
Explanatory document for the amended Nordic synchronous area methodology to determine limits on the amount of exchange of FRR/RR between synchronous areas defined in accordance with Article 176(1)/178(1) and to determine limits on the amount of sharing of FRR/ RR between synchronous areas defined in accordance with Article 177(1)/179(1) of the Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation

Explanatory document to the proposed methodology of 28 March 2023

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1. Introduction

The Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation (hereinafter “**SO Regulation**”)¹ sets out rules on relevant subjects that should be coordinated between Transmission System Operators, as well as between TSOs and Distribution System Operators and with significant grid users, where applicable. The goal of SO Regulation/ Regulation (EU) 2019/943 is the safeguarding of operational security, frequency quality and the efficient use of the interconnected system and resources. In order to deliver these objectives, a number of steps are required.

One of these steps is to determine the limits for the exchange of FRR between synchronous areas. Pursuant to Article 118(1)(z) of the SO Regulation, all Transmission System Operators in the Nordic Synchronous Area shall jointly develop common proposals for the methodology to determine limits on the amount of exchange of FRR between synchronous areas defined in accordance with Article 176(1) and the methodology to determine limits on the amount of sharing of FRR between synchronous areas defined in accordance with Article 177(1). Furthermore, Pursuant to Article 118(1)(aa) of the SO Regulation, all Transmission System Operators in the Nordic Synchronous Area shall jointly develop common proposals for: [...] the methodology to determine limits on the amount of exchange of RR between synchronous areas defined in accordance with Article 178(1) and the methodology to determine limits on the amount of sharing of RR between synchronous areas defined in accordance with Article 179(1)”.

According to Articles 6(3)(d)(ix) and 6(3)(d)(x) of the SO Regulation the methodologies for limits on the amounts of exchange/sharing of FRR/RR between synchronous areas in accordance with Articles 176(1),

¹ As amended by Commission Implementing Regulation (EU) 2021/280 of 22 February 2021, amending Regulations (EU) 2015/1222, (EU) 2016/1719, (EU) 2017/2195 and (EU) 2017/1485 in order to align them with Regulation (EU) 2019/943.

177(1), 178(1) and 179(1) shall be submitted for approval by the relevant national regulatory authorities (hereinafter "NRAs").

The methodology that is accompanied by this explanatory document amends the methodology that has been approved by the NRAs in July 2019. This methodology is from all TSOs of the Nordic synchronous area (hereinafter "TSOs").

This document contains an explanation of the amended Methodology. The legal requirements for the Methodology and the interpretation of the scope are presented in Chapter 2. Chapter 3 describes the objective of the limits on the amount of exchange/sharing of FRR/RR between synchronous areas. Chapter 4 provides an overview of the existing situation and chapter 5 describes the developments that trigger the need for this amendment. The proposed limits are described in Chapter 6. Chapter 7 describes the expected impact on the relevant objectives of the SO Regulation. Finally, Chapter 8 provides the timeline for implementation and Chapter 9 describes the public consultation.

2. Legal requirements and interpretation

2.1 Legal references and requirements

Several articles in the SO Regulation set out requirements which the Methodology must take into account. These are cited below.

- (1) Article 118(1)(z), 118(1)(aa) and (2) of the SO Regulation constitutes the legal basis that the Methodology should take into account. Article 118 has the following content:

"1. By 12 months after entry into force of this Regulation, all TSOs of each synchronous area shall jointly develop common proposals for:[...]

(z) the methodology to determine limits on the amount of exchange of FRR between synchronous areas defined in accordance with Article 176(1) and the methodology to determine limits on the amount of sharing of FRR between synchronous areas defined in accordance with Article 177(1); and

(aa) the methodology to determine limits on the amount of exchange of RR between synchronous areas defined in accordance with Article 178(1) and the methodology to determine limits on the amount of sharing of RR between synchronous areas defined in accordance with Article 179(1).; [...]

2. All TSOs of each synchronous area shall submit the methodologies and conditions listed in Article 6(3)(d) for approval by all the regulatory authorities of the concerned synchronous area. Within 1 month after the approval of these methodologies and conditions, all TSOs of each synchronous area shall conclude a synchronous area operational agreement which shall enter into force within 3 months after the approval of the methodologies and conditions."

- (2) Article 176(1) of the SO Regulation has the following content:

"1. All TSOs of each synchronous area shall specify in the synchronous area operational agreement a method to determine the limits for the exchange of FRR with other synchronous areas. That method shall take into account:

(a) the operational impact between the synchronous areas;

(b) the stability of the FRP of the synchronous area;

(c) the ability of TSOs of the synchronous area to comply with the frequency quality target parameters defined in accordance with Article 127 and the FRCE target parameters defined in accordance with Article 128; and

(d) the operational security.”

(3) Article 177(1) of the SO Regulation has the following content:

” 1. All TSOs of each synchronous area shall specify in the synchronous area operational agreement a methodology to determine limits for the sharing of FRR with other synchronous areas. That methodology shall take into account:

(a) the operational impact between the synchronous areas;

(b) the stability of the FRP of the synchronous area;

(c) the maximum reduction of FRR that can be taken into account in the FRR dimensioning in accordance with Article 157 as a result of the FRR sharing;

(d) the ability of the synchronous area to comply with the frequency quality target parameters defined in accordance with Article 127 and the FRCE target parameters defined in accordance with Article 128; and

(e) the operational security.”

(4) Article 178(1) of the SO Regulation has the following content:

”1. All TSOs of each synchronous area shall define in the synchronous area operational agreement a method to determine limits for the exchange of RR with other synchronous areas. That method shall take into account:

(a) the operational impact between the synchronous areas;

(b) the stability of the RRP of the synchronous area;

(c) the ability of the synchronous area to comply with the frequency quality target parameters defined in accordance with Article 127 and the FRCE target parameters defined in accordance with Article 128; and

(d) the operational security.”

(5) Article 179(1) of the SO Regulation has the following content:

”1. All TSOs of each synchronous area shall define in the synchronous area operational agreement a method for determining the limits for sharing of RR with other synchronous areas. That method shall take into account:

(a) the operational impact between the synchronous areas;

(b) the stability of the RRP of the synchronous area;

(c) the maximum reduction of RR that can be taken into account in the RR dimensioning rules in accordance with Article 160 as a result of the RR sharing;

(d) the ability of the TSOs of the synchronous area to comply with the frequency quality target parameters defined in accordance with Article 127 and the ability of the LFC blocks to comply with the FRCE error target parameters defined in accordance with Article 128; and

(e) the operational security.

(6) Article 6(3)(d)(ix) and 6(3)(d)(x) 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: [...]

(d) methodologies, conditions and values included in the synchronous area operational agreements in Article 118 concerning: [...]

(ix) limits on the amount of exchange of FRR between synchronous areas defined in accordance with Article 176(1) and limits on the amount of sharing of FRR between synchronous areas defined in accordance with Article 177(1);

(x) limits on the amount of exchange of RR between synchronous areas defined in accordance with Article 178(1) and limits on the amount of sharing of RR between synchronous areas defined in accordance with Article 179(1);

2.2 Interpretation and scope of the Methodology

The Nordic TSOs apply two types of Frequency Restoration Reserves (FRR), manual FRR (mFRR) and automatic FRR (aFRR). This methodology applies to both mFRR and aFRR. The TSOs currently do not apply Replacement Reserves (RR). Consequently, this methodology does not include limits on the amount of exchange and sharing of RR between synchronous areas.

The dimensioning rules for FRR in accordance with Article 157 of the SO Regulation result in the required FRR capacity to be guaranteed by each TSO. Part of this FRR capacity requirement can be fulfilled by exchanging or sharing FRR with other synchronous systems. The limits on the amount of this exchange and sharing are the scope of this Methodology.

Until now, the exchange and sharing of FRR capacity between Nordic TSOs and TSOs in other synchronous areas takes place based on bilateral agreements. Within the next years, the Nordic synchronous area will join the 'European platforms for exchange of balancing energy from frequency restoration reserves with manual activation' in accordance with Article 20 of Commission Regulation (EU) 2017/2195. Similarly, the Nordic synchronous area will join the 'European platforms for exchange of balancing energy from frequency restoration reserves with automatic activation' in accordance with Article 21 of Commission Regulation (EU) 2017/2195. The Methodology will apply to both bilateral exchange and sharing of FRR capacity and to the exchange of FRR energy via the European platforms.

3. Objective of limits for the exchange and sharing of FRR

FRR exchange and sharing contributes to the efficient operation of the electricity system by allocating FRR more efficiently. However, in order to maintain operational security, FRR exchange and sharing cannot be done unlimitly. The objective of the limits on the amount of exchange and sharing of FRR is to guarantee that operational security is maintained. In particular, one of the objectives is that the limits shall make sure that the stability of the Frequency Restoration Process can be ensured and that the synchronous area can comply with the frequency quality target parameters defined in accordance with Article 127 and the FRCE target parameters defined in accordance with Article 128.

4. The existing situation

Currently, the Nordic FRR requirements are specified per control area, and each TSO has the obligation to meet their required amount of FRR. For fulfilling part of their obligation each TSO may exchange or share FRR capacity with one or more TSOs in one or more other synchronous area(s). Since situations may be different for the different HVDC interconnectors, the TSOs do not apply generic rules on limits of the amount of FRR that can be exchanged or shared with TSOs in other synchronous area. The Nordic TSO involved in the exchange or sharing is responsible for assessing and monitoring the impact of the exchange and/or sharing on the available FRR in its own area and the possible impact on other control areas in the synchronous area. Currently the exchange and sharing arrangements with other synchronous areas exist as shown in Table 1.

Table 1: Existing FRR exchange and sharing arrangements with other synchronous areas (Arrows illustrate the direction of the exchanges).

Involved control areas	Exchange/sharing of	Volumes
Finland ↔ Estonia	mFRR exchange	no limits specified
Finland – Estonia	mFRR sharing	140MW
Finland ← Estonia	aFRR exchange	35 MW
West Denmark – East Denmark ²	mFRR sharing	300MW

The cross-border activation of FRR between Finland and Estonia is currently arranged bilaterally between the exchanging TSOs. West Denmark (DK1) is fully integrated in the Nordic balancing market for mFRR³ which means that mFRR is exchanged continuously subject to the limitations on the border.

5. Developments in the Nordic Power system that trigger this amendment

5.1 Increasing exchange of FRR capacity between synchronous areas (trigger for amending Article 3)

Within the coming years, FRR capacity markets may be introduced that allow for exchanging FRR capacity between TSOs of different synchronous areas. Accordingly, FRR exchange contracts may not be only established bilaterally between TSOs as today (see [Table 1](#)) but may also result from a common capacity market.

The FRR capacity markets will however not change the responsibilities for the TSOs to ensure that sufficient FRR capacity is available for their control area to comply with the FRR dimensioning methodology for the Nordic LFC block⁴. If FRR capacity is exchanged, the total FRR capacity requirement for a TSO will become lower or higher than the volume dimensioned for its control area.

Each TSO makes sure by internal processes that the FRR capacity resulting from capacity markets and bilateral FRR capacity exchange will be available for the TSO's control area. On a Nordic level, the LFC block monitor will monitor the distributed availability of FRR capacity in the Nordic LFC block.

5.2 Implementation of platforms for exchanging FRR energy (trigger for new Article 5)

Today, exchange on the HVDC interconnectors between the Nordic and CE Synchronous Areas is mainly based on the results of the day-ahead and intraday markets. The exchanges of balancing energy (FRR) are limited in size and mainly with Estonia and Western-Denmark (DK1) (see chapter 4). The existing HVDC interconnectors have therefore been constructed for stable operation which means that they typically follow day-night patterns and change from import to export in the morning and back to import in the evening. This operation results in less than 1000 direction changes per year.

In 2024, the Nordic TSOs will join the 'European platforms for exchange of balancing energy from frequency restoration reserves' for both mFRR (Mari) and aFRR (Picasso)⁵. By connecting to the Mari and Picasso platforms almost all European countries will have access to Nordic balancing power and the other way

² Another sharing agreement exist between Sweden (bidding zone SE4) and Denmark East.

³ Nordic Regulating Power Market (RPM).

⁴ 'Amended Nordic synchronous area methodology 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'

⁵ in accordance with Article 20 and 21 of Commission Regulation (EU) 2017/2195.

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around. Because of the large availability of FRR at a competitive price in the Nordic synchronous area, potentially large amounts of FRR may be exchanged over the HVDC interconnectors between the Nordic and other synchronous areas. This exchange may have significant impact on the flows on these HVDC interconnectors.

The exchange of balancing energy initiated by Mari (for scheduled mFRR and directly activated mFRR) and Picasso (for aFRR) will come on top of the exchanged energy in the day-ahead and intraday markets and will result in similar challenges. Considering that the limitations for the day-ahead and intraday markets are currently defined to maximise the use of the interconnector for the day-ahead and intraday market, the HVDC interconnectors do not leave room for exchange of balancing energy, unless the day-ahead and intraday market do not use the full potential.

Unless it is proven differently in specific cases, the TSOs consider it inefficient to restrict the day-ahead and intraday market in order to create the possibility to exchange more in the balancing markets. Furthermore, the TSOs do not want to compromise on operational security or the ability to comply with the frequency quality target parameters defined in accordance with Article 127 and the FRCE target parameters defined in accordance with Article 128. Consequently, the TSOs conclude that the allocation constraints for exchange on HVDC interconnectors shall – after the connection to the European balancing platforms – apply to the day-ahead market, intraday market and the exchange of balancing energy together.

In addition to this, the volatility of exchange over the HVDC interconnectors is expected to increase after connecting the Mari and Picasso. This means that balancing market results may require more frequent changes of the HVDC setpoints. Since HVDC interconnectors are historically designed for stable operation, they do not necessarily support continuously changing setpoints. Some relevant challenges may be:

- Operation within dead bands around zero flow;
- Frequent direction changes of flows as a result of energy markets and balancing markets;
- Large and fast changes in flows.

Since the TSOs operate a variety of HVDC interconnectors these operational restrictions are different for each HVDC interconnector. Consequently, the TSOs conclude that it shall be possible to set operational restrictions for FRR on each HVDC interconnector individually.

6. Methodology for limits for the exchange of FRR/RR

The TSOs currently do not apply Replacement Reserves (RR). For this reason, this methodology only specifies rules for exchange of FRR.

6.1 Amendment to Article 3

As discussed in section 5.1, within the coming years, exchange of FRR capacity between synchronous areas may also be agreed and organized between the TSOs as common capacity markets. This is confirmed by the proposed addition of paragraph 4 to Article 3. The proposed Article 3(5) further reconfirms that the responsibilities for the TSOs to ensure sufficient FRR capacity is the same as for the existing bilateral exchange and sharing contracts. The TSOs still need to comply with the Nordic FRR dimensioning methodology in accordance with the methodology on Article 157(1)⁶ and make sure that sufficient FRR capacity is available for the Nordic LFC block.

6.2 Amendment: new Article 5

Considering the developments in the Nordic power system (see chapter 5), the TSOs expect that the operation of HVDC interconnectors will be different from today. Firstly, there will be more flow changes than today

⁶ 'Amended Nordic synchronous area methodology 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'

because changes to day-ahead and intraday schedules may happen every 15 minutes instead of every hour. Secondly, there will be more exchange in balancing energy when the Nordic balancing markets connects to Mari and Picasso. This will result in more fluctuation caused by 15 minutes schedules of day-ahead, intraday and scheduled mFRR exchange. In addition, occasionally there will be the need for direct mFRR activation, sometimes with large volumes, especially related to disturbances. Moreover, there will also be continuous changes (every 4 seconds) for aFRR exchange. In general, the TSOs expect larger volatility than today over time because of more automated activations.

Considering the above, the TSOs consider the activation of FRR very similar to a change in the day-ahead or intraday schedule and consequently adding to the issues being mitigated by allocation constraints as stipulated for the day-ahead and intraday markets.

This amendment adds Article 5 to the methodology which stipulates in paragraph 1 that FRR exchange resulting from the balancing platforms shall not cause breaching of the allocation constraints as specified for the HVDC interconnectors for the exchange resulting from the day-ahead market and the intraday market. Article 5(1) ensures that the trades in the day-ahead market and the intraday market are maximised unless FRR capacity is exchanged or shared in accordance with Article 3(3) and Article 4 of this methodology and Article 33 of the Commission Regulation (EU) 2017/2195 (EBGL).

In addition to this, the new Article 5(2) provides the possibility to limit the impact for HVDC interconnectors that are technically not able to facilitate the expected more volatile future market results. In order to minimise the restrictions to the market, the TSOs do not propose a generic restriction. Instead, the TSOs propose that technical and operational limits will be applied only to the HVDC interconnectors that cannot facilitate this volatility. Restrictions may be defined in case of technical or operational limitations of the HVDC cable, including converter stations, filters, circuit breakers, capacitors, control systems etc. Examples of possible restrictions are limiting the ramping rate, reducing the FRR exchange capacity on the HVDC interconnector, making capacity available in only one direction or not to allow exchange of FRR on balancing platforms at all.

Article 5(3) describes the process that needs to be followed by the TSOs to implement the additional restrictions as referred to in Article 5(2). This paragraph aims for safeguarding a diligent and transparent evaluation and decision process. Finally, if – for whatever reason – the restrictions referred to in Article 5(2) are not required anymore, they shall be removed, which is stipulated in Article 5(4).

7. Expected impact of the Methodology on the relevant objectives of the SO Regulation

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 serves the objectives to:

- Article 4(1)(d) ensuring the conditions for maintaining operational security throughout the Union; and
- Article 4(1)(h) contributing to the efficient operation and development of the electricity transmission system and electricity sector in the Union.

Where the objective of maintaining operational security (article 4(1)(d)) may require stricter limits, operational efficiency may increase with limits that are less strict. The Methodology balances the objectives of ensuring the conditions for maintaining operational security and efficient operation of the electricity system.

8. Timescale for the implementation

The proposed limits for the exchange and sharing of FRR in Articles 3 and 4 have been implemented. The new Article 5 will be implemented for mFRR as soon as the Nordic TSOs start the Nordic mFRR Energy Activation Market (mFRR EAM) starts. For aFRR, the implementation shall be not later than when the TSOs connect to the Picasso platform⁷.

9. Public consultation

Article 11 of the SO Regulation states that: *“TSOs responsible for submitting proposals for terms and conditions or methodologies or their amendments in accordance with this Regulation shall consult stakeholders, including the relevant authorities of each Member State, on the draft proposals for terms and conditions or methodologies listed in Article 6(2) and (3). The consultation shall last for a period of not less than one month.”*

This proposal has been consulted in the period 1 February to 1 March 2023. The TSOs have not received views of stakeholders resulting from this public consultation.

⁷ Picasso: European platforms for the exchange of aFRR in accordance with Article 21 of Commission Regulation (EU) 2017/2195.