

GC0127/GC0128 WORKGROUP ALTERNATIVE 2

Please note all red text indicates new additions/amendments as part of the legal text to facilitate WAGCM2. This WAGCM includes the amendments below plus the Original Proposal legal text.

Extract from Glossary and Definitions – New definitions

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Interim Demand Loading Point	The loading point in MW of an Electricity Storage Module between zero and Maximum Capacity (import).
Limited Frequency Sensitive Mode – Underfrequency (LFSM-U)	An operating mode which is either Limited Frequency Sensitive Mode – Underfrequency Exporting (LFSM-UE) ; or Limited Frequency Sensitive Mode – Underfrequency Importing (LFSM-UI)
Limited Frequency Sensitive Mode – Underfrequency Exporting (LFSM-UE)	A Power Generating Module (including a DC Connected Power Park Module) or HVDC System operating in a mode which is exporting energy to the Total System which increases its Active Power output in response to a fall in System Frequency below a certain value.
Limited Frequency Sensitive Mode – Underfrequency Importing (LFSM-UI)	An Electricity Storage Module operating mode which is importing energy from the Total System which decreases Active Power import in response to a change in System Frequency below a certain value.

Extract from Planning Code – New reference

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PC.A.5.5.4 Each **Electricity Storage Module Owner** shall provide **Frequency** response curves demonstrating the ability of their **Electricity Storage Modules** to transition from a mode analogous to **Demand** to a mode analogous to generation within 20 seconds in accordance with the requirements of ECC.6.3.7.2.2.

Extract from the CC's

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CC.3 SCOPE

CC.3.1 The **CC** applies to **The Company** and to **GB Code Users**, which in the **CC** means:

- (a) **GB Generators** (other than those which only have **Embedded Small Power Stations**), including those undertaking **OTSDUW**;
- (b) **Network Operators**;

- (c) **Non-Embedded Customers;**
- (d) **DC Converter Station owners;** (e) **BM Participants** and **Externally Interconnected System Operators** in respect of CC.6.5 only; and
- (f) **GB Generators** who own and operate **Electricity Storage Modules** for whom only the requirements of CC.6.3.7(g) apply.

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CC.6.3.7(g) Limited Frequency Sensitive Mode – Underfrequency importing (LFSM-UI)

- (i) **Limited Frequency Sensitive Mode - Underfrequency Importing (LFSM - UI)** only applies to **Electricity Storage Modules** which are operating in a mode analogous to **Demand**.
- (ii) In the event that the **System Frequency** falls below 49.5Hz, each **Electricity Storage Module**, which is operating in a mode analogous to **Demand**, and which is also capable of reversing operation from an **Interim Demand Loading Point** (including its **Maximum Capacity** (Pmax Import)) to an exporting mode of operation shall be capable of reversing its mode of operation within 20 seconds. The transition from import mode of operation to export mode of operation shall commence linearly and proportionally as soon as practicable and at the very least within at least 500ms from when the **System Frequency** falls below 49.5Hz. During this transition period, the **Electricity Storage Module** is required to remain stable over the entire operating range of the **Electricity Storage Module**.

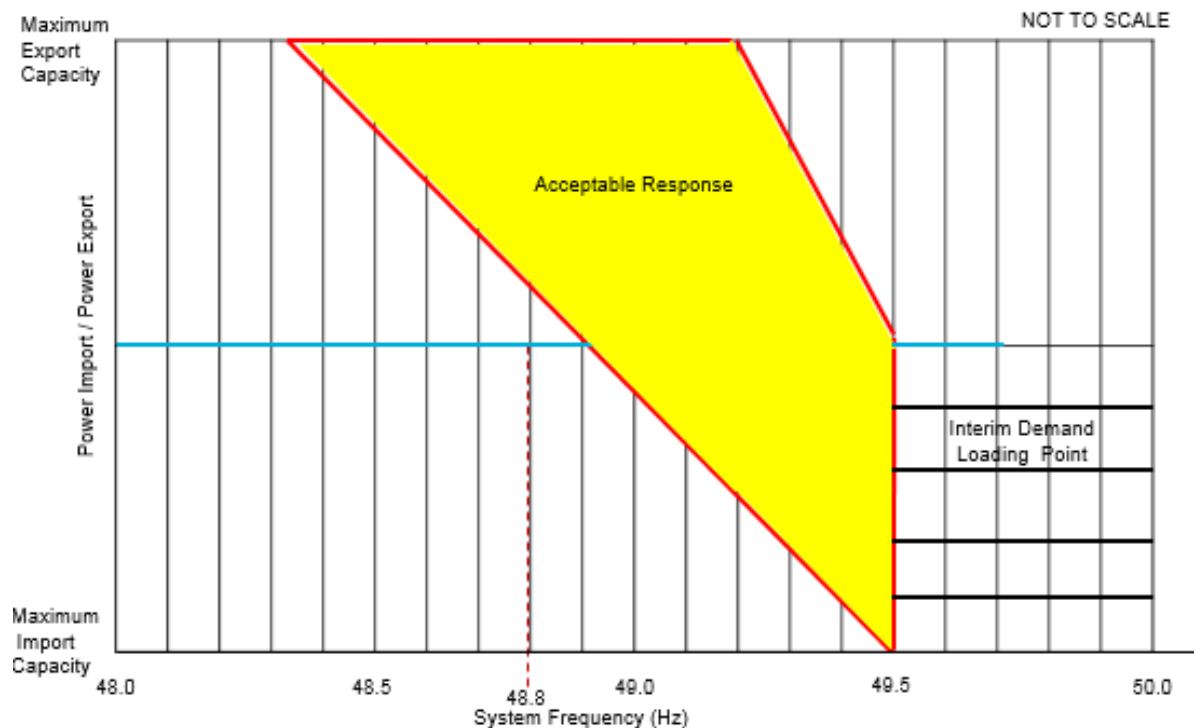


Figure 4a – Required capability of an **Electricity Storage Module** when operating in a mode analogous to **Demand** subject to a **Frequency** deviation of below 49.5Hz.

- (iii) Each **Electricity Storage Module** which is capable of meeting the requirements of CC.6.3.7(g), shall also be capable of achieving a frequency response characteristic within the shaded area shown in Figure 4a
- (iv) In the event of an **Electricity Storage Module** remaining in a demand mode at or below a **System Frequency** of 48.9Hz or below, each **Electricity Storage Module** shall be expected to trip through the operation of automatic low frequency relays in accordance with the requirements of OC6.6.6.
- (v) All **Electricity Storage Modules** which are not capable of reversing their power flow in less than 20 seconds as described in ECC.6.3.7(g)(ii); shall be required to trip when operating in a **Demand** mode and the **System Frequency** is at or below 49.2Hz in accordance with the requirements of OC6.6.6.
- (vi) For the avoidance of doubt, the provision of **LFSM - UI** for **Electricity Storage Modules** is not an **Ancillary Service** and would only be required under abnormal **System Frequency** conditions and when the **Electricity Storage Module** is in an operating in a mode analogous to **Demand**.

Extract from ECC's

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ECC.6.3.7.2	Limited Frequency Sensitive Mode – Underfrequency (LFSM-U) Limited Frequency Sensitive Mode – Underfrequency (LFSM-U) consists of two operating modes which are Limited Frequency Sensitive Mode – Underfrequency exporting (LFSM-UE) whilst they are exporting power into the Total System ; and Limited Frequency Sensitive Mode – Underfrequency importing (LFSM-UI) which applies to Electricity Storage Modules whilst they are importing energy from the Total System .
ECC.6.3.7.2.1	Limited Frequency Sensitive Mode – Underfrequency exporting (LFSM-UE)
ECC.6.3.7.2.1.1	Each Type C Power Generating Module and Type D Power Generating Module (including DC Connected Power Park Modules) or HVDC Systems operating in Limited Frequency Sensitive Mode shall be capable of increasing Active Power output in response to System Frequency when this falls below 49.5Hz. For the avoidance of doubt, the provision of this increase in Active Power output is not a mandatory Ancillary Service and it is not anticipated Power Generating Modules (including DC Connected Power Park Modules) or HVDC Systems are operated in an inefficient mode to facilitate delivery of LFSM-UE response, but any inherent capability (where available) should be made without undue delay. The Power Generating Module (including DC Connected Power Park Modules) or HVDC Systems shall be capable of stable operation during LFSM-UE Mode. For example, an EU Generator which is operating with no headroom (eg it is operating

at maximum output or is de-loading as part of a run down sequence and has no headroom) would not be required to provide **LFSM-UE**.

ECC.6.3.7.2.1.2

(i) The rate of change of **Active Power** output must be at a minimum a rate of 2 percent of output per 0.1 Hz deviation of **System Frequency** below 49.5Hz (ie a **Droop** of 10%) as shown in Figure ECC.6.3.7.2.1.2 below. This requirement only applies if the **Power Generating Module** has headroom and the ability to increase **Active Power** output. In the case of a **Power Park Module** or **DC Connected Power Park Module** the requirements of Figure ECC.6.3.7.2.1.2 shall be reduced pro-rata to the amount of **Power Park Units** in service and available to generate. For the avoidance of doubt, this would not preclude an **EU Generator** or **HVDC System Owner** from designing their **Power Generating Module** with a lower **Droop** setting, for example between 3 – 5%.

(ii) As much as possible of the proportional increase in **Active Power** output must result from the **Frequency** control device (or speed governor) action and must be achieved for **Frequencies** below 49.5 Hz. The **Power Generating Module** (including **DC Connected Power Park Modules**) or **HVDC Systems** shall be capable of initiating a power **Frequency** response with minimal delay. If the delay exceeds 2 seconds the **EU Generator** or **HVDC System Owner** shall justify the delay, providing technical evidence to **The Company**).

(iii) The actual delivery of **Active Power Frequency Response** in **LFSM-UE** mode shall take into account

The ambient conditions when the response is to be triggered

The operating conditions of the **Power Generating Module** (including **DC Connected Power Park Modules**) or **HVDC Systems** in particular limitations on operation near **Maximum Capacity** or **Maximum HVDC Active Power Transmission Capacity** at low **Frequencies** and the respective impact of ambient conditions as detailed in ECC.6.3.3.

The availability of primary energy sources.

(iv) In **LFSM-UE** Mode, the **Power Generating Module** (including **DC Connected Power Park Modules**) and **HVDC Systems**, shall be capable of providing a power increase up to its **Maximum Capacity** or **Maximum HVDC Active Power Transmission Capacity** (as applicable).

Active Power Frequency response capability of when operating in LFSM-U

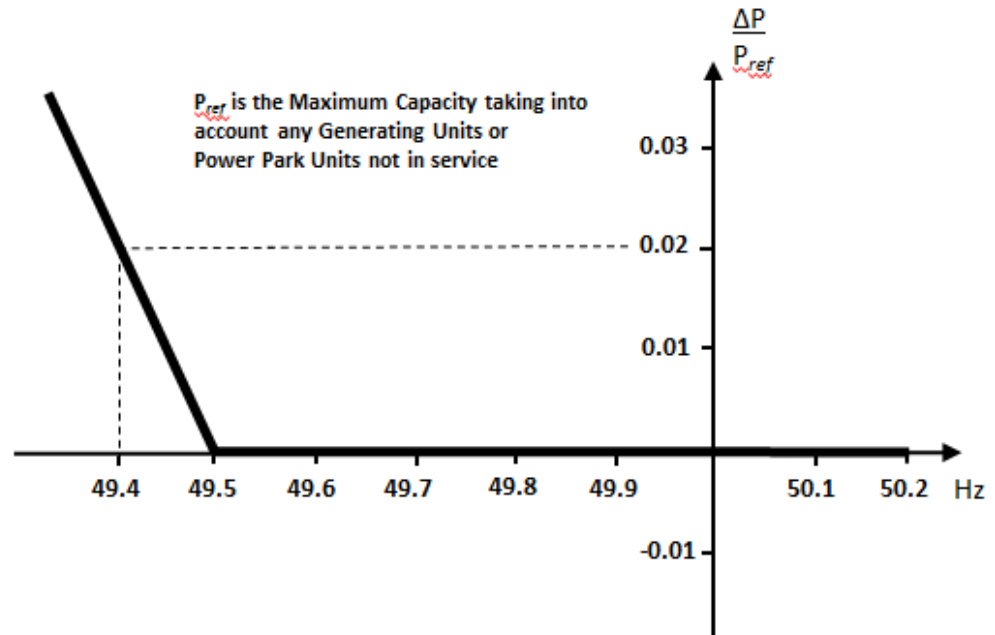


Figure ECC.6.3.7.2.1.2 – P_{ref} is the reference **Active Power** to which ΔP is related and ΔP is the change in **Active Power** output from the **Power Generating Module** (including **DC Connected Power Park Modules**) or **HVDC System**. The **Power Generating Module** (including **DC Connected Power Park Modules** or **HVDC Systems**) has to provide a positive **Active Power** output change with a droop of 10% or less based on P_{ref} .

ECC.6.3.7.2.2 Limited Frequency Sensitive Mode – Underfrequency importing (LFSM-UI)

ECC.6.3.7.2.2.1 **Limited Frequency Sensitive Mode - Underfrequency Importing (LFSM - UI)** only applies to **Electricity Storage Modules** which are operating in a mode analogous to **Demand**.

ECC.6.3.7.2.2.2 In the event that the **System Frequency** falls below 49.5Hz, each **Electricity Storage Module**, which is operating in a mode analogous to **Demand** and which is also capable of reversing operation from an **Interim Demand Loading Point** (including its **Maximum Capacity** (Pmax Import)) to an exporting mode of operation shall be capable of reversing its mode of operation within 20 seconds. The transition from import mode of operation to export mode of operation shall commence linearly and proportionally as soon as practicable and at the very least within at least within 500ms from when the **System Frequency** falls below 49.5Hz. During this transition period, the **Electricity Storage Module** is required to remain stable over the entire operating range of the **Electricity Storage Module**.

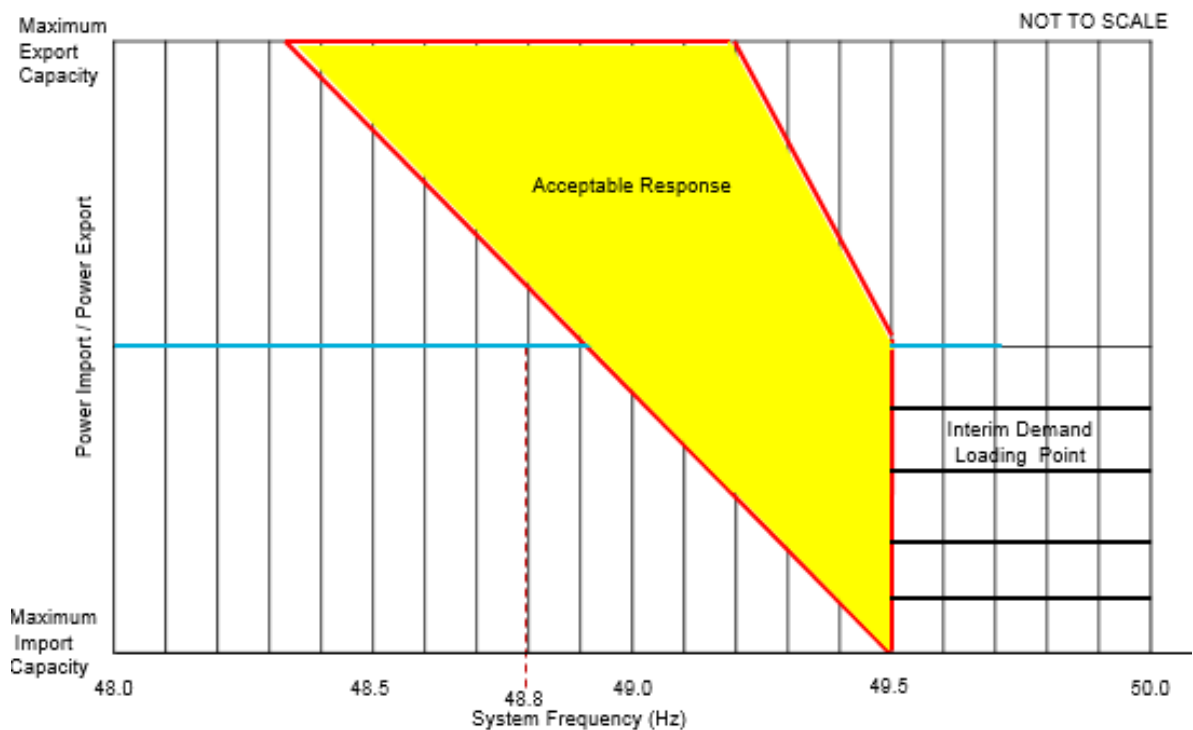


Figure ECC.6.3.7.2.2.2 – Required capability of an **Electricity Storage Module** when operating in a mode analogous to **Demand** subject to a **Frequency** deviation of below 49.5Hz.

- ECC.6.3.7.2.2.3 Each **Electricity Storage Module** which is capable of meeting the requirements of ECC.6.3.7.2.2, shall also be capable of achieving a frequency response characteristic within the shaded area shown in Figure ECC.6.3.7.2.2.2.
- ECC.6.3.7.2.2.4 In the event of an **Electricity Storage Module** remains in a **Demand** mode at or below a **System Frequency** of 48.9Hz or below, each **Electricity Storage Module** shall be expected to trip through the operation of automatic low frequency relays in accordance with the requirements of OC6.6.6.

- ECC.6.3.7.2.2.7 All **Electricity Storage Modules** which are not capable of reversing their power flow in less than 20 seconds as described in ECC.6.3.7.2.2.1 shall be required to trip when operating in a **Demand** mode and the **System Frequency** is at or below 49.2Hz in accordance with the requirements of OC6.6.6.
- ECC.6.3.7.2.2.8 For the avoidance of doubt, the provision of **LFSM - UI** for **Electricity Storage Modules** is not an **Ancillary Service** and would only be required under abnormal **System Frequency** conditions and when the **Electricity Storage Module** is in an operating in a mode analogous to **Demand**.

Extracts from Balancing Code 3

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BC3.7.2 Plant In Limited Frequency Sensitive Mode

BC.3.7.2.1 Plant in Limited Frequency Sensitive Mode applicable to GB Code Users

The following requirements are applicable to **GB Code Users** in respect of **Plant** operating in **Limited Frequency Sensitive Mode**. For the avoidance of doubt, these requirements do not apply to **EU Generators** and **HVDC System Owners** for whom the requirements of BC.3.7.2.2 apply.

- (a) Each **Synchronised Genset** (or **DC Converter** at a **DC Converter Station**) operating in a **Limited Frequency Sensitive Mode** which is producing **Active Power** is also required to reduce **Active Power** output in response to **System Frequency** when this rises above 50.4 Hz. In the case of **DC Converters** at **DC Converter Stations**, the provisions of BC3.7.7 are also applicable. For the avoidance of doubt, the provision of this reduction in **Active Power** output is not an **Ancillary Service**. Such provision is known as "**Limited High Frequency Response**".
- (b) (i) The rate of change of **Active Power** output must be at a minimum rate of 2 per cent of output per 0.1 Hz deviation of **System Frequency** above 50.4 Hz.
- (ii) The reduction in **Active Power** output must be continuously and linearly proportional, as far as is practicable, to the excess of **Frequency** above 50.4 Hz and must be provided increasingly with time over the period specified in (iii) below.
- (iii) As much as possible of the proportional reduction in **Active Power** output must result from the frequency control device (or speed governor) action and must be achieved within 10 seconds of the time of the **Frequency** increase above 50.4 Hz.
- (iv) The residue of the proportional reduction in **Active Power** output which results from automatic action of the **Genset** (or **DC Converter** at a **DC Converter Station**) output control devices other than the frequency control devices (or speed governors) must be achieved within 3 minutes from the time of the Frequency increase above 50.4 Hz.
- (v) Any further residue of the proportional reduction which results from non-automatic action initiated by the Generator or DC Converter Station owner shall be initiated within 2 minutes, and achieved within 5 minutes, of the time of the Frequency increase above 50.4 Hz.
- (c) Each **GB Code User** in respect of a **Genset** (or **DC Converter** at a **DC Converter Station**) which is providing **Limited High Frequency Response** in accordance with this BC3.7.2 must continue to provide it until the **Frequency** has returned to or below 50.4 Hz or until otherwise instructed by **The Company**.

(d)Each **GB Code User** in respect of an **Electricity Storage Module** is also required to meet the requirements of CC.6.3.7(g)

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BC.3.7.2.2 Plant in Limited Frequency Sensitive Mode applicable to EU Code Users

EU Code Users in respect of **Gensets** and **HVDC Systems** are required to operate in **Limited Frequency Sensitive Mode** at all times unless instructed by **The Company** to operate in **Frequency Sensitive Mode**. Where **EU Code Users Gensets** and **HVDC Systems** are required to operate in **Limited Frequency Sensitive Mode** then the requirements of ECC.6.3.7.1 and ECC.6.3.7.2 shall apply. For the avoidance of doubt, the requirements defined in BC.3.7.2.1 do not apply to **New Generators** and **HVDC System Owners**. Each **EU Code User** in respect of an **Electricity Storage Module** is also required to meet the requirements of ECC.6.3.7.2.2.