European Network of
Transmission System Operators
for Electricity

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Explanatory note for Additional Properties of Frequency Containment Reserves

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DISCLAIMER

This document is released on behalf of all CE transmission system operators ("TSOs") only for the purposes of the public consultation on the TSOs' proposal for the determination of LFC blocks ("LFC blocks determination") in accordance with Article 141(2) of the Commission Regulation (EU) No 2017/1485 of 2 August establishing a guideline on electricity transmission system operation ("SO GL"). This version of the LFC blocks determination proposal does not in any case represent a firm, binding or definitive TSOs' position on the content.

Explanatory note

Regarding Article 3.1:

In case of system imbalances and resulting deviations of system frequency, FCR are activated to stabilize the system. For effective stabilization, FCR needs to be quick enough to avoid non-acceptable (dynamic) deviations of system frequency. Thus, activation has to start a soon as possible after occurrence of the deviation. Nevertheless, depending on the used technology of FCR providing units, sometime delay of activation is unavoidable. To ensure that this time delay remains within acceptable limits, a maximum delay shall not be exceeded. In addition, if quicker response is possible based on the applied technology, it should not be artificially delayed to contribute as effective as possible to stabilize the system.

Regarding Article 3.2:

Since FCR are the fundamental component for stabilizing system frequency, it is of utmost importance that these reserves are available and can be activated over the whole permitted range of system frequency. Because of different technologies of FCR providing units and different possible voltage levels of connection of these units, it is very important to require on one hand respective parameter settings of the FCR providing units and on the other hand consideration of possible shedding concepts of DSOs. Even if these DSO shedding concepts usually strive for shedding load branches only in case of low frequency, there might be FCR providing units affected as well resulting in loosing respective FCR capacity.

Regarding Article 3.3:

FCR providing units with limited energy reservoir bear in general the additional risk of losing effective FCR capacity in case of longer lasting deviations of system frequency due to empty reservoirs. Thus, a charging concept based on defined energy exchange with the grid (state-of-charge management, SOC) for such units is essential for guaranteeing continuous activation particularly in stressed system states. To be able to cover the minimum requirements (continuous activation in normal state and full activation for at least [30] minutes) a minimum ratio of rated power to prequalified power and a respective minimum energy reservoir in relation to the prequalified power has to be considered and checked in the course of prequalification. Nevertheless, this requirement is determined only for stand-alone-operation of FCR providing units with limited energy reservoir, which means that operation is completely separated from operation of FCR providing units or FCR providing groups with non-limited energy reservoirs, and can be adapted accordingly when applying pool concepts with non-limited FCR providing units by ensuring availability of sufficient non-limited FCR capacity. In exceptional cases where a FCR providing unit or FCR providing group is technically not able to implement SOC management (e.g. hydro power plants) or a FCR provider chooses not to implement SOC, the respective FCR provider shall be able to compensate a possible lack of energy and hence a lack of FCR provision by shifting FCR activation to providing groups or providing units with unlimited energy reservoirs. FCR providing groups and units withlimited energy reservoirs must respect the rules given by 156 (9, 10, 11) SO GL independent of the operations mode in stand-alone operation or in combination with FCR providing groups and units with unlimited provision capacbility.

Normal state with frequency deviations larger than +/-50 mHz implies an energy depletion with a possible impact on the energy availability for the alert state.

As normal state includes a constant frequency deviation of a maximum of 49.99 mHz the active state of charge management for FCR providing units or groups with limited energy reservoir must guarantee that a continuous activation of FCR is also possible in this scenario. Hence, an additional power dimensioning of 25% (50 mHz divided by 200 mHz) is required to allow continuous FCR provision while applying SOC

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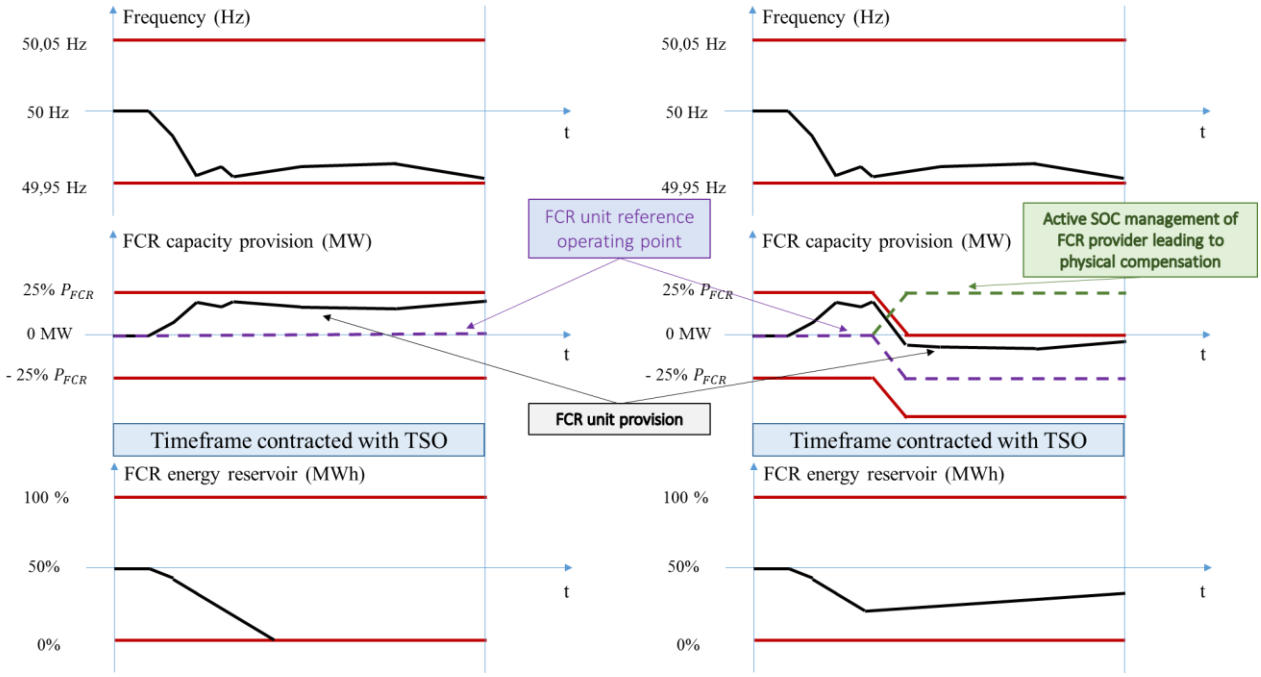
management at the same time. The following figure illustrates the requirement for additional power dimensioning of 25%:



The figure illustrates the relationship between frequency deviation, FCR power provision and energy reservoir usage.

On the left side of the figure, a theoretical case of reservoir exhaustion without active SOC management is presented during the timeframe contracted with TSO. The FCR unit reference operating point is used to represent the SOC strategy.

On the right side of the figure, the same case is presented applying a theoretical SOC strategy with physical compensation. It is shown that a shift of the reference operating point enables to charge the reservoir. After shifting the operating point, to continue to provide FCR up to 200mHz frequency deviation, it can be understand that 125% (so additional 25%) of FCR unit prequalified power might be reached.

If the SOC management made use of over fulfilment of activation (e.g. when system frequency exceeds 50 Hz, energy intake is higher than required), possible negative impacts on system stability, like power swings, could occur. Thus, such SOC management is not allowed.

A SOC management cannot prevent a full exhaustion of the energy reservoir in case of very long lasting deviations (alert states). Therefore, a reserve mode is necessary to achieve a deterministic and controllable behaviour of FCR providing groups and units and prevent from provoking an arbitrary behaviour of these units in such critical situations.

To allow for prolonging activation for short-term frequency deviations as long as possible, an additional concept to avoid exhaustions, which is called “Reserve Mode”, has to be adopted. The idea is to relieve FCR providing units with limited energy reservoir from the “mean deviation” of system frequency. By applying this approach the availability of FCR providing units with limited energy reservoir can be prolonged (see also graph below) depending on the mean value of system frequency.

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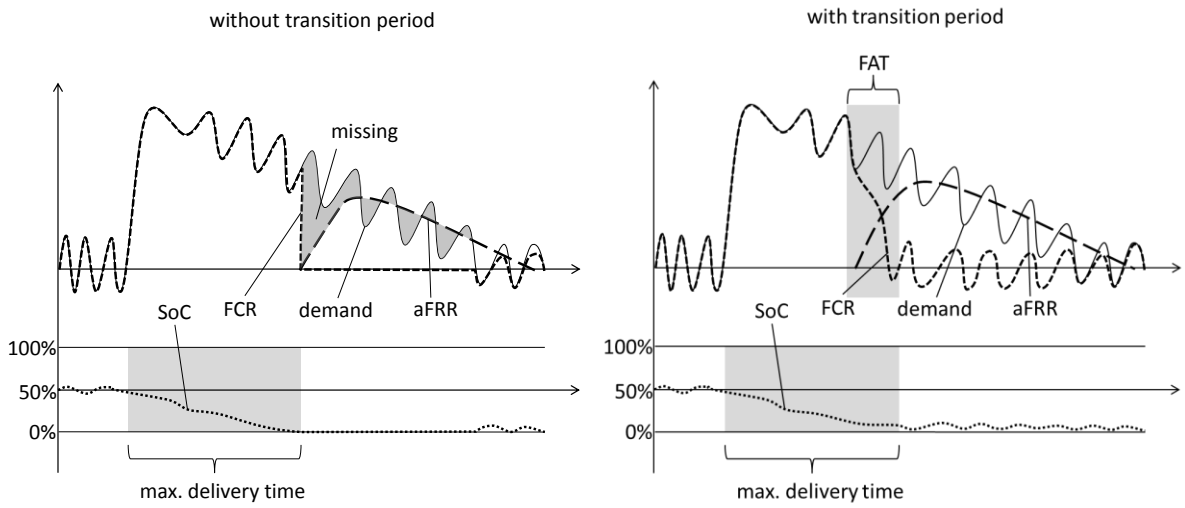

Regarding Article 3.4:

FCR are essential for system frequency. They need to be available continuously and in particular in stressed system states, e.g. in case of system splits. Therefore, the fundamental concept of FCR is based on the idea of possible autonomous activation of FCR providing units. Thus, local frequency measurement was usually provided in the past. In the course of development of new concepts, in particular aggregation of large numbers of (small) units, the question has come up if centralization of measurement of system frequency could be allowed to avoid costs of measuring devices in every single unit.

Though the idea is understandable, a completely decentralized measurement would endanger the system in case of outage of the centralized measurement or of the communication or also in case of system split, where the individual FCR providing units might be located in different islands but would be controlled by the same frequency input. Thus, independent local measurement of system frequency is essential to ensure autonomous operation of FCR providing units. Thus, when centralized control for the case of communication problems or system split at least provision of separate frequency measurements for every geographical area behind a connection point to the voltage level of 110 kV and above is necessary to ensure a minimum geographical information and possible autonomous activation of FCR.

The FCR provider shall ensure autonomous activation of FCR by using such local measurement in case of system splits (that the FCR provider will have to detect) or communication errors.

Regarding Article 3.5:

In emergency state, when the deviation of system frequency exceeds 200 mHz, the procured FCR are exhausted by principle. To prevent a system collapse and a respective disconnection of all generating units and demand facilities, the FCR providing units have to continue activation of the procured volume. In case they are able to further increase/decrease power output such additional activation to the procured volume shall not be inhibited.

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