Nordic System Operation Agreement (SOA) – Annex Load-Frequency Control & Reserves (LFCR)

Appendix 2:

Exchange and sharing agreements

FINGRID ENERGINET SVENSKA KRAFTNÄT Statnett kraftnät åland

Version	Approval date	Entry into force	Revision
V1	26/06/2021	26/06/2021	Initial version
V2	11/12/2024	01/01/2025	Addition of Appendix 2C: Exchange and sharing of FRR capacity, DK2-SE4
V3	22/10/2025	22/10/2025	Removal of Appendix 2A: Exchange and sharing of FRR capacity, Finland-Estonia. Appendix 2C becomes new Appendix 2A and Appendix 2B remains unchanged.
V4	06/05/2026	06/05/2026	Updates of Appendix 2A, Reduction of FRR need and use of slower reserves (NRA-approved)

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1 Appendix 2A: Exchange and sharing of FRR capacity, DK2-SE4

1.1 Introduction

This document is an appendix to the LFCR Annex to the Nordic System Operation Agreement (hereafter referred to as "Nordic SOA"). This appendix includes the assessment of arrangements for sharing of mFRR capacity between bidding zones DK2 (Eastern Denmark) and SE4 (Southern Sweden) utilizing the Øresund connection. The assessment in chapter 2A of this appendix has been approved by RGN on 6th May 2026.

Regional Group Nordic

Assessment of arrangements for sharing of FRR capacity between bidding zones

Arrangement for sharing between SE4 and DK2 on Øresund interconnections

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Date: 6th May 2026

Responsible for assessment: Erik Ek and Klaus Winther

Content

General

1. Basic information and a short description of the sharing arrangement of capacity

Sharing

2. Evaluation of how the arrangement comply with the approved Nordic methodology to determine limits for sharing of FRR.

General

1. Basic information and a short description of the exchange/sharing arrangement

Exchange	Sharing	Volume MW
	X	+150-200 MW

Nominal size of interconnector	Specific conditions regarding flow control
Øresund, DK2→SE4 1750 MW (TTC) SE4→DK2 1350 MW (TTC)	Øresund consists of two 400 kV (and two 132 kV) AC interconnectors. The 400 kV interconnectors have overload capability; if one cable is disconnected the power flow over the other can be 1300 MW for maximum 90 minutes.

Describe the conditions agreed for capacity sharing

This sharing arrangement concerns sharing of 150-200 MW mFRR in upwards direction between DK2 and SE4. The volume shared is part of the mFRR volume dimensioned for handling reference incidents. It is a mutual sharing agreement, meaning that Svk and Energinet both have the role of 'control capability providing TSO' and 'control capability receiving TSO'.

As 'control capability providing TSO' Svk and Energinet will commit to always securing a minimum of 150 MW standard mFRR bids for reference incident in SE4 and DK2 respectively, via mFRR capacity market. Procuring the volume in mFRR capacity market ensures that, if the volume is procured outside of SE4 or DK2, there will be a cross-zonal capacity reservation securing availability of 150 MW in each area.

As 'control capability receiving TSO', Svk and Energinet are allowed to decrease the dimensioned need of standard mFRR reserves for reference incident with 150-200 MW in SE4 and DK2 respectively. For Svenska kraftnät, the sharing agreement allows SE4 to reduce its procurement for reference incidents by 150-200 MW. For Energinet, the agreement allows for reducing the procurement for reference incident and/orDK2 to procure and utilize 150-200 MW of slower reserves (specific mFRR product, which is approved by the Danish Utility Regulator) for reference incident. If the slower reserves are activated, SE4 will temporarily support DK2 via Øresund until the slower reserves are fully activated.

When the 'control capability receiving TSO' choose to decrease dimensioned need of standard mFRR reserves for reference incident with more than 150 MW (up to 200 MW), the 'control capability receiving TSO' takes full responsibility for the risk. The 'control capability providing TSO' is under no obligation to have more than 150 MW mFRR available. If there is 200 MW mFRR available at the 'control capability providing TSO' then 200 MW will be activated upon request from the 'control capability receiving TSO' and the 'control capability receiving TSO' may take that into account when continuously evaluating system states. However, the 'control capability receiving TSO' is not allowed to take non-standard reserves from the 'control capability providing TSO' (such as the gas turbines in SE4 or the slow reserves in DK2) into account when defining system state.

Describe the operational procedures for energy activation including information exchange

Before the introduction of the common bid selection for direct activation, Svk and Energinet will need to agree on a manual Agreed Supportive Power (ASP) on Øresund each time they wish to utilize the shared reserve volume. The TSO who has the mFRR need (control capability receiving TSO) will call the other TSO (control capability providing TSO) to request an ASP. The control capability providing TSO will make a judgement on if it is possible to provide ASP. If it is possible, the control capability providing TSO will request a local direct activation and record the ASP on Øresund. Local direct activation activates mFRR standard bids and can deviate from price order if needed.

When there is a common bid selection for direct activation, the control capability receiving TSO can request the direct activation themselves. There will no longer be a need to make a call or arrange an ASP.

Since the Øresund interconnectors are AC cables there is no need to make a power flow adjustment on the cables, but the schedule shall reflect the ASP to ensure correct settlement of the activations.

Activation of shared mFRR capacity should respect the available capacity of the interconnections after confirmed day-ahead and intra-day trades. If it is possible to import mFRR to SE4 from SE3, or to DK2 over Great Belt, without causing an overload, that should always have priority to overloading Øresund. Overloading of Øresund should be avoided if possible and when done should always respect the limitations stated above. To activate reserves which cause an overload on Øresund, the control capability receiving TSO will always have to call the control capability providing TSO, even when there is a common bid selection for direct activation.

The shared bids are only activated if the need of the providing TSO for mFRR in real time is fulfilled. In case of common need for the shared mFRR reserves, and in emergency situations, each country has priority to their own resources.

Sharing

2. Evaluation of how the arrangement comply with the approved Nordic methodology to determine limits for sharing of FRR

Nordic synchronous area approved 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 the methodology to determine limits on the amount of sharing of FRR/RR between synchronous areas defined in accordance with Article 177(1)/179(1)

Article 4 – Limits for sharing of aFRR and mFRR

3. The Nordic TSO involved in sharing of FRR is responsible for complying with Article 177 of the SO Regulation;
4. The TSO who intends to exercise the right to implement sharing of FRR with a TSO in another synchronous area shall make an assessment against article 177 and the criteria below. The TSO shall:
    a. secure that dimensioning requirements in the Nordic LFC block are satisfied
        i. Disturbances leading to activations of the shared reserves, shall be reported for common Nordic evaluations of Nordic consequences
        ii. The shared volume may be counted for in the LFC block compliance monitoring for reserve availability as long as b), c), d) and e) below is fulfilled
    b. secure that the needed availability of grid capacity between source and sink has a probability of at least 99%;
    c. secure that the needed availability of FRR from the reserve instructing TSO in the other synchronous area has a probability of at least 99%;
    d. secure that the reduction in positive FRR capacity for disturbances within the Nordic LFC block does not exceed 50% of the size of the positive reference incident in the relevant control area;
    e. secure that the reduction in negative FRR capacity for disturbances within the Nordic LFC block does not exceed 50% of the size of the negative reference incident in the relevant control area.

An assessment against SOGL article 177(1) of the operational impact between the synchronous areas, the stability of the FRP of the synchronous area, 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, 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 the operational security.

Not applicable. Article 177 sets the requirements for sharing between synchronous areas. This sharing takes place within the synchronous area and within the LFC block.

An assessment according to article 4.2(a) above against dimensioning requirements in the Nordic LFC block.

Not applicable, article 4.2(a) sets the requirements for sharing between synchronous areas. However, there is no risk that the sharing agreement will violate SOGL article 157.2(e) or 157.2(f) since the sharing will not cause the dimensioned total FRR volume to become less than the reference incident for the LFC block.

An assessment according to article 4.2(b) above against requirements for availability of grid capacity.

Not applicable. Article 4.2(b) sets the requirements for sharing between synchronous areas. This sharing takes place within the synchronous area and within the LFC block. The availability of grid capacity is still assessed below for transparency.

To ensure that both DK2 and SE4 have sufficient balancing energy available this sharing agreement is applied together with the sharing agreement between DK1-DK2 and sharing within Sweden.

Looking at the available transmission capacity DK2 → SE4, the shared reserves can be transferred to SE4 for most of the time. When there are bottlenecks between DK2 and SE4 there is almost always free capacity from SE3. Hence, looking at the sum of free transmission capacity, the reserves can be accessed from either DK2 or SE3 to support SE4 during a reference incident. Historically there has been available grid capacity either from DK2 or SE3 >99 % of the time. If an RI occurs when there is no transmission capacity from either SE3 or DK2, there are multiple ways in which that could be managed. Svk can contact Litgrid, PSE or TenneT for an ASP (agreed supportive power) over NordBalt, SwePol Link or Baltic Cable. If the risk is identified in advance Svk can countertrade SE3-SE4 using our slower countertrade resources, and, by doing so, make mFRR from SE3 available. It is allowed to have a short-term overload on the Øresund interconnection so shared reserves in DK2 can be activated while Svk arranges for the ASP or countertrade.

The installed capacity on Øresund is 1750 MW in both directions but the TTC on SE4→DK2 is limited to 1350 MW due to stability and internal reasons in DK2, hence there should always be room on Øresund for the shared 150-200 MW, that will be replaced within 90 minutes with the slower reserves in DK2, without overloading Øresund.

If a reference incident occurs in DK2 while having limited mFRR standard bids in DK2, and limited available support from Øresund then Great Belt,, Kontek and Kriegers Flak connections can provide support via PICASSO until the slow non-standard resources in DK2 are fully activated. In the situation that import capacity is limited from all directions, DK2 will rely on import from the Øresund connection while the slower reserves ramp up, creating a short-term overload on Øresund.

An assessment according to article 4.2(c) above for availability of FRR from the reserve instructing TSO

Not applicable. Article 4.2(c) sets the requirements for sharing between synchronous areas. This sharing takes place within the synchronous area and within the LFC block. The question is still answered below for transparency.

The availability of shared reserves from the control capability providing TSO is secured by using the mFRR capacity market.

If the control capability receiving TSO would like to rely on more than 150 MW of sharing, they are responsible for evaluating if it is sufficiently probable that the volume will be available. This evaluation should be done on a day-to-day basis.

An assessment according to 4.2(d) above for max reduction in positive FRR capacity for disturbances secured for the relevant control area

Not applicable. Article 4.2(d) sets the requirements for sharing between synchronous areas. This sharing takes place within the synchronous area and within the LFC block. The question is still answered below for transparency.

The sharing agreement does not allow that more than 50% of the Swedish or Danish mFRR requirement is shared. The maximum mFRR sharing volume is 200 MW and the reference incident in Sweden is 1450 MW and in Denmark is 700 MW.

An assessment according to 4.2(e) above for max reduction in negative FRR capacity for disturbances secured for the relevant control area

Not applicable.

Comments from NOD on assessment:

NOD has no remarks to this assessment. This sharing agreement is within the Nordic synchronous system and hence, there is no obligation from SOGL.

Any changes to the arrangements, described in this assessment, shall be presented to NOD in due time before implementation for common Nordic evaluation.

Copy of decisions in RGN meeting (from MoM):

RGN approved the Annex LFCR Appendix 2 update.

Date of approval of assessments in RGN:

6th May 2026

2 Appendix 2B: Exchange and sharing of FRR capacity DK1-DK2

2.1 Introduction

This document is an appendix to the Annex Load-Frequency Control & Reserves (hereafter referred to as LFCR Annex) to the Nordic System Operation Agreement (hereafter referred to as "Nordic SOA"). This appendix includes the assessment of arrangements for *sharing of mFRR capacity between bidding zones DK1 (Western Denmark) and DK2 (Eastern Denmark) on the Great Belt HVDC interconnector*. The assessment in chapter **Virhe. Viitteen lähdettä ei löytynyt.**of this appendix has been approved by RGN on *12 May 2020*.

2.2 Assessment

Regional Group Nordic

Assessment of arrangements for exchange and sharing of FRR capacity between synchronous systems.

Arrangement for sharing of mFRR between DK1 and DK2 on Great Belt interconnection.

Date: 22nd April 2020

Responsible for assessment: Klaus Winther

Content

General

1. Basic information and a short description of the exchange/sharing arrangement of capacity

Sharing

2. Evaluation of how the arrangement comply with the approved Nordic methodology for sharing.

General

1. Basic information and a short description of the exchange/sharing arrangement

Exchange	Sharing	Volume MW
	X	+ 300 MW

Nominal size of interconnector	Specific conditions regarding flow control
Great Belt, ± 600 MW	Cannot be regulated continuously in the interval - 30 MW < P < 30 MW

Describe the conditions agreed for capacity exchange/sharing

Energinet is sharing + 300 MW of mFRR between DK1 and DK2.

The amount of mFRR purchased in DK1 is reduced with 300 MW.

In case of a fault in DK1 (Reference Incident is 700 MW), resources are in normal situations covered by 300 MW mFRR capacity purchased in DK1 and utilisation of voluntary bids in the regulating power market in addition to 90 MW aFRR in a capacity market.

In very rare situations, the need for mFRR can be complemented by additional mFRR purchased in DK2 over the Great Belt interconnector or, as a last option, remedial actions will take place in DK1.

The flow direction on the interconnector is normally from west to east (DK1 to DK2). The free capacity is defined on a day to day basis. If reduced capacity or flow in opposite direction, additional mFRR reserves are purchased in DK1.

In case of fault in DK2 (Reference incident is 600 MW), resources are covered by 428 MW mFRR capacity purchased in DK2 and 200 MW capacity purchased in DK2 with a longer activation time than 15 minutes, a sharing agreement with SVK of 300 MW mFRR and additional voluntary bids in the regulating power market. The bid margin in the regulating power market in DK2 (contracted capacity and voluntary bids) are normally (1% fractal) more than 600 MW after activation of bids for balancing, which implies that reserves with longer activation times than 15 minutes (200 MW) together with the sharing agreement with SVK of 300 MW mFRR not will be required.

In case of simultaneously incidents in both synchronous areas, DK1 and DK2 at the same time and in case of that fully 300 MW mFRR already has been activated in DK2 and “transferred” to DK1, the reference incidents in DK2 (600 MW) is still covered by mFFR in DK2, however some of the reserves have longer activation time than standard mFRR (15 minutes), therefore it is possibly that part of the sharing agreement of 300 MW mFRR between DK2 and SVK will become effective for a shorter period, this in form of a telephone call between Energinet and Svk in cooperation with Statnett.

Describe the operational procedures for energy activation including information exchange

Control centre staff of Statnett, in the role of LFC Block monitor, in cooperation with control centre staff of Svenska Kraftnät, to be informed by telephone calls

Standard procedure for activation of mFRR is used (Regulating power market). Reserves are accessible in NOIS.

Sharing

2. Evaluation of how the arrangement complies with article 177 in SOGL for sharing

Nordic synchronous area approved 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 the methodology to determine limits on the amount of sharing of FRR/RR between synchronous areas defined in accordance with Article 177(1)/179(1)

Article 4 – Limits for sharing of aFRR and mFRR

1. The Nordic TSO involved in sharing of FRR is responsible for complying with Article 177 of the SO Regulation;
2. The TSO who intends to exercise the right to implement sharing of FRR with a TSO in another synchronous area shall make an assessment against article 177 and the criteria below. The TSO shall:

    a. secure that dimensioning requirements in the Nordic LFC block are satisfied
        i. Disturbances leading to activations of the shared reserves, shall be reported for common Nordic evaluations of Nordic consequences
        ii. The shared volume may be counted for in the LFC block compliance monitoring for reserve availability as long as b), c), d) and e) below is fulfilled
    b. secure that the needed availability of grid capacity between source and sink has a probability of at least 99%;
    c. secure that the needed availability of FRR from the reserve instructing TSO in the other synchronous area has a probability of at least 99%;
    d. secure that the reduction in positive FRR capacity for disturbances within the Nordic LFC block does not exceed 50% of the size of the positive reference incident in the relevant control area;
    e. secure that the reduction in negative FRR capacity for disturbances within the Nordic LFC block does not exceed 50% of the size of the negative reference incident in the relevant control area.

An assessment against SOGL article 177(1)of the operational impact between the synchronous areas, the stability of the FRP of the synchronous area, 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, 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 the operational security.

As the sharing agreement only come into force in very rare situations it is not supposed to have any impact on overall stability and frequency quality in the Nordic LFC block.

As for all incidents in the Nordic area, Svk as synchronous area monitor will report the incident and initiate an analyse if required.

An assessment according to article 4.2(a) above against dimensioning requirements in the Nordic LFC block.

As the sharing agreement only comes into force in very rare situations and because we do not dimension for N-2 faults and normally have free capacity on the Øresund connection the sharing agreement has no impact on the dimensioning requirements in the Nordic LFC block.

An assessment according to article 4.2(b) above against requirements for availability of grid capacity.

The grid capacity is evaluated on a day by day basis, if not 100 % capacity is available on the interconnector, additional procurement of mFRR will take place in DK1. DK2 will be secured by contracted mFRR reserves in DK2.

An assessment according to article 4.2(c) above for availability of FRR from the reserve instructing TSO

The availability of FRR from the reserve instructing TSO is secured by using the Nordic regulating power market for activation (NOIS).

An assessment according to 4.2(d) above for max reduction in positive FRR capacity for disturbances secured for the relevant control area

The Sharing agreement secure that not more than 50 % of mFRR requirement is shared, defined in article 4 – Limits for sharing of aFRR and mFRR

An assessment according to 4.2(e) above for max reduction in negative FRR capacity for disturbances secured for the relevant control area

The Sharing agreement secure that not more than 50 % of mFRR requirement is shared, defined in article 4 – Limits for sharing of aFRR and mFRR

Comments from NOD on assessment:

NOD has no specific remarks to this assessment. NOD considers that availability of mFRR and aFRR resources from DK1 and specifications for provision over Great Belt are similar to service provision from inside of the Nordic LFC block.

SOGL has a restriction for reduction of the positive and negative reserve capacity in the LFC block of less than 30%, but this is currently not a realistic concern in the Nordic LFC block. If this should change, the TSOs will have to agree about some arrangement for distribution of reserve reduction in case of sharing with other synchronous systems.

Any changes to the arrangements, described in this assessment, shall be presented to NOD in due time before implementation for common Nordic evaluation.

Copy of decisions in RGN meeting (from MoM):

RGN approved NOD proposal on the assessment of arrangement for sharing of mFRR between DK1 and DK2 on Great Belt interconnection.

Date of approval of assessments in RGN:

12th May 2020