DESIGN NOTE

Balancing Services: FCR

The design for Frequency Containment Reserves (FCR).

Document Version: September 2025

Version history

Version	Date	Additional information (purpose, main changes, …)
1	30 September 2025	1st version of the design note with the review of the FCR Service
2		
3		
4		

Content

1. Introduction

As part of managing the electricity system, ELIA ensures the balance of the grid. Specifically, ELIA uses Balancing Services procured from **Balancing Service Providers (BSPs)** to manage the (residual) imbalances between electricity production and consumption. The imbalances can occur when **Balance Responsible Parties (BRPs)**[1] are not able to balance the offtake and the injection within their customer portfolios or when ELIA activates energy for other purposes than balancing.
ELIA procures three types of Balancing Services from BSPs:

- Frequency Containment Reserves (FCR);
- automatic Frequency Restoration Reserves (aFRR);
- manual Frequency Restoration Reserves (mFRR).

This design note concerns the **Frequency Containment Reserves (FCR)**. BSPs provide FCR Service to ELIA in accordance with the **BSP Contract FCR, part of the Terms and Conditions** for Balancing Service Providers for Frequency Containment Reserve (hereafter referred to as **T&C BSP FCR**)[2],in accordance with the EBGL, the Code of Conduct and the Federal Grid Code. The current T&C BSP FCR entered into force on June 18th, 2025.

The Frequency Containment Reserve service is a key service for the operational reliability of the power system of the synchronous area. During the last years, the design of the FCR service has evolved on a national level but also on a European level through the FCR cooperation[3] which is a joint initiative of EU TSO's aiming to procure together FCR services. FCR cooperation members have also worked on the harmonization of the characteristics of the FCR product on a regional level.

The design of the FCR service design has evolved on a national level with the integration of new technologies in the FCR service including energy limited assets like batteries. The settlement and prequalification processes have also been improved. On the EU level, a great step has been achieved with the harmonization of the FCR procurement process on a regional level through the FCR cooperation.

This design note is an update of the previous documents written by Elia that describe the specifications of the design of the FCR product. This document summarizes and gives an update of the elements contained in the previous design notes. It will cover the following topics:

1. Introduction of the FCR product
2. Balancing Service Provider: what is a BSP and how does one qualify to access the service?
3. The prequalification process: How does a BSP add volume to their portfolio?
4. FCR Capacity Procurement: How can a BSP offer volume to Elia (and other TSOs) for the delivery of FCR
5. FCR Energy Bids: How to submit Energy Bids to Elia once selected in the capacity auction?
6. Activation of FCR: Ho should BSPs deliver the Service?
7. Remuneration: How are BSPs remunerated for delivering the Service?
8. Controls: How are BSPs monitored on the delivery of FCR?
9. Incentives: What are the consequences of failing the controls?

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[1] For more information, visit https://www.ELIA.be/en/electricity-market-and-system/role-of-brp
[2] Available online: FCR
3 For more information, visit Frequency Containment Reserves

Regulatory framework for establishing the T&C BSP FCR

EBGL[4]
Article 5(4). The proposals for the following terms and conditions or methodologies shall be subject to approval by each regulatory authority of each concerned Member State on a case-by-case basis: […] (c) the terms and conditions related to balancing pursuant to Article 18. **Article 18(1).** No later than six months after entry into force of this Regulation and for all scheduling areas of a Member State, the TSOs of this Member State shall develop a proposal regarding: (a) the terms and conditions for BSPs; […] [**Article 18(4) and (5)** contain rules on the content of the terms and conditions for BSPs]
Federal Grid Code
Article 225. De aanbieder van balanceringsdiensten stelt aan de transmissienetbeheerder aanbiedingen van balanceringsenergie ter beschikking overeenkomstig aan de modaliteiten en voorwaarden van toepassing op de aanbieders van balanceringsdiensten. Die modaliteiten en voorwaarden van toepassing op de aanbieders van balanceringsdiensten worden bepaald door de transmissienetbeheerder krachtens artikel 18.1 en 18.5 van de Europese richtsnoeren EBGL en voor goedkeuring voorgelegd aan de commissie overeenkomstig artikel 5.4 van de Europese richtsnoeren EBGL en de artikelen 4, 5 en 6 van dit besluit. […]. De aanbieder van balanceringsdiensten sluit met de transmissienetbeheerder één of meerdere overeenkomsten voor balanceringsdiensten af waarin hij zich ertoe verbindt om de modaliteiten en voorwaarden van toepassing op aanbieders van balanceringsdiensten na te leven. Deze overeenkomsten worden eveneens ter goedkeuring voorgelegd aan de commissie. / Le fournisseur de services d'équilibrage soumet au gestionnaire de réseau de transport des offres d'énergie d'équilibrage conformément aux modalités et conditions applicables aux fournisseurs de services d'équilibrage. Ces modalités et conditions applicables aux fournisseurs de service d'équilibrage sont déterminées par le gestionnaire de réseau de transport en vertu de l'article 18.1 et 18.5 de la ligne directrice européenne EBGL et soumises à la commission pour approbation conformément à l'article 5.4 de la ligne directrice européenne EBGL et aux articles 4, 5 et 6 du présent arrêté. […] Le fournisseur de services d'équilibrage conclut un ou plusieurs contrats de services d'équilibrage avec le gestionnaire de réseau de transport dans le(s)quel(s) il s'engage à respecter les modalités et conditions applicables aux fournisseurs de services d'équilibrage. Ces contrats sont également soumis à la commission pour approbation.

[4] *Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing*

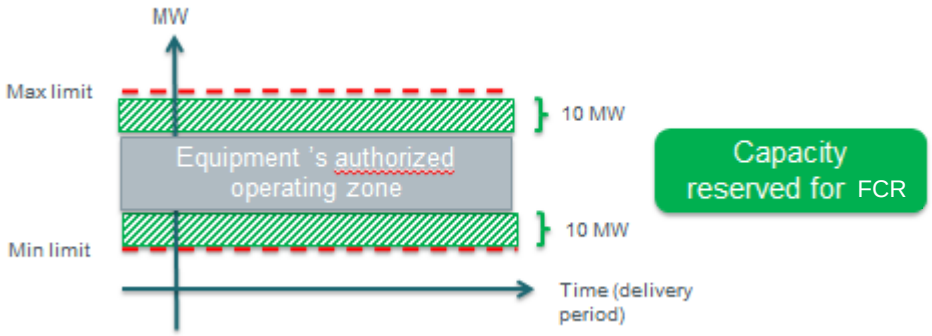
2. FCR Service and its purpose

2.1. Primary control service or FCR – service description

As defined in Policy 1 of ENTSO-e operational handbook, “the objective of primary control is to maintain a balance between generation and consumption (demand) within the synchronous area. By the joint action of all interconnected parties / TSOs, primary control aims at the operational reliability of the power system of the synchronous area and **stabilizes the system frequency at a stationary value** after a disturbance or incident in the timeframe of seconds, but without restoring the system frequency and the power exchanges to their reference values”

Whatever the technology behind, any equipment offered by a Balancing Service Provider (BSP) to deliver FCR must reserve at all times during the delivery period a **capacity band (MW)** equivalent to their contractual obligation for the unique use of FCR reaction. By doing so, Elia can respect its obligation to **always have power available to be physically used** to compensate a frequency deviation **after its occurrence**, within the margins defined by ENTSO-e.

This obligation can be illustrated as on the graph below, for equipment contracted for 10 MW FCR.



Rules organizing the FCR service are defined at European level as well as FCR volume yearly allocated to each TSO and can be found in published documents on ENTSO-e website.

3. The role of the Balancing Service Provider (BSP)

EBGL definitions – Article 2
(6) **'balancing service provider'** means a market participant with reserve-providing units or reserve-Providing Groups able to provide Balancing Services to TSOs;
Federal Grid Code
Article 225. De aanbieder van balanceringsdiensten stelt aan de transmissienetbeheerder aanbiedingen van balanceringsenergie ter beschikking overeenkomstig aan de modaliteiten en voorwaarden van toepassing op de aanbieders van balanceringsdiensten. […] / Le fournisseur de services d'équilibrage soumet au gestionnaire de réseau de transport des offres d'énergie d'équilibrage conformément aux modalités et conditions applicables aux fournisseurs de services d'équilibrage. […] **Article 226 § 3.** De aanbieder van balanceringsdiensten is aangeduid door een betrokken netgebruiker volgens de bepalingen voorzien in de modaliteiten en voorwaarden van toepassing op de aanbieders van balanceringsdiensten. Wanneer er geen enkele aanbieder voor balanceringsdiensten is aangeduid voor de installaties bedoeld in paragraaf 1, dan wordt de betrokken netgebruiker automatisch aanbieder van balanceringsdiensten en krijgt hij de verplichting toegewezen om het beschikbare vermogen ter beschikking te stellen van de transmissienetbeheerder zoals bepaald in paragraaf 1. / Le fournisseur de services d'équilibrage est désigné par un utilisateur de réseau concerné selon des dispositions prévues dans les modalités et conditions applicables aux fournisseurs de services d'équilibrage. Lorsqu'aucun fournisseur de services d'équilibrages n'est désigné pour les installations visées au paragraphe 1er l'utilisateur de réseau concerné devient par défaut fournisseur de services d'équilibrage et se voit attribuer l'obligation de mise à disposition de puissance disponible au gestionnaire de réseau de transport tel que visé au paragraphe 1er.

In accordance with the EBGL, the Code of Conduct and the Federal Grid Code, the **BSP** is the market party that provides Balancing Services to ELIA and therefore concludes the BSP Contract FCR[5] with ELIA. The BSP is either a Grid User or a third party appointed by the Grid User. The "third party BSP" has an agreement (i.e., the Grid User Declaration) with the Grid User of the Technical Facility that will be used by the BSP to offer Balancing Services.

3.1. Qualification as BSP for FCR

A market party can become a BSP by going through an application procedure[6]. The procedure includes the completion of an application form and a sworn statement from the market party interested to become a BSP. Next to these steps, Elia ensures that this market party is financially stable and meets minimum requirements in terms of solvency. Following approval of the application, the BSP Contract FCR must be signed in order to be allowed to participate in the FCR Service.

[5] *The same applies for aFRR and mFRR services.*
[6] *Available online: https://www.ELIA.be/en/electricity-market-and-system/system-services/becoming-a-balancing-service-provider*

3.2. Interdependencies with other parties

EBGL definitions – Article 2
(7) **'balance responsible party'** means a market participant or its chosen representative responsible for its imbalances;
SOGL[7] definitions – Article 3
(90) **'scheduling agent'** means the entity or entities with the task of providing schedules from market participants to TSOs, or where applicable third parties;

The most relevant interactions with other responsibilities related to Balancing Services in specific or Ancillary Services in general concern the **interdependencies of the BSP with:**

- the **Balance Responsible Party** (BRP), as per section 3.2.1; and
- the **Scheduling Agent**, as per section 3.2.2.

3.2.1. Impact of FCR on the BRP

Since FCR does not include the activation of energy, the BSP does not need to designate a BRP (i.e., the "BRP_{BSP}") who will take **responsibility for imbalances that may result from FCR activations**. However, all Delivery Points used by a BSP for the provision of Balancing Services must be related to an Access Point that is included in the perimeter of a BRP ("BRP_{source}").

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3.2.2. Impact of FCR on the Scheduling Agent

As described in section 3.3.2, ELIA receives Daily Schedules (in MW) for all Delivery Points DP_{SU}. The schedules are delivered to ELIA by the Scheduling Agent. Currently, the party appointed as BRP_{source} also needs to take the role of Outage Planning Agent and Scheduling Agent and BSP for the concerned Delivery Point DP_{SU} (see section 3.3.2) in compliance with article 243 of the Code of Conduct.

3.3. Participation to the FCR Service

BSPs can provide FCR Capacity to ELIA. The rules for participation to both markets are explained in the following sections.

Code of Conduct
Art. 242. Tot de datum van inwerkingtreding van de eerstvolgende wijziging van de betrokken type-overeenkomst(en) voor balanceringsdiensten waarin al dan niet eisen worden bepaald met toepassing van artikel 18.7, b) of c), van de Europese richtsnoeren EBGL, dient het beschikbare opwaartse of neerwaartse actieve vermogen te worden aangeboden door een aanbieder van balanceringsdiensten, aangesteld overeenkomstig artikel 218, onder de vorm van aanbiedingen van balanceringsenergie aan de transmissienetbeheerder voor: 1° elke elektriciteitsproductie-eenheid waarvan het maximaal vermogen groter is dan of gelijk is aan 25 MW; 2° elke energieopslagfaciliteit, van het type C of D overeenkomstig de maximumcapaciteitsdrempelwaarden in het technisch reglement. / Jusqu'à la date d'entrée en vigueur de la prochaine modification du ou des contrats types pertinents

[7] *Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation*

pour les services d'équilibrage où des exigences sont définies ou non en application de l'article 18.7, b) ou c) de la ligne directrice européenne EBGL, la puissance active disponible à la hausse ou à la baisse doit être proposée par un fournisseur de services d'équilibrage nommé conformément à l'article 218 sous la forme d'offres d'énergie d'équilibrage au gestionnaire du réseau de transport pour : 1° chaque unité de production d'électricité dont la puissance maximale est supérieure ou égale à 25 MW ; 2° chaque installation de stockage d'énergie de type C ou D, conformément aux seuils de puissance maximale du règlement technique.

3.3.1. FCR Capacity Product

To offer FCR through Capacity Auctions in which Capacity Bids are to be submitted, the BSP must in advance have prequalified Delivery Point(s) with which he intends to deliver the service (see section 4.2 on the prequalification test). Chapter 5 describes the procurement of FCR Capacities by ELIA.

3.3.2. Delivery Points and FCR Providing Groups

SOGL definitions – Article 3
(10) **'reserve providing unit'** means a single or an aggregation of power generating modules and/or demand units connected to a common connection point fulfilling the requirements to provide FCR, FRR or RR; (11) **'reserve Providing Group'** means an aggregation of power generating modules, demand units and/or reserve providing units connected to more than one connection point fulfilling the requirements to provide FCR, FRR or RR;

At European level, the concepts reserve providing unit (RPU) and reserve providing group (RPG) are defined. Elia has translated these concepts into the T&C BSP FCR as following:

BSPs provide FCR on Delivery Points. Delivery Points are always located behind one connection point to the ELIA or distribution grid and therefore represent "reserve providing units" (as defined in SOGL article 3).

A "Providing Group" is defined in the T&C BSP FCR as "Any subset of Delivery Points part of the Pool of the BSP". A Providing Group is therefore the aggregation of Delivery Points by a BSP to deliver the FCR Service.

The following possibilities of aggregation of Delivery Points are allowed:

- A Delivery Point **DP_{SU}** (or 'single-unit' Delivery Point) corresponds to one Technical Unit (possibly the same as the Technical Facility) in the ELIA LFC Block for which ELIA receives Daily Schedules[8]. An FCR Bid may be offered on an aggregation of Delivery Points of the type DP_{SU}.
    - For example: the FCR bid available for a CCGT (a Technical Facility) may, depending on the Operating Mode, be offered on the whole of the plant rather than separately on the Technical Units (2 gas turbines and 1 steam turbine).

[8] *This is typically due to scheduling obligations. Information on scheduling design can be consulted in iCAROS design notes: https://www.ELIA.be/en/electricity-market-and-system/system-services/alleviating-congestion-risk*

- A BSP may offer an FCR Bid on any group of **DP_{PG}** (i.e., Technical Units located within the ELIA LFC Block for which ELIA does not receive a Daily Schedule). Multiple DP_{PG} can be grouped to benefit from a portfolio effect aiming for example to reach the minimum size of a bid (1 MW) to participate in FCR Capacity Auctions.
- A BSP may also offer an FCR Bid including **both DP_{SU} and DP_{PG}**. On this point, FCR differs from the other balancing services. Concrete rules on the aggregation of Delivery Points in FCR Bids are explained in section 6.1.2.1.

3.3.3. Combinability rules

A Delivery Point part of a BSP Contract FCR can be included in a BSP Contract aFRR/mFRR and/or an FSP Contract DA/ID with ToE at the condition that the BSP is the same party. The combination of Balancing Services on other Delivery Points upstream or downstream of a Delivery Point supplying the FCR Service is, however, not possible.

Concretely, this means a BSP can include the same Delivery Point in bids for FCR and aFRR/mFRR for the same CCTU and therefore simultaneously deliver FCR with aFRR/mFRR.

Can the FCR Energy bid be combined with	FCR
aFRR energy bid	Yes
aFRR Backup	Yes
aFRR Prequalification bid	No
mFRR energy bid	Yes
mFRR Backup	Yes
mFRR Prequalification bid	No

3.3.4. Delivery Points with Limited Energy Reservoir

Additional Properties – Article 2
(h) **LER FCR providing units or LER FCR providing groups:** FCR providing units or groups with limited energy reservoirs, fulfilling the criteria according to Article 3(4);
Additional Properties – Article 3
(2) FCR providing units or FCR providing groups are deemed as LER FCR providing units or LER FCR providing groups in case a full continuous activation for a period of 2 hours in either positive or negative direction might, without consideration of the effect of an active energy reservoir management, lead to a limitation of its capability to provide the full FCR activation in accordance with Article 156(8) of SO GL, due to the depletion of its energy reservoir(s) taking into account the effective initial availability of the energy reservoir(s)

A Delivery Point with Limited Energy Reservoir (DP LER) is defined by Elia as:
“A Delivery Point part of a Providing Group as defined in Article 2(2) of the Additional Properties, for which the full activation of FCR for a period of 2 hours in either positive or negative direction might, without consideration of the effect of an Active Energy Reservoir Management, lead to a limitation of its capability to provide the full FCR activation due to the depletion of its energy reservoir(s) taking into account the Effective Energy Reservoir effectively available. “

Delivery Points with Limited Energy Reservoir have to comply with more requirements than a non-LER Delivery Point. BSPs with DP LER in their portfolio. BSPs with such Delivery Points must delivery Elia an Energy Management Strategy (see section 4.2) and must implement Reserve Mode (see section 7.4) for which they must supply Elia with the Reserve Mode simulation (see section 4.3). Both documents should be supplied to Elia before the prequalification test.

4. Prequalification process

SOGL – Article 159 on FRR prequalification process
1. By 12 months after entry into force of this Regulation each TSO shall develop a FRR prequalification process and shall clarify and make publicly available its details. 2. A potential FRR provider shall demonstrate to the reserve connecting TSO or the TSO designated by the reserve connecting TSO in the FRR exchange agreement that it complies with the FRR minimum technical requirements in Article 158(1), the FRR availability requirements in Article 158(2), the ramping rate requirements in Article 158(1) and the connection requirements in Article 158(3) by completing successfully the prequalification process of potential FRR providing units or FRR Providing Groups, described in paragraphs 3 to 6 of this Article. […]

In accordance with article 159(2) of the SOGL, a BSP offering the FCR Service must complete a prequalification process to – among other things – demonstrate the compliance of its portfolio with the requirements of the FCR Service. In the context of this prequalification process, after the signature of the BSP Contract FCR, the BSP must successfully complete:

- the communication test, as described in section 4.1; and
- a prequalification test, as described in section 4.2.

4.1. Communication test

After signature of the BSP Contract FCR and before submission of any FCR Capacity Bid, the BSP must successfully complete the communication test in alignment with ELIA. The BSP must always respect the requirements of the communication test during the validity of the BSP Contract FCR.

During the communication test ELIA will check that:

- The requested real time data from the BSP can be received by ELIA;
- The availability test (see section 8) can be triggered by ELIA and leads to the corresponding activation (MW).

Signal	**Level**	**Sent by**
Test request *This is the test request that ELIA will send to the supplier each time a test should be performed* *This signal also contains the following information:* *- FCR delivery point(s) concerned;* *- Type of test (capacity or energy)* *When receiving this signal, the supplier should activate the full FCR prequalified volume for the given FCR delivery point(s), following the test profile provided by Elia.*	BSP	**ELIA**

Feedback of test request *Each supplier will return a signal to ELIA so that it can be verified if its test request has been received correctly. The value is the mirror of the received signal.*	BSP	BSP
Real-time data *Measured value of the total power produced/consumed by a delivery point / Declarative baseline / a logical signal (0 or 1) that indicates whether the supplier is currently participating in the Primary Control or not / State of Charge (in case of DP LER)*	Delivery point	BSP

4.2. Energy Management requirements for assets with a limited energy reservoir

For aFRR and FCR, BSPs with Delivery Points with Limited Energy Reservoir (hereafter LER) must currently provide their Energy Management Strategy (EMS) to Elia priori to any participation. The EMS aims to prove the ability of the Delivery Point (on its own or together with other Delivery Points in the pool of the BSP) to comply with the requirements of the aFRR/FCR Service.

The EMS requirements can be seen as serving two distinct purposes related to two different phases for offering contracted services:

1. **Validation/prequalification phase.** As part of the prequalification, the BSP intending to use a DP with LER must describe the EMS of the concerned DP(s) and needs to demonstrate that this EMS allows continuously delivering the maximum volumes of contracted services the BSP intends to offer in the aFRR and/or FCR Capacity auctions.
2. **Service delivery/monitoring phase**. During the provision of the contracted services, the description of the EMS, together with the submission of relevant data, enables monitoring whether i) the DP with LER is effectively operated in line with the validated EMS, and ii) that the EMS remains effectively sufficient for ensuring that the contracted service can be delivered.

The description of the EMS for one or more DP with LER contains at least the following information:

- The identification and characteristics of the DP with LER for which the EMS is submitted.
- An exhaustive description of the energy management strategy.
- An indication of whether or not the submitted EMS is intended to replace an earlier validated EMS.
- An overview of the contracted services for which the DP with LER is intended to be used, including an overview of the maximum volumes the BSP intends to offer for each of the contracted services at a given moment in time.
- If applicable, an overview of the intended use of the DP with LER for non-contracted services in moments the contracted service is also offered (not applicable for FCR).
- An indication of whether the BSP intends to prove the effectiveness of the EMS via a deterministic analysis or via a simulation based on historical data.
    - If the BSP opts for a deterministic proof of the effectiveness of the EMS, a description of the proof that will be used is required;

- If case the BSP opts for a proof based on a simulation, the assumptions used by the BSP (e.g., related to the liquidity on the intraday market) are required.

To this end, the BSP must use the "EMS description" template published on the Elia website[9], which contains more information related to the specific information to be provided. Note that the template could evolve over time based on a return of experience.

4.3. Reserve Mode simulation

Additional Properties – Article 2
(j) reserve mode: activation of active power response depending on short-term frequency deviations in relation to the mean frequency deviation.

Reserve Mode is an additional operating mode, described by the **Additional properties of FCR in accordance with Article 154(2) of the Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation.** This additional operating mode is mandatory for FCR providing units or groups with a limited energy reservoir. More information on the specifics of Reserve Mode can be found in Section 7.4.

4.3.1. Reserve Mode simulation Process

Once a BSP wants to prequalify a providing group or unit that requires the implementation of Reserve Mode, the BSP must provide Elia with a simulation of FCR Delivery in a frequency scenario covering both Normal Mode and Reserve Mode FCR delivery and transition periods. This simulation must be carried out using a template and must be as close as possible to the actual behavior during operations. The template is made available in the file "FCR Reserve Mode Simulation Template" which is published on the ELIA website and is available on demand by e-mail to the contractual responsible. The BSP must provide this simulation only once, before prequalification of the first FCR Providing Unit or Group that has Reserve Mode implemented, or after entry-into-force of the T&C BSP FCR as approved on 15/05/2025. Reserve Mode is explained further in section 7.4.7

4.3.1. Reserve Mode simulation Derogation

BSPs with assets that have technical limitations regarding the implementation of Reserve Mode can submit a request for derogation with Elia. In this request for derogation the BSP must specify which Delivery Points are to be included in the derogation and must provide a sound technical justification as to why Reserve Mode cannot be implemented. This request to derogation should be sent to the Key Account Manager of the BSP.

4.4. System Split Requirements

Additional Properties – Article 3
(6) FCR providing groups shall implement alternatively on of the following approaches:

9 *https://www.elia.be/en/electricity-market-and-system/system-services/technical-documentation-concerning-the-provision-of-ancillary-services*

a) decentralised frequency measurements per connection point (based on local frequency measurement) that can be used as a fallback solution to ensure an autonomous function and a proper activation in case of errors in the central control (e.g. outage of SCADA, faults of communication lines) or in case of a system split affecting the perimeter of the group; if the group includes FCR providing units, local frequency measurements available for these units pursuant to paragraph 5 shall be part of the fallback solution;
b) a smart solution with equivalent effect to the decentralized frequency measurements pursuant to letter a)

The Additional properties introduced requirements on frequency measurement and control. These requirements are introduced to avoid improper FCR Reaction during a System Split event. A system split in a synchronous area is a separation of the synchronous area in two or more areas of different frequencies due to the generation and load repartition. This usually happens due to the outage of multiples transmission network elements (in cascade), linking the areas. In case of system split, the main risk linked to a Centralized FCR Controller with a unique frequency measurement is that the assets are not reacting correctly to the local frequency but rather to a frequency measurement made in another area. Therefore, FCR providing Units or Groups shall implement one of the following approaches:

- Decentralized frequency measurements per connection point. In this approach, the FCR Providing Unit uses local frequency measurements to determine the FCR Requested. Since local frequency measurements are used, there is no risk of incorrect FCR delivery during a system split scenario.
- A centralized FCR controller with decentralized frequency measurements per connection point to be used as a fallback in case of an error in the centralized control or in case of a system split affecting the perimeter of the group. In this approach a central FCR controller is used to determine the reaction of the FCR Providing Units or Group. However, the BSP implements an observation function, which uses local frequency measurements to detect a system split in the perimeter of the group. Each DP linked to the centralized FCR controller has a frequency meter to provide the observation function with input.
- An alternative solution in which the decentralized frequency measurements can be shared amongst delivery points in the same electrical zone[10] as defined by Elia, provided the total contribution of the assets reacting to one measurement point does not exceed 1.5 MW. This approach differs from the second approach by not including a local frequency meter at each DPs but sharing frequency meters between DPs in the same electrical zone up to a shared capacity of 1.5 MW. As frequency measurements must be local, meaning that a frequency meter must be installed at the site of each Delivery Point, with an exception for Virtual Delivery Points and Technical Units used as part of the Energy Management Strategy which are not performing the FCR Service, the third approach is only viable for Virtual Delivery Points.

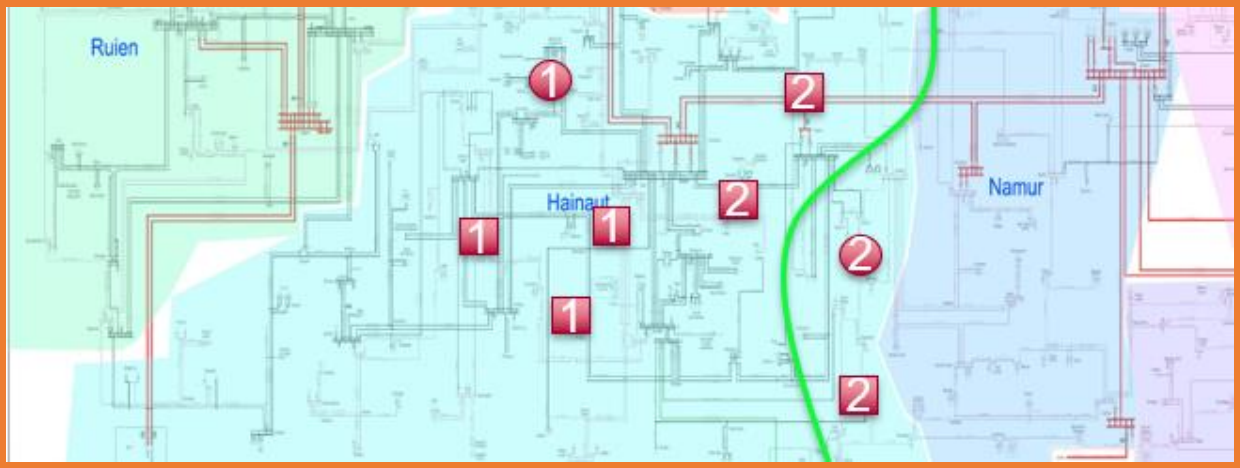
To this purpose, the BSP needs to demonstrate that its proposed system split countermeasures are effective and shall use as much as possible local frequency measurement. The BSP can do this by submitting a document containing a description of their control strategy and a list of the Delivery Points per strategy (if multiple control strategies are used). The required information for the system split countermeasures is described in the document “FCR System Split Countermeasures Requirements” which is published on the ELIA website and is available on demand by e-mail to the contractual responsible.

[10] As of writing of this Design Note, the number of electrical zones is ten: 380kV, Hainaut East, Hainaut West, Langerbrugge East, Langerbrugge West, Ruien, Merksem, Stalen, Liège and Schaerbeek. More information can be found here: Congestion Risk Indicators

Example:

The following figure shows part the Belgian grid divided into several electrical zones, with a different color identifying each of the zones. Each of the colored bubbles represents a local frequency measurement. The green line represents a system split. If the BSP introduces the alternative solution in the example, two frequency meters are required, as the BSP has 6 assets of 0.5 MW in the Hainaut electrical zone.

In case of a system split, there is an intrinsic risk that some of the assets are reacting improperly. If the BSP uses the alternative solution, it must introduce a second meter. In this case, the two assets, having a Centralized Controller using frequency measurements of meter 2, to the left of the system split are not reacting properly. This means the improper FCR activation is limited to 1 MW. If only frequency meter 2 was used for all assets in this electrical zone, the improper activation of FCR would be 2.5 MW. By capping the volume steered by one centralized frequency measurement, the amount of improper FCR activation is limited in case of a system split.



4.5. Prequalification test

This section reflects the design in the current BSP Contract FCR. There is a proposal for amendment that foresees changes in the design related to the prequalification test.

The BSP must perform a prequalification test prior to first participation in capacity auctions or if it wishes to increase its maximal FCR Power capacity in such auctions (FCR_{max}). As already raised above, the following steps:

- Signature of the BSP Contract FCR;
- Achievement of the communication test;
- Compliance with the Energy Management Strategy, Reserve Mode and System Split Requirements

are required before a prequalification test can take place.

The outcome of the prequalification test(s) determines the FCR_{max} that can be offered to ELIA by the BSP in FCR capacity auctions. Elia's ambition with its prequalification test is to verify the following requirements:

1) <u>Phase I: The linearity of the FCR reaction & the reaction time constraint</u>

   To verify linearity, ELIA fixes **intermediate steps before full delivery**. Each step corresponds to a frequency deviation block of **50 mHz** and the supplier will each time deliver an **additional** FCR volume of minimum 90 % for at least 2 minutes before going to the next step.

The response time to switch from one step to another is 12.5 seconds, 7.5 seconds response time and 5 seconds of tolerance. The 7.5 seconds response time comes directly from rules fixed by ENTSO-e in the System Operation Guideline (art.154) whereas a linear reaction and a response time principle of respectively 15 seconds to frequency deviation of 100 mHz and 30 seconds to frequency deviation of 200 mHz are also fixed.

2) Phase II: The continuous activation while frequency is in normal mode constraint

To verify whether the Providing Unit or Group is capable of delivering FCR in normal mode, the second phase of the prequalification test consists of the Providing Unit or Group reacting to the frequency and delivering FCR as they would when awarded.

4.5.1. Organization of a prequalification test

To organize a prequalification test, the BSP and ELIA agree on a time window of 24 hours. During this time window, the supplier can start the prequalification test. The BSP must first start following the relevant synthetic frequency profiles detailed below and once this test is over, continue with the real time frequency follow up over a period of 4 hours.

The prequalification test is not remunerated by ELIA.

4.5.2. Specifications of a prequalification test

During a prequalification test, the following general principles are followed:

- The 2 prequalification test phases defined by ELIA (described below) are applicable for each FCR group requesting a FCR prequalification, independent from its technical characteristics. In other words, Elia does not apply specific additional prequalification test for FCR groups with limited energy reservoirs.
- ELIA will prequalify the FCR group in each direction (upward and downward).
- Delivery Points can be tested individually or as part of a Providing Group;
- A Delivery Point submitted in an FCR Bid in the framework of a prequalification test cannot also be included in an aFRR Energy Bid, an mFRR Energy Bid, a Supporting aFRR Providing Group, a Supporting mFRR Providing Group or another prequalification test for the same quarter-hour.

ELIA defines 2 distinct prequalification test phases:

- The first prequalification phase, called “**synthetic frequency profile**”; During this phase, the participating providing group follow a set profile of frequency steps of 50mHz.
- The second prequalification phase, called “**Follow up of real time frequency**”. During this phase, the participating providing group reacts to the actual measured frequency as if during normal FCR delivery.

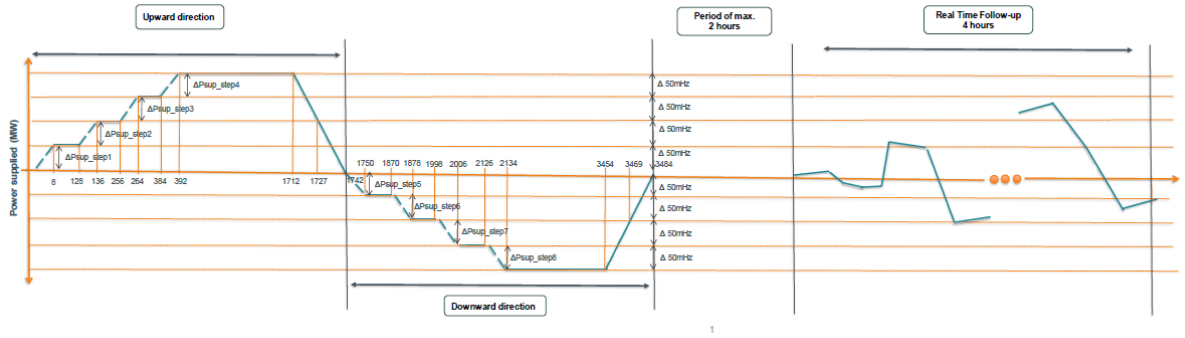


Figure 1. Prequalification test profile

4.5.3. Outcomes of a prequalification test

Based on the test data, ELIA will determine the maximal FCR volume prequalified for the FCR providing group concerned.

For each frequency step, the power delivered of 10s averages is calculated. Then the minimum of the 10s averages is selected. The prequalified volume is determined by selecting the worst results of the providing group during the targeted frequency steps and during the periods of full FCR delivery (frequency steps 4 and 8).

Then, during phase 2, the performance of the response to the actual frequency will determine whether this volume is further derated. The derating factor is determined as the actual supplied FCR divided by the expected FCR. If the FCR Service is delivered as expected, the derating factor is equal to 1.

A second derating factor E_{max} can be added by Elia if the providing group contains a Delivery Point that has a non-compliant measurement device. The application of an additional derating factor to the FCR volume prequalified reduces therefore this volume due to the non-compliance with the expected delivery.

The detailed evaluation of the steps described above is as follows:

1. **Evaluation of the synthetic prequalification test**

ELIA will consider tele-measurements on each delivery point part of the FCR providing group requesting a prequalification test and gathered via the SCADA2SCADA connection and apply the following rules:

- The minimal power value (of 10s averages) at each frequency step of 50 mHz (over a period of 120 seconds) will be taken as reference value for the related step;

$$\Delta\, FCR\ Power\ supplied = \min_{concerned\ frequency\ step}[FCR\ Power\ supplied\ (10s\ window)] - \min_{previous\ frequency\ step}[FCR\ Power\ supplied\ (10s\ window)]$$

- The lowest result for a specific step (of both upward and downward directions) determines the total prequalified FCR volume of the first phase of the prequalification test.

$$MIN\ \Delta\ FCR\ Power\ supplied = \max\left\{\begin{matrix}\min\ (all\ \Delta\ FCR\ Power\ supplied);\\ 0\end{matrix}\right\}$$

- The maximal FCR Power supplied in each direction, upwards and downwards is determined by the 4th frequency step (respectively the 8th frequency step) for the upward direction (respectively downward):

$$in\ the\ upward\ direction:$$

$$Max\ FCR\ Power\ supplied\ Up = \min_{frequency\ step\ 4}\{FCR\ Power\ supplied\ (10s\ window)\}$$

$$in\ the\ downward\ direction:$$

$$Max\ FCR\ Power\ supplied\ Down = \min_{frequency\ step\ 8}\{FCR\ Power\ supplied\ (10s\ window)\}$$

The outcome of the first phase of the prequalification test is the $FCR_{max,synthetic\ profile}$

If

$$4 * MIN\ \Delta\ FCR\ Power\ supplied\ \geq 0{,}9 * \min\left\{\begin{matrix}Max\ FCR\ Power\ supplied\ Up;\\ Max\ FCR\ Power\ supplied\ Down\end{matrix}\right\}$$

Then

$$FCR_{max,synthetic\ profile}\ =\ \min\left\{\begin{matrix}Max\ FCR\ Power\ supplied\ Up;\\ Max\ FCR\ Power\ supplied\ Down\end{matrix}\right\}$$

Otherwise

$$FCR_{max,synthetic\ profile}\ = 4 * MIN\ \Delta\ FCR\ Power\ supplie$$

2. For the follow up of real time frequency over 4 hours

ELIA will monitor the FCR reaction of the FCR providing group or providing unit doing the prequalification over a period of 4 h. During these 4 hours, the supplier will have to react to frequency locally measured as if he was selected to deliver the FCR service to ELIA.

If during the real-time follow-up of the Frequency, one or several Frequency Variations occur, ELIA will check the largest one and calculate the $\Delta\ FCR_{max,follow\text{-}up}$ as follows:

$$\Delta\ FCR_{max,follow-up} = \min\left\{\frac{FCR\ Supplied}{FCR\ Requested_{Frequency\ Variation}}\ ;1\right\}$$

Where:

- FCR Supplied is computed in accordance with section 9.2.2;
- $FCR\ Requested_{Frequency\ Variation}$ is computed in accordance with section 9.2.2;

3. Calculation of FCR_{max}

After the prequalification test, the FCR_{max} value is calculated by Elia using the results of both phases. The FCR_{max} value is calculated as follows:

$$\mathrm{FCR_{max}} = \min\left\{\begin{array}{l}\sum_{\substack{DP \in \\ Providing\ Group}} \mathrm{DP_{FCR,cb}}\ ; \\ \mathrm{FCR_{max,synthetic\ profile}} * \Delta\ \mathrm{FCR_{max,follow-up}}\end{array}\right\} * \mathrm{E_{max}}$$

Where:

- E_{max}: value calculated based on Private Measurement precision, as declared by the BSP in Annex 4 of their FCR BSP contract, for each Delivery Point non-compliant with measurement requirements in Annex 3. E_{max} is calculated as the difference between the worst accuracy over all Delivery Points included in the prequalification test and the accuracy criteria set by Elia in Annex 3 (1%) as follows

$$E_{max} = 100\% - (worst\ accuracy - 1\%)$$

- $\mathrm{DP_{FCR,cb}}$: The value, declared by the BSP, that signifies the contribution (in MW) of a Delivery Point to the Pool supplying FCR Capacity

Example:

A BSP aims to prequalify 10MW of FCR.

The outcome of phase I of the Prequalification test is an $FCR_{max,synthetic\ profile} = 9\ MW$

In phase II, the BSP does not fully deliver the FCR Supplied during the monitored frequency deviation and the $\Delta\ FCR_{max,follow-up} = 0.95$

The outcome of the Prequalification test is then

$$\mathrm{FCR_{max}} = \min\left\{\begin{array}{l}\sum_{\substack{DP \in \\ Providing\ Group}} \mathrm{DP_{FCR,cb}}\ ; \\ \mathrm{FCR_{max,synthetic\ profile}} * \Delta\ \mathrm{FCR_{max,follow-up}}\end{array}\right\} * \mathrm{E_{max}} = \min\{10MW; 9MW * 0.95\} * 1 = 8.55\mathrm{MW}$$

Given all Delivery Points participating in the test have compliant measurement devices ($E_{max} = 1$).

4.5.4. Possible modifications of the FCR_{max}

A BSP may also use a prequalification test to increase its total prequalified volume:

- The BSP either includes the entire Pool in the test and thereby the test sets the new prequalified volume; or
- The BSP prequalifies (a) new Delivery Point(s) and the BSP's prequalified volume is increased with the volume prequalified based on the test.

No test is required if a Delivery Point is added without impact on FCR_{max} (i.e. $DP_{FCR,cb}$ is declared by the BSP as equal to 0 MW). A test is not mandatory if the BSP removes a Delivery Point from its pool. In this situation, the concerned $DP_{FCR,cb}$ will be subtracted from FCR_{max}.

5. FCR Capacity procurement

5.1. Procurement of FCR capacity

ELIA procures all FCR Capacities for Day D through the Regional Procurement Platform (Regelleistung[11]). Through the platform, one capacity auction for each CCTU (i.e. block of 4 hours[12])(i.e. in total 6 capacity auctions) for Day D is performed. The 6 capacity auctions are performed at the same time in Day D-1 for delivery on Day D, taking into account the following timeline:

- FCR Capacity Gate Opening Time (GOT) for the 6 capacity auctions of Day D-1 is scheduled on Day D-7 at 00:00 CET;
- FCR Capacity Gate Closure Time (GCT) for the 6 capacity auctions of Day D-1 is scheduled on Day D-1 at 08:00 CET;
- Publication of the results for the 6 auctions of Day D-1 is performed at the latest Day D-1 at 08:30 CET.

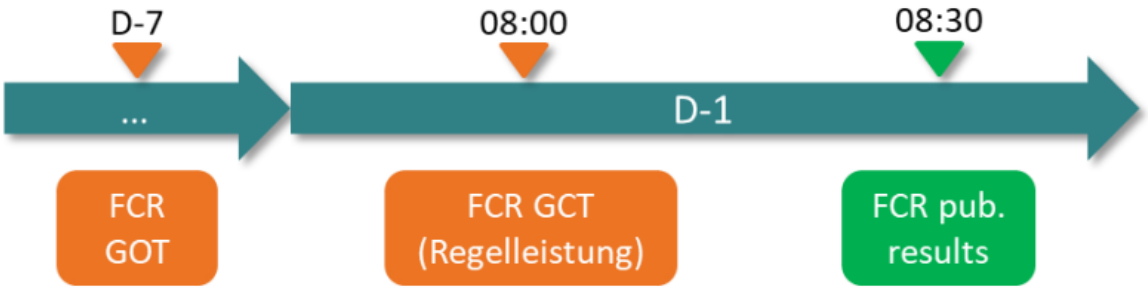


Figure 2. Capacity auction process

For each FCR Capacity Bid, the BSP defines the following specifications:

- The applicable CCTU;
- A volume (in MW), taking into account the following specifications[13]:
    - The minimum size of an FCR Capacity Bid is 1MW;
    - The volume granularity of an FCR Capacity Bid is 1MW;
    - Per CCTU, the total offered volume of FCR Capacity must be less than or equal to the FCR_{max} (see section 4.2) of the concerned BSP.
    - Divisibility of the FCR Capacity bid: the max volume of an indivisible FCR Capacity bid is 25MW.
- The price applicable (in €/MW/h), defined with maximum 2 decimals.

Regelleistung selects the capacity bids for each CCTU based on the “merit order” principle. The bids are ranked from lowest to highest price and FCR Capacity Bids are selected so as to respect the Core Share obligation[14] and minimize

[11] *https://www.regelleistung.net/ext/*
[12] *The CCTU or “Capacity Contracting Time Unit” is defined in the T&C BSP FCR as a period of 4 hours for which the FCR Capacity Bids offered by the BSP to ELIA can be activated as FCR Energy Bids.*
[13] *These constraints are defined at the level of the FCR Cooperation*
[14] *As per Annex VI of the SOGL, the TSOs of an LFC block shall ensure that at least 30 % of their total combined initial FCR obligations, is physically provided inside their LFC block.*

the total cost of procurement of the participating TSOs and considering constraints set in local legislation. The results of the FCR Capacity auctions are known by 08:30 D-1 at the latest and auction results will be published at the latest 24 hours after a FCR Capacity GCT on www.regelleistung.net.
In case of a lack of liquidity or IT problems, it is possible that not all FCR Capacity is procured in the first auctions at 08:00 and that the capacity requirements from the FCR Core share are not met. In this case, ELIA opens a second capacity auction for the concerned CCTU, with the following characteristics:

- FCR Capacity GOT is opened on Day D-1, no later than 30 minutes after publication of the result of the first capacity auction;
- Publication of the required volume of FCR Balancing Capacity is performed by ELIA on Day D-1, no later than 30 minutes after publication of the result of the first capacity auction;
- FCR Capacity GCT is scheduled on Day D-1 at 15:00 CET;
- Publication of the result is performed at the latest Day D-1 at 15:30 CET.

5.2. Transfers of FCR capacity

In order to grant the BSP more flexibility and to allow them to optimize the cost of delivering the Service, for instance but not exclusively when having to carry out planned or unplanned maintenance, ELIA gives the BSP the possibility to transfer in day-ahead or in intraday for one or more quarter-hours part or all of their FCR Obligations to one or several Counterpart BSP(s) to the date of the performance of the Obligation. This exchange of obligations is performed via the SMART application.

The transfer must be communicated to ELIA and accepted by one hour prior to the start of the first quarter-hour for which a transfer would take place.
When a Transfer of Obligation is accepted, ELIA adapts the FCR Obligation of the BSP and the Counterpart BSP for the applicable quarter-hour(s) by:

- adding the volume transferred to the FCR Obligation of the party taking over the FCR Obligation; and
- reducing by the volume transferred the FCR Obligation of the party ceding the FCR Obligation.

The BSP and the Counterpart BSP undertake the necessary actions to provide the FCR Service for the applicable quarter-hour(s) (without any action by ELIA). Consequently, the availability control and the activation control as well as the resulting penalties for non-compliance, among other provisions, will be based on the amended FCR Obligation of the BSP and the Counterpart BSP, resulting from the Transfer of Obligation.

In order to reflect the agreed Transfer of Obligation, the Counterpart BSP and the BSP should update their concerned FCR Energy Bids at the latest at the FCR Balancing GCT of the first quarter-hour for which the Transfer of Obligation applies.

Note that a transfer of FCR Capacity Obligation does not affect the remuneration of FCR Capacity as this only takes into account the awards during the auction and not the transfers afterwards. BSPs involved in a transfer of FCR Capacity obligation must discuss the terms of the trade among them.

6. Submission of FCR Energy Bids

This section reflects the design in the current BSP Contract FCR. The bidding tool for energy bidding currently is BMAP but is expected to migrate to BIPLE in 2026.

FCR Energy Bids differ from the traditional sense of bids, as the FCR Energy bids do not include pricing. The submission of energy bids for FCR allows the BSP to provide Elia with additional information on the delivery of the FCR, which was not included in the Capacity Bid. There is no merit order for the FCR Energy Bids.

6.1. Submission of FCR Energy Bids to ELIA.

6.1.1. Timeline for energy bid submission

EBGL
Article 2 – Definitions (27) '**balancing energy gate closure time'** means the point in time when submission or update of a balancing energy bid for a standard product on a common merit order list is no longer permitted; (38) **'TSO energy bid submission gate closure time'** means the latest point in time when a connecting TSO can forward the balancing energy bids received from a BSP to the activation optimisation function; **Article 20.6 –** […] all TSOs shall implement and make operational the European platform for the exchange of balancing energy from frequency restoration reserves with manual activation and they shall use the European platform to: (a) submit all balancing energy bids from all standard products for frequency restoration reserves with manual activation; (b) exchange all balancing energy bids from all standard products for frequency restoration reserves with manual activation, except for unavailable bids pursuant to Article 29(14); (c) strive to fulfil all their needs for balancing energy from the frequency restoration reserves with manual activation. Article 24 – Balancing energy gate closure time 3. After the balancing energy gate closure time, the BSPs shall no longer be permitted to submit or update their balancing energy bids. 4. After the balancing energy gate closure time, BSPs shall report to the connecting TSO any unavailable volumes of balancing energy bids without undue delay in accordance to 158(4)(b) and 161(4)(b) of Regulation (EU) 2017/1485. If the BSP has a connection point to a DSO, and if required by the DSO, the BSP shall also report any unavailable volumes of balancing energy bids to the DSO without undue delay. Article 29 – Activation of balancing energy bids from common merit order list 9. Each connecting TSO shall submit, prior to the TSO energy bid submission gate closure time, all balancing energy bids received from BSPs to the activation optimisation function, taking into account the requirements in Articles 26 and 27. The connecting TSOs shall not modify or withhold balancing energy bids, except for: (a) balancing energy bids related to Articles 26 and 27; (b) balancing energy bids that are manifestly erroneous and include an unfeasible delivery volume; (c) balancing energy bids that are not forwarded to the European platforms in accordance with paragraph 10.

14. Each TSO may declare the balancing energy bids submitted to the activation optimisation function unavailable for the activation by other TSOs because they are restricted due to internal congestion or due to operational security constraints within the connecting TSO scheduling area.

BSPs should submit FCR Energy Bids for each quarter-hour of a day D when selected in the capacity auction.
As defined in the T&C BSP FCR, the Balancing Energy Gate Closure Time (BE GCT or FCR Balancing GCT) is D-1 at 15:00 CET. FCR Energy Bids can be submitted and updated until BE GCT. At BE GCT, the submitted bids are firm and can no longer be modified by the BSP.

6.1.2. Characteristics of FCR Energy Bids set by the BSP

The BSP submits FCR Energy Bids through a dedicated web-based platform, BMAP, put at disposal by ELIA. The user manual for this platform is available on ELIA website. Table 1 gives the list of the bid characteristics, which are discussed in more detail in the next subsections.

FCR Energy bid characteristics
Start and End time of the FCR Energy bid
List of Delivery Points
For DP_{SU}, the upward and downward FCR Power
Offered Bid volume

Table 1 List of characteristics of FCR Energy Bids declared by the BSP

6.1.2.1. Start and End time of the FCR Energy Bid

An FCR Energy Bid is a multiple of quarter-hours, with a minimum duration of a single quarter-hour and a maximum of 24 hours.

6.1.2.2. List of Delivery Points

The BSP may choose which Delivery Points part of the Pool are included in the FCR Energy Bid, while complying with the following conditions:

- The sum of the offered volume of a FCR Energy Bid must be inferior or equal to the BSP's FCR Power Obligations at all times
- The total offered volume of a FCR Energy Bid must be inferior or equal to the sum of the $DP_{FCR,cb}$ of each Delivery Point mentioned in the FCR Energy Bid.

6.1.2.3. The upward and downward FCR Power (only for DP_{SU})

In case of DP_{SU} in the Energy Bid, the BSP must specify the upward and downward FCR Power the DP_{SU} will contribute in the FCR reaction.

6.1.2.4. Offered "bid volume"

The minimum granularity of the offered volume is 1 MW and the minimum value for the offered volume is 1 MW.

6.2. Update of FCR Energy Bid by the BSP after GCT

ELIA will facilitate reductions of the bid volume after BE GCT **in case a partial or full Forced Outage** of a Delivery Point that affects the bid volume of an FCR Energy Bid. The BSP must request to decrease the bid volume for the quarter-hours for which the Forced Outage applies. After notifying Elia, the BSP has 4 hours to reconstruct the impacted FCR Obligation. During the 4 hours of Forced Outage, no incentives are applied on the volume of the included Delivery Points. After these 4 hours, Elia applies incentives in accordance with section 10.1.

7. Activation of FCR

7.1. FCR requested

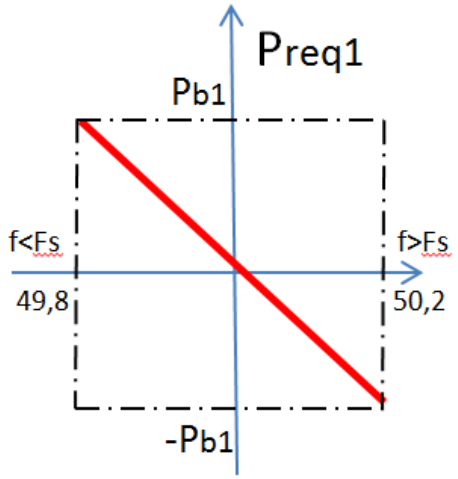
For a specific Period and a specific Frequency Deviation, the quantity of FCR to be supplied (upwards or downwards) will be determined via the power/frequency ratio λ0 and on the basis of a Frequency Deviation Δf according to the following formula:

$$\text{FCR Requested} = -\lambda_0 * \text{FCR}_{\text{energy bid}} * \Delta f$$

With:

- λ_0: the power/frequency ratio, as defined by ENTSO-E Regional Group Continental Europe, equal to $\frac{15000\ [MW/Hz]}{3000\ [MW]} = 5\ Hz^{-1}$;
- $\text{FCR}_{\text{energy bid}}$: is the total volume offered by the BSP in the concerned FCR Energy Bid for the concerned quarter-hour;
- $\Delta f = F - 50Hz$ is the frequency deviation, determined with 3 decimals.

This description is represented in the following figure:



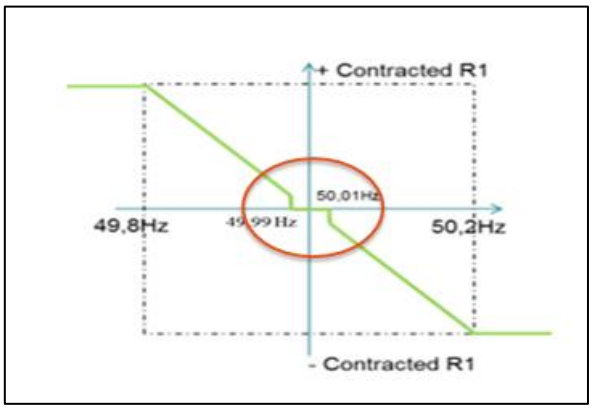
Example:
A BSP has submitted an energy bid of 10 MW of FCR for the CCTU. During the CCTU, a frequency deviation of 150mHz is measured.

FCR Requested = $5\ \text{Hz}^{-1} * 10\ \text{MW} * 0.150\ \text{Hz} = \mathbf{7.5\ MW}$

7.2. Deadband around 50 Hz

For FCR, a deadband of 10 mHz around 50 Hz is authorized, as illustrated in the graph below.

This requirement is described in **Annex V of System Operation Guideline** and is in line with other TSOs partners of the regional auction platform.



The introduction of this deadband reflects the evolution of technologies capable of FCR delivery and will benefit to all market parties (limit the losses on the FCR asset, use as part of the energy management strategy…).

7.3. Activation rules

SOGL Article 154
Each TSO of the CE synchronous area shall ensure that the combined reaction of FCR of a LFC area comply with the following requirements: (a) the activation of FCR shall not be artificially delayed and begin as soon as possible after a frequency deviation; (b) in case of a frequency deviation equal to or larger than 200 mHz, at least 50 % of the full FCR capacity shall be delivered at the latest after 15 seconds; (c) in case of a frequency deviation equal to or larger than 200 mHz, 100 % of the full FCR capacity shall be delivered at the latest after 30 seconds; (d) in case of a frequency deviation equal to or larger than 200 mHz, the activation of the full FCR capacity shall rise at least linearly from 15 to 30 seconds; and (e) in case of a frequency deviation smaller than 200 mHz the related activated FCR capacity shall be at least proportional with the same time behaviour referred to in points (a) to (d).
Additional properties of FCR in accordance with Article 154(2) of the Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation - Article 3
Each TSO shall ensure that the activation of all FCR providing units and FCR providing groups: a) is not artificially delayed and begins as soon as possible but no later than 2 seconds after a frequency deviation; b) rises at least linearly. c) When one of the requirements a) or b) cannot be met, the FCR providing group or FCR providing unit shall provide technical evidence to the reserve connecting TSO. The reserve connecting TSO assesses these justifications and decides whether or not the unit or group can be qualified to provide FCR.

A FCR reserve providing unit or group must automatically react (linear and proportional reaction) to frequency deviations measured from local frequency meters. Furthermore, as described in Art.154 of system Operation guideline and the Additional Properties, a FCR supplier will respect the following activation rules:

- "The activation of FCR shall not be artificially delayed and begin no later than 2 seconds after a frequency deviation"
- "In case of frequency deviation equal to or larger than 200 mHz, at least 50 % of the full FCR capacity shall be delivered after 15 seconds"
- "In case of a frequency deviation equal to or larger than 200 mHz, 100 % of the FCR capacity shall be delivered at latest after 30 seconds"
- "In case of a frequency deviation equal to or larger than 200 mHz, the activation of the full FCR capacity shall at least rise linearly from 15 to 30 seconds and";
- "In case of a frequency deviation smaller than 200 mHz, the related activated FCR capacity shall be at least proportional with the same time behavior referred to in the previous points"

A BSP can request a derogation to these activation rules. Specifically, regarding the possibility to react slower than 2s and the linear rise. This derogation must be requested before the prequalification test and should contain a demonstration of technical limitations and is limited to the Delivery points participating in the prequalification test.

7.4. Reserve Mode

Additional properties of FCR in accordance with Article 154(2) of the Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation - Article 3
LER FCR providing units (either single or belonging to a LER FCR providing group) that are prequalified for the first time after the entry into force of the methodology and which are connected to the grid by means of inverters shall ensure that close to the upper or lower bounds of the energy reservoir the remaining capacity is sufficient for keeping a proper response on short-term frequency deviations. Therefore, they shall switch from the normal mode (reaction to normal frequency deviation) into a reserve mode (reaction to zero-mean frequency deviation)

Reserve Mode = As defined in article 2(2) of the Additional Properties: activation of active power response depending on short-term frequency deviations in relation to the mean frequency deviation;

The rationale for Reserve Mode is to ensure that Delivery Points with LER can maintain the provision of limited FCR activation based on short-term frequency deviations during Alert State and avoid depleted energy reservoirs. Without Reserve Mode, the LER would stop providing FCR, when its reservoir reaches its physical limits. With LER penetration increasing in the Synchronous Area, this introduces a risk during these extreme events. By introducing Reserve Mode, the BSP can guarantee a limited level of FCR delivery based on the **zero-mean frequency** during Alert Mode.

All FCR Providing Units or Groups that include Delivery Points LER prequalified after **21/01/2023** should have Reserve Mode capabilities implemented, unless a derogation is granted. A derogation can be requested by the BSP if they can justify the FCR Providing Unit is technically not capable of delivering Reserve Mode.

When the Synchronous Area Continental Europe enters into Alert State[15] (or Emergency State), and the Providing Units or Groups reach or exceed the upper (SoC_{max}) or lower (SoC_{min}) thresholds of their energy reservoir (as defined below), these Providing Units or Groups shall switch to the Reserve Mode. These thresholds are defined by the amount of energy required to provide continuously FCR for a time interval equal to the local Full Activation Time (FAT) of aFRR:

$$SoC_{min} = \frac{P * t_{FAT}}{C}$$

$$SoC_{max} = 1 - SoC_{min}$$

Where:

- C is the energy capacity of the DP LER in MWh;
- P is the provided FCR Power corresponding to a frequency deviation of ±200 mHz, in MW;
- t_{FAT} is the Full Activation Time of aFRR in h, defined by Elia as 5 min.

The transition from Normal Mode to Reserve Mode is therefore initiated at instant $t_{start} = t(SoC \leq SoC_{min} | SoC \geq SoC_{max})$, in Alert State, and lasts t_{FAT}.

[15] Elia does not notify BSPs of Alert State of Emergency State. BSPs are expected to track the frequency themselves in order to comply with the minimum requirements of FCR Delivery (25min of uninterrupted delivery). Reserve Mode should only be entered after these 25 min and once the SoC thresholds are exceeded.

When the system is back to Normal State, the transition from Reserve Mode to Normal Mode is initiated when the State of Charge is restored, i.e. at instant $t_{restore} = t(SoC_{min} < SoC < SoC_{max})$.

During Reserve Mode, the FCR activation formula is the following:

$$\text{FCR Requested} = -\lambda_0 * \text{FCR}_{\text{energy bid}} * f_{reaction}$$

This formula differs from the activation formula mentioned in section 7.1, with Δf replaced by $f_{reaction}$.
Depending on whether the DP is in normal operation, reserve mode or during transition, the $f_{reaction}$ is dependent on respectively the actual frequency deviation, the zero-mean frequency deviation or both.

The zero-mean frequency deviation is the deviation to the average of the frequency for the previous 5 minutes. What it means is that a BSP is not reacting to the actual frequency deviation (compared to 50Hz), but to the smaller deviations. The alternative without Reserve Mode would be the complete loss of FCR delivered by LER assets. The actual long-lasting deviation should be tackled by aFRR and mFRR at this point in time. The zero-mean frequency deviation is calculated as follows:

$$\Delta f_{zm}(t) = \Delta f(t) - \frac{1}{t_{FAT}} \sum_{k=0}^{N_{FAT}-1} \Delta f(t - k * ts)$$

Where:

- ts is the Time Step;
- $N_{FAT} = \frac{t_{FAT}}{TS}$ is the number of timesteps in the time period of the Full Activation Time of aFRR.

As the transition from one state to the other is linear, the reaction function is given by:

$$f_{reaction}(t) = \Delta f_{zm}(t) * T + (1 - T) * \Delta f(t)$$

Where:

- $f_{reaction}$ is the reaction function that provides the frequency deviation to which a BSP must react;
- Δf_{zm} is the zero-mean frequency which represents the short-term frequency deviation, determined with 3 decimals;
- $\Delta f = F - 50Hz$ is the frequency deviation, determined with 3 decimals;
- T is the weighting function that defines the operating mode.
    - In Normal Mode, $T = 0$;
    - In Reserve Mode, $T = 1$;
    - During transition from Normal Mode to Reserve Mode:

$$T = \begin{cases} 0 & t < t_{start} \\ \dfrac{t - t_{start}}{t_{FAT}} & t_{start} < t < t_{start} + t_{FAT} \\ 1 & t > t_{start} + t_{FAT} \end{cases}$$

- During transition from Reserve mode to Normal Mode:

$$T = \begin{cases} 1 & t < t_{restore} \\ 1 - \frac{t - t_{restore}}{t_{FAT}} & t_{restore} < t < t_{restore} + t_{FAT} \\ 0 & t > t_{restore} + t_{FAT} \end{cases}$$

8. Remuneration

8.1. Remuneration of FCR Awarded

The FCR capacity auctions result in an FCR Awarded for the concerned BSPs. The awarded FCR Capacity is remunerated according to the paid-as-clear mechanism.
The remuneration for one FCR Capacity Bid is equal to the multiplication of:

- the price, in €/MW/h, of the awarded FCR Capacity Bid; and
- the number of MW awarded of said FCR Capacity Bid; and
- the number of hours of the CCTU concerned.

There is no remuneration for energy in FCR.

9. Controls

The following control mechanisms are in place for FCR:

Table 2: Overview of FCR Control Mechanisms

Control mechanism	Requirements linked to control
FCR Made Available	FCR Obligation
Capacity Availability Test	Availability of Awarded Capacity
Energy Availability Test	Availability of required Energy Reservoir (25 min)
Activation Control	Actual FCR Delivery

9.1. Availability controls

9.1.1. Control of the FCR Made Available

BSPs are obliged to submit FCR Energy Bids in respect of their FCR Obligation (either due to the FCR Balancing Capacity the BSP sold to ELIA in the capacity auction or due to a Transfer of Obligation from another BSP). ELIA verifies therefore for each quarter-hour whether the FCR Energy Bid(s) submitted provide ELIA at least the volume of the concerned FCR Obligation(s).

To determine whether the BSP for a specific quarter-hour complies with its FCR Obligations, ELIA verifies whether the sum of the volume of all contracted FCR Energy Bids is at least equal to the FCR Obligation of the BSP.

When this above-mentioned sum is not equal to the corresponding FCR Obligation for the concerned quarter-hour, the following rules applies:

- If the volume is lower than the FCR Obligation, FCR Made Available is set to this volume.
- If the volume is higher than (or equal to) the FCR Obligation, FCR Made Available is set to the FCR Obligation.

If ELIA observes, during the control, that the FCR Made Available is lower than the FCR Obligation for a quarter-hour, ELIA applies penalties in accordance with section 10.1.

ELIA only exempts from this penalty the unavailability of volumes on contracted FCR Energy Bids that were confronted with a forced outage, for the duration of the reconstitution time of 4 hours as raised already in section 6.2.

9.1.2. Availability test

The principle of an availability test is to check whether the full contracted capacity (for which the BSP is remunerated) is **available** for activation at any given time. When an availability test is triggered by ELIA, **the rules defined hereunder in sections 9.1.2.1 to 9.1.2.8 are applicable**.

9.1.2.1. Possible availability tests

To verify both capacity and energy requirements, ELIA identifies 2 different test profiles. Both tests are applied by ELIA on the nominated delivery points:

- The **capacity test** aims at verifying that the BSP can effectively deliver at least all its FCR contracted obligation on the nominated delivery points, in both directions. As the objective of this test is to measure the instantaneous power reaction, its duration is very brief (only 120 seconds in each direction at full activation) and will only last long enough so ELIA can register the reaction in its tele-measures.
- The **energy test** verifies that the energy requirements can be respected at all times. To do so, ELIA will request a full activation on the nominated delivery points and over a minimal duration of 25 minutes of the entire FCR contracted obligation in one direction.

Test profiles are known in advance and will be fixed contractually. They are presented in the section below.

9.1.2.2. FCR volumes activated for an availability test

- ELIA will verify if the contracted volume was effectively available as contractually required. To determine the required reaction (MW), ELIA will use the information submitted via the nomination process, in which the BSP announces on which FCR delivery points of its portfolio he will deliver its contracted FCR volume for the next quarter hour.
- Directly related to principle 1, ELIA can activate a volume that corresponds to a part of the BSP's contractual obligation by only selecting the FCR volume nominated on some delivery points via the intraday nomination process. In other words, ELIA will not necessarily verify with one availability test the obligation of a whole FCR service type.
- Directly related to principles 1 and 2, ELIA will only consider tele-measures of delivery points from delivery points nominated via the intraday nomination process **and** selected by ELIA for an availability test for the test verification.

9.1.2.3. Trigger of an availability test

- ELIA will notify the BSP of the availability test using an electronic message in XML data format.

- Test profiles are known in advance by the supplier and are fixed contractually.
- The configuration and identification of test signals per FCR delivery points happens during the prequalification process as defined in section 4.1.

9.1.2.4. Profiles and triggers of availability tests

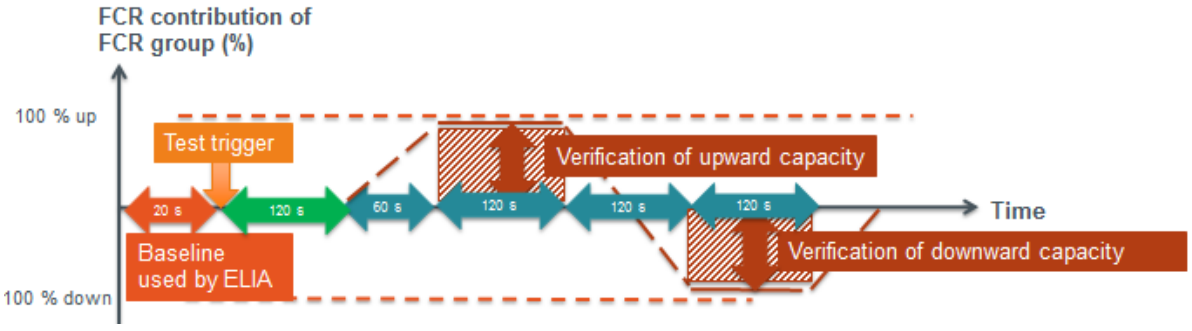
ELIA triggers automatically its availability tests when the frequency passes by 50 Hz to minimize any negative effects on the frequency of the grid.

a. Capacity test profile

The capacity availability test has a duration of 9 minutes.
From the moment when the signal is sent by ELIA, the BSP

i. Stabilizes their injection or offtake to the same level as was during the reference period for the test (20 seconds preceding the reception of the test signal) within a delay of 120 seconds;
ii. Activates the full requested power in the upward direction within a delay of 60 seconds starting immediately after the end of the stabilization phase. These 60 seconds cover the time needed to send, treat and start the test signal as well as the authorized timing to reach 100 % of FCR activation (by product definition) and as explained in section 7.3 above;
iii. Maintains this reaction for 120 seconds;
iv. Activates their full requested power in the downward direction, within a delay of 300 seconds, starting from the moment of the reception of the signal + 120 seconds;
v. Maintains this power for 120 seconds;
vi. Stops the reaction.

The following figure describes the test profile of the FCR capacity test:



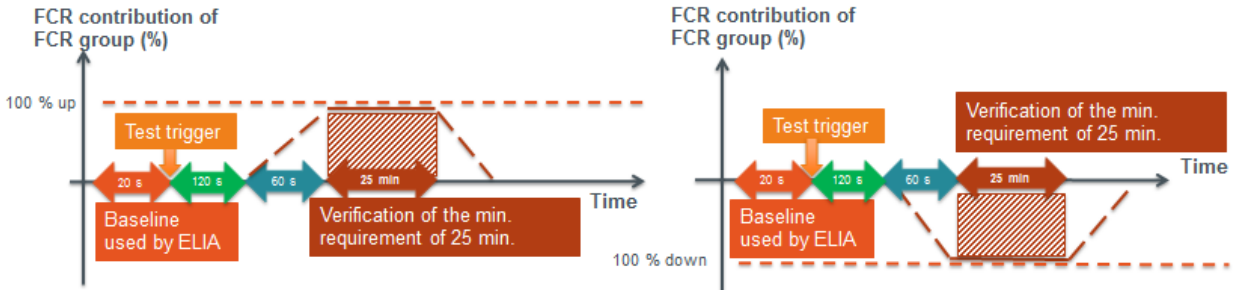
b. Energy test profile

From the moment when the signal is sent by ELIA, the BSP

i. Stabilizes their injection or offtake to the same level as was during the reference period for the test (20 seconds preceding the reception of the test signal) within a delay of 120 seconds;
ii. Activates the full requested volume in the upward (or downward) direction within a delay of 60 seconds starting after the stabilization phase;
iii. Maintains this power for 1500 seconds;

iv. Stops the reaction.

The following figure describes the test profile of the FCR energy test (for the two possible directions):



An Energy Availability test is always in one specific direction. The direction of the test is mentioned in the test trigger signal sent by Elia.

9.1.2.5. Reference to determine the test success or failure

ELIA triggers an availability test when frequency passes by 50 Hz. The baseline used to evaluate test success or failure will correspond to the average power measured on the last 20 seconds before the test signal is sent.

$$baseline = \frac{1}{20} * \sum_{ts=TS_0-19}^{TS_0} [\, P_{meas}\,(ts) - CH/DCH\ Correction\,(ts) + \ FCR\ Requested(ts)\,]$$

Where:

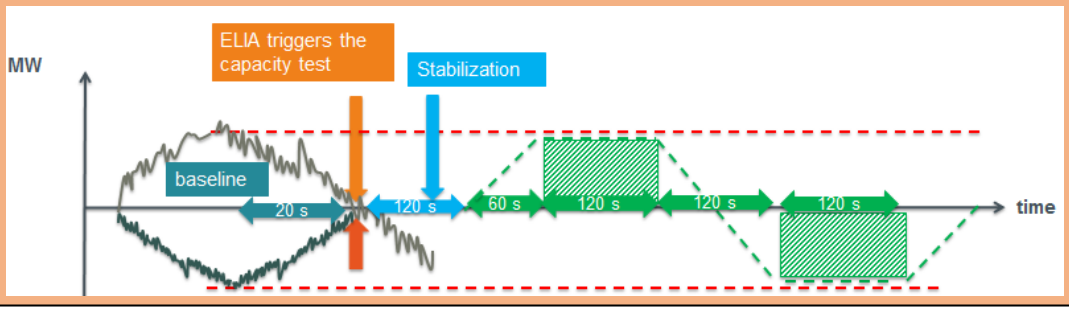
- CH/DCH Correction is determined by

$$CH/DCH\ Correction\,(ts) = \sum_{\substack{All\ DP\ with\ Limited\ Energy\ Reservoirs \\ \in\ tested\ FCR\ Energy\ Bid(s)}} DP_{CH-DCH}\,(ts)$$

The FCR Requested (ts) is added to the baseline calculation to compensate for slight deviations from 50Hz during the 20s on which the baseline is calculated.

Example of availability test principles

- A BSP has a contract with ELIA for 10 MW FCR.
- The BSP knows in advance the profile of ELIA's capacity test (120 seconds full upward activation followed by 120 seconds full downward activation).
- At the moment ELIA triggers the capacity test (in orange in the illustration below), the BSP knows:
    - The volume he has to activate (green boxes), equal to the full FCR volume of the Energy Bid (10 MW);
    - The baseline ELIA will use to verify the test success or failure (in dark blue)
- After the trigger, the BSP has 120s to prepare, 60s to ramp up to the requested volume (10 MW) and then must hold this activation for 120 seconds.
- Afterwards the BSP has 120 seconds to ramp down to the expected downwards volume (10 MW) and must hold this activation for another 120 seconds. After the 120 seconds, the BSP must return to normal operation.



9.1.2.6. Specific rule only applicable for energy limited FCR providing groups/units

After the realization of an energy availability test, the BSP has the right to reconstitute its energy over a maximal duration of 2 hours as stated in the System Operation guideline. ELIA will not consider this interval of 2 hours for its activation control.

9.1.2.7. Verification of the test success

ELIA will only verify that **the minimal contractual requirement is met**. In other words, over delivery is authorized and will not be capped.

Independently of the type of test requested (energy test or capacity test), ELIA applies the principles below to evaluate test success or failure.

- ELIA will gather the tele-measurements of all the nominated delivery points selected by ELIA for the test and analyze the aggregated reaction to confirm that:
    - The BSP at least delivered its contractual obligation (reaction) in upward direction and;
    - The BSP at least delivered its contractual obligation (reaction) in downward direction.

- ELIA calculates a moving average (each 10 seconds of the full upwards or downwards activation(s)).

$$V_{FCR\ Power\ supplied}(10s\ window) = \frac{1}{10} * \sum_{ts=TS}^{TS+9} FCR\ Power\ supplied_{test}\ (ts)$$

- A capacity availability test is compliant if the following conditions are simultaneously satisfied:

  a. less than 3 values of the 10 second average FCR Power supplied, $AV_{FCR\ Power\ supplied,test}\ (10s\ window)$, are inferior to the FCR Capacity Requested for the phase of provision of the FCR Capacity Requested upward (i.e phase ii);

  b. less than 3 values of the 10 second average FCR Power supplied, $AV_{FCR\ Power\ supplied,test}\ (10s\ window)$, are inferior to the FCR Capacity Requested for the phase of provision of the FCR Capacity Requested downward (i.e phase v);

- If a capacity availability test is not compliant, ELIA will calculate the FCR Missing MW.

  To this purpose, ELIA only considers the two phases of provision of the FCR Capacity Requested (i.e. phases ii and v from the capacity test described above). The FCR Missing MW corresponds to the greatest difference, over all Times Steps of concerned phases, between:

  i. the FCR Capacity Requested;

  ii. the 10 seconds average FCR Power supplied.

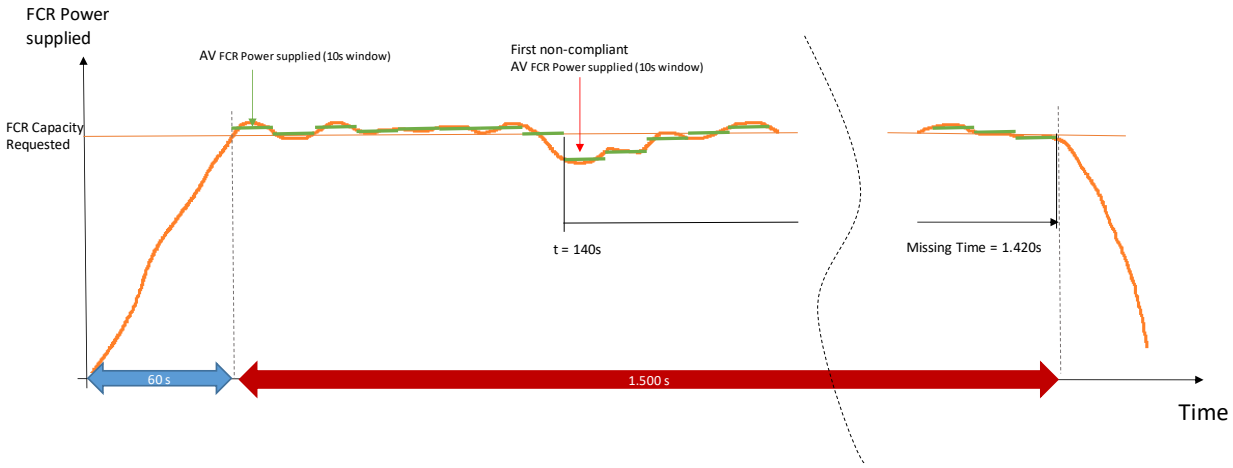
$$\text{FCR Missing MW} = \max\left\{\min_{all\ 10s\ windows}\left[\begin{matrix}FCR\ Capacity\ Requested\ ; \\ FCR\ Capacity\ Requested - AV_{FCR\ Power\ supplied}\ (10s\ window)\end{matrix}\right];\ 0\right\}$$

- An energy availability test is compliant if less than 26 values of the 10 second average FCR Power supplied, $AV_{FCR\ Power\ supplied,test}\ (10s\ window)$, are inferior to the FCR Capacity Requested for the phase of provision of the FCR Capacity Requested (i.e phase ii).

- If an energy availability test is not compliant, ELIA will calculate the FCR Missing Time and Failed Energy Factor. To determine both parameters, ELIA only considers the phase of provision of the FCR Capacity Requested, i.e. the 1 500 seconds of phase ii.

- The FCR Missing Time corresponds to the period (in seconds) between:
  a. the start time of the 10 seconds interval, in which the first 10 second average FCR Power supplied, AV_(FCR Power supplied) (10s window), was inferior to the FCR Capacity Requested for the energy availability test;
  b. the end time of the energy availability test.

  A graphical example is shown below:



In the example hereabove, the ramping phase starts at t = 0 second. The interval during which the first $AV_{FCR\ Power\ supplied}(10s\ window)$ is inferior to the FCR Capacity Requested starts at t = 140 seconds. Taking into account that the energy availability test ends at t = 1 560 seconds, the FCR Missing Time for the example amounts 1 420 seconds.

- The Failed Energy Factor is the ratio between FCR Missing Energy and the energy corresponding to the FCR Capacity Requested for the energy availability test. The FCR Missing Energy and the Failed Energy Factor are determined as follows:

$$FCR\ Missing\ Energy = \sum_{all\ 10s\ windows} \left(Max\left[FCR\ Capacity\ Requested - AV_{FCR\ Power\ supplied}(10s\ window); 0\right] * \frac{10s}{3600s} \right)$$

$$\text{Failed Energy Factor} = \frac{\text{FCR Missing Energy}}{\frac{1500s}{3600s/h} * \text{FCR Capacity Requested}}$$

9.1.2.8. Frequency of activation of availability tests

- ELIA can trigger the capacity availability test maximally 12 times per year (rolling window).

  However, if results of 2 successive capacity availability tests are positive, Elia reduces the limitation to maximally 6 capacity availability tests on the rolling window. Any failed capacity availability test sets this limitation back to 12 times.

- ELIA can trigger the energy availability test maximally 3 times per year (rolling window).

  However, if result of an energy availability test is negative, ELIA has the right to organize an additional energy availability test.

The availability tests are part of FCR contract, and no additional compensation from ELIA is foreseen for these tests. Potential BSPs should consider this in their bidding strategy when offering FCR reserve products to ELIA during the tendering.

9.2. Activation control

This section reflects the design in the current BSP Contract FCR. There is a proposal for amendment that foresees changes in the design related to activation control and the related incentives.

The activation control mechanism consists in selecting a sample of frequency deviations for each delivery period and verifying the BSP's portfolio response to that frequency deviation.

9.2.1. Interval selection

ELIA selects maximum 6 frequency deviations for each month, with a maximum of 2 frequency deviations within one delivery period (CCTU).

As presented in section 5.2.1, the BSP will communicate via the FCR Energy Bids to ELIA which delivery points are participating to the delivery of FCR. ELIA will use this information as input for its activation control by only considering the measurements of all delivery points nominated in the FCR Energy Bids.

This will improve the analysis quality as non-delivering assets of the BSP's portfolio could sometimes create disturbance in the measurements.

9.2.2. Activation control process

The activation control is performed by comparing the FCR Power Supplied (measured as per the method described below) with the FCR Power Requested (calculated based on the requirements below). In case the BSP fails to meet the requirements, incentives will be applied as described in chapter 10.

Determination of the FCR Supplied by the BSP

The FCR Supplied, for the analyzed Frequency Variation, is computed as follows:

in the upward direction,

$$FCR\ Supplied = \max\left\{\ Pmeas_{before} - Pmeas_{after}\ ;\ 0\right\}$$

in the downward direction,

$$FCR\ Supplied = \max\left\{\ Pmeas_{after} - Pmeas_{before};\ 0\right\}$$

Where:

- The FCR Supplied is determined based on the contribution of all Delivery Points considered in the bid. To this purpose, ELIA computes the P_{meas} for each Time Step. In case Delivery Points with Limited Energy Reservoir are included in the FCR Energy Bid, a correction value for the charging/discharging of the concerned Delivery Point, based on the $DP_{CH\text{-}DCH}$ communicated in real-time by the BSP, is taken into account

$$P_{meas}(ts) = \sum_{\substack{All\ DP \in \\ FCR\ Energy\ Bid(s)}} [DP_{measured}\ (ts) - DP_{CH-DCH}(ts)]$$

- The $Pmeas_{before}$ is computed over the period of 20 seconds exactly preceding the Frequency Variation (period comprised between TS_{before} -19 and TS_{before}), as follows:

$$Pmeas_{before} = \frac{1}{20} * \sum_{ts=TS_{before}-19}^{TS_{before}} P_{meas}\ (ts)$$

- The $Pmeas_{after}$ is computed over the period of 30 seconds starting at the time the Frequency Variation reaches its maximum value (period comprised between TS_{after} and TS_{after}+29), as follows:

  $In\ the\ upward\ direction,$

$$Pmeas_{after} = \min_{ts\ \in\ [TS_{after};TS_{after}+29]} [P_{meas}(ts)]$$

  $In\ the\ downward\ direction,$

$$Pmeas_{after} = \max_{ts\ \in\ [TS_{after};TS_{after}+29]} [P_{meas}(ts)]$$

If the measurements used to calculate the FCR Supplied are corrupted in some way due to rapid power changes that are not related to the delivery of the FCR Service, the BSP can request a new Frequency Variation sample on the condition they deliver to Elia:

- the list of Delivery Points that undergo a proven rapid change during the examined period such that these are excluded from the calculation of the FCR Supplied
- A justification of why these Delivery Points underwent a rapid power change unrelated to the FCR delivery.

Determination of the FCR Requested

The determination of the FCR Power Required for the analyzed Frequency Variation will be made by calculating the absolute difference between FCR Requested before the Frequency Variation and FCR Requested after the Frequency Variation:

$$FCR\ Requested_{Frequency\ Variation} = \left| FCR\ Requested_{before} - FCR\ Requested_{after} \right|$$

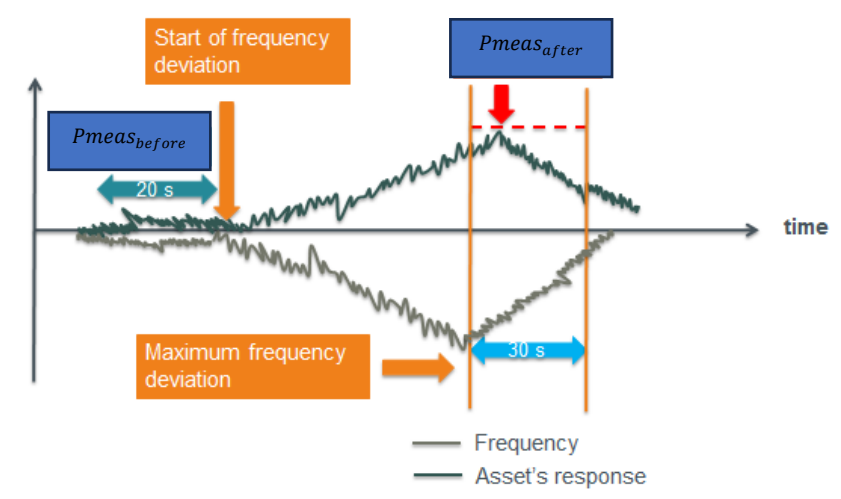
- $FCR\ Requested_{before}$ is the FCR Requested, as described in chapter 7.1, corresponding to the Frequency F_{before}, which is the average value of the Frequency (in Hz) during the period of 20 seconds preceding the start of Frequency Variation (as communicated by ELIA for the selected Frequency Variation);

$$F_{before} = \frac{1}{20} * \sum_{ts=TS_{before}-19}^{TS_{before}} F(ts)$$

- FCR Requested$_{after}$ is the FCR Requested, as described in chapter 7.1, corresponding to the Frequency F$_{after}$, which is the average value of the Frequency (in Hz) during a period of 20 seconds starting at the time the Frequency Variation reaches its maximum value;

$$F_{after} = \frac{1}{20} * \sum_{ts=TS_{after}}^{TS_{after}+19} F(ts)$$

Example of activation control in the upward direction



10. Incentives

10.1. Incentives for MW (not) Made Available

ELIA strongly values being able to rely on the FCR Balancing Capacity bought by BSPs as this is an important part in operating the grid securely. Therefore, in case a BSP does not submit sufficient FCR energy compared to its FCR Obligation (as explained in section 9.1.1), the BSP is subject to incentives. However, ELIA also understands that unexpected problems may occur that are not to be interpreted as a sign of risky portfolio management from the BSP. Consequently, the incentive makes the distinction between one-time events and repeated behavior:

- The penalty is calculated separately for each **CCTU**.
- The penalized volume (expressed in MW/h) reflects the sum of the "MW not made available" during all quarter-hours of the concerned CCTU.
- The financial value of the penalty ("**CP$_{WA}$**") is based on the concerned BSP's average[16] balancing capacity price for Awarded FCR during the last 30 days.

[16] *The average is a weighted average: the volume of awarded capacity for CCTU(x) serves as a weight for the price of awarded capacity for CCTU(x) in order to determine the average price for the CCTU's of the entire period.*

- The penalty increases with an 'aggravating factor' ("**#CCTU$_{non\text{-}compliant}$**"). The factor takes into consideration the number of CCTU with "MW not made available" on day D and during the previous 29 days compared to the overall number of CCTU with FCR Capacity for the concerned FCR Capacity Product awarded to the concerned BSP during the same period. This factor therefore allows that the penalty makes the distinction between BSP's with few problems to respect their FCR Obligations and BSP's with structural problems.

$$P_{FCR\ Made\ Available}(Month\ M) = \sum_{All\ CCTU\ of\ Month\ M} P_{mFRR\ Made\ Available}(CCTU)$$

$$P_{FCR\ Made\ Available}(CCTU) = \#CCTU_{non-compliant} * MW_{not\ made\ available} * CP_{WA}$$

These formulas are aligned over the three balancing products.

Example:
Situation day D:
- On day D-1 for CCTU 1, 2, 3 ELIA awarded a BSP with 100 MW FCR Capacity.
- During CCTU 2 (i.e., 04:00-08:00) the BSP submits FCR Energy bids = 10MW for all quarter-hours except the first (i.e., quarter-hour 17 of the day) in which the BSP offers 0MW.
=> As the BSP only has one quarter-hour with "MW not made available" of 10MW of the CCTU, the penalized volume equals 2,5MW/h for the CCTU (i.e., 10 MW / 4).
- During CCTU 3 (i.e., 08:00-12:00) the BSP is not able to submit any FCR Energy bids: therefore 0 MW for all quarter-hours.
*=> As the BSP has "MW not made available" of 10MW for all 16 quarter-hours of the CCTU, the penalized volume equals 40MW/h for the CCTU (i.e., 16 * 10 MW / 4)*
- Therefore, on day D the BSP has 2 CCTU with "MW not made available" for FCR.
Situation for the preceding 29 days:
- The BSP had 25 CCTU with awarded FCR Capacity.
- The weighted average capacity price for that BSP for the FCR Product = 5 €/MW/h.

- Penalty - CASE 1: *The BSP has no CCTU with "MW not made available" in the 29 days preceding day D:*
CCTU 1: no "MW not made available" => no penalty
CCTU 2: Penalty = 2 ∗ 2,5 MW/h ∗ 5 €/MW/h = 25 €
CCTU 3: Penalty = 2 ∗ 40 MW/h ∗ 5 €/MW/h = 400 €

- Penalty - CASE 2: *The BSP has 10 CCTU with "MW not made available" in the 29 days preceding day D:*
CCTU 1: no "MW not made available" => no penalty
CCTU 2: Penalty = 12 ∗ 2,5 MW/h ∗ 5 €/MW/h = 150 €
CCTU 3: Penalty = 12 ∗ 40 MW/h ∗ 5 €/MW/h = 2400 €

10.2. Incentives for FCR Missing MW

In case of a failed capacity availability test (as described in section 9.1.2), the under-delivery during the test (i.e., the "Missing MW") is subject to incentives. The financial penalty is determined as follows:

$$P_{FCR\ Missing\ MW} = \sum_{month\ M} \alpha * FCR\ Missing\ MW * CP_{WA} * \#CCTU * hours_{CCTU}$$

With:

- α is a penalty factor that is equal to:
  - 0.75 by default;
  - 1.5 in case the availability test concerns a second consecutive failed availability test.

- $FCR\ Missing\ MW$ is the FCR Missing MW of the concerned capacity availability test defined in section 9.1.2.
- CP_{WA} is the weighted average[17] of capacity prices corresponding to all FCR Capacity Bids awarded to the BSP for the period comprised between Day D-29 until Day D (i.e., 30 Days), where Day D is the date of performance of the concerned availability test. The weight is the FCR Awarded for the concerned FCR Capacity Bid.
- $\#CCTU$ is the number of CCTU for which at least one FCR Capacity Bid has been awarded to the BSP for the period comprised between Day D-29 until Day D (i.e., 30 Days), where Day D is the date of performance of the concerned availability test.
- $hours_{CCTU}$ is number of hours in a CCTU (i.e., 4).

As explained in section 9.1.2, ELIA reduces a BSP's prequalified volume in case of two failed consecutive capacity availability tests.

$$new\ FCR_{max} = FCR_{max} - \min\{FCR\ Missing\ MW_{test\ 1}; FCR\ Missing\ MW_{test\ 2}\}$$

[17] *The average is a weighted average: the volume of awarded capacity for CCTU(x) serves as a weight for the price of awarded capacity for CCTU(x) in order to determine the average price for the CCTU's of the entire period.*

10.3. Incentives for FCR Missing Time

In case of a failed Energy availability test (as described in section 9.1.2), the under-delivery during the test (i.e., the "FCR Missing Time") is subject to incentives. The financial penalty is determined as follows:

$$P_{FCR\ Missing\ Time} = \sum_{month\ M} \alpha * \frac{FCR\ Missing\ Time}{1500} * CP_{WA} * CV_A * \#CCTU * hours_{CCTU}$$

With:

- α: incentive factor proportional to the percentage of the Failed Energy Factor, as calculated in Chapter 9.1.2.8. The value of α is defined according to the table below:

• Failed Energy Factor	• Value of α
• ≤10%	• 0,50
• >10% et ≤30%	• 0,75
• >30%	• 1

In case the incentive concerns a second consecutive failed energy availability test, α is equal to 1,5.

- $FCR\ Missing\ Time$ is the FCR Missing Time of the concerned energy availability test defined in section 9.1.2.
- CP_{WA} is the weighted average[18] of capacity prices corresponding to all FCR Capacity Bids awarded to the BSP for the period comprised between Day D-29 until Day D (i.e., 30 Days), where Day D is the date of performance of the concerned availability test. The weight is the FCR Awarded for the concerned FCR Capacity Bid.
- CVA is the average volume corresponding to all FCR Capacity Bids awarded to the BSP for the period comprised between Day D-29 until Day D (i.e. 30 Days), where Day D is the date of performance of the concerned availability test.
- $\#CCTU$ is the number of CCTU for which at least one FCR Capacity Bid has been awarded to the BSP for the period comprised between Day D-29 until Day D (i.e., 30 Days), where Day D is the date of performance of the concerned availability test.
- $hours_{CCTU}$ is number of hours in a CCTU (i.e., 4).

10.4. Incentives for FCR Activation Control

This section reflects the design in the current BSP Contract FCR. There is a proposal for amendment that foresees changes in the design related to activation control and the related incentives.

In case of failed activation control, the financial incentive for Month M is determined as follows:

[18] *The average is a weighted average: the volume of awarded capacity for CCTU(x) serves as a weight for the price of awarded capacity for CCTU(x) in order to determine the average price for the CCTU's of the entire period.*

$$P_{non-compliant\ activations} = \sum_{\substack{all\ analyzed\ Frequency\ Variations \\ of\ Month\ M}} [0{,}2 * failure\ factor * Remuneration\ (Month\ M)]$$

$$failure\ factor = \max\left\{\frac{FCR\ Requested_{Frequency\ Variation} - FCR\ Supplied}{FCR\ Requested_{Frequency\ Variation}}; 0\right\}$$

Where:

- $Remuneration\ (Month\ M)$ is the total remuneration for the FCR Awarded for Month M.
- $FCR\ Requested_{Frequency\ Variation}$ is the FCR Requested of the analyzed Frequency Variation as described in section 9.2.2.
- $FCR\ Supplied$ is the FCR delivered by the BSP for the analyzed Frequency Variation as described in section 9.2.2.

10.5. Cap on financial penalties

The sum of the financial penalties under section 10.1, section 10.2, section 10.3 and section 10.4 is subject to a monthly cap. This penalty cap is equal to the total remuneration (cf. section 8) for the FCR Service for the concerned Month.

A. LIST OF USEFUL REFERENCES

Federal Grid Code of April 22, 2019:
https://www.ejustice.just.fgov.be/eli/arrete/2019/04/22/2019012009/justel (French version)
https://www.ejustice.just.fgov.be/cgi_loi/change_lg.pl?language=nl&la=N&cn=2019042202&table_name=wet (Dutch version)

Code of Conduct of October 20, 2022:
https://www.creg.be/sites/default/files/assets/Publications/Decisions/B2409Annex1.pdf

ELIA webpage on **Balancing Services** (including documents such as Balancing Rules, LFC BOA, and LFC Means):
https://www.ELIA.be/en/electricity-market-and-system/system-services/keeping-the-balance/mfrr

ELIA webpage on the **FCR Service**:
FCR

ELIA's current **T&C BSP FCR** entered into force on June 18, 2025:
https://www.elia.be/-/media/project/elia/elia-site/electricity-market-and-system---document-library/balancing---balancing-services-and-bsp/2025/20250527_tc-bsp-fcr_en.pdf

Guideline on Electricity Balancing (**EBGL**) of November 23, 2017:
https://www.entsoe.eu/network_codes/eb/

Guideline on Electricity Transmission System Operation (**SOGL**) of August 2, 2017:
https://www.entsoe.eu/network_codes/sys-ops/

Website of **Regelleistung**
www.regelleistung.net > European cooperations > FCR Cooperation

ELIA webpage on **technical documentation**
Technical documentation concerning the provision of ancillary services