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# Terms of Reference for a study assessing aFRR products

- v1 -

WGAS subgroup 5

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## 1. Background for the study

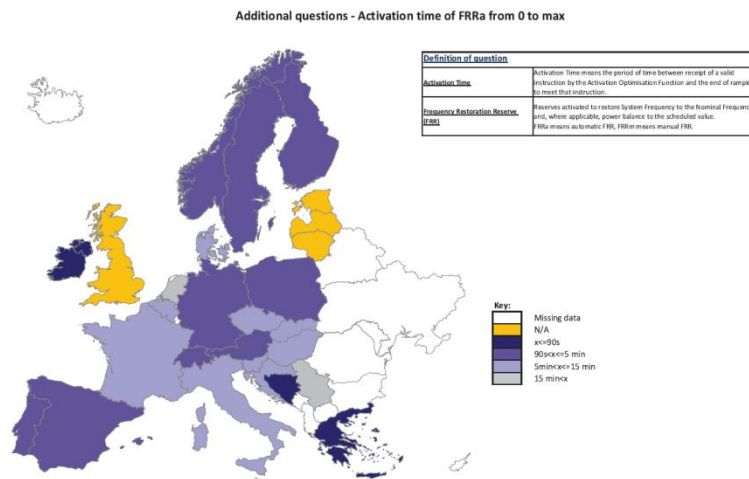
### 1.1. aFRR in Europe: diversity of Full Activation Time and activation schemes

The 2013 ENTSO-E survey on Ancillary Services Procurement and Balancing Market Design shows a diversity of aFRR balancing energy products and activation schemes across Europe.

The map below shows that the aFRR Full Activation Time is different for most European TSOs. It lies within a range between ca. 1 and 15 minutes.

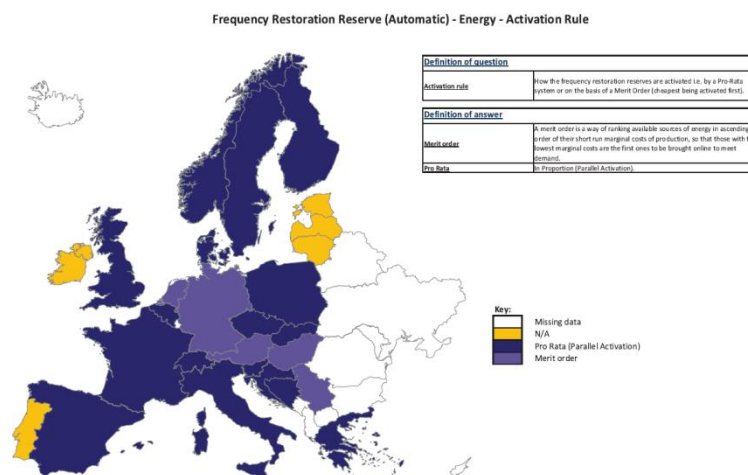
The difference in aFRR Full Activation Times in Europe can be due to:

- Reasons for FRCE (ACE) / frequency regulation quality;
- Different technical capabilities of aFRR providers within the TSO areas;
- Reasons of market liquidity (the less strict the requirement, the more BSPs technically capable of providing); and/or
- Historic rather arbitrary Full Activation Time requirements.

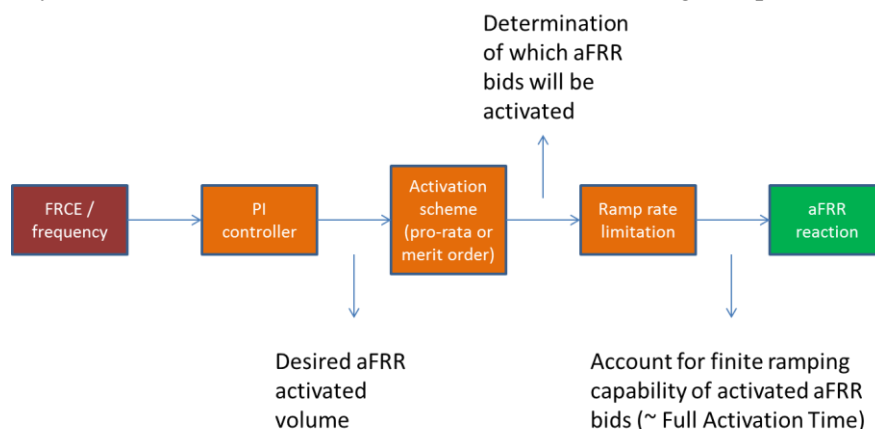


There are different ways of activating aFRR balancing energy across Europe (see map below):

- Pro-rata activation: all aFRR energy bids are activated in parallel to control the system; and
- Merit order activation: activation of the cheapest aFRR energy bids only to control the system.



Most TSOs apply a pro-rata activation of aFRR balancing energy. The graph below provides a simplified overview of the way that aFRR is activated and shows the factors affecting the speed of the aFRR response.



The speed of the aFRR response within a TSO area depends on:

- Settings of the PI-controller (out of scope of this paper) <sup>1</sup>;
- aFRR Full Activation Time; and
- aFRR activation algorithm (merit order activation or pro-rata activation).

Hence the above shows that the speed of aFRR response is different for most European TSOs.

## 1.2. Importance of speed of activation of reserves

The dimensioning requirements of the Network Code on Load-Frequency-Control and Reserves [Art. 46.2 b,c] states a.o. that TSOs must define / determine:

- The amount of aFRR and mFRR and RR;
- The ratio of aFRR and mFRR and RR; and
- The aFRR Full Activation Time, the mFRR Full Activation Time and RR Full Activation Time,

in a way to respect their FRCE Target Parameters.

The NC LFC&R reveals an important link between the Full Activation Time, the required volumes of reserves, the activation mode (automatic, manual) and the resulting balancing quality.

The speed of activation of reserves is important for TSOs in order to respect their balancing obligations. This speed is affected by:

- The Full Activation Time of the reserves; and
- The way of activating reserves (e.g. parallel activation of all bids or sequential merit order activation of bids, manual versus automatic...).

<sup>1</sup> For reasons of completeness it must also be highlighted that the settings of the PI-controller for the aFRR activation impact the final aFRR response. This paper assumes that the limiting factors in the aFRR speed are the aFRR Full Activation Time and activation scheme, and not the settings of the PI-controller.

### 1.3. Network Code on Electricity Balancing

The NC on EB determines a.o. that:

- The European Integration Model for the exchange of aFRR balancing energy is based on a Common Merit Order list, unless the target model is changed (based on a CBA); and
- A limited set of standard balancing energy products must be defined.

The requirements of the NC on EB will most likely affect the speed of the aFRR response at several TSOs because:

- It requires a transition from a pro-rata to a merit order aFRR scheme for some TSOs; and/or
- It might require a change of aFRR Full Activation Time at different TSOs for the sake of harmonization to come up with a limited set of aFRR standard products.

This might impact the FRCE regulation quality and/or dimensioning of aFRR capacity (cfr. NC LFC&R).

Harmonization of aFRR activation scheme and/or aFRR Full Activation Time will possibly impact the frequency quality in terms of duration of deviation and/or amplitude of frequency deviations, while at the same time it facilitates the cross-border exchange of balancing energy and therefore increase competition in the aFRR balancing energy market. As a result it is expected that prices for balancing energy will go down.

It must be highlighted that such harmonization risks also impacting the aFRR capacity market:

- The faster (slower) the Full Activation Time, the less (more) resources are technically able to offer aFRR capacity; less liquidity in the market will result in higher capacity prices.
- A change in aFRR Full Activation Time and or activation scheme can impact the FRCE / frequency quality and hence might indirectly impact the required aFRR volumes.

Given that

- there is no obligation for exchange of balancing capacity in the NC on EB;
- the exchange of aFRR capacity is constrained by available cross-zonal commercial capacity; and
- at least 50% of the aFRR capacity must be procured within the local TSO LFC Block,

it is expected that at least a large share of the balancing capacity markets remain local. Therefore the exchange of balancing capacity will not profit from harmonization performed for the cross-border exchange of balancing energy.

The harmonization of aFRR Full Activation Time and activation mechanisms might:

- Increase liquidity in the balancing energy market due to XB exchange and therefore might result in a price decrease for balancing energy capacity;
- Increase (decrease) local TSO aFRR capacity procurement costs (volumes & prices) which are reflected in the local access tariffs or in local costs allocated to the BRPs.

When discussing such harmonization for aFRR balancing energy, all impacts (incl. on aFRR capacity) must be considered as opposed to only considering beneficial impacts on the energy side:

#### Transition from pro-rata to merit order approach:

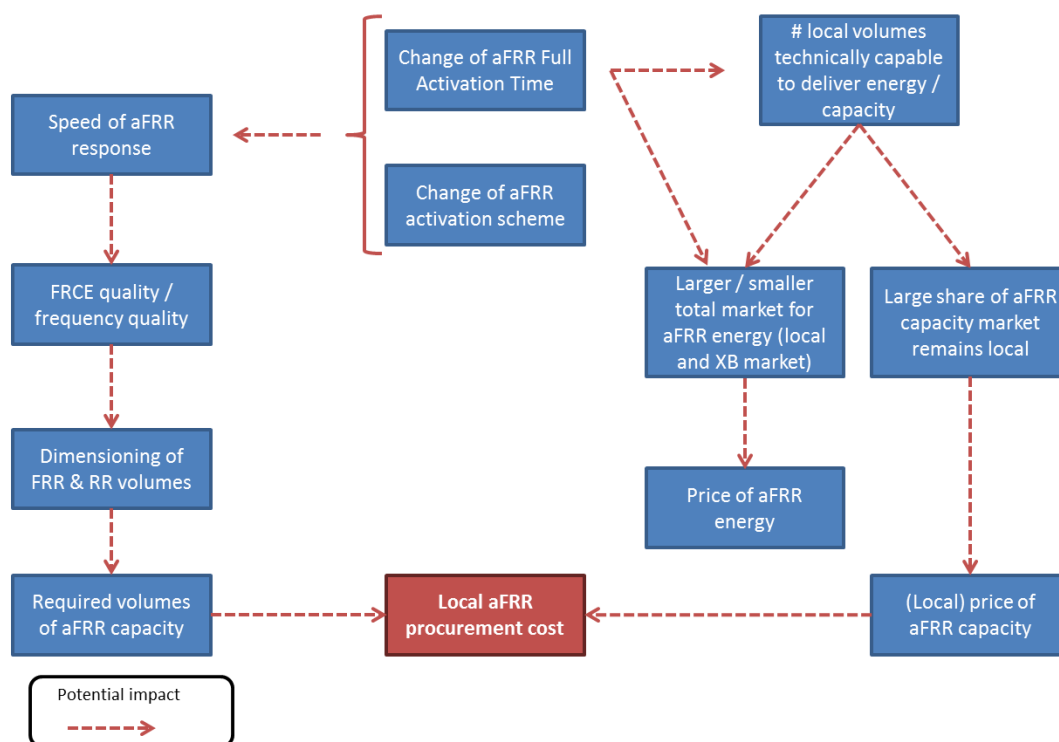
- What is the impact on frequency quality?

- Can a TSO keep the same aFRR Full Activation Time without compromising FRCE regulation quality?
- Does a TSO need more aFRR volumes and/or lower aFRR Full Activation Time to maintain its current regulation quality?

**Increase / decrease of aFRR Full Activation Time**

- What is the impact of an increase/decrease in aFRR Full Activation Time on the liquidity in the aFRR capacity and energy markets? What is the impact on aFRR capacity procurement costs?
- What is the impact of a decrease/increase in aFRR Full Activation Time on the FRCE regulation quality? Does it result in an increase/decrease of required aFRR capacity volumes?

The picture below provides a high level overview of potential impacts of the harmonization of aFRR Full Activation Time and activation scheme on (local) capacity procurement costs:



## 2. Scope of the study

To answer the above questions the ENTSO-E WG AS SG5 decided to launch a study providing more in-depth insights regarding the consequences of a change in aFRR Full Activation Time and/or a transition from pro-rata to merit order aFRR activation scheme.

In order to facilitate the readability of results and take into account the different size and frequency quality targets of synchronous area, we require that the result should be provided by synchronous area and not aggregated for whole Europe. At least in a first step and due to complexity of exchange of aFRR, markets for aFRR could be per synchronous area.

### The scope of the study is:

- Provide an overview of aFRR Full Activation Time and aFRR ramp rate requirements throughout Europe:
  - What are the requirements for time to restore frequency and duration of aFRR delivery in each EU synchronous area? This first input allows the definition of requirements for frequency quality.
  - What is the volume of aFRR required, by TSO and synchronous area? This first point provides an overview of possible market size.
  - E.g. is the ramping rate [MW/min] fixed for each bid or flexible?
  - Is the Full Activation Time fixed for each bid or flexible?
  - Ramp rates defined on unit base (i.e. technical capabilities of a unit) or arbitrary requirement for all bids (regardless technology)?
  - What is the requested ramp rate in the aFRR energy activation signal? Does it respect the contractual ramp rates?
  - Who sets the above mentioned boundaries, the TSO or BSP?
- Provide an overview throughout Europe in which countries the metered or required aFRR balancing energy is settled, and how TSO check the compliancy between delivery of the aFRR product (duration, activation speed) and the requirement for the product (only for qualification, real time, ex post ...).
- Provide an overview of the share of aFRR balancing energy TSOs use compared to their total activated FRR/RR balancing energy.
- Provide an analysis - based on local production parks - of the technical capability of large units (>50 - 100 MW) to provide aFRR bids for different aFRR Full Activation Times throughout Europe. In addition give an estimation of available volumes by aggregation of units or DSM and estimation of the price at which delivery becomes economic viable for them.
  - Analyze - on the basis of technical capability only - the impact on liquidity in aFRR capacity markets and aFRR energy markets (offered volumes) for a change in aFRR Full Activation Time. Elaborate qualitatively on the estimated impact of such change on aFRR capacity procurement costs and local access tariffs.
- Provide an overview of the differences between the aFRR regulation speed of pro-rata and merit order systems. Take into account that in Europe different implementations of pro-rata and merit order aFRR schemes exist. Will the differences in aFRR regulation speed affect the FRCE and frequency

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quality in case of a transition to a merit order aFRR scheme (while keeping same aFRR capacity volumes and aFRR Full Activation Time)?

- Provide an overview of impacts of MO activation on FRCE quality for small deviations and large deviation (close to local dimensioning generation unit tripping). For pro-rata all aFRR bids are activated in parallel for small and large deviations resulting in overall fast activation. Merit order schemes tend to activate less aFRR bids for smaller deviations, whereas more (all) bids are activated for larger deviations. Hence there can be an impact on regulation speed for small (and –to investigate– also for large?) deviations. Depending on repartition of small / large deviation, the impact on FRCE is not the same.
- If there is an impact on the FRCE regulation quality and/or frequency quality, what are the preferred mitigating actions? Will there be an impact on the aFRR capacity procurement costs and local access tariffs? If any, what compensation mechanism could be defined?
- Qualitatively elaborate the link between a change in aFRR Full Activation Time and/or change in aFRR activation scheme (transition pro-rata to merit order) on:
  - FRCE regulation quality;
  - Frequency quality;
  - aFRR capacity and energy market liquidity; and
  - Required volumes of aFRR capacity.
- Elaborate qualitatively whether it would have disadvantages if all TSOs in Europe would have the same aFRR activation scheme and Full Activation Times from a control point of view only (instability...)?

**Limits of scope of the study:**

The aim of the study is to focus on technical issues only. In addition to those technical questions there are other questions related to the transition towards a merit order aFRR scheme (see below). However these are out of scope of this study:

- differences in pricing mechanisms between pro-rata and merit order systems;
- the way to organize the activation of balancing energy if two different merit order lists (aFRR and mFRR) coexists (in case of implementation of a merit order aFRR activation scheme);
- ...