equipment connects to the System. We believe this approach is consistent with that used for the European Connection Network Codes and minimises the risk of any unforeseen changes being applied to existing storage projects. However, as part of the drafting we note that in the definition of "EU Code User" the date 2019 should be changed to 2020 and 2018 should be changed to 2019. These are typos as the report specifies an offset based on Ofgem's decision date in the implementation section of the Code Administrator Consultation.	No.
InterGen	Yes. GC0096 removes some uncertainties, thereby encouraging a greater range of participants and more competition in provision of services to aid system operation.	Yes. Assuming an Authority decision in summer 2019, the proposed implementation approach provides a clearer background against which InterGen can plan.	Further work on this subject will no doubt be required. Technical detail will need to be defined, especially in proving compliance, and this may be a difficult process particularly for some forms of "hybrid" installations (e.g. energy storage alongside thermal stations). Further, the status of electricity storage will have to be addressed at European level at some point,

			and this may require the issues covered in GC0096 to be revisited.
Scottish Power Renewables	Yes. GC0096 clarifies new and co-located storage systems connection requirements in line with the latest version of the UK Grid Code. There should not be any more ambiguous treatment (like use to be in the past) to energy storage systems grid connection	Yes	No
EDF Energy	Yes. Specifically objectives (a), (b) and (c): The code amendments will provide consistency for developers and manufacturers in the provision of new plant. The code amendments will help to ensure that new storage plant can contribute to system operability, security and efficiency.	Yes, we agree that new Energy Storage plant should meet applicable sections of the Grid Code which are consistent with the existing generator requirements and that the modified definitions and technical requirements for Storage will incorporate the European Network Code Requirements.	It is important for system security and for effective competition that equivalent Distribution Code changes for Energy Storage follow on from this GC0096.
RES Ltd	Yes, subject to the comments below. Clear and unambiguous requirements for energy storage will facilitate participation by electricity storage	Yes	Minor typo in legal text Glossary and Definitions for Existing Pumped Storage Unit “A Generating Unit within an Exisiting Pumped Storage Plant.” Minor typo in legal text Glossary and Definitions for Non-Synchronous Electricity Storage

	operators providing important services to the ESO and providing additional competition in the electricity market.		Module “A Power Park Module comprising soley of one or more Non-Synchronous Electricity Storage Units.” Minor typo in legal text Glossary and Definitions for Pumped Storage Generator “A Generator which owns and/or operates any Pumped Storage Plant including an Exisiting Pumped Storage Plant.” Problematic construction in legal text Glossary and Definitions for Regenerative Braking. The energy extracted from regenerative braking of electric locomotives is not “stored and reused”, it is output to the System via the railway overhead lines. Similar will apply to other regenerative braking systems e.g. in elevators. I suggest the following amended definition “A method of braking in which energy is extracted from the parts braked, which may be returned directly to the System and the purpose of the braking is motion control.” The addition of the purpose is to avoid confusion with energy extraction from a non-synchronous flywheel where the purpose is provision of energy to the System. Problematic construction in legal text Glossary and Definitions for Registered Capacity. The definition for all other entities refers to the power from that entity to the System but in the case of an Electricity Storage Module it is the amount of power transferable in either direction. This is inconsistent without a clear reason. Also, there may be confusion where the normal full load Active Power in the importing direction differs from that exporting. I suggest that this is revised to ensure similar treatment to HVDC etc. which may also have different active power capabilities importing and exporting but only power transferred from the HVDC is considered in these definitions.

			The legal text Glossary and Definitions for Registered Import Capability defines this for HVDC etc. but not for Electricity Storage Units. Such inclusion could help avoid the confusion / inconsistency described above in my comments on Registered Capacity.
SSE	In broad terms, we believe that including arrangements for Storage within the Grid Code will be better in terms of (a) by facilitating the development of the transmission system by allowing for that technology to know what is required of them when connecting. In terms of (b) it will also, as a result of including arrangements for Storage within the Grid Code, facilitate competition by allowing for more parties (in this case Storage) to offer services as they know the applicable technical requirements. That having been said, we are concerned that the proposed definition of “Electricity Storage Module” could appear to introduce undue discrimination in respect of ‘Non-Controllable Electricity Storage Equipment’ which, in our view, has not been justified. This difference in treatment between storage equipment in terms of needing (in the	We note and support the proposed implementation approach set out in Section 8.	Nothing further at this time.

	case of 'controllable') to comply with Grid Code obligations or not (in the case of 'non-controllable') will not appear to better facilitate the Applicable Objectives and needs to be addressed (in a future Modification? Or by sending back GC0096?) in order to ensure (i) there is no unintended discrimination in treatment and (ii) a level playing field is achieved for all providers of services from storage to network operators and the market place.		
Elexon	As recognised in Ofgem and BEIS' Smart Systems and Flexibility Plan, electricity storage operators raised concerns that they believe the regulatory and industry arrangements should more clearly explain how they apply to electricity storage. In light of these concerns and growing numbers connecting electricity storage facilities to the distribution and transmission systems, we believe that GC0096 will provide clarity to market participants about how the Grid Code's requirements apply to electricity storage facilities.	We recognise the proposer's and workgroup's efforts to design a pragmatic approach to implementation that addresses respondent's concerns about how changes may affect the projects that are in development	Currently the Grid Code defines Pumped Storage Plant as 'The Dinorwig, Ffestiniog, Cruachan and Foyers Power Stations.' The BSC's definition of Pumped Storage Plant 'has the meaning given to that term in the Grid Code'. The meaning of Pumped Storage Plant is important because BSC Section Q6.1.18 requires that the NETSO sends to the BMRA the Total Instantaneous Out-Turn Generation for a variety of fuel types, including for Pumped Storage Plant. GC0096 proposes that the Grid Code differentiates between Pumped Storage Plant and Existing Pumped Storage Plant. This is because certain existing Pumped Storage Plant (i.e. the Dinorwig, Ffestiniog, Cruachan and Foyers Power Stations) are subject to specific, existing Grid Code requirements and should be treated differently to 'future' Pumped Storage Plant. The proposed change to the Grid Code meaning of Pumped Storage Plant will exclude Existing Pumped Storage Plant. This means that the BSC

	In general the proposal seeks to treat electricity storage facilities like other generators. This approach is aligned with Ofgem's treatment of storage as a form of generation, which it has proposed to make clear by consulting on changes to the standard conditions of the generation licence. To achieve this outcome, GC0096 proposes to extend existing Grid Code provisions to electricity storage by expanding existing definitions to include electricity storage. This is instead of creating distinct and different arrangements for storage facilities. Whilst in general the proposal seeks to treat storage like generation, the nature of operating electricity storage means it can operate like other demand facilities, e.g. HVDC. To ensure consistency between storage and other demand facilities, GC0096 seeks to ensure that certain requirements that apply to demand facilities also apply to storage facilities depending on its mode of operation. We believe the effort to treat storage similarly to		definition of Pumped Storage Plant will consequently no longer cover the Dinorwig, Ffestiniog, Cruachan and Foyers Power Stations, and so the NETSO will no longer be required to report out-turn generation for these Power Stations as it currently does. ELEXON raised this consequence as part of the later stages of the Workgroup's consideration of GC0096. The NETSO representative said they would raise a BSC Modification to ensure the BSC meaning of Pumped Storage Plant includes the Grid Code terms Pumped Storage Plant and Existing Pumped Storage Plant. To date no further action has been taken to discuss or raise the necessary BSC Modification. We encourage NETSO to discuss with us how best to raise a BSC Modification in a timely manner.

	comparable technologies depending on its mode of operation should help to achieve a level playing field, which provides consistency and certainty in treatment. In principle this should avoid unintended consequences and undue discrimination. For these reasons we believe that the solution ought to support the achievement of Objectives (a) and (b)		

10 Second Code Administrator Consultation Response Summary

The Code Administrator Consultation was issued on 18 October 2019 for one calendar month, with a close date of 18 November 2019. Two responses were received. Both respondents agreed that the modification better facilitates the Grid Code objectives. One respondent raised a concern around an omission to clarify testing for Electricity Storage Modules within OC5.7. The full responses can be located in Annex 6.

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

The amendments to the legal text following Panel send back to Workgroup are highlighted in the 'about this document' section for the purposes of this Consultation.

Annex 2 – Terms of Reference

Please find in zip folder labelled Annex 2.

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

Please find in zip folder labelled Annex 4.

Annex 5 – First Code Administrator Consultation Responses

Please find in zip folder labelled Annex 5.

Annex 6 - Second Code Administrator Consultation Responses

Please find in zip folder labelled Annex 6.

