ELIA

System Split Requirements

Content

1. Introduction

On 30th of June 2021, all NRAs of the Continental Europe Synchronous Area have approved the Additional properties of FCR (hereafter, referred to as “Additional Properties”) 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 (“SO Regulation”). This methodology introduces common additional properties of the FCR required to ensure operational security in the Continental Europe Synchronous Area (SACE).

The details of the Additional Properties have been presented and discussed during the incentive study of 2022[1].

One of the additional properties addresses the risks related to decentralized assets with a centralized control model that relies on a central frequency measurement. While the integration of decentralized assets represents an opportunity to the grid to leverage the flexibility at lower voltage level and thus create more liquidity on the market, the conventional centralized control model of those assets based on a centralized frequency measurement also creates risks in terms of the reliability of the FCR Service. It has however to be noted that decentralized assets with a local control and measurements does not carry those risks. Two main risks come inherently with a centralized control:

1. Outage of controller (SCADA) and/or failure of communication (between the assets and the controller)
2. Inappropriate FCR activation of all assets, in case of system split.

As Elia does not intent to start imposing specific requirements on IT redundancy, the focus lies on the case of system split.

[1] 20220429_Public consultation on the Analysis and implementation of the FCR evolutions in accordance to article 154(2) of SOGL (elia.be)

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 net-work 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.

Example of an incorrect FCR activation due to system split.

The following figure shows a part of the Belgian grid. Each of the squares represents a decentralized asset. The green line represents the fault-line, dividing Belgium into two zones with a different frequency, a system split.

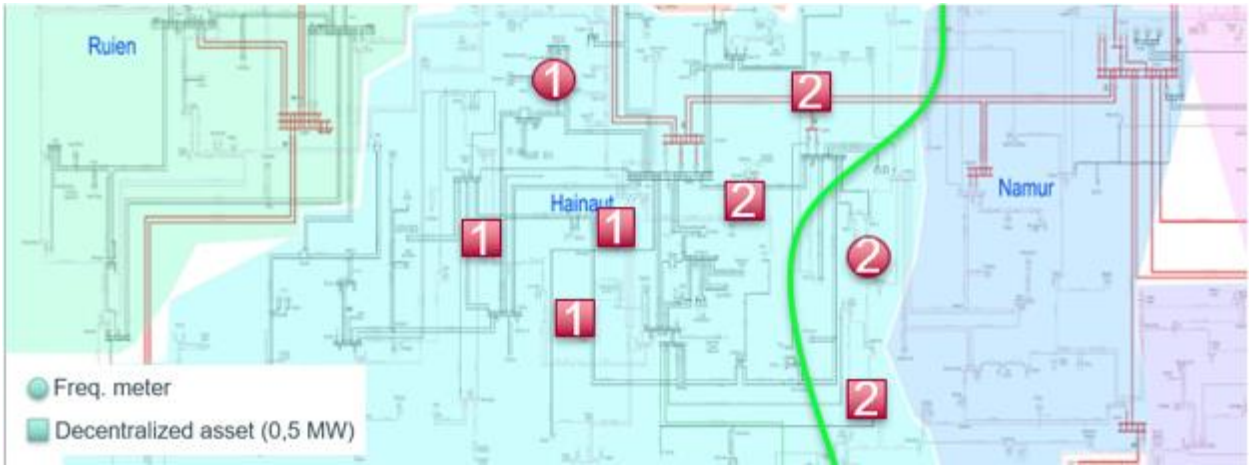

Figure 1: Illustration of part of the Belgian grid

If the BSP is using a centralized control, with only one frequency measurement (e.g. meter 1), the asset on the right of the green line will react to an inaccurate frequency and therefore its FCR delivery will be incorrect, which will further deteriorate the frequency in that area.

2. Appropriate FCR Activation in case of system split

This chapter covers the obligations that target described issues that could arise from BSPs having a Centralized FCR Controller using a unique frequency measurement. The following articles of the Additional Properties are especially relevant to the BSP with decentralized assets:

"*7. FCR providing groups shall implement alternatively one of the following approaches:*

a) Decentralised Frequency Measurements at least per connection point in analogy to what is foreseen for FCR providing units in paragraph 6;

b) a Centralised FCR Controller with Decentralised Frequency Measurements per connection point (based on local frequency measurement) to be used as a fallback solution to ensure an autonomous function and a proper activation in case of errors in the Centralised FCR Controller itself (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 6 shall be part of the fallback solution;

c) an alternative solution with equivalent effect to the fallback solution pursuant to b), as in guaranteeing a proper activation in case of errors in the Centralised FCR Controller or in case of a system split.

8. In case the Decentralised Frequency Measurements are used as a fallback solution pursuant to paragraph 7(b):

a) an observation function shall detect any kind of errors of the central control or frequency discrepancies among the technical entities within the perimeter of the group;

b) the FCR provider shall immediately initiate appropriate counter-measures to ensure that the FCR provision is not significantly negatively impacted by switching to the Decentralised Frequency Measurements; and

c) the minimum accuracy of the local frequency measurement used as a fallback solution can be reduced according to the national terms and conditions

applicable to the reserve connecting TSO.

9. In case the alternative solution with equivalent effect pursuant to paragraph 7(c) is implemented:

a) if the FCR providing group includes FCR providing units, the local frequency measurements available for these units pursuant to paragraph 6 may be integrated in the alternative solution;

b) the FCR provider shall demonstrate the effectiveness of the alternative solution with respect to the decentralised frequency measurements; and

c) the solution may be implemented only if allowed by the national terms and conditions, applicable to the reserve connecting TSO."

The Additional Properties therefore allow for three solutions:

1. **Decentralized Frequency Measurements** at least per connection point;
2. **a Centralized FCR Controller with Decentralized Frequency Measurements** per connection point (based on local frequency measurement) to be used as a fallback solution;
3. **an alternative solution** with equivalent effect to the fallback solution.

In case the BSP has implemented solution one and does not use a Centralized controller, the risk of improper FCR delivery during system split is mitigated.

The obligations which are detailed in the following sections aim to mitigate the described issues that could arise from BSPs having a Centralized FCR Controller.

3. Obligation and conditions on the use of Centralized Controller with Decentralized Frequency Measurement

To address the risk of system split, the Additional Properties foresee per default to install a local frequency measurement at least at each connection point. The rationale is that a local frequency measurement can then be used in an observation function to detect the system split and trigger appropriate countermeasures.

3.1 Observation function

The observation function is intended to detect frequency discrepancies among the assets within the perimeter of the pool steered by the Centralized Controller. An observation function is necessary for all BSPs having a Centralized FCR Controller. The design of the observation function highly depends on the BSP and the distribution of its assets. A BSP is expected to explain to Elia its strategy to detect a system split.

Example of an observation function

The following figure shows the Belgian grid divided into several zones, with a different color identifying each of the zones. Each of the colored bubbles represents a local frequency measurement. For the sake of simplicity, the frequency measurement is located on the connection point behind which asset(s) react to this frequency measurement. The number in the bubbles are used for identification purposes only as explained below. The yellow line and the magenta line represent 2 different system split scenarios.

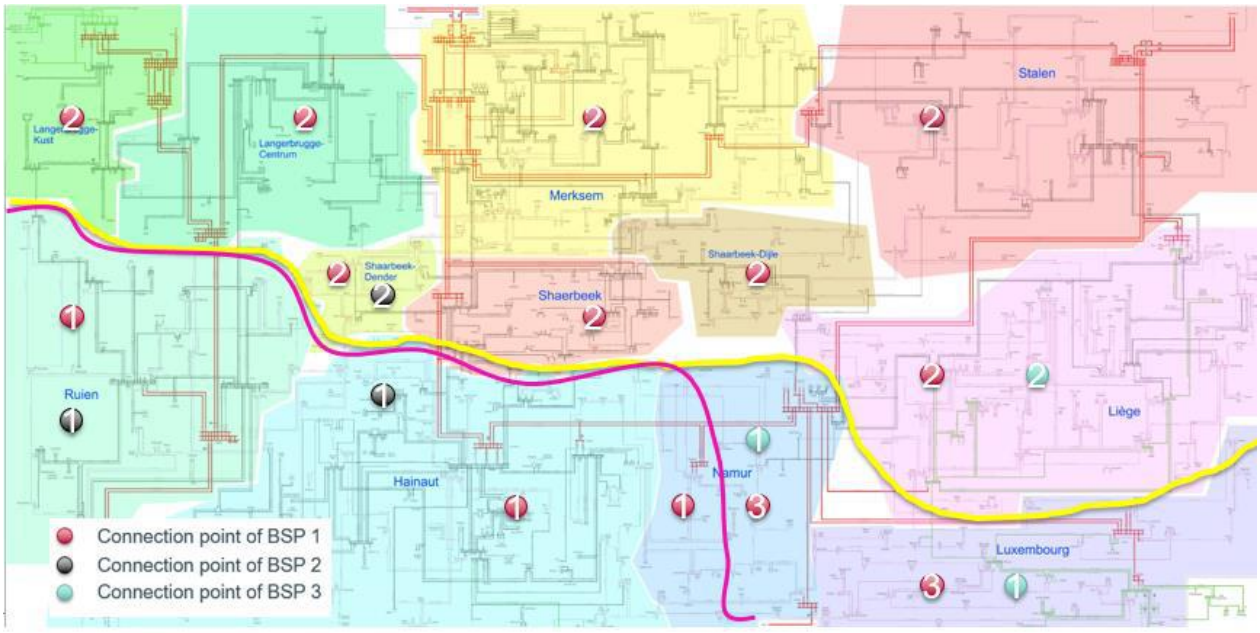

Figure 2: Illustration of the Belgian grid divided in several zones

The observation function shall compare the frequency between each of the connection points and identify the “fault line” (in yellow or magenta), if such fault line is between connections points. The fault line in this “yellow” case considers a system split between zones only.

For every BSP, the following results should be achieved if the observation function has been properly implemented:

- BSP 1 (red bubbles): the BSP has assets in every zone.
    - Bubbles 1&3: assets located in Ruien, Hainaut, Liège react to the frequency “south” of the system split.
    - Bubbles 2: assets located in the rest of the zones react to the frequency “north” of the system split.
- BSP 2 (black bubbles); the BSP only has assets in the “western” zones.
    - Bubbles 1: assets located in Ruien, Hainaut react to the frequency “south” of the system split.
    - Bubbles 2: assets located in Schaerbeek react to the frequency “north” of the system split.
- BSP 3 (turquoise bubbles): the BSP only has assets in the “eastern” zones.
    - Bubbles 1: assets located in react to the frequency “south” of the system split.
    - Bubbles 2: assets located in Liège react to the frequency “north” of the system split.

In case the fault line is the one in magenta, the system split is within a zone. Given that BSP 1 has 2 assets in the zone Namur, the BSP shall be able to detect the “intra-zonal” system split. The assets behind bubbles 1 & 3 should react correctly.

3.2 Appropriate countermeasures & minimum accuracy of local frequency measurement

Regarding the appropriate countermeasures, Elia proposes that measures to mitigate inappropriate FCR activation (after system split) are in place within a reasonable time and no longer than 2s considering the initial event trigger. Elia expects that the countermeasures are to be activated automatically. For all BSPs having a Centralized FCR Controller, Elia expects that the countermeasures are explained altogether with the observation function.

In essence, the countermeasures should be a new control strategy considering the distribution of assets and technologies in frequency areas resulting from the system split, if relevant. The FCR service shall be provided in accordance to SO Regulation Art. 154.7(a-e) and Additional Properties Art 3.2 (a-b) after the time to put in place the counter-measures.

4. Alternative solution: defined zones for system split

As explained, having a Centralized Controller with a unique frequency measurement may lead to inappropriate FCR activation in case of system split. The default solution foreseen by the Additional Properties requires decentralized frequency measurements per Delivery Point to be used as a fallback solution to ensure autonomous function and proper activation in case of errors in the Centralized FCR Controller or in case of a system split affecting the perimeter of the group. As described in Annex 3.C of the T&C BSP FCR, each Delivery Point must have a local frequency meter installed. Therefore, the default solution must be put in place for all non-virtual Delivery Points.

In case of a Virtual Delivery Point however, one frequency meter for all Technical Units part of the Virtual Delivery point suffices. The BSP may decide on where to install the frequency meter of the Virtual Delivery Point. Virtual Delivery Points are therefore not inherently compliant with the previous solution.

Elia proposes one alternative solution which balances its needs for operational security and the potential entry barriers that the solution may create.
The aim of the alternative solution of Elia is to provide a standard “off-the-shelf” solution that a BSP can readily use without having to perform an additional design and therefore to further lower potential entry barriers stemming from the obligation. This alternative solution can be used for decentralized assets which are not equipped with a local frequency meter which is used for FCR activation (Decentralized Frequency Measurement), in other words assets pooled in a Virtual Delivery Point.

The solution follows the rationale that there are zones within which a system split is unlikely to occur. A unique frequency meter per zone could be accepted to control all the assets in that zone. The determination of the zones is the critical aspect. If the zone is Belgium, one frequency meter would be sufficient. In the other extreme, if one zone needs to be defined for each single connection point, the default obligation as stated in Additional Properties Art. 3.7(b) would apply. Elia's solution consists in dividing the Belgian grid into electrical zones[2] that are small enough such that the split within the zones is unlikely (and if it occurs the consequences on FCR activation are assessed as acceptable at this stage). These zones can change if Operational Security Analysis indicates a need or if requested by market parties. If this need is detected Elia will present its analysis to the impacted market parties before adapting the Electrical Zones. Before implementing the update of the Electrical Zones, the impacted market parties will be informed of the moment from which the update will apply.

In accordance with the T&C BSP FCR, a BSP can rely today on the same frequency measurement for the activation of several Technical Units aggregated in a Virtual Delivery Point. Per definition, a Virtual-Delivery Point has a total contribution that does not exceed 1.5 MW.

The alternative solution intends to apply the same logic, while mitigating the risk of inadequate FCR activation in case of a system split. A BSP can rely on the same frequency measurement for several Virtual Delivery Points provided the total contribution of the assets reacting to this measurement in the corresponding zone does not exceed 1.5 MW. The BSP may decide on where in the zone to install the frequency meter of the Virtual Delivery Point(s), which would ideally be distributed geographically to minimize the overall risk.

[2] At the moment of submitting the Rules the number of zones is ten: 380kV, Hainaut East, Hainaut West, Langerbrugge East, Langerbrugge West, Ruien, Merksem, Stalen, Liège and Schaerbeek..

The alternative solution thus requires a unique frequency measurement for each 1.5MW of Technical Units located in the same zone and each zone should have its individual frequency measurements.

In case of split, the BSP shall detect subsequent frequency measurement divergence with the observation function and apply relevant countermeasures to ensure that the assets are reacting correctly to the frequency measurement at zone levels. Frequency checks may be performed between Delivery Points to identify divergence with central measurement.

4.1 Example of the alternative solution

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. As the BSP has 6 assets of 0.5 MW in the Hainaut electrical zone, two frequency meters are required.

In case of a system split, there is an intrinsic risk that the two assets, having a Centralized Controller using frequency measurements of meter 2, to the left of the system split are not reacting properly. In this case 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.

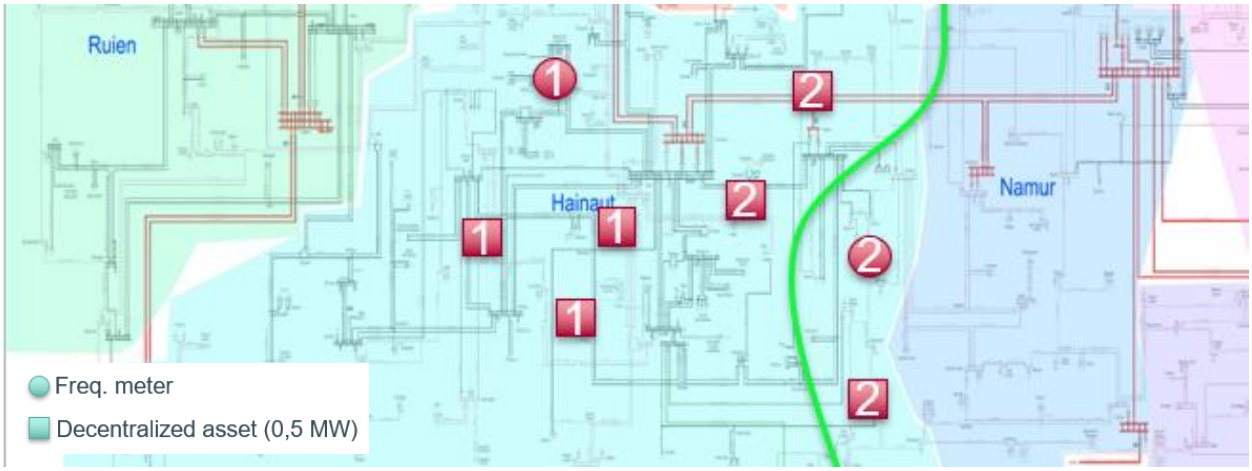

Figure 3: Part of the Belgian grid divided into several electrical zones.