Amended Nordic LFC block methodology for FRR dimensioning in accordance with Article 157(1) of the Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation

04 April 2023

All TSOs of the Nordic LFC block, taking into account the following:

Whereas

(1) This document is a common methodology developed by all Transmission System Operators within the Nordic synchronous area (hereafter referred to as "**TSOs**") for the FRR dimensioning rules in accordance with Article 157(1) of Commission Regulation (EU) 2017/1485 establishing a guideline on electricity transmission system operation (hereafter referred to as "**SO Regulation**"). This methodology is hereafter referred to as '**Methodology**'. The methodology is an amended version of the methodology *'Amended Nordic synchronous area proposal for the FRR dimensioning rules in accordance with Article 157(1) of the Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation'* of 13 May 2019 that was approved by the NRAs in July 2019.

(2) The Methodology takes into account the general principles and goals set in SO Regulation as well as Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity (Regulation (EU) No 2019/943). Article 119(1)(h) of the SO Regulation sets for this purpose requirements for the TSOs to "*jointly develop common proposals for: [..] the FRR dimensioning rules defined in accordance with Article 157(1);"*

(3) Article 157(1) of the SO Regulation defines the scope of this Methodology: *"1. All TSOs of a LFC Block shall set out FRR dimensioning rules in the LFC Block operational agreement.".* In Article 157(2) of the SO Regulation, the minimum requirements for the FRR dimensioning rules are specified.

(4) The TSOs apply two types of Frequency Restoration Reserves (FRR). This Methodology covers the dimensioning of both manual FRR (mFRR) and automatic FRR (aFRR).

(5) In regard to regulatory approval, Article 6(3) of the SO Regulation states:

"The proposals for the following terms and conditions or methodologies shall be subject to approval by all regulatory authorities of the concerned region, on which a Member State may provide an opinion to the concerned regulatory authority: […]
(e) methodologies and conditions included in the LFC block operational agreements in Article 119, concerning: […]
(iv) the FRR dimensioning rules in accordance with Article 157(1);"

(6) According to Article 6(6) of the SO Regulation, the expected impact of the Methodology on the objectives of the SO Regulation has to be described and is presented below.

(7) The Methodology generally contributes to and does not in any way hamper the achievement of the objectives of Article 4 of the SO Regulation. In particular, the Methodology contributes to these objectives by specifying the dimensioning rules for mFRR and aFRR, which are key reserves that are used in the common Nordic load-frequency control processes. Sufficient mFRR and aFRR guarantee the right FRCE and frequency quality level and consequently maintain the operational security by reducing the risk for automatic Low Frequency Demand Disconnection (LFDD), forced manual load shedding, tripping or automatic reduction of generation and for system blackouts due to under or over frequency. The Methodology also considers available transmission capacity for exchange of balancing energy.

(8) In conclusion, the Methodology contributes to the general objectives of the SO Regulation to the benefit of all market participants and electricity end consumers.

SUBMIT THE FOLLOWING AMENDED METHODOLOGY FOR THE DIMENSIONING RULES FOR FRR TO ALL REGULATORY AUTHORITIES OF THE NORDIC LFC BLOCK:

Article 1 - Subject matter and scope

The FRR dimensioning rules described in this Methodology are the common methodology of TSOs in accordance with article 157(1) of the SO Regulation. The Methodology applies solely to the Nordic LFC block.

The Nordic LFC block comprises the Nordic synchronous area which covers transmission systems of East-Denmark (DK2), Finland, Sweden and Norway.

This Methodology has been developed by Energinet, Fingrid Oyj, Kraftnät Åland AB, Svenska kraftnät and Statnett SF.

Article 2 - Definitions and interpretation

1. For the purposes of this Methodology, the terms used shall have the meaning of the definitions included in Article 3 of the SO Regulation.
2. In addition, this Methodology applies the following definitions and interpretations:
    a. Normal imbalances: Imbalances caused by the continuous mismatch between generation, demand, import and export. Normal imbalances include stochastic imbalances, deterministic imbalances and forecast errors; In this Methodology the imbalances are represented by the Area Control Error Open Loop (ACE OL);
        i Fast-changing imbalance: The fast-changing imbalance are the imbalances that are intended to be handled by FRR. They are obtained by filtering ACE OL data, imbalances which change faster than the maximum Full Activation Time of automatic FRR are filtered out.
        ii Slow-changing imbalance: The slow-changing imbalance are the imbalances that are intended to be handled with manual FRR. They are obtained by filtering ACE OL data, imbalances which change faster than the Time to Restore Frequency are filtered out.
        iii Short-term imbalances: The short-term imbalances are calculated by subtracting the slow-changing imbalance time series from the fast-changing imbalance time series. In the context of FRR dimensioning the short term imbalances are defined as the variation in normal imbalance during a quarter hour.
    b. Available transmission capacity (ATC): In this Methodology ATC is the cross-zonal capacity available for exchange of balancing energy across a border between two LFC areas. It is equivalent to the remaining cross-zonal capacity after the clearing of the intraday market. Exchange of balancing energy encompasses both imbalance netting and transmission of FRR.
3. In this Methodology, unless the context requires otherwise:
    a. the singular indicates the plural and vice versa;
    b. the headings are inserted for convenience only and do not affect the interpretation of the Methodology; and
    c. any reference to legislation, regulations, directives, orders, instruments, codes or any other enactment shall include any modification, extension or re-enactment of it when in force.

Article 3 – FRR dimensioning for the LFC block

1. The total amount of reserve capacity on FRR for the LFC block shall be the combination of the automatic and manual FRR for normal imbalances and the manual FRR for reference incident in both positive and negative direction.
2. The reserve requirements on automatic and manual FRR indicated in paragraph 1 will set the ratio between automatic and manual FRR for the LFC block and per LFC area, and the ratio will be dynamic. Dimensioning of reserve capacity on automatic FRR is described in Article 8(5).
3. All TSOs shall use the input data as described in Article 5.
4. All TSOs shall dimension FRR with the objective to minimise, within geographical limitations, the total amount of required FRR for the LFC block taking into account:
    a. The rules for dimensioning the total amount of reserve capacity on FRR for the LFC block as described in Article 6;
    b. The rules for dimensioning FRR for reference incident as described in Article 7;
    c. The rules for dimensioning FRR for normal imbalances as described in Article 8.
5. The TSOs geographically distribute the required FRR by dimensioning FRR per LFC area in accordance with the rules set out in Article 7 and 8.

Article 4 – Full Activation Time for FRR

Full Activation Time, FAT, for mFRR and aFRR are in accordance with Electricity Balancing Guideline Article 25, 4(c), (EU) 2017/2195.

Article 5– Input to FRR dimensioning methodology

The input to the FRR dimensioning methodology shall be:

a. *Historical LFC block imbalance*: aggregated historical LFC area imbalance of all LFC areas with a sample rate of minimum one minute;
b. *Historical LFC area imbalance* for each LFC area, consisting of consecutive historical records of the LFC area imbalance in accordance with the requirements for historical records in Article 157(2)(a) of the SO Regulation. The sampling of those historical records shall be minimum one minute. The LFC area imbalance will be calculated as the power deficit or surplus, if the TSO would not have taken any regulation actions to restore FRCE of the LFC area to zero;
c. *Reference incident for the LFC Block* in both positive and negative direction: the largest of the reference incidents of all control areas, which shall be the largest imbalance that may result from an instantaneous change of active power of a single power generating module, single demand facility, single HVDC interconnector or from a tripping of an AC line within the LFC block;
d. *Reference incident for each control area* in both positive and negative direction*:* the largest imbalance that may result from an instantaneous change of active power of a single power generating module, single demand facility, single HVDC interconnector or from a tripping of an AC line within the control area;
e. *Reference incident for each LFC area* in both positive and negative direction*:* the largest imbalance that may result from an instantaneous change of active power of a single power generating module, single demand facility, single HVDC interconnector or from a tripping of an AC line within the LFC area;
f. *Historical data on ATC* per LFC area border and direction with a sample rate of minimum one minute.

Article 6 – Rules for dimensioning the total amount of reserve capacity on FRR for the LFC block

1. The total amount of reserve capacity on positive FRR for the LFC block shall be sufficient to cover the positive LFC block imbalances for at least 99 % of the time, based on the historical records referred to in Article 5(1)(a);
2. The total amount of reserve capacity on negative FRR for the LFC block shall be sufficient to cover the negative LFC block imbalances for at least 99 % of the time, based on the historical records referred to in Article 5(1)(a);
3. The reserve capacity on FRR of the LFC block shall be sufficient to respect the current FRCE target parameters for the LFC block as specified in the synchronous area operational agreement in accordance with Article 118(1)(d)/128 of the SO Regulation. The TSOs shall ensure that the following probabilistic restrictions are fulfilled:
    a. The probability that the FRCE of the LFC block shall be outside the Level 1 FRCE range shall be less than 30 %; and
    b. The probability that the FRCE of the LFC block shall be outside the Level 2 FRCE range shall be less than 5 %.
4. A probabilistic methodology is used for dimensioning of FRR reserves for the LFC block, and to fulfil the FRCE target parameters set out in paragraph 3 of this article, the TSOs shall take into account:
    a. The ATC per LFC area border and direction based on historical records;

b. The restrictions defined in the agreements for sharing or exchange of reserves due to possible violations of operational security and the FRR availability requirements as specified in the LFC block operational agreement in accordance with Article 119(1)(l)/158(2) of the SO Regulation;
c. Any expected significant changes to the distribution of LFC block imbalances; or
d. Other relevant influencing factors relative to the time period considered.

Article 7 – Rules for dimensioning FRR for reference incident

1. The reserve capacity on positive FRR for reference incident for the LFC block shall be the sum of reserve capacity on positive FRR for reference incident for all control areas after possible sharing according to Article 7(3);
2. For each control area, the required capacity on positive FRR for reference incident shall cover at least the positive reference incident for the control area. Each TSO shall make sure that each LFC area within its control area will have access to sufficient positive FRR for reference incident to cover the positive reference incident for the LFC area, taking into account the ATC between LFC areas;
3. The required reserve capacity on positive FRR for reference incident for the LFC block shall be reduced by sharing of the required reserve capacity on positive FRR for reference incident of control areas subject to all of the following conditions:
    a. Agreement on sharing by all TSOs of the LFC block;
    b. The probability that the required ATC will be available shall be calculated based on the historical data on ATC (specified in Article 5(1)(f)). and shall not be less than a specified threshold of 99% (hereafter referred to as "ATC threshold"). The ATC threshold is evaluated and updated at least once a year in order to meet the objective specified in Article 3(4) and the requirements for the LFC block as specified in Article 6);
4. Paragraph 3(a) and 3(b) shall take into account known long-term grid outages, cross-zonal capacity allocated for the exchange of balancing capacity by the market and other factors which may impact the results for the time period for which FRR is dimensioned.
5. The reserve capacity on negative FRR for reference incident for the LFC block shall be the sum of reserve capacity on negative FRR for reference incident for all control areas after possible sharing according to Article 7(6);
6. For each control area, the required capacity on negative FRR for reference incident shall cover at least the negative reference incident for the control area. Each TSO shall make sure that each LFC area within its control area will have access to sufficient negative FRR for reference incident to cover the negative reference incident for the LFC area, taking into account the ATC between LFC areas;
7. The required reserve capacity on negative FRR for reference incident for the LFC block shall be reduced by sharing of the required reserve capacity on negative FRR for reference incident of control areas subject to all of the following conditions:
    a. Agreement on sharing by all TSOs of the LFC block;
    b. The probability that the required ATC will be available shall be calculated based on the historical data on ATC (specified in Article 5(1)(f)) and shall not be less than a specified threshold of 99% (hereafter referred to as "ATC threshold"). The ATC threshold is evaluated and updated at least once a year in order to meet the objective specified in article 3(4) and the requirements for the LFC block as specified in Article 6.;
8. Paragraph 7(a) and 7(b) shall take into account known long-term grid outages, cross-zonal capacity allocated for the exchange of balancing capacity by the market and other factors which may impact the results for the time period for which FRR is dimensioned.
9. The minimum reserve capacity for automatic FRR is 0, as this reserve is not dimensioned to handle reference incidents.

Article 8 – Rules for dimensioning FRR for normal imbalances

1. The reserve capacity on positive FRR for normal imbalances for the LFC block shall be the sum of reserve capacities on positive FRR for normal imbalances for all LFC areas;
2. The reserve capacity on positive FRR for normal imbalances for the LFC block shall be minimised within the geographical limitations for the distribution of these reserves over the LFC block, based on the following rules:
    a. For each LFC area, it shall be taken into account that a normal imbalance can be partly or completely covered by imbalance netting.. This is done by performing an aggregation of normal imbalances between LFC areas within the control block, taking the remaining ATC after the dimensioning of reserve capacity on positive and negative FRR for reference incident into account in the aggregation. The result of the imbalance netting is a new set of normal imbalances for each LFC area;
    b. For each LFC area, the probability that the imbalances, after imbalance netting is taken into account, can be completely covered by reserve capacity on positive FRR for normal imbalances shall not be less than a defined risk level for the LFC Block. The risk level is applied to each individual LFC area to set the FRR need. The risk level is determined in accordance with Article 10;
    c. Paragraph a. and b. shall take into account known long-term grid outages, cross-zonal capacity allocated for the exchange of balancing capacity by the market and other factors, which may impact the results for the time period for which FRR is dimensioned.
3. The reserve capacity on negative FRR for normal imbalances for the LFC block shall be the sum of reserve capacities on negative FRR for normal imbalances for all LFC areas;
4. The reserve capacity on negative FRR for normal imbalances for the LFC block shall be minimised within the geographical limitations for the distribution of these reserves over the LFC block, based on the following rules:
    a. For each LFC area, it shall be taken into account that a normal imbalance can be partly or completely covered by imbalance netting. This is done by performing an aggregation of normal imbalances between LFC areas within the control block, taking the remaining ATC after the dimensioning of reserve capacity on positive and negative FRR for reference incident into account in the aggregation. The result of the imbalance netting is a new set of normal imbalances for each LFC area;
    b. For each LFC area, the probability that the imbalances, after imbalance netting is taken into account, can be completely covered by reserve capacity on negative FRR for normal imbalances shall not be less than a defined risk level for the LFC Block. The risk level is applied to each individual LFC area to set the FRR need. The risk level is determined in accordance with Article 10;
    c. Paragraph a. and b. shall take into account known long-term grid outages, cross-zonal capacity allocated for the exchange of balancing capacity by the market and other factors, which may impact the results for the time period for which FRR is dimensioned.
5. The minimum reserve capacity on automatic FRR for normal imbalances for the LFC areas are calculated from the short-term imbalances. The short-term imbalances represent the imbalances that are intended to be handled with automatic FRR. The determination of short-term imbalances shall take into account the activation time of automatic FRR and the manual FRR, the full activation time of automatic FRR and manual FRR are stated in Article 4.

Article 9 – Process for FRR dimensioning

The FRR dimensioning process shall follow step 1 to 3 of this Article and be conducted at least once a year. The TSOs aim to dimension FRR on a daily basis.

1. Collection of input data including the input data specified in Article 5;
2. Dimensioning calculations in accordance with the rules in Article 3 to 8, including
    a. baseline calculations, including
        i. stand-alone FRR requirements per LFC area based on a confidence interval on the probability distribution of historical ACE OL data, where the confidence interval corresponds to the risk level;
        ii. calculation of minimum LFC block and control area requirements, without taking limitations in ATC into account (so called copper plate), by applying a confidence interval on the probability distribution of the historical ACE OL of the LFC block. The confidence interval corresponds to the risk level.
    b. optimisations, including
        i. aggregation of reserve capacity on FRR for reference incident between the LFC areas within a control area taking limitations in ATC into account in accordance with Article 7(2) and 7(5);
        ii. sharing of FRR for reference incident between control areas taking limitations in ATC into account in accordance with Article 7(3) and 7(6);
        iii. statistical aggregation of normal imbalances between LFC areas within a control area taking limitations in ATC into account in accordance with Article 8(2)(a) and 8(4)(a);
        iv. statistical aggregation of normal imbalances between LFC areas within the LFC block taking limitations in ATC into account in accordance with Article 8(2)(a) and 8(4)(a).
    c. calculation of minimum amount of aFRR in accordance with the rules in Article 8(5).
3. Determination of FRR volume requirements and the minimum requirement for aFRR;

Article 10 – Process for yearly tuning of the FRR dimensioning

1. The FRR dimensioning process shall be evaluated yearly in order to ensure compliance for the LFC Block with Article 6(1-3). The evaluation is based on operational experience with the results from the dimensioning process.
2. A yearly tuning of the parameters ATC threshold, mentioned in Article 7(3)(b) and 7(7)(b), and risk level, mentioned in Article 8(2)(b) and Article 8(4)(b), shall be performed based on the results of the evaluation.

Article 11 – Publication and implementation

1. The relevant TSOs shall publish (in accordance with Article 8 of the SO Regulation) the Methodology without undue delay after the competent NRAs have approved the Methodology or a decision has been taken by the Agency for the Cooperation of Energy Regulators in accordance with Article 6 of the SO Regulation.
2. The TSOs shall implement the dimensioning rules for FRR when all TSOs in Nordic LFC Block are using fully ACE based balancing.

Article 12 - Language

The reference language for this Methodology shall be English. For the avoidance of doubt, where TSOs needs to translate this Methodology into national language(s), in the event of inconsistencies between the English version published by TSOs in Nordic Synchronous Area in accordance with

Article 8(1) of the SO Regulation and any version in another language the relevant TSOs shall, in accordance with national legislation, provide the relevant national regulatory authority with an updated translation of the Methodology.