Supporting Document for the Proposals in Accordance with Article 6(3)(e) of SOGL submitted by 50Hertz Transmission GmbH, Amprion GmbH, CREOS S. A., Energinet, TenneT TSO GmbH and TransnetBW GmbH for the LFC Block TNG+TTG+AMP+50HZT+EN+CREOS

Content

1 Introduction

1.1 Geographical Scope and Basic Principles of the Proposals

The TSOs 50Hertz Transmission GmbH (50HZT), Amprion GmbH (AMP), CREOS, Energinet(EN), TenneT TSO GmbH (TTG) and TransnetBW GmbH (TNG) form the LFC block in accordance with Table 1. This LFC block is the geographical scope of the proposal.

For the avoidance of doubt, following aspects are worth mentioning in context of the implementation of SOGL:

- The LFC block and the respective LFC process responsibility structure serving as basis for the proposals **correspond to the status-quo**.
- The determination of the LFC blocks in each synchronous area is not part of the proposals in accordance with Article 6(3)(e) of SOGL and which are submitted by all TSOs of each LFC block but is a common proposals of all TSOs of the synchronous area CE in accordance with Article 6(3)(g) of SOGL.
- Since SOGL foresees the same deadlines for the submission of the SAOA proposal in accordance with Article 6(3)(d) of SOGL and the proposals for the LFC block in accordance with Article 6(3)(e) of SOGL, the TSOs have to submit all proposals at the same time.
- Hence, the proposals submitted by all TSOs of each LFC block assume the approval of the LFC block determination proposal by the regulatory authorities of the synchronous area CE.

Country	TSO (full company name)	TSO (short name)	Monitoring Area	LFC AREA	LFC Block
Germany	TransnetBW GmbH	TransnetBW	TNG	TNG	TNG+TTG+AMP+50HZT+EN+CREOS
	TenneT TSO GmbH	TenneT GER	TTG	TTG+EN	TNG+TTG+AMP+50HZT+EN+CREOS
	Amprion GmbH	Amprion	AMP	AMP+CREOS	TNG+TTG+AMP+50HZT+EN+CREOS
	50Hertz Transmission GmbH	50Hertz	50HZT	50HZT	TNG+TTG+AMP+50HZT+EN+CREOS
Denmark (West)	Energinet	Energinet	EN	TTG+EN	TNG+TTG+AMP+50HZT+EN+CREOS
Luxembourg	CREOS	CREOS	CREOS	AMP+CREOS	TNG+TTG+AMP+50HZT+EN+CREOS

Table 1: Responsibility structure in the LFC block TNG+TTG+AMP+50HZT+EN+CREOS

1.2 Load-Frequency-Control Responsibility Structure of the LFC Block

This section describes the load-frequency-control process responsibility structure of the LFC block in order to contribute to the understanding of proposals.

The LFC block consists of four LFC areas. Two of the LFC areas are operated by two TSOs. At the same time, there are differences in the operation of these LFC areas which have an impact on the proposal.

In the LFC area AMP+CREOS, there is only one frequency restoration process (FRP) for this LFC area. Consequently, in the LFC area there is

- one frequency restoration control error (FRCE) for the LFC area which includes the imbalances of CREOS and AMP;
- one controller for the activation of automatic frequency restoration reserves (aFRR); and
- a common process to determine the necessary amount of manual frequency restoration reserves activation.

The operation of the FRP in the LFC area TTG+EN is organized in a different way due to two operational conditions:

- There is a bidding zone border between TTG and EN and the flows on this border must be controlled so that the operational security is maintained.
- The load and generation, number of interconnections, wind infeed of the EN area is significantly bigger than CREOS.

This difference is reflected by the following operational arrangements;

- EN uses an own FRP in order to regulate their local FRCE to zero, to fulfill the FRCE quality targets and to control the flow on the bidding zone border to TTG.
- The remaining FRCE is part of the FRCE of the LFC area TTG+EN, for which TTG is responsible. I.e. the remaining FRCE in the EN area is covered by aFRR and mFRR activation by TTG and subsequently in the whole LFC block.

The responsibilities in the LFC block regarding the fulfillment of the obligations regarding the load-frequency-control processes are organized in the following way:

- All TSOs are responsible to fulfill the requirements and obligations for the common LFC-block

- The TSOs 50HZT, AMP, TNG and TTG are responsible for the fulfillment of the respective obligations for the geographical area comprising the LFC areas AMP+CREOS, 50HZT, TNG and the monitoring area TTG. This area is called “DE area” in the proposals.
- EN is responsible for the fulfilment of the obligations in the monitoring area EN, i.e. the part of Denmark which is synchronously interconnected with CE. This area is called “DKW area” in the poposals.

1.3 FRCE Target Values

One of the obligations of the TSOs of an LFC block is to endeavour to fulfil the FRCE target values. In accordance with Article 118(1)(d) of SOGL, the FRCE target values for each LFC block are part of the synchronous area operational agreement and do not require regulatory approval. Nonetheless, since FRCE target values are referred to in the proposals, the concept is briefly explained in this section.

The frequency quality target parameter for the synchronous area CE is defined as maximum time outside of the standard frequency range 49.95 Hz-50.05 Hz. This maximum time is equal to 15,000 minutes per year (cf. Table 2 of Annex III of SOGL).

At the same time, the frequency quality is the result of the single FRCE qualities of all LFC blocks. Since the synchronous area consists of more than one LFC block, it is necessary to distribute the common frequency quality target to individual LFC block targets, i.e. FRCE target values.

Therefore, Article 128 of SOGL includes the following requirements:

> “*1. All TSOs of the CE and Nordic synchronous areas shall specify in the synchronous area operational agreement the values of the level 1 FRCE range and the level 2 FRCE range for each LFC block of the CE and Nordic synchronous areas at least annually.*
>
> *2. All TSOs of the CE and Nordic synchronous areas, if consisting of more than one LFC block, shall ensure that the Level 1 FRCE ranges and the Level 2 FRCE ranges of the LFC blocks of those synchronous areas are proportional to the square root of the sum of the initial FCR obligations of the TSOs constituting the LFC blocks in accordance with Article 153."*

While Article 128(1) states the requirement that two FRCE target values need to be defined, Article 128(2) of SOGL provides a boundary condition for the calculation. The target values are proportional to the square root of the sum of the initial FCR obligations of the TSOs of each LFC block.

Article 128(4) requires a distribution of the FRCE target values inside the LFC block:

> *"4. Where an LFC block consists of more than one LFC area, all TSOs of the LFC block shall specify in the LFC block operational agreement the values of the FRCE target parameters for each LFC area."*

The TSOs of the LFC block TNG+TTG+AMP+50HZT+EN+CREOS intend to apply the methodology which will be defined in the synchronous area operational agreement for the LFC areas of the LFC block as well as for the DKW and DE area. This approach corresponds to the status-quo.

The FRCE target values will be calculated by all TSOs of CE on annual basis (and published by EN-TSO-E in accordance with Article 185 of SOGL).

1.4 Legal Basis for the Proposals

Article 6(3)(e) of SOGL requires all TSOs of the LFC block to consult and propose methodologies and conditions included in the LFC block operational agreements in Article 119, concerning:

- ramping restrictions for active power output in accordance with Article 137(3) and Article (4);
- coordination actions aiming to reduce FRCE as defined in Article 152(14);

- measures to reduce FRCE by requiring changes in the active power production or consumption of power generating modules and demand units in accordance with Article 152(16);
- the FRR dimensioning rules in accordance with Article 157(1).

2 Proposal on Measures for FRCE Reduction - Article 152(12) and Article 152(16)

SOGL requires the TSOs to define measures for FRCE reduction in accordance with Article 152(14) and Article 152(16). Article 152(14) states

> "*14. The LFC block monitor shall be responsible for identifying any violation of the limits in paragraphs 12 and 13 and:*
>
> *(a) shall inform the other TSOs of the LFC block; and*
>
> *(b) together with the TSOs of the LFC block shall implement coordinated actions to reduce the FRCE which shall be specified in the LFC block operational agreement*.".

Article 152(14) of SOGL refers to limits defined in Article 152(12) of SOGL and Article 152(13) of SOGL which are quoted below:

> *"12. Where the 1-minute average of the FRCE of a LFC block is above the Level 2 FRCE range at least during the time necessary to restore frequency and where the TSOs of a LFC block do not expect that FRCE will be sufficiently reduced by undertaking the actions in paragraph 15, TSOs shall have the right to require changes in the active power production or consumption of power generating modules and demand units within their respective areas to reduce the FRCE as specified in paragraph 16.*
>
> *13. For the CE and Nordic synchronous areas, where the FRCE of a LFC block exceeds 25 % of the reference incident of the synchronous area for more than 30 consecutive minutes and if the TSOs of a LFC block do not expect to reduce sufficiently the FRCE with the actions taken pursuant to paragraph 15, the TSOs shall require changes in the active power production or consumption of power generating modules and demand units within their respective areas to reduce the FRCE as specified in paragraph 16."*

Hence, the TSOs need to monitor the FRCE against the limits and implement coordinated actions before referring to measures in Article 152(16) of SOGL.

Moreover, three requirements in the respective articles should be considered in context of the proposals.

Firstly, there are two types of limits:

- Article 152(12) of SOGL refers to the Level 2 FRCE range which is a limit calculated based on a methodology defined in accordance with Article 128(1) and Article 128(2) of SOGL. This methodology is part of the synchronous area operational agreement. Therefore, neither the methodology, nor the resulting values are part of the proposal of the LFC block.
- Article 152(13) of SOGL refers to a limit calculated based on the reference incident of a synchronous area. The reference incident of CE is defined by Article 153(2)(b)(i) of SOGL and is equal to 3,000 MW. Hence, the limit set forth by Article 152(13) of SOGL is equal to 750 MW.

Secondly, besides the mathematically defined limits, the articles refer to an expectation of the TSOs by stating that the measures in accordance with Article 152(16) of SOGL will be applied if the TSOs do not expect that the FRCE can be reduced sufficiently without this measures.

Moreover, Article 152(12) of SOGL formulates the right of the TSOs to execute the measures in accordance with Article 152(16) of SOGL, while Article 152(13) of SOGL formulates the obligation of the TSOs to execute the measures.

At the same time, one of the objectives of SOGL stated in Article 4(2)(d) of SOGL is to use market based mechanisms as far as possible.

In result, the TSOs propose the following measures to reduce FRCE in Article 5 and Article 6 of the proposal:

- Activation of automatic frequency restoration reserves (aFRR) and manual frequency restoration reserves (mFRR) including cross-border activation: This measure comprises the activation of the reserves procured and activated via market mechanisms and cross-border activation of reserves (which in future will be governed by the implementation of the electricity balancing guideline).
- Activation of other reserves contracted in accordance with national legislation: Besides aFRR and mFRR there might be additional products contracted in accordance with the national legislation. For instance, in Germany, there is a special products for certain types of load (so called "abschaltbare Lasten") which do not fulfil the requirements of aFRR and mFRR but can be activated fast enough to reduce the FRCE.
- Procurement of energy in the intraday market (only for DE area): This measure is available in the DE area and can be applied in order to reduce the FRCE in cases where it is expected that aFRR and mFRR are not sufficient to cover the FRCE. In particular, this measure can be used in case of high load-forecast and renewable forecast errors.
- Activation of emergency contracts with other TSOs: In case the market-based measures are not sufficient, emergency contracts with other TSOs can be activated in order to reduce FRCE.

The TSOs shall endeavour to make use of market-based mechanisms, i.e., the activation of aFRR and mFRR including cross-border activation, the activation of other contracted reserves, and for DE, the procurement of energy in the intraday market, as far as possible while applying the actions. At the same time, the availability of the measures (quantity and timeframe) can vary. Moreover, all measures besides aFRR activation must be activated manually by the operator and hence require a forecast of the operational conditions in the future. Therefore, the proposal lists factors which will be taken into account while implementing the measures:

- Availability of measures in accordance with Article 152(15) of SOGL: The availability of cross-border reserve activation must be considered. In particular, the European balancing platforms will provide a standardized, market-based access to aFRR and mFRR in Europe to all TSOs.
- Availability of all reserve types: Besides, cross-border activation, a scenario could occur when a significant fraction of aFRR, mFRR or other contracted reserves is either physically not available or there are malfunctions of the respective IT processes.
- Gate closure times, activation lead times, full activation times, minimum and maximum duration periods and other time constraints related to the available measures: Not all measures are available immediately. Some measures, e.g. activation of emergency contracts or procurement of energy on the intraday market have longer lead times than others, e.g. mFRR activation. It might be necessary, to activate a measure with a longer lead time (e.g. 30 minutes) if there is an expectation that measures with a shorter lead time (e.g. aFRR and mFRR) will not be sufficient to reduce FRCE.
- Operational security: The activation of measures directed towards the reduction of FRCE must not lead to a potential violation of operational security limits. E.g. even if there are cross-border reserves available, a limited cross-zonal capacity could prevent their activation.

The measures and considerations above represent the status-quo of the operation in the LFC block. The measures to adjust the output of power generating modules and demand units directly are not part of the proposal since these measures are already covered by the respective national legislation in Denmark, Germany and Luxembourg.

3 Proposal on Ramping Restrictions – Article 137(3) and Article 137(4)

Article 137(3) of SO GL gives the right to all connecting TSOs of an HVDC interconnector "[…] *to determine in the LFC block operational agreement common restrictions for the active power output of that HVDC interconnector to limit its influence on the fulfilment of the FRCE target parameter of the connected LFC blocks by agreeing on ramping periods and/or maximum ramping rates for this HVDC interconnector. Those common restrictions shall not apply for imbalance netting, frequency coupling as well as cross-border activation of FRR and RR over HVDC interconnectors.*".

Article 137(4) of SO GL gives all TSOs of an LFC block the right "[…] *to determine in the LFC block operational agreement the following measures to support the fulfilment of the FRCE target parameter of the LFC block and to alleviate deterministic frequency deviations, taking into account the technological restrictions of power generating modules and demand units*".

Currently, there are ramping restrictions on HVDC interconnectors in place but no ramping restrictions on power generating modules and demand units.

For HVDC interconnectors the gradient of active power output to synchronous area NE is limited to ±30 MW/min. All TSOs agree that different ramping periods can be applied.

The TSOs propose to keep the existing ramping restrictions on HVDC interconnectors and do not exercise the right to introduce new ramping restrictions on power generating modules and demand units.

By default, there are no ramping restrictions to other interconnectors, the TSOs would need to submit a new proposal in case they intend to introduce other ramping restrictions.

4 Dimensioning Proposal – Article 157(1)

Article 157(1) of SOGL requires the TSOs to define FRR dimensioning rules. Article 157(2) of SOGL defines specific requirements to FRR dimensioning. In particular, SO GL defines minimum values for FRR which shall cover at least

- the dimensioning incident of the LFC block as well as
- 99% of the imbalances of the LFC block.

Moreover, Article 157(3) requires the specific allocation of responsibilities between the TSOs of the LFC block.

The proposal of the TSOs corresponds to the responsibility in the LFC block structure and takes into account the bidding zone border between TTG and DKW. The basic principle is that the minimum values prescribed by the SOGL are fulfilled as follows:

- EN is responsible to fulfil the minimum dimensioning requirements for the DKW area.
- The TSOs 50HZT, AMP, TNG and TTG are responsible to fulfil the minimum dimensioning requirements for the DE area.

By this the minimum requirements of the whole LFC block are fulfilled at all times.

Due to the size of the DKW area, the relevant minimum value is defined by the dimensioning incident. I.e. the remaining degree of freedom in accordance with SOGL are the shares of aFRR and mFRR. The shares between aFRR and mFRR are determined based on an evaluation which part of the stochastic imbalances can be covered by mFRR activation. The rest is attributed to aFRR.

For the DE area, the stochastic imbalances exceed the dimensioning incident of the LFC block. Hence, a probabilistic methodology is required for the DE area. The probabilistic methodology determines the dimensioning amounts based on the probability of the expected imbalances. The historical records of imbalances serve as basis for the determination of this probability. Article 157(2)(a) of SOGL defines the following requirements for the historical records: "*The sampling of those historical records shall cover at least the time to restore frequency. The time period considered for those records shall be*

representative and include at least one full year period ending not earlier than 6 months before the calculation date".

Obviously, not each observed imbalance can be considered as representative for the time period for which dimensioning is performed. E.g. the imbalance patterns on a winter Monday differ from those on a Sunday in June. The proposal lists the seasonal and external factors according to which historical imbalances will be judged with respect to the relevance for the dimensioning period. The proposal differs between seasonal factors which classify the historical records with respect to the date, time of day and type of day as well as external factors, e.g. PV infeed. The used factors will be published on the internet with a lead time of one month.

The FRR amounts determined in accordance with the probabilistic methodology for DE will be checked against the minimum requirements of the SOGL so that the FRR will not be lower than this values.

The distribution between aFRR and mFRR is calculated (as for DKW) based on an estimation which parts of the imbalances will be covered by mFRR.

The deficit probability to be used for dimensioning may depend e.g. on the used external characteristics as well as on other parameter if the methodology. Updates will be done to ensure a stabile security of supply.