| Modification | At what stage is this document in the process? |
|---|---|
| **DCRP/MP/20/06 Report to Authority**<br>Modifications to Storage within the existing Distribution Code documentation. | 01 Modification<br>02 DCRP report<br>03 Public Consultation<br>04 Final Modification Report |

The purpose of this document is to assist the Authority in its decision to implement the proposed modification to the Distribution Code to accommodate energy storage devices. The proposed modification aims to remove the current exemptions applied to storage within existing Distribution Code documents.

**Date of publication: 16 June 2021**

**Recommendation**

The Distribution Code Review Panel (DCRP) recommend that the proposed modifications are made to EREC G98, EREC G99 and the Distribution Code (v45)

| | |
|---|---|
|  | The DNOs and DCRP recommend that this modification should be:<br>Submitted to the Authority for approval |
|  | High Impact:<br>DNOs, Aggregators/Manufacturers/Regulator/Directly connected Demand (including response providers), |
|  | Medium Impact:<br>Developers & operators of medium and small generating units/suppliers |
|  | Low Impact:<br>None |

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## Timetable

| | |
|---|---|
| Workgroup Report presented to Panel | 03 December 2020 |
| Draft Modification Report issued for consultation | 12 December 2020 |
| Consultation Closed | 12 February 2021 |
| Final Modification Report available for Panel | 26 April 2021 |
| Revised Final Modification Report post Ofgem send back | 16 June 2021 |

**Any questions?**


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## Purpose of the Modification

Ofgem approved the implementation of the EU Network Code "Requirements for Generators" (RfG) on 15 May 2018 (with compliance required from 27 April 2019). The implementation consisted of parallel changes to the Grid and Distribution Codes, and the introduction of ERECs G98 and G99.

Given the novelty of some of the requirements in EREC G98 and EREC G99 there has been an ongoing review with stakeholders of both the underlying requirements and their expression in the drafting of EREC G98 and EREC G99, namely the removal of the current exclusions relating to Storage in these documents.

## Details of the Proposal

Ofgem approved modifications to the Grid Code relating to storage devices on the transmission network (GC0096 – Energy Storage) on 20 May 2020. As a result of this decision the requirements for storage have been explicitly set out in the Grid Code documents. The DCRP has agreed that the Distribution Code and its associated documents, ie ERECs G98 and G99 should now be amended in line with these changes. A DCRP working group was convened to consider the changes in more detail.

In essence, as well as removing the exclusions for storage, the proposal introduces a requirement for storage to support the system on falling frequency. This is a proposal that NGESO introduced in the deliberations of GC0096 in 2016, but which was not taken forward at that time. NGESO also led the work in the European Stakeholder Committee Expert Group (ESC EG) charged with introducing storage to the Requirements for Generators European Network Code. The ESC EG's report recommends that NGESO's proposed falling frequency characteristic should be included in the revised RfG

Following liaison with NGESO, the workgroup included the NGESO GC0096 initial proposal for the falling frequency characteristic in its recommendations. Grid Code modification GC0148 is now underway and NGESO have formally reintroduced the same falling frequency characteristic into their proposal. In line with all the common technical requirements, the DNOs will ensure that the requirements in the Distribution Code, G98 and G99 are, and remain, harmonized with those in the Grid Code to the extent possible. In this particular case the DNOs and the Workgroup anticipate that the GC0148 work will result in an additional new characteristic defining how storage devices respond to frequency as the frequency recovers and rises again following a downward excursion. It is DNOs intention to then raise another Distribution Code modification to incorporate this recovery characteristic.

## Workgroup Activities

The workgroup met five times between July 2020 and March 2021. The workgroup included representatives from storage manufacturers, trade bodies and DNOs. A list of workgroup members is included in Appendix 6.

Given the simple nature of the existing storage exclusions in G98 and G99, the significant part of the Workgroup's discussion centred on the inclusion of the falling frequency characteristic

and also making sure the approach accommodated electric vehicles appropriately in the proposed drafting. The workgroup also considered when the requirements should be introduced, ie how to give manufacturers appropriate lead time to implement the requirements and bring to market in advance of the requirements becoming mandatory.

In discussing the responses to the consultation, it was noted that NGESO had realised that NGESO's current proposals for the falling frequency characteristic only deal with falling frequency, and do not cover frequency recovery. Accordingly the WG recommended that the partial requirement on falling frequency be included, but made non-mandatory for the time being. This will help manufacturers to be aware of the future requirements, and can be made mandatory when the equivalent work is brought to a conclusion in GC0148.

## Interaction with Stakeholders

The output from the workgroup was briefed to the ENA's Distributed Energy Resources Technical Forum (which also includes some manufacturers and trade associations) on 15 December and on 02 February 2021.

The workgroup's thinking was also briefed by the ENA on 01 December 2020 specifically to the Society of Motor Manufacturers and Traders on behalf of all EV manufacturers.

The workgroup also noted the engagement that the Agency for the Co-operation of Energy Regulators (ACER) and the European Network of Transmission System Operators for Electricity (ENTSO-e) had with Orgalim and Chargeurope as representatives of the EV industry in Europe in November and December 2020. This engagement was undertaken to ensure that European manufacturers of storage and EVs were familiar with the ESC EG's recommendations, which of course included the NGESO proposed falling frequency characteristic.

The membership of the ESG EG included the European Association for the Storage of Energy (EASE), who were very engaged and active in the EG's deliberations.

## Responses to the Consultation

Six responses were received, from National Grid ESO, Graviticity, Scottish Power Energy Networks, EDF, Northern Powergrid and Scottish Southern Electricity Enterprise. All six are generally supportive of the changes, with the main points from their responses summarised below.

National Grid ESO's response was broadly supportive, though raised the issue of device behaviour after a falling frequency event. The response noted that the draft requirement did not specify the behaviour of storage as frequency recovered. This was discussed by the working group who noted that Grid Code modification GC0148 will naturally be covering this aspect and it seemed therefore premature for EREC G98 and EREC G99 to try to foreshadow those discussions.

Graviticity responded with a focus on possible commercial implications of the frequency response requirements. The WG understood the concerns, but considered they were misplaced given the emergency nature of the response, and its expected very short duration and infrequency.

Scottish Power Energy Network's response was supportive and offered some editorial improvements to the forewords of EREC G98, and EREC G99 and also to sections 6.3.3, 13.2.3.3, 13.2.5.1, and 13.6.2.

EDF responded to the consultation in support noting it will provide consistency for developers and manufacturers in the provision of new plant, and will help to ensure that new storage plant can contribute to system operability, security and efficiency. They also stated it is appropriate to include mandatory cessation of active power import on falling frequency in line with those implemented in the Grid Code.

Northern Powergrid's response was supportive and included versions of EREC G98 and EREC G99 marked up with several editorial suggestions.

Scottish Southern Electricity Enterprise responded in broad support of the proposal, with the bulk of the response focusing on the proposed approach to vehicle to grid (V2G) and the clarity of the requirements for V2G owners. The WG recognise the challenge of explaining the scope of the requirements to all electric vehicle owners, ie not just V2G. To this end a new diagram will be added to the next version of the ENA Distributed Generation Guides to be a point of reference to aid interpretation.

## Impacts on Total System and the DNOs' Systems

There will be a beneficial impact on the Total System from the future support to falling frequency from distribution connected storage. There are no other effects on the Total System nor on DNOs' systems.

## Impacts on the Users of DNOs' Systems

Users with new energy storage devices will have to ensure that those devices are fully compliant with EREC G98 or EREC G99 as appropriate.

## Assessment against Distribution Code Objectives

*(i) To permit the development, maintenance and operation of an efficient, coordinated and economical system for the distribution of electricity.*

The proposal has a positive impact on this objective by aligning the characteristics of storage with other generation.

*(ii) To facilitate competition in the generation and supply of electricity.*

The proposal has a positive impact on this objective by aligning the characteristics of storage with other generation.

*(iii) Efficiently discharge the obligations imposed upon DNOs by the Distribution Licence and comply with the Regulation (where Regulation has the meaning defined in the Distribution Licence) and any relevant legally binding decision of the European Commission and/or Agency for the Co-operation of Energy Regulators.*

The proposal has a neutral impact on this objective.

*(iv) Promote efficiency in the implementation and administration of the Distribution Code.*

The proposal has a positive impact on this objective by reducing the scope for uncertainty and ambiguity in the minds of users.

## Impact on other Industry documents

There are no impacts on other industry documents.

## Environmental Impact Assessment

There are no environmental impacts associated with this proposed modification.

## Distribution Code Review Panel Recommendation

The responses to the consultation were discussed at the DCRP meeting on 1st April 2021 and the Panel agreed that the changes should be submitted to Ofgem.

## Recommendation

The Licensed Distribution Network Operators and the DCRP recommend that this modification report should;

- be submitted to the Authority for approval; and
- subject to the agreement of the Authority the modification should be implemented from the date the revised Distribution Code and associated documents are published. This date is recommended as 01 July 2021 or such other date as the Authority directs.

## Appendices

Appendix 1 – Details of the proposed changes to documents

Appendix 2 – Responses to the consultation

Appendix 3 – Distribution Code Modifications

Appendix 4 – EREC G98

Appendix 5 – EREC G99

Appendix 6 – List of working group members' organizations

# Details of Proposed Changes

The modifications proposed have been outlined in this section and cover the three affected Distribution Code documents.

## 1.1 Distribution Code v45 Modifications

### 1.1.1 Definitions sections – Demand Unit

The modification required to the current version of the distribution code (v45) to remove the exclusion of storage focuses on the removal of the last paragraph in the definition of demand unit:

| | |
|---|---|
| **Demand Unit** | An appliance or a device whose Active Power Demand or Reactive Power production or consumption is being actively controlled by the Customer in whose Demand Facility it is installed and which has been commissioned on or after 18 August 2019 in pursuance of a contract to this end with the DNO.<br><br>Such an appliance or device commissioned before this date, but which has been materially altered will also be included in this definition.<br><br>Where there is more than one Demand Unit in a Demand Facility, these Demand Units shall together be considered as one Demand Unit if they cannot be operated independently from each other.<br><br>Demand Units of Customers where the Customer has concluded a final and binding contract for the purchase of a Demand Unit before 07 September 2018 are not included the scope of DPC9. The Customer must have notified the DNO of the conclusion of this final and binding contract by 07 March 2019.<br><br>~~Any Demand Unit including storage, with the exception of a pumped storage Power Generating Module, as a component part is also excluded from the requirements of DPC9~~ |

This change was consulted on with no adverse comment from the responses received.

## 1.2 G98 Issue 1 Amendment 5 Modifications

### 1.2.1 Foreword

The foreword will be amended in two places to include text covering storage devices operating in import and export mode, and the footnote to cover this change explaining the legal status of the requirements in EREC G98 in relation to any derogations that may be sought in future. The wording of the foreword will read:

> This Engineering Recommendation (EREC) G98 is published by the Energy Networks Association (ENA) and comes into effect on 27 April 2019 for **Micro-generators** commissioned on or after that date. The definition of **Micro-generators** within this document includes **Electricity Storage** devices and hence this document also applies to **Electricity Storage** devices (including any electric vehicle operating in vehicle to grid mode, but not otherwise) when operating in an export mode. The applicability of the requirements in this document to **Electricity**

**Storage** depends on the date on which the **Electricity Storage** devices are commissioned as detailed in paragraph 2.2.

It should be noted that there is likely to be a new requirement for **Electricity Storage** devices when operating in an import mode to switch to an export mode of operation when the system frequency falls below a defined threshold. In this case, the requirement would apply when the **Electricity Storage** device(s) is operating in import mode. The specifics of the requirement for both falling frequency and during system recovery are being considered by a NETSO working group and are not yet mandatory. The likely future requirement for **Electricity Storage** devices to transition from importing to exporting is described as an optional performance characteristic in this EREC G98. The NETSO working group is expected to confirm the characteristic described here, and to define the requirements as the frequency recovers. It is currently expected that the NETSO working group will conclude during 2022, following which the requirements will become mandatory.

The foreword footnote will be amended in line with the changes made to the foreword itself, the proposed text will read:

[1] **Electricity Storage** devices shall meet the requirements of this EREC G98 but are not subject to the requirements of European Regulation (EU) 2016/631, European Regulation (EU) 2016/1388 and European Regulation EU 2016/1485. The requirements of this EREC G98 shall therefore be complied with by **Electricity Storage** devices under EREC G98 (and not under any of the aforementioned European Regulations). Any derogation sought for an **Electricity Storage** device shall be deemed a derogation from this EREC G98 only (and not from the aforementioned European Regulations).

### 1.2.2 Section 2 – Scope

Two changes to the scope are proposed; a new section under 2.2 to cover devices commissioned prior to and post the proposed implementation date of September 2022;

This EREC G98 applies to including **Electricity Storage** devices commissioned on or after 01 September 2022. **Micro-generating Plant** including **Electricity Storage** devices commissioned before 01 September 2022 shall comply with this EREC G98 taking account of the specific exclusions for **Electricity Storage** in Appendix 1.

All subsections will be increased in numbering by 0.1 to allow for this change. A minor editorial change to section 2.15 (will become 2.16 with the addition of section 2.2) dealing with exclusions where the term ‘Electricity Storage’ will be removed from legal text.

### 1.2.3 Section 3 – References

A small editorial change to section 3.1 is proposed, replacing the bold text of referenced document titles in line with formatting used for the tile of the ESQCR.

**Electricity Safety, Quality and Continuity Regulations (ESQCR)**

The Electricity Safety, Quality and Continuity Regulations 2002 - Statutory Instrument Number 2665 -HMSO ISBN 0-11-042920-6 abbreviated to ESQCR in this document.

**Commission Regulation (EU) No 2016/631**

Establishing a network code on Requirements for Grid Connection of Generators.

**Directive 2009/72/EC** **of the European Parliament and of the Council**

Concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC.

### 1.2.4 Section 4 – Terms and definitions

Some additional text in the definition for electricity storage is proposed to cover the inclusion of electric vehicles. Although respondents to the consultation all expected there to be no V2G applications with capabilities of 16A or less, the WG thought it appropriate to remove any confusion that might arise by not addressing this specifically. Hence it now reads:

**Electricity Storage**

**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. In this context an **Electricity Storage** device includes electric vehicles if configured to work in vehicle to grid mode, ie acting as source of electrical energy supply to the **Customer's Installation** and/or the **DNO's Distribution Network**.

### 1.2.5 Section 9 – General technical requirements

Section 9.4.2 of G98 has new text covering device behaviour during falling frequency:

The **Micro-generator** shall be capable of maintaining constant output at its **Registered Capacity** regardless of changes in frequency in the range 49.5 – 50.4 Hz. Below 49.5 Hz, the power output should not drop by more than pro-rata with frequency, ie the maximum permitted requirement is 100% power at 49.5 Hz falling linearly to 95% power at 47.0 Hz as illustrated in Figure 2.

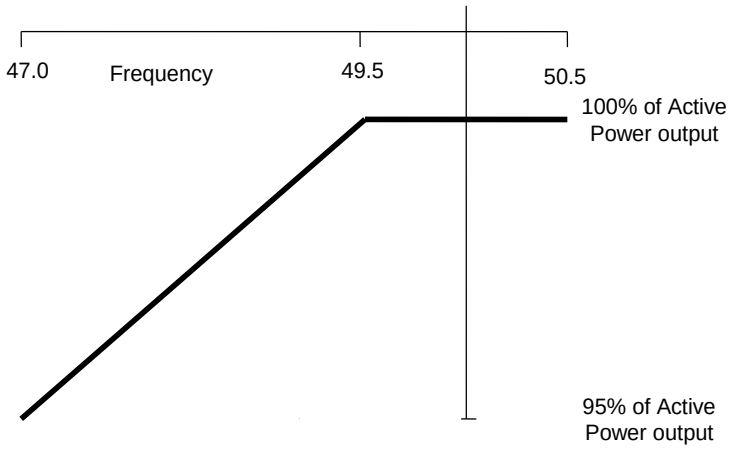



**Figure 2 – Change in Active Power output with falling frequency**

This paragraph describes an optional performance characteristic as discussed in the foreword. A **Micro-generating Plant** that incorporates an **Electricity Storage** device can support the **Total**

**System** by being arranged to automatically respond to falling frequency in line with the characteristic of Figure 3.

The required characteristics are:

(a) When the frequency falls to 49.5 Hz the automatic response shall start;

(b) The frequency response characteristic shall be within the shaded area of Figure 3;

(c) If the **Electricity Storage** device is not capable of moving from an import level to an appropriate export level within 20 s of the frequency falling to 49.2 Hz, then it shall cease to import; and

(d) If the **Electricity Storage** device has not achieved at least zero **Active Power** import when the frequency has reached 48.9 Hz it shall cease to import immediately.

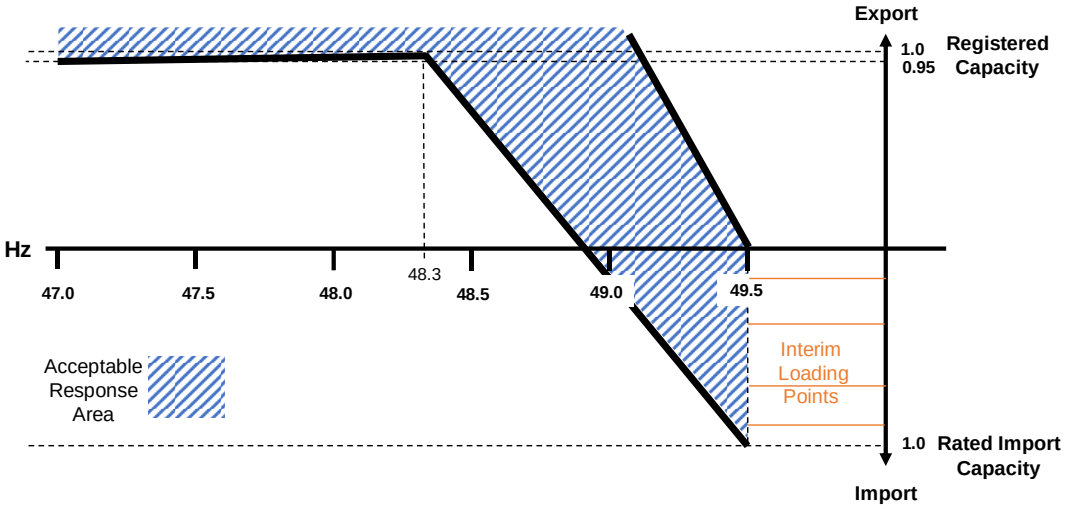



**Figure 3 Change in Active Power of Electricity Storage Device with falling frequency** (not to scale)

### 1.2.6 G98 Section – Annex 1

In this section text has been added to cover the devices commissioned prior to the proposed implementation date of September 2022. A minor editorial change has also made removing the text from the last paragraph stating, 'as **Electricity Storage** devices are exempt from the European Network code requirements for generators.' This will satisfy the requirement to remove the exemptions on storage currently within EREC G98.

**Other Exceptions**

For **Electricity Storage** devices commissioned before 01 September 2022, and/or **Micro-generating Plant**, including **Electricity Storage** devices, with a **Registered Capacity** of less than 800 W, the following sections of EREC G98 do not apply:

- 9.3 (Limited Frequency Sensitive Mode – Overfrequency); and
- 9.4.2 and 9.4.3 (constant **Active Power** output).

For the purpose of assessing the 800 W threshold, the **Registered Capacity** of the **Micro-generating Plant** should not include the capacity of **Electricity Storage** devices commissioned before 01 September 2022 where they are AC coupled with generation. However, where the **Electricity Storage** devices are **DC** coupled with generation, the **Registered Capacity** of the **Micro-generating Plant** is dictated by the **Inverter** rating, and this will determine whether the 800 W exception applies. Where **Electricity Storage** devices are **DC** coupled with generation with a

**Registered Capacity** of or greater than 800 W, then the **Electricity Storage** exceptions do not apply to the **Inverter**.

### 1.2.7 G98 section – Annex 1 Requirements for type testing of inverter connected micro-generators

The text in this section has been amended to cater for the removal of the exclusion of storage. New text has been added to both section A 1.2.8 and A2.2.7 as shown below, and as a result the original text for A 1.2.8 and A 2.2.7 has become A 1.2.9 and A2.2.7 respectively.

Micro-generators which include Electricity Storage.

This paragraph provides a method for demonstrating compliance with the optional performance characteristic as discussed in the foreword. The **Manufacturer** shall demonstrate how the **Micro-generator Active Power** when acting as a load (ie replenishing its energy store) responds to changes in system frequency.

In general four tests are proposed, one set of two at rated import capacity, and one set of two at 40% of rated import capacity**.**

In both cases the test is to reduce frequency from 50 Hz at 2 $Hzs^{-1}$. In the first case the lower frequency reached will be 49.0 Hz and the second case the lower frequency will be 48.8 Hz.

In all cases the response shall meet the requirements of 9.4.3.

## 1.3 G99 Issue 1 Amendment 7 Modifications

### 1.3.1 G99 Foreword section

Additional text has been included to cover both this modification and the anticipated future mandatory requirements on falling frequency:

> The definition of **Power Generating Modules** within this document includes **Electricity Storage** and hence this document also applies to **Electricity Storage** devices when operating in export mode and includes **Vehicle to Grid Electric Vehicle**s[1]. The applicability of the requirements in this document to **Electricity Storage** depends on the date on which the **Electricity Storage** devices are commissioned as detailed in paragraph 2.2.
>
> It should be noted that there is likely to be a new requirement for **Electricity Storage** devices when operating in an import mode to switch to an export mode of operation when the system frequency falls below a defined threshold. In this case, the requirement would apply when the **Electricity Storage** device(s) is operating in import mode. The specifics of the requirement for both falling frequency and during system recovery are being considered by a **NETSO** working group and are not yet mandatory. The likely future requirement for **Electricity Storage** devices to transition from importing to exporting is described as an optional performance characteristic in this EREC G99. The **NETSO** working group is expected to confirm the characteristic described here, and to define the requirements as the frequency recovers. It is currently expected that the **NETSO** working group will conclude during 2022, following which the requirements will become mandatory.

### 1.3.2 Foreword footnote

In line with the change to the foreword the footnote will also be amended to reflect the new text,

> [1] **Electricity Storage** devices shall meet the requirements of this EREC G99 but are not subject to the requirements of European Regulation (EU) 2016/631, European Regulation (EU) 2016/1388 and European Regulation EU 2016/1485. The requirements of this EREC G99 shall therefore be complied with by **Electricity Storage** devices under EREC G99 (and not under any of the aforementioned European Regulations). Any derogation sought for an **Electricity Storage** device shall be deemed a derogation from this EREC G99 only (and not from the aforementioned European Regulations).

### 1.3.3 Section 1 - Purpose

In section 1.2 of the document following text has been modified to remove the exclusion of storage.

1.2 The requirements set out in this EREC are designed to facilitate the connection of **Power Generating Module**(s) whilst maintaining the integrity of the **Distribution Network**, both in terms of safety and supply quality. It applies to all **Power Generating Module**(s) within the scope of Section 2, irrespective of the type of electrical machine and equipment used to convert any primary energy source into electrical energy. ~~Note that although **Electricity Storage** is in the scope of this EREC G99, a number of technical requirements do not apply, as **Electricity Storage** (except for pumped-storage) is currently excluded from the Requirements for Generators Network~~ The time based~~Code. The~~ exclusions for **Electricity Storage** and other exceptions are noted in Annex A.4. The rest of this document applies to **Electricity Storage** in full.

A new section (2.2) is proposed, this results in the number system for all sub-sections to this part of G99 increasing by 0.1 thereafter. The new section reads:

2.2 **Power Generating Modules** comprising **Electricity Storage** devices commissioned before 01 September 2022 are exempt from a small number of requirements. These specific exclusions for **Electricity Storage** are listed in Annex A4. **Power Generating Modules** comprising **Electricity Storage** devices commissioned on or after 01 September 2022 shall comply with EREC G99 in full.

### 1.3.4 Section 4 – Terms and definitions

It is proposed the wording for the definition 'Generating Unit' will be amended to include Vehicle to Grid devices as part of electricity storage.

**Generating Unit**
Any apparatus which produces electricity. This includes micro-generators and controllable **Electricity Storage** devices. A **Vehicle to Grid Electric Vehicle** is considered as an **Electricity Storage** device. Where an electric vehicle and/or its charger have been configured such that the electric vehicle cannot operate as a **Vehicle to Grid Electric Vehicle**, then it shall be considered as a load and is not included in the requirements of this EREC G99.

Two new definitions are proposed in line with the requirements in the event of falling frequency and the inclusion of EVs into G99. They are,

**Rated Import Capacity**
The normal maximum **Active Power** capacity of a **Power Generating Module** incorporating **Electricity Storage**, ie the maximum possible flow of **Active Power** into the **Power Generating Module** terminals when replenishing its energy store.

**Vehicle to Grid Electric Vehicle**
An electric vehicle and any associated internal or external charging devices that can import electricity from and export electricity to the **Distribution Network**.

A small editorial change to the definition synchronous generating modules has been proposed to include in brackets 'including electricity storage devices.'

An amendment to the accompanying text to figure 4.7 is proposed where; **'**1 x 3.68 kW PV **Inverter** plus 1 x 3.68 kW **Electricity Storage** device = 7.36kW **Power Generating Facility'.**

### 1.3.5 Section 5 – Legal Aspects

A new footnote (6) is proposed stating 'For storage commissioned before 01 September 2022 please see Annex A4.2.

Legal text within section 5.19 has been removed in line with the removal of the exclusion to storage within the document, the removed text reads; 'and Annex 4.2 details certain requirements which do not apply to **Electricity Storage** devices.' The proposed text within section 5.19 will now read,

5.19 In **GB** law, **Electricity Storage** is treated just as generation. Accordingly, this EREC G99 includes **Electricity Storage** in the definition of a **Generating Unit**.

### 1.3.6 Section 6 – Connection Application

Table 6.1 shall have scenario numbering added with new scenarios from 8 to 12 added to cover the inclusion of electricity storage devices, they are as shown below,

| Scenario Number | Details of the existing **Power Generating Facility** | Planned expansion to the **Power Generating Facility** | Compliance requirements |
|---|---|---|---|
| **8** | **Electricity Storage** commissioned under EREC G83 or EREC G59 | **Electricity Storage** AC coupled – ie storage complete with its own **Inverter**s<br>Figure 6.8 | Original and additional **Electricity Storage** devices**Error! Bookmark not defined.** treated separately. Additional **Electricity Storage** devices need to comply with EREC G99; all need to comply with operational requirements. |
| **9** | **Electricity Storage** commissioned under EREC G98 or EREC G99 | **Electricity Storage** AC coupled – ie storage complete with its own **Inverter**s<br>Figure 6.9 | **Electricity Storage** devices**Error! Bookmark not defined.** aggregated to form a new single **Power Generating Module**. Compliance required for the new module size, with EREC G99 and with operational requirements. |
| **10** | **Electricity Storage** and / or **Solar Power Park Module** commissioned under EREC G98 or EREC G99 | **Vehicle to Grid Electric Vehicle** connected AC<br>Figure 6.10 | The **Inverter** on board the **Vehicle to Grid Electric Vehicle** is a **Power Generating Module**Error! Bookmark not defined..<br>The **Customer** is a **Generator** and must ensure that the **Vehicle to Grid Electric Vehicle** and installation is fully compliant with EREC G99. |

| Scenario Number | Details of the existing **Power Generating Facility** | Planned expansion to the **Power Generating Facility** | Compliance requirements |
|---|---|---|---|
| **11** | **Electricity Storage** and / or Solar **Power Park Module** commissioned under EREC G98 or EREC G99 | **Vehicle to Grid Electric Vehicle** connected DC<br>Figure 6.11 | The **Vehicle to Grid Electric Vehicle Inverter** is a **Power Generating Module**Error! Bookmark not defined..<br>The **Customer** is a **Generator** and must ensure that the **Vehicle to Grid Electric Vehicle** installation is fully compliant with EREC G99. |
| **12** | **Electricity Storage** commissioned under EREC G98 or EREC G99 | Combined **Vehicle to Grid Electric Vehicle** and solar PV connected at DC<br>Figure 6.12 | Existing **Electricity Storage** devices**Error! Bookmark not defined.** aggregated with the combined **Vehicle to Grid Electric Vehicle** and solar PV to form a new **Power Generating Module**Error! Bookmark not defined.. Compliance required for the new module size, with EREC G99 and with operational requirements.<br>The **Customer** is a **Generator** and must ensure that the **Vehicle to Grid Electric Vehicle** installation is fully compliant with EREC G99. |

Proposed changes to the accompanying text to Figure 6.7 reads:

**Figure 6.7. Example: Existing 60 kW Type A Power Park Module to EREC G99 plus later addition of 3 x 10 kW Electricity Storage devices with own Inverters**

**= (60 kW + 30 kW**Error! Bookmark not defined.**) 90 kW Type A Power Park Module**

**= 90 kW Power Generating Facility**

This proposed change will allow for the inclusion new storage devices connected downstream of the connection point.

Figures 6.8 – 6.12 are proposed to provide examples for electricity storage devices to be connected, this will result in the current figure 6.8 becoming 6.13 in amendment 7. Figures 6.8 – 6.12, along with new accompanying text as shown below:

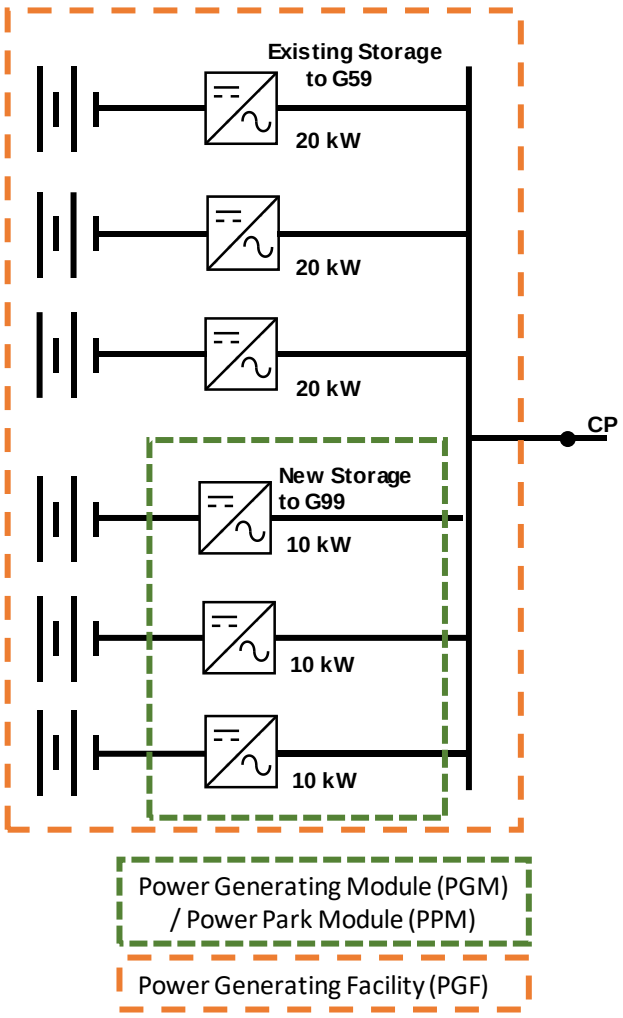



**Figure 6.8. Example: Existing 3 x 20 kW Electricity Storage devices to EREC G59 plus later addition of 3 x 10 kW Electricity Storage devices**[Error! Bookmark not defined.] **with own Inverters**

**= 60 kW Electricity Storage + 30 kW Type A Power Park Module**

**= 90 kW Power Generating Facility**

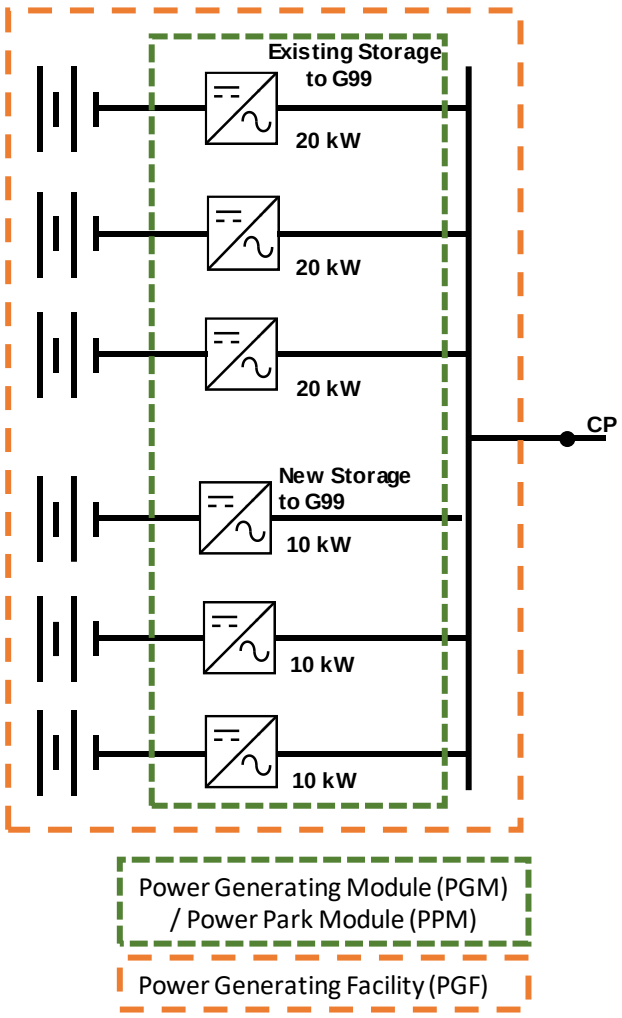
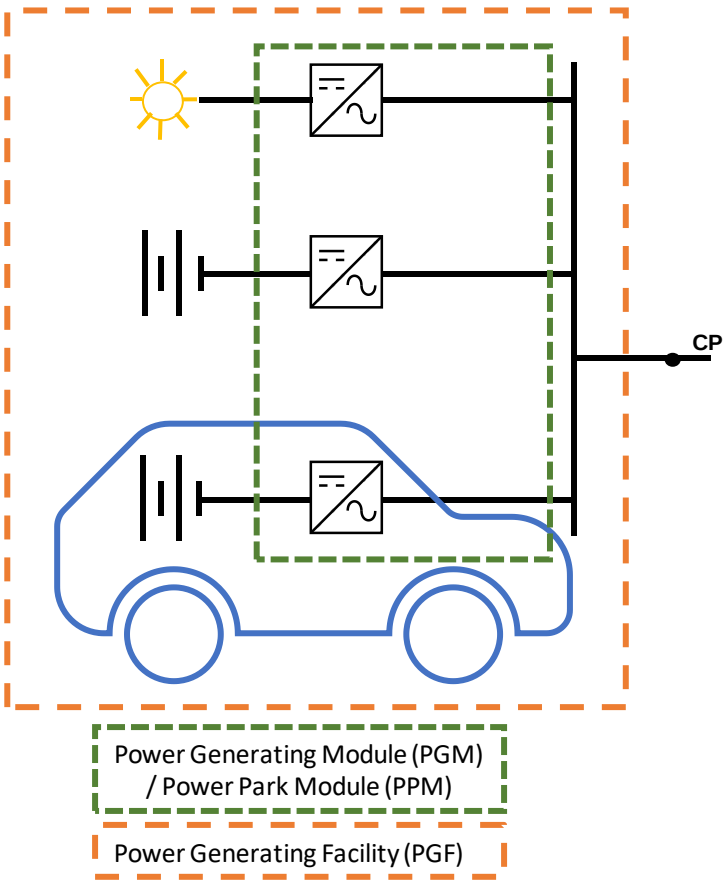



**Figure 6.9. Example: Existing 60 kW Type A Power Park Module to EREC G99 plus later addition of 3 x 10 kW Electricity Storage devices**[Error! Bookmark not defined.] **with own Inverters**

**= (60 kW + 30 kW) 90 kW Type A Power Park Module**

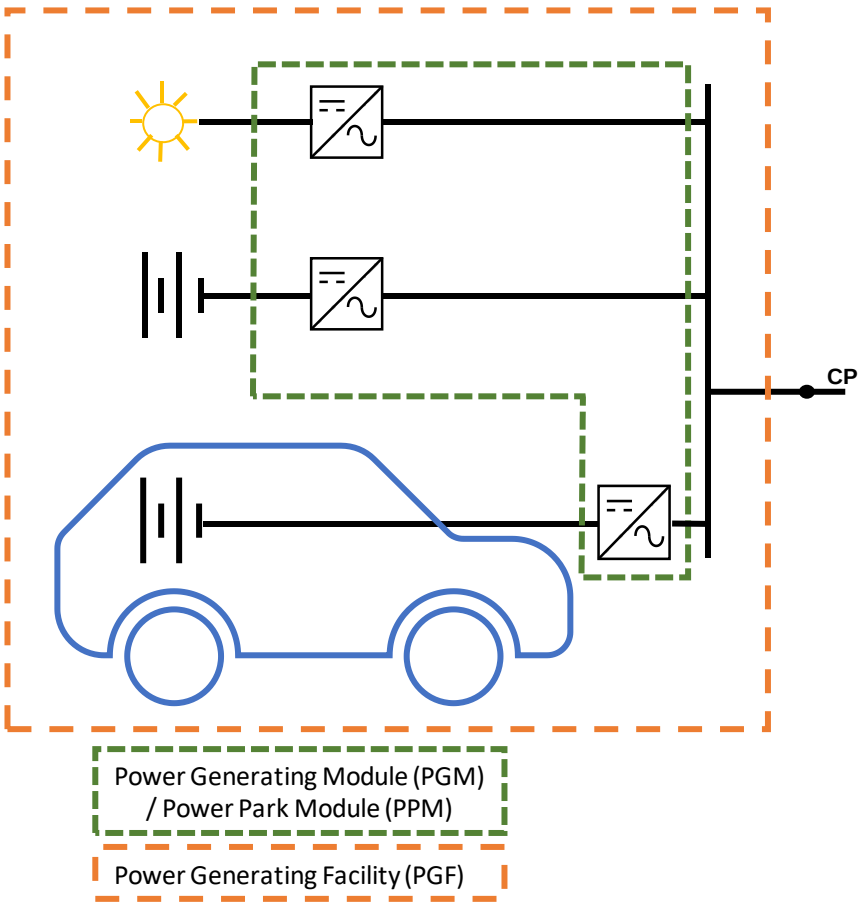
**= 90 kW Power Generating Facility**




The **Vehicle to Grid Electric Vehicle** is a **Power Generating Unit**. The **Power Generating Module** is comprised of the stationary **Electricity Storage** device**,** the solar PV **Power Park Module** and the **Vehicle to Grid Electric Vehicle**.

Before a **Vehicle to Grid Electric Vehicle** is connected to the fixed installation the **Customer** must ensure there is an appropriate **Connection Agreement** with the **DNO** and that the whole **Power Generating Module** is compliant with this EREC G99.

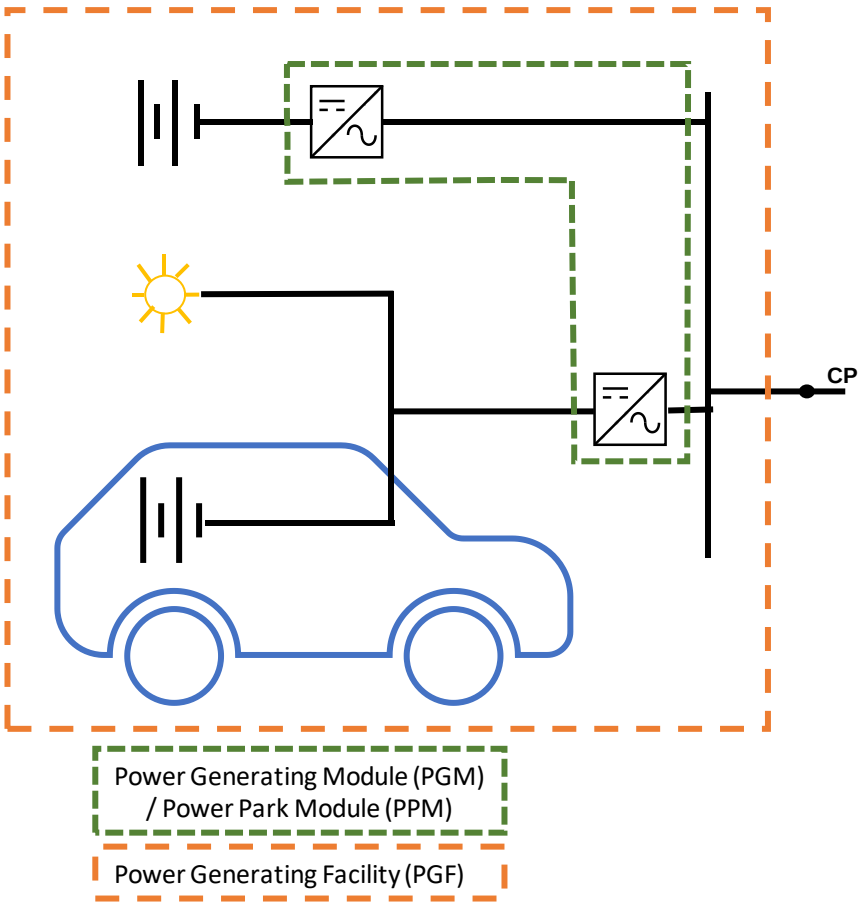
**Figure 6.10 Example of a Vehicle to Grid Electric Vehicle where the charging device is included in the EV and there is a stationary Electricity Storage device**Error! Bookmark not defined. **and a solar PV Power Park Module at the same premises**




The **Vehicle to Grid Electric Vehicle** charging device in the **Customer's Installation** is a **Power Generating Unit**. The **Power Generating Module** is comprised of the stationary **Electricity Storage** device, the solar PV **Power Park Module** and the **Vehicle to Grid Electric Vehicle Power Generating Unit**.

Before an **Vehicle to Grid Electric Vehicle** is connected to the fixed installation the **Customer** must ensure there is an appropriate **Connection Agreement** with the **DNO** and that the whole **Power Generating Module** is compliant with EREC G99.

**Figure 6.11 Example of a Vehicle to Grid Electric Vehicle where the Inverter is located in the Customer's Installation and there is a stationary Electricity Storage device** Error! Bookmark not defined. **and a solar PV Power Park Module at the same premises.**




The **Vehicle to Grid Electric Vehicle Inverter** is combined with the solar PV and is a **Power Park Unit**. The **Power Generating Module** is comprised of the stationary **Electricity Storage** device and the combined **Vehicle to Grid Electric Vehicle** and solar PV **Power Park Unit**.

Before an **Vehicle to Grid Electric Vehicle** is connected to the fixed installation the **Customer** must ensure there is an appropriate **Connection Agreement** with the **DNO** and that the **Power Generating Module** is compliant with EREC G99.

**Figure 6.12 Example of a Vehicle to Grid Electric Vehicle with a combined Inverter also facilitating solar PV and a stationary Electricity Storage device**Error! Bookmark not defined. **at the same premises.**

The legal text in section 6.2.2.4 of G99 amendment 6 is proposed to be removed in line with the requirement to remove the exclusions on storage, the text to be deleted is;

6.2.2.4 Note that a number of sections of EREC G98 do not apply to **Electricity Storage** devices that are covered by this procedure. Refer to Appendix 1 of EREC G98 for details.

### 1.3.7 Section 7 – Connection Arrangements

New text has been added, as 7.1.3, to ensure that non-controllable sources of energy are not inadvertently included in the requirements as storage:

7.1.3 In general the technical requirements in EREC G99 will not apply for non controllable storage technology such as synchronous compensators and synchronous flywheels. This is because there will be no need to make any specific design accommodation for such equipment as it is unlikely that they will support any possible power island for a significant length of time. Where such equipment can act as a source of electrical energy for more than a few seconds (say typically 20 s), the **DNO** will advise the **Customer** if the **Customer's Installation** requires any special

consideration, such as reverse power protection or short circuit current contribution assessment, on a case by case basis.

### 1.3.8 Section 11 – Type A power generating module technical requirements

The proposed implementation date for the removal of the storage exclusions shall be added to section 11.1.1(b):

**Electricity Storage Power Generation Modules** within the **Power Generating Facility** commissioned before 01 September 2022.

The wording 'frequency characteristic' has been removed from section 11.2.3.2 and new text shall be added in section 11.2.3.3 as follows:

This paragraph describes an optional performance characteristic as discussed in the foreword. **Electricity Storage Power Generation Modules** can support the **Total System** by being arranged to automatically respond to falling frequency in line with the characteristic of Figure 11.2 until the stored energy is depleted.

The characteristics are:

(a) When the frequency falls to 49.5 Hz the automatic response shall start;

(b) The frequency response characteristic shall be within the shaded area of Figure 11.2;

(c) If the **Electricity Storage** device is not capable of moving from an import level to an appropriate export level within 20 s of the frequency falling to 49.2 Hz, then it shall cease to import; and

(d) If the **Electricity Storage** device has not achieved at least zero **Active Power** import when the frequency has reached 48.9 Hz it shall cease to import immediately.

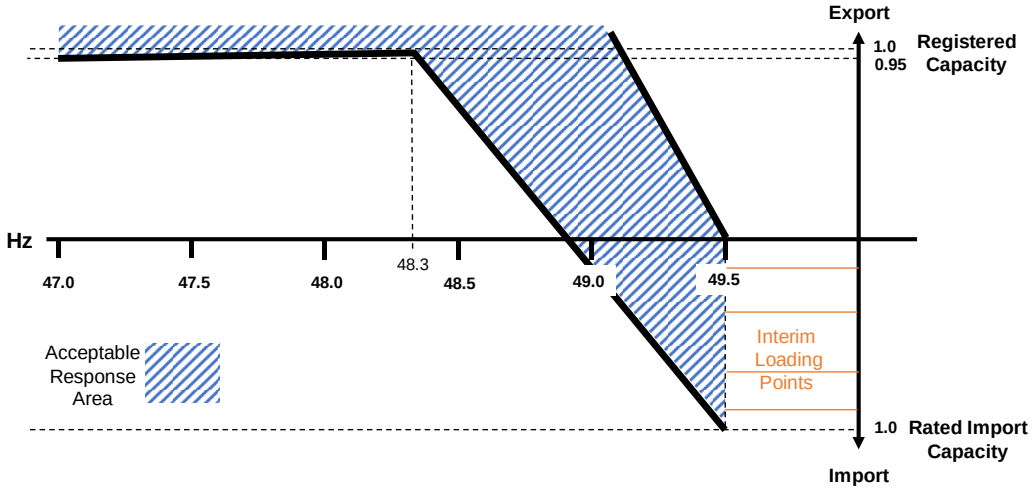



**Figure 11.2 Change in Active Power of Electricity Storage Device with falling frequency** (not to scale)

### 1.3.9 Section 12 – Type B power generating module technical requirements

The proposed implementation date for the removal of storage shall be added to section 12.1.1(b) in the following wording,

**Electricity Storage Power Generation Modules** within the **Power Generating Facility** commissioned before 01 September 2022.

New text has been added in section 12.2.3.3 as follows:

This paragraph describes an optional performance characteristic as discussed in the foreword. **Electricity Storage Power Generation Modules** can support the **Total System** by being arranged to automatically respond to falling frequency in line with the characteristic of Figure 12.2 until the stored energy is depleted.

The characteristics are:

(a) When the frequency falls to 49.5 Hz the automatic response shall start;

(b) The frequency response characteristic shall be within the shaded area of Figure 12.2;

(c) If the **Electricity Storage** device is not capable of moving from an import level to an appropriate export level within 20 s of the frequency falling to 49.2 Hz, then it shall cease to import; and

(d) If the **Electricity Storage** device has not achieved at least zero **Active Power** import when the frequency has reached 48.9 Hz it shall cease to import immediately.

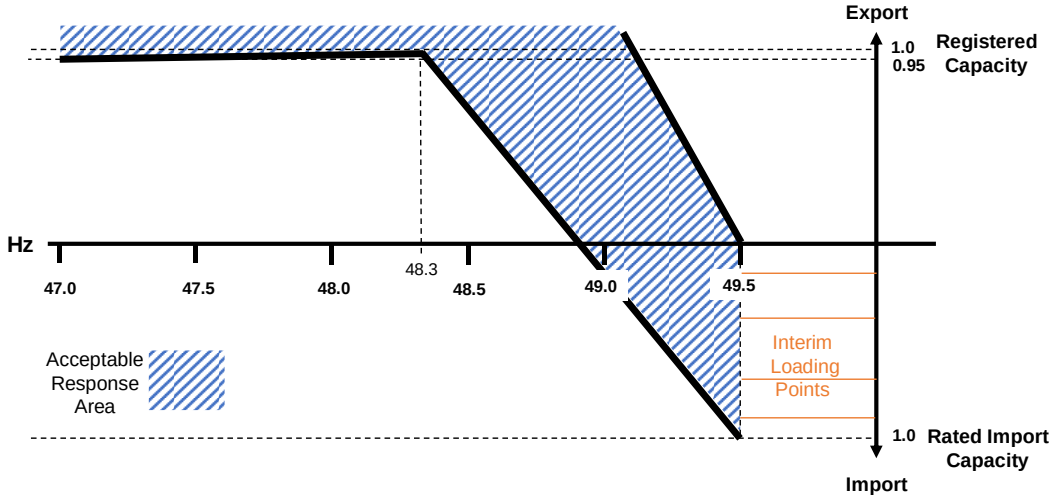



**Figure 12.2 Change in Active Power of Electricity Storage Device with falling frequency** (not to scale)

To allow for the additional figures to be included, the titling of figures 12.3 and 12.4 has been amended to 12.4 and 12.5, respectively. The reference to these figures in section 12.3.1.1 has been amended to reflect the change.

In section 12.6.2 the titles of the figures shown, and all references within the subsections have been amended to increase the figures titles by .1, as per the changes to section 12.3.1.1.

### 1.3.10 Section 13 – Type C and type D power generating module technical requirements

The proposed implementation date for the removal of storage has been added to section 13.1.1(b) in the following wording,

**Electricity Storage Power Generation Modules** within the **Power Generating Facility** commissioned before 01 September 2022.

New text has been added in section 13.2.3.3 as follows:

This paragraph describes an optional performance characteristic as discussed in the foreword. **Electricity Storage Power Generation Modules** can support the **Total System** by being arranged to automatically respond to falling frequency in line with the characteristic of Figure 13.2 until the stored energy is depleted.

The characteristics are:

(e) When the frequency falls to 49.5 Hz the automatic response shall start;

(f) The frequency response characteristic shall be within the shaded area of Figure 13.2;

(g) If the **Electricity Storage** device is not capable of moving from an import level to an appropriate export level within 20 s of the frequency falling to 49.2 Hz, then it shall cease to import; and

(h) If the **Electricity Storage** device has not achieved at least zero **Active Power** import when the frequency has reached 48.9 Hz it shall cease to import immediately.

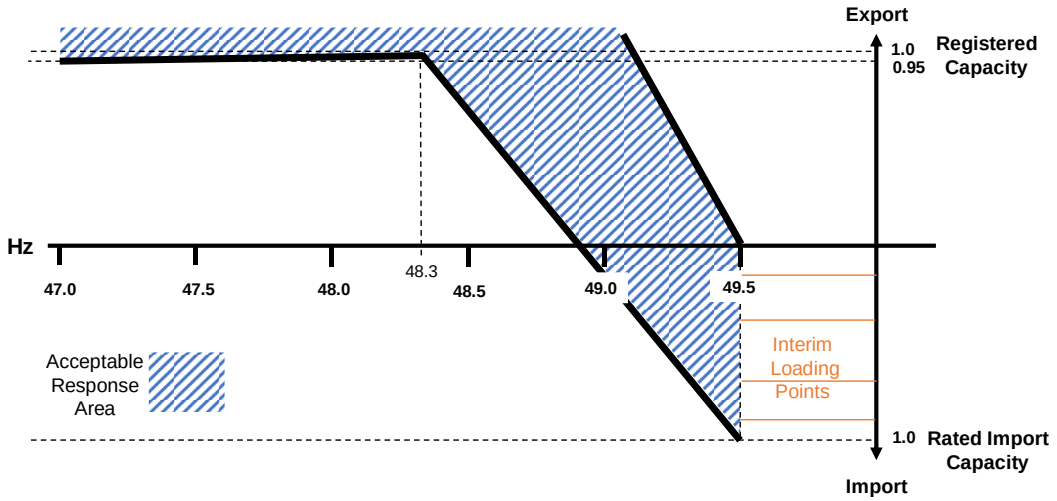



**Figure 13.2 Change in Active Power of Electricity Storage Device with falling frequency** (not to scale)

The titling of all remaining figures used in this section has increased by .1, these figures are referenced in sections,

- 13.2.4.1(b)
- 13.2.5.1(a)
- 13.2.6.4(a)
- 13.2.6.4(c)
- 13.3.1.1
- 13.4.4.1
- 13.5.1
- 13.5.4
- 13.5.5
- 13.5.6
- 13.6.2(a)
- 13.6.2(b)
- 13.6.2(c)
- 13.6.2(f)
- 13.6.2(g)

the title of table 13.1 and the accompanying text to table 13.2.

Section 13.2.6.4(e) has the words ‘Electricity Storage devices and’ added to the existing text in line with the required changes:

(e) with regard to disconnection due to under frequency, **Generator**s responsible for **Power Generating Module**s capable of acting as a load, including but not limited to **Electricity Storage** devices and pumped-storage **Power Generating Module**s, shall be capable of disconnecting their load in case of under frequency which will be agreed with the **DNO**. For the avoidance of doubt this requirement does not apply to station auxiliary supplies[13].

A reference to a new footnote (13) shall also be added to the above text, the new footnote shall read,

> [13] See foreword for possible future arrangements.

### 1.3.11 Section 15 – Common compliance and commissioning requirements for all power generating modules

A new section of text, 15.1.3 has been added to include electricity storage devices with respect to generating module commissioning.

> Compliance at a **Customer's Installation** with, for example:
>
> - both **Electricity Storage** devices and demand, or
> - both **Power Generating Unit**s and/or **Power Generating Modules** that are not **Electricity Storage** devices, and **Electricity Storage** devices,
>
> can be demonstrated through the combined capability of all **Power Generating Modules** that form the **Generator's Installation**. Demonstration that each **Power Generating Module** (including **Electricity Storage** devices) individually meets the requirements in this EREC G99 is required where the **Generator** intends to operate the **Power Generating Unit**s in their installation individually, for example, if the **Electricity Storage** devices are out of service.
>
> For a **Type A Power Generating Module** comprised of more than one **Power Generating Unit**s with separate primary energy sources, demonstration of compliance of each group of **Power Generating Unit**s with a separate primary energy source is an acceptable method of demonstrating compliance for the **Power Park Module**.

A new section 15.5 with a sub section 15.5.1, has been included to cover the compliance of vehicle to grid devices.

> Compliance of Vehicle to Grid Electric Vehicles
>
> The owner of the installation where a **Vehicle to Grid Electric Vehicle** is connected to the **Distribution Network** is a **Generator** and is responsible for compliance of the **Vehicle to Grid Electric Vehicle** with this EREC G99.

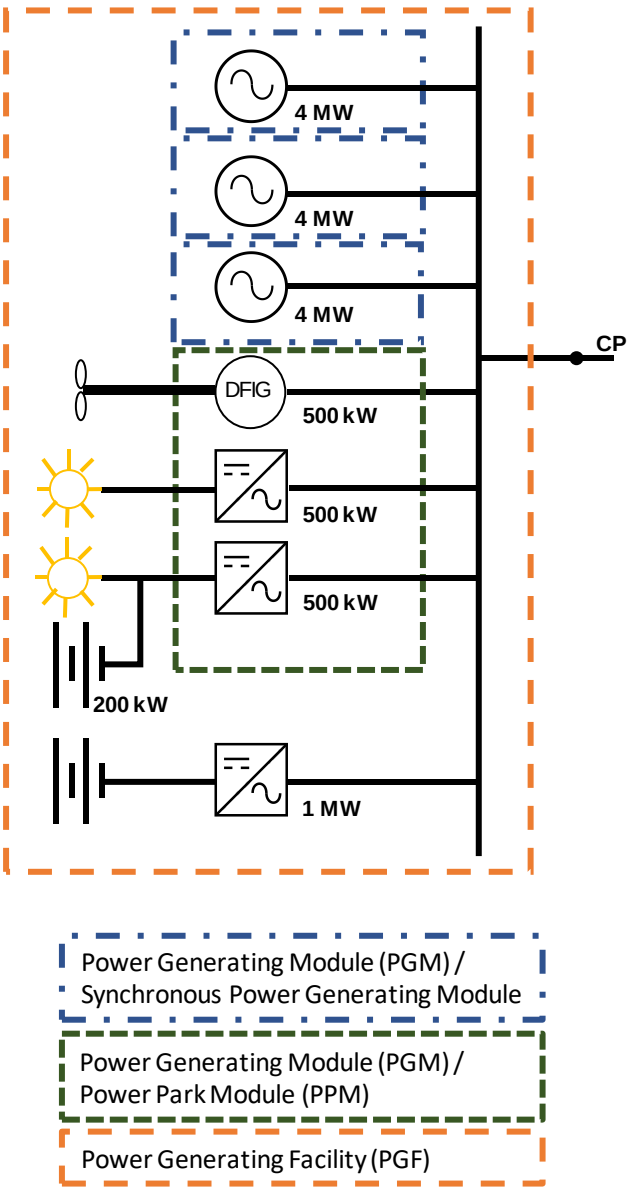
### 1.3.12 Section A.4 – Emerging technologies and other exceptions

Section A.4.2.1 has additional text added:

> A.4.2.1 For **Electricity Storage** devices commissioned before 01 September 2022 the following sections and their corresponding compliance requirements in Annex A, Annex B and Annex C of EREC G99 do not apply:

New sections of text and accompanying diagrams have been included within section A4, as shown below:

> A.4.2.2 Where **Electricity Storage** devices are **DC** coupled with generation, the **Electricity Storage** exceptions do not apply to the **Inverter**.
>
> A.4.2.3 For **Electricity Storage** devices commissioned before 01 September 2022 the Type categorisation in the example in Figure 4.6 has a different interpretation: The non integral **Electricity Storage** device is not part of the Type classification and hence this is a 3 x 4 MW **Type B Synchronous Power Generating Module**s plus a 1.5 MW **Type B Power Park Module** plus 1 MW **Electricity Storage** device. This is illustrated in Figure A.4.1.




3 x 4 MW **Type B** Gas Engines plus 1 x 500 kW asynchronous **Generating Unit** plus 1 x 500 kW **Inverter** plus 1 x 500 kW **Inverter** with 200 kW Integral **Electricity Storage** plus 1 MW **Electricity Storage** device

= 3 x 4 MW **Type B Synchronous Power Generating Module**s plus 1.5 MW **Type B Power Park Module** plus 1 MW **Electricity Storage**

= 14.5 MW **Power Generating Facility** (Large power station in North of Scotland)

Note the **Electricity Storage** device using the same **Inverter** as the PV does not contribute to the **Power Park Module Registered Capacity**, because the **Registered Capacity** is based on the **Inverter** rating. The **Electricity Storage** device using a dedicated **Inverter** is also a **Power Generating Module** but is excluded from some of the requirements of this EREC G99, but included in the **Power Generating Facility**.

**Figure A.4.1 Example of Connection of Electricity Storage with Type A and Type B Power Generating Modules in the same Power Generating Facility**

A.4.2.4 For **Electricity Storage** devices commissioned before [01 September 2022] the connection scenario examples detailed below have a different interpretation or applicability to that detailed in Section 6:

A.4.2.4.1 Scenario 7 and Figure 6.7: The **Electricity Storage** devices are not included in the **Power Park Module** in this example, hence this example is a 60 kW **Power Park Module** and a 90 kW **Power Generating Facility**. This is illustrated in Figure A.4.2.

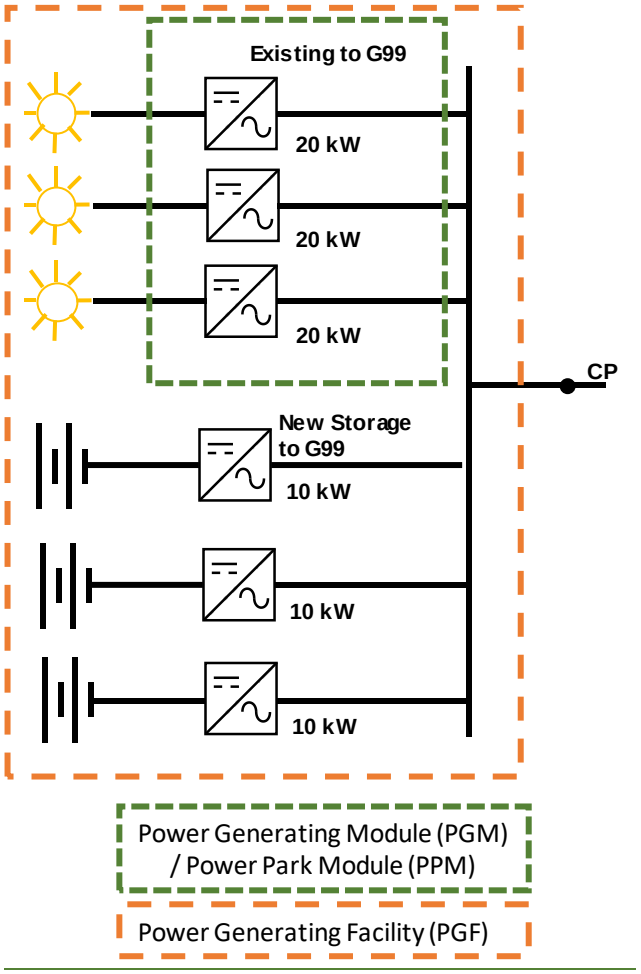



**Figure A.4.2. Example: Existing 60 kW Type A Power Park Module to EREC G99 plus later addition of 3 x 10 kW Electricity Storage devices with own Inverters**

**= 60 kW Type A Power Park Module plus 30 kW Electricity Storage (exempt from certain Type A requirements)**

**= 90 kW Power Generating Facility**

A.4.2.4.2 Scenario 8 and Figure 6.8: The later addition of 3 x 10kW **Electricity Storage** devices do not form a **Type A Power Park Module** and hence this example is 60 kW **Electricity Storage** + 30 kW **Electricity Storage** = 90 kW **Power Generating Facility.** This is illustrated in Figure A.4.3.

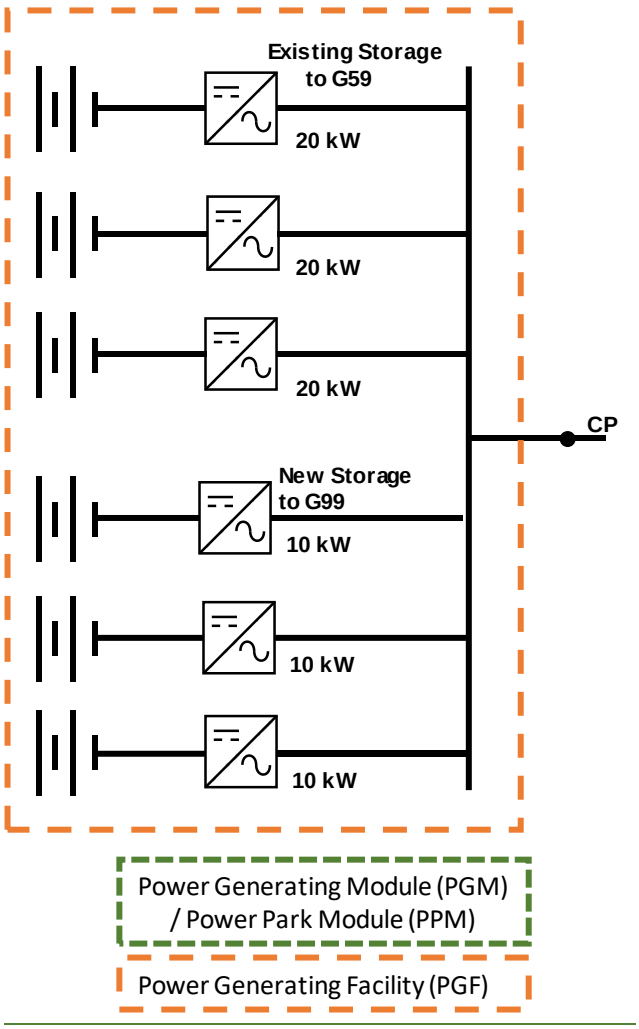



**Figure A.4.3. Example: Existing 3 x 20 kW Electricity Storage devices to EREC G59 plus later addition of 3 x 10 kW Electricity Storage devices with own Inverters**

**= 60 kW Electricity Storage + 30 kW Electricity Storage (exempt from certain Type A requirements)**

**= 90 kW Power Generating Facility**

A.4.2.4.3 Scenario 9 and Figure 6.9: The existing **Electricity Storage** devices and the later addition of 3 x 10kW **Electricity Storage** devices do not form a **Type A Power Park Module** and hence this example is 60 kW **Electricity Storage** + 30 kW **Electricity Storage** = 90 kW **Power Generating Facility**. This is illustrated in Figure A.4.4.

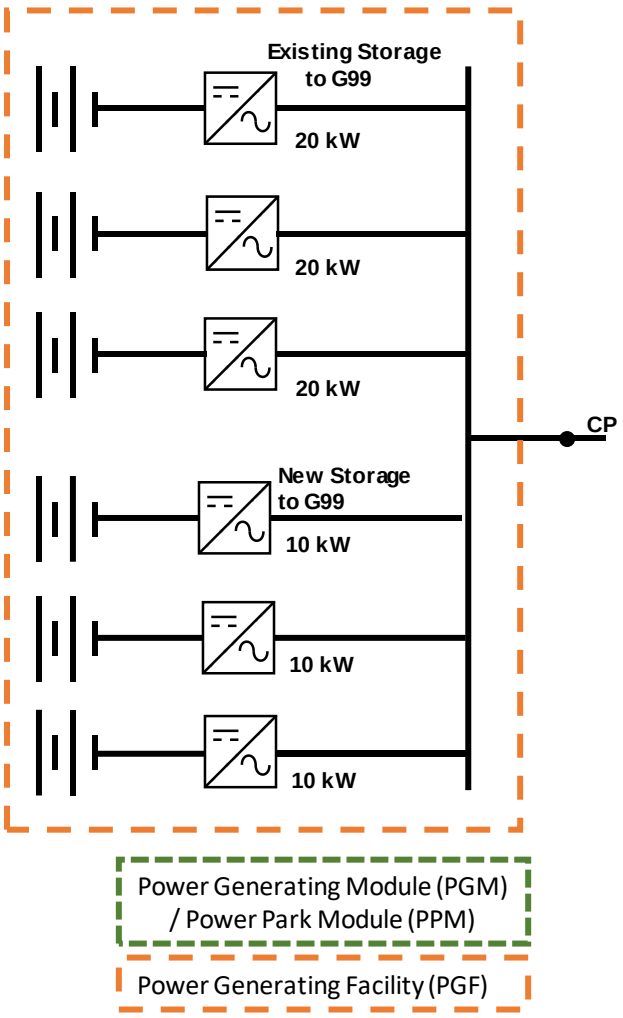



**Figure A.4.4. Example: Existing 3 x 20 kW Electricity Storage devices to EREC G99 plus later addition of 3 x 10 kW Electricity Storage devices with own Inverters**

**= 60 kW Electricity Storage (exempt from certain Type A requirements) + 30 kW Electricity Storage (exempt from certain Type A requirements)**

**= 90 kW Power Generating Facility**

A.4.2.4.4 Scenario 10 and Figure 6.10; This example is not applicable, however it should be noted that before a **Vehicle to Grid Electric Vehicle** is connected to the fixed installation the **Customer** must ensure there is an appropriate **Connection Agreement** with the **DNO** and that the **Power Generating Module** is compliant with this EREC G99 ie compliant with all the requirements in this document except the exclusions stated in this Annex A.4.2.

A.4.2.4.5 Scenario 11 and Figure 6.11: This example is not applicable it should be noted that before a **Vehicle to Grid Electric Vehicle** is connected to the fixed installation the **Customer** must ensure there is an appropriate **Connection Agreement** with the **DNO** and that the **Power Generating Module** is compliant with this EREC G99 ie compliant with all the requirements in this document except the exclusions stated in this Annex A.4.2.

A.4.2.4.6 Scenario 12 and Figure 6.12: This example is not applicable however it should be noted that before a **Vehicle to Grid Electric Vehicle** is connected to the fixed installation the **Customer** must ensure there is an appropriate **Connection Agreement** with the **DNO** and that the **Power Generating Module** is compliant with this EREC G99 ie compliant with all the requirements in this document except the exclusions stated in this Annex A.4.2.

### 1.3.13 Section A.7 – Requirements for type testing power generating modules

A new section of text has been added, A.7.1.7 detailing the requirements of electrical storage in relation to power park modules.

A.7.1.7 **Power Park Modules** which include **Electricity Storage**

This paragraph provides a method for demonstrating compliance with the optional performance characteristic as discussed in the foreword. The tests shall be carried out to demonstrate how the **Power Park Module Active Power** when acting as a load (ie replenishing its energy store) responds to changes in system frequency.

In general, four tests are proposed, one set of two at **Rated Import Capacity**, and one set of two at 40% of **Rated Import Capacity**.

In both cases the test is to reduce frequency from 50 Hz at 2 $Hzs^{-1}$. In the first case the lower frequency reached will be 49.0 Hz and the second case the lower frequency will be 48.8 Hz.

In all cases the response shall meet the requirements of 11.2.3.3.

A new title has been included to section A.7.2.3.1 for 'All Synchronous Power Generating Modules' and a new section of text to section A.7.2.3.2 as shown below,

**A.7.2.3.2 Synchronous Power Generating Modules** which include **Electricity Storage**

This paragraph provides a method for demonstrating compliance with the optional performance characteristic as discussed in the foreword. The tests shall be carried out to demonstrate how the **Synchronous Power Generating Module Active Power** when acting as a load (ie replenishing its energy store) responds to changes in system frequency.

In general four tests are proposed, one set of two at **Rated Import Capacity**, and one set of two at 40% of **Rated Import Capacity.**

In both cases the test is to reduce frequency from 50 Hz at 2 $Hzs^{-1}$. In the first case the lower frequency reached will be 49.0 Hz and the second case the lower frequency will be 48.8 Hz.

In all cases the response shall meet the requirements of 11.2.3.3.

### 1.3.14 Section B.5 – Compliance testing of synchronous power generating modules

A new section (B.5.4) has been added to accompany form B, it is as below:

**B.5.4 Synchronous Power Generating Modules incorporating Electricity Storage**

B.5.4.1 This paragraph provides a method for demonstrating compliance with the optional performance characteristic as discussed in the foreword. The tests shall be carried out to demonstrate how the **Synchronous Power Generating Module Active Power** when acting as a load (ie replenishing its energy store) responds to changes in system frequency.

B.5.4.2 In general four tests are proposed, one set of two at **Rated Import Capacity**, and one set of two at 40% of **Rated Import Capacity.**

B.5.4.3 In both cases the test is to reduce frequency from 50 Hz at 2 $Hzs^{-1}$. In the first case the lower frequency reached will be 49.0 Hz and the second case the lower frequency will be 48.8 Hz.

B.5.4.4 In all cases the response shall meet the requirements of 12.2.3.3.

### 1.3.15 Section B.6 – Compliance testing of power ark modules

A new section (B.6.3) has been added to accompany form B, it is as below:

**B.6.3 Power Park Modules incorporating Electricity Storage**

B.6.3.1 This paragraph provides a method for demonstrating compliance with the optional performance characteristic as discussed in the foreword. The tests shall be carried out to demonstrate how the **Power Park Module Active Power** when acting as a load (ie replenishing its energy store) responds to changes in system frequency.

B.6.3.2 In general four tests are proposed, one set of two at **Rated Import Capacity**, and one set of two at 40% of **Rated Import Capacity**.

B.6.3.3 In both cases the test is to reduce frequency from 50 Hz at 2 $Hzs^{-1}$. In the first case the lower frequency reached will be 49.0 Hz and the second case the lower frequency will be 48.8 Hz.

B.6.3.4 In all cases the response shall meet the requirements of 12.2.3.3.

### 1.3.16 Section C.8 – Compliance testing of type C and type D synchronous power generating modules

A section of text has been included under C.8.8 to meet the requirements of removing the current exclusion to storage within the document:

**C.8.8 Synchronous Power Generating Modules incorporating Electricity Storage**

C.8.8.1 This paragraph provides a method for demonstrating compliance with the optional performance characteristic as discussed in the foreword. The tests shall be carried out to demonstrate how the **Synchronous Power Generating Module Active Power** when acting as a load (ie replenishing its energy store) responds to changes in system frequency.

C.8.8.2 In general four tests are proposed, one set of two at **Rated Import Capacity**, and one set of two at 40% of **Rated Import Capacity.**

C.8.8.3 In both cases the test is to reduce frequency from 50 Hz at 2 $Hzs^{-1}$. In the first case the lower frequency reached will be 49.0 Hz and the second case the lower frequency will be 48.8 Hz.

C.8.8.4 In all cases the response shall meet the requirements of 13.2.3.3.

### 1.3.17 Section C.9 – Compliance testing of type C and type D power park modules

A new section of text is included within Annex C added as section C.9.6 and incorporates electricity storage compliance in relation to type C & type D power park modules:

**C.9.6 Power Park Modules incorporating Electricity Storage**

C.9.6.1 This paragraph provides a method for demonstrating compliance with the optional performance characteristic as discussed in the foreword. The tests shall be carried out to demonstrate how the **Power Park Module Active Power** when acting as a load (ie replenishing its energy store) responds to changes in system frequency.

C.9.6.2 In general four tests are proposed, one set of two at **Rated Import Capacity**, and one set of two at 40% of **Rated Import Capacity**.

C.9.6.3 In both cases the test is to reduce frequency from 50 Hz at 2 $Hzs^{-1}$. In the first case the lower frequency reached will be 49.0 Hz and the second case the lower frequency will be 48.8 Hz.

C.9.6.4 In all cases the response shall meet the requirements of 13.2.3.3.

Appendix 2 - Responses to the consultation – see separate attachment.

Appendix 3 – Distribution Code Modification – see separate attachment.

Appendix 4 – EREC G98– see separate attachment

Appendix 5 - EREC G99 – see separate attachment

Appendix 6 - List of working group members

| Name | Organization |
|---|---|
| Richard Harrison | Clarke Energy |
| Ian Wassman | ComAp Controls |
| Eduard Sanz | Connected Energy Ltd |
| Gillian Williamson | Electricity North West |
| Christopher McCann | ENA |
| Mike Kay | ENA |
| Charles Wood | Energy UK |
| Krishna Anaparthi | Fluence |
| Alastair Shearer | GTC/BUUK |
| William Cass | Last Mile |
| David Hill | NI Networks |
| Alan Creighton | Northern Powergrid |
| Hui Heng | Scottish and Southern Energy |
| Paul Graham | Sembcorp |
| Jason Kirrage | SolarEdge |
| Tony Robinson | TVRI |
| Matt White | UK Power Networks |
| Chanda Faithful | Western Power Distribution |
| Mark Horrocks | WSP |