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| **Query Ref. No.** | **MANDATORY FREQUENCY RESPONSE (MFR)****FREQUENTLY ASKED QUESTIONS - (in no particular order)** |
| **Introduction** NESO has a licence obligation to manage and Frequency on the GB Transmission System. The provision of frequency response is required by generators to manage the frequency and is a condition of connection to the electricity transmission system. The requirement to have frequency response capability is documented in the Grid Code (CC/ECC.6.3.7). Grid Code CC/ECC.6.3.7, BC3.7.1 and BC3.7.2 describes two categories of frequency response:• Limited Frequency Sensitive Mode (LFSM)• Frequency Sensitive Mode (FSM)These will be described in further detail below.  |
|  | ***What is Limited Frequency Sensitive Mode (LFSM)?*** |
|  | **Limited Frequency Sensitive Mode (LFSM)** is a default operating mode that requires automatic changes in active power during high or low frequency events. LFSM-Overfrequency (LFSM-O) requires a change during high frequency events. LFSM-Underfrequency (LFSM-U) requires a change during low frequency events where headroom is available on the plant. In general, the LFSM requirements apply to:- * LFSM (BC3.7.2) applies to Large Power Stations which are caught by the requirements of the Grid Code Connection Conditions,
* LFSM (ECC.6.3.7.1) (LFSM-O) applies to a Generator who owns and operates a Power Station of any size comprising a Type A, B, C or D1 Power Generating Module and is caught by the requirements of the Grid Code European Connection Conditions (i.e. a CUSC Party).
* LFSM-U (ECC.6.3.7.3) applies to a Generator who owns and operates a Power Station of any size comprising a Type C or D Power Generating Module and is caught by the requirements of the Grid Code European Connection Conditions (i.e. a CUSC Party).

In the above cases, the requirements to have an Ancillary Services Agreement are set out in CC.8.1 or ECC8.1 as relevant, CC8.1 being applicable to Generators required to meet the requirements of the Connection Conditions and ECC.8.1 being applicable to Generators required to meet the requirements of the European Connection Conditions**LFSM-O** is mandatory and requires active power changes in cases of high frequency. Specifically, that units decrease their active power by at least 2% for every 0.1Hz rise above 50.4Hz. It should be noted that when in an export mode of operation the requirement applies to Electricity Storage Modules, however there are special provisions for Electricity Storage Modules when in an import mode of operation as detailed in ECC.6.3.7.2.3**LFSM-U** should be delivered if the capability/headroom exists but is not required if operation would be inefficient or if a unit is already operating at maximum capacity. It applies in cases of low frequency. Units must increase their active power by at least 2% for every 0.1Hz below 49.5Hz. LFSM is not an ancillary service and for the avoidance of doubt LFSM is not explicitly instructed. In the absence of any reason code instruction to operate in any different frequency response mode, the BMU should be operating in LFSM.LFSM is designed to be a safety net for extreme conditions (hence the wide frequency threshold for delivery) and as such one would hope that it is very rarely needed, but still important to have the automated capability built in.*1Type A, B, C and D Power Generating Modules are defined in the Grid Code Glossary and Definitions* *(****Type A*** *– 800W and less than 1MW connected below 110kV,* ***Type B*** *- 1MWW and less than 10MW connected below 110kV,* ***Type C*** *-10MW and less than 50MW connected below 110kV,* ***Type D*** *- 50MW plus or connected at or above 110kV)* |
|  | ***What is Frequency Sensitive Mode (FSM)?*** |
|  | **Frequency Sensitive Mode (FSM)** is an operating mode that can be instructed and requires delivery of a combination of Primary, Secondary and High frequency response. In general, FSM requirements apply to:- * FSM (CC.6.3.7) applies to Large Power Stations which are caught by the requirements of the Grid Code Connection Conditions,
* FSM (ECC.6.3.7.3) applies to a Generator who owns and operates a Power Station of any size comprising a Type C or D1 Power Generating Module and is caught by the requirements of the Grid Code European Connection Conditions (i.e. a CUSC Party).

In the above cases, the requirements to have an Ancillary Services Agreement are set out in CC.8.1 or ECC8.1 as relevant, CC8.1 being applicable to Generators required to meet the requirements of the Connection Conditions and ECC.8.1 being applicable to Generators required to meet the requirements of the European Connection ConditionsIt is a paid service. If instructed, the service provider will receive an Ancillary Service (AS) Reason Code instruction via Electronic Despatch Logger (EDL) to effectively arm/disarm them for FSM. This instruction will be open ended until a BMU is instructed either to a different operating mode, or the FSM mode is disarmed, at which point the BMU will default back to LFSM. The holding price for this will be whatever they have submitted through the Frequency Response Price Submission System [**FRPS**](https://extranet.nationalenergyso.com/FRPS)portal.When in FSM, a provider will most likely be providing Mandatory Frequency Response (MFR) (although there are some Commercial Frequency Response modes) and MFR is described further below. The Mandatory Service Agreement (MSA) sets out the basic requirements of a BMU for the provision, delivery and payment for MFR whilst in FSM. Grid Code BC3 and CC/ECC 6.3.7 covers the detailed technical requirements for FSM.*1Type A, B, C and D Power Generating Modules are defined in the Grid Code Glossary and Definitions* *(****Type A*** *– 800W and less than 1MW connected below 110kV,* ***Type B*** *- 1MWW and less than 10MW connected below 110kV,* ***Type C*** *-10MW and less than 50MW connected below 110kV,* ***Type D*** *- 50MW plus or connected at or above 110kV)* |
|  | ***What is the difference between LFSM and FSM?***

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| **Operating Mode & Requirements**  | **LFSM-U** | **LFSM-O** |
| When in FSM | <49.5Hz | >50.5Hz |
| When in LFSM | <49.5Hz | >50.4Hz |
| Required change in active power | 2% per 0.1Hz | 2% per 0.1Hz |
| Obligation | Best Endeavours | Mandatory |

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|  | ***What is Mandatory Frequency Response?*** |
|  | **Mandatory Frequency Response (MFR)** is an automatic change in active power output in response to a frequency change. The service helps us to keep frequency within statutory and operational limits. The provision of MFR discharges obligations to provide FSM, which apply to Large Power Stations or those Generators who are CUSC signatories who own and operate Type C and Type D Power Generating Modules as set out in ECC.8.1 Part I of the Grid Code. As such these are Balancing Mechanism Units (BMUs). This requirement and the associated Grid Code reference is be set out in their Bilateral Connection Agreement (BCA) and is summarised under the Site Specific Technical Conditions (Appendix F).Providers of MFR can offer  a combination of Primary/Secondary/High (P/S/H) and/or Primary/High (P/H) depending on the technical capabilities of the BMU. The instruction codes will differ for each, as described further below. MFR is a paid service, and providers can submit prices monthly via our FRPS portal. Thus, if a provider does not wish to actively participate in MFR, whilst they must have the provision to be instructed for MFR, they are able to price themselves such that they are unlikely to be instructed. **Primary response**: Response provided within 10 seconds of an event, which can be sustained for a further 20 seconds. **Secondary response**: Response provided within 30 seconds of an event, which can be sustained for a further 30 minutes. **High frequency response**: Response provided within 10 seconds of an event, which can be sustained indefinitely.MFR is instructed by NESO using reason codes sent via EDL to a BMU. These reason codes distinguish between the mandatory and commercial frequency responses but also whether the combination of P/S/H or P/H is to be instructed, as above. Mode A is the default mode, and the mandatory mode, for MFR. For the P/S/H combination mode, an MF reason code would be instructed (we drop the A given it is the most common reason code but implicitly MF = MFA). For the P/H combination mode, an MP reason code would be instructed (we drop the A again such that MP=MPA). The MSA document should therefore cover MF(A) and/or MP(A) only, depending on which combinations the BMU is technically capable of offering.Modes B, C, D and E relate to commercial frequency response modes, which are optional, and are instructed as below:The MFB, MFC, MFD and MFE reason codes are used to instruct BMUs into these commercial frequency response modes for P/S/H. The MPB, MPC, MPD and MPE reason codes are used to instruct BMUs into these commercial frequency response modes for P/H. An MN instruction will then be issued to cease delivery of FSM (whether MFR or Commercial Frequency Response) and the unit should return to its default state delivering LFSM.For the avoidance of doubt, DC/DM/DR are not considered as FSM (they are commercial services). |
|  | ***Would you please confirm that under the MSA we would only have to deliver LFSM for frequency response?*** |
|  | The capability of LFSM is a mandatory requirement for BMUs under the Grid Code Although a unit is instructed to either be in LFSM mode or Frequency Sensitive Mode (FSM) mode – effectively LFSM is a subcomponent of FSM. So when doing FSM, that includes LFSM plus the Primary/Secondary/High, and the LFSM-O is slightly adjusted to only apply from above 50.5Hz. This is the reason the two modes are not mutually exclusive. |
|  | ***Please Confirm the electrical point that LFSM should be operated, if multiple BMU’s share 1 Point of Connection (PoC) - i.e. at BMU or PoC*** |
|  | Normally each BMU has its own separate frequency controller that provides the required LFSM response. However, as a part of Grid Code testing, Compliance will be checked at the Point of Connection (POC) with respect to the Power Generating Module as we are interested in the response at the Connection Point (i.e. the Grid Entry Point or User System Entry Point) and so the BMU frequency controller must be configured to ensure the correct delivery is observed at the POC. Strictly speaking, Grid Code compliance requirements for frequency response are with respect to each Power Generating Module not the BMU or Power Station. |
|  | ***Who will be receiving the LFSM signals? Will they come via the Route to Market provider, or will it come directly to the BESS power plant controller (PPC)?*** |
|  | Limited Frequency Sensitive Mode (LFSM) is the default mode that BMUs should operate in at all times. They will be expected to configure the load controllers on site to automatically respond as per the Grid Code LFSM requirements (i.e.at 50.4Hz, BMU to reduce output by a minimum of 2% per 0.1Hz). LFSM is designed to be a safety net for extreme conditions (hence the wide frequency threshold for delivery) and as such one would hope that it is very rarely needed, but still important to have the automated capability built in. As such, they will not receive any instructions from NESO to deliver LFSM, except as the way to cease delivery of FSM (i.e. on stopping FSM delivery units return to LFSM delivery). This is the “MN” reason code in the EDL specification. Given the wide frequency thresholds, it is perfectly possible that a BMU can/will also be instructed to a variety of FSM modes depending on their appetite for providing commercial ancillary services (e.g. DC/DM/DR) or just the Mandatory Frequency Response (MFR). Again, the load controller would be configured to deliver as per the service terms or requirements of the relevant service(s).The instructions from the ENCC to the Generator to switch the plant into FSM or LFSM will be via the Generators Control Point and be via EDL, API or telephone. |
|  | ***We will not have to provide Mandatory Frequency Response when delivering commercial frequency services – can you confirm that Dynamic Containment / Moderation / Regulation are considered to be “commercial services”?*** |
|  | Delivery of DC/DM/DR is considered as delivering a commercial service and so FSM mode does not need to be delivered whilst providing these services. However LFSM would still be required, as per LFSM guidance.Note that we allow providers to stack the delivery of opposite direction FSM with DC/DM/DR (e.g. providing Primary/Secondary Response with Dynamic Containment High). Reserve services do not count towards this and units must still be capable of delivering their mandatory requirements. |
|  | ***Please confirm that any LFSM function is in addition to any remote or local Power set-point?*** |
|  | The governor system of a plant will include a load controller. LFSM is essentially part of the Governor control system, it is just that in LFSM mode the dead band is set out to a very wide range so it only responds at extreme frequencies. The target load of the Generator is fixed by the load controller’s set point.Hence the power set point is part of the overall Governor System and includes LFSM control as well as FSM control as it is part of the governor system. In essence the governor system is the same and will have different settings and dead band loops to achieve the desired functionality.The FSM settings are achieved simply by switching from LFSM to FSM and this is achieved by switching out the wider dead band in place of a smaller one with corresponding changes to the droop. |
|  | ***Is there any Active Network Management (ANM) system that will be setting the export limits (Upper and Lower) for the system?*** |
|  | There will be no NESO ANM that will have any involvement in LFSM/FSM – implicitly the site load controller should automatically respond as described above. ANMs are typically installed by the TO/DNO in congested parts of the network to advance connections ahead of future reinforcement works being completed. As such there are ANMs that exist in certain parts of the network but if that were applicable to this project it would have been in the connection agreement appendices. |
|  | ***NESO will not send signals for us to respond to frequency deviation, but the site will be expected to respond based on its on-site frequency meter?*** |
|  | Correct. For LFSM – at 50.4Hz and above your BMU should respond automatically, as per GC (a minimum of 2% reduction in output per 0.1Hz). However, NESO will send instructions via EDL to arm you for FSM, where you will respond automatically to the frequency as per the terms of the instructed mode. |
|  | ***How will NESO evaluate our response, will there be specific performance files that need to be sent?*** |
|  | Post-event review teams will monitor generator performance. In addition, any Generator caught by the requirements of the European Connection Conditions and which owns and operates a Power Station comprising a Type C or Type D Power Generating Module will be required to install Frequency Monitoring equipment in accordance with the requirements of ECC.6.6.2. |
|  | ***What are the penalties for failure to deliver/not delivering correctly*** |
|  | As part of the connection process – your assets/plant would have to undergo testing to demonstrate compliance with the Final Metering System (FMS) requirement. If the asset failed to demonstrate the capability, then as they are not in compliance with the Connection and Use of System Code (CUSC) and the Grid Code, they could be prevented from connecting to the system. If in real time they do not fulfil the expected response, then section **4.1.3 Frequency Response** of the CUSC covers the impact of shortfall on response payments. As noted above, any Generator caught by the requirements of the European Connection Conditions and which owns and operates a Power Station comprising a Type C or Type D Power Generating Module will be required to install Frequency Monitoring equipment in accordance with the requirements of ECC.6.6.2 |
|  | ***How is MFR paid?*** |
|  | Further to the execution of the final MSA i.e. the MSA based on the Grid Code compliant tested data**Holding payment (£/h)**Holding payments are made for the capability of the unit to provide response when the unit has been instructed into frequency response mode. **Response energy payment (£/MWh)** Response energy payments remunerate the amount of energy delivered to and from the system when providing frequency response. This payment is set out in the Connection and Use of System Code (CUSC). **Price submissions** Generators submit their own prices for holding payments on a monthly basis via the Frequency Response Price Submission System (FRPS). FRPS is available between the 5th and 15th working day of each month. Previously submitted prices are published on our website. You can register and log in on the [**FRPS site**](https://extranet.nationalenergyso.com/FRPS) **Monthly volume** The volume of MFR that has been dispatched each month is published in our [**capability report**.](https://www.neso.energy/industry-information/balancing-services/frequency-response-services/mandatory-frequency-response-mfr#Document-library) (Frequency response volumes) |
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