
**Explanatory document for the amended Nordic synchronous area
proposal for ramping restrictions for active power output in
accordance with Article 137(3) and (4) of the Commission Regulation
(EU) 2017/1485 of 2 August 2017 establishing a guideline on
electricity transmission system operation**

1. Introduction

The Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation (hereinafter “**SO Regulation**”) 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 the SO Regulation is to ensure provision of an efficient functioning of the interconnected transmission systems to support all market activities. In order to deliver these objectives, a number of steps are required.

One of these steps is to define the ramping restrictions for active power output for the Nordic LFC Block. Pursuant to Article 119(1)(c) of the SO Regulation, all Transmission System Operators in the Nordic LFC Block shall jointly develop common proposals for ramping restrictions for active power output in accordance with Article 137(3) and (4).

According to Article 6(3)(e)(i) of the SO Regulation the proposal for ramping restrictions for active power output in accordance with Article 137(3) and (4) shall be submitted for approval by the relevant national regulatory authorities (hereinafter “NRAs”) no later than 14 September, 2018. The proposal has been submitted for regulatory approval to all NRAs in the Nordic LFC block by 14 September 2018. According to Article 6(6) of the SO Regulation the proposal needs to be submitted to ACER as well, who may issue an opinion on the Proposal if requested by the NRAs.

On 14 March 2019, the Nordic NRAs sent a Request for Amendment (RfA). In this RfA the NRAs indicated that the *NRAs can support most of the proposed text of the ramping restrictions for active power output Proposal. However, in order to allow for the individual NRA approvals of the ramping restrictions for active power output Proposal, the following amendments to the ramping restrictions for active power output Proposal are requested by the NRAs:*

- *NRAs note that Regulation 2017/1485 does not define a BRP. If the intention is to use the Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing (hereinafter referred to as “Regulation 2017/2195”) definition, a reference should be added to the proposal. Otherwise the proposal should define a BRP for the purposes of this proposal.*
- *Article 137(4) (see below) has granted the right to determine obligations on ramping periods and/or maximum ramping rates for power generating modules and/or demand units to support the fulfilment of the FRCE target parameter. The proposal shall determine and justify how a restriction on BRPs – as defined in Regulation 2017/2195 or in the proposal itself – is used for the above-mentioned purpose. The proposal shall also include a description of the restriction on the units which are the actual subjects of the provision regarding ramping restrictions.*
- *Article 137(3) (see below) has granted the right to determine common restrictions for the active power output of an 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. The proposal shall determine and justify how the proposed restrictions are used to limit HVDC interconnectors’ influence on the fulfilment of the FRCE target parameter.*
- *NRAs note that the TSOs’ plan for future developments such as the introduction of 15 minutes ISP will require amendments to the proposed methodology. NRAs request the TSOs to describe a proposed timeline and process for amendment of the proposal.’*

Accordingly, the TSOs shall submit an amended proposal (hereafter referred to as “**Proposal**”) for approval by the relevant NRAs no later than 14 May, 2019. The Proposal is submitted for regulatory approval to all NRAs in the Nordic LFC block.

This document contains an explanation of the amended Proposal from all TSOs of the Nordic synchronous area (hereinafter “**TSOs**”). It is structured as follows. The legal requirements for the Proposal are presented in Chapter 2. Chapter 3 starts with describing the objective of the ramping restrictions. Chapter 4 provides an

overview of the existing situation and Chapter 5 an outlook to future developments. The proposed ramping restrictions are described in Chapter 0. Chapter 7 describes the expected impact on the relevant objectives of the SO Regulation. Finally, Chapter 0 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 Proposal must take into account. These are cited below.

- (1) Article 119(1)(c) and (2) of the SO Regulation constitutes the legal basis that the Proposal should take into account. Article 119 has the following content:

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

(c) ramping restrictions for active power output in accordance with Article 137(3) and (4); [...]

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

- (2) Article 137(3) and (4) of the SO Regulation has the following content:

“3. All connecting TSOs of an HVDC interconnector shall have the right 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. All TSOs of a synchronous area shall coordinate these measures within the synchronous area.

4. All TSOs of an LFC block shall have 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:

(a) obligations on ramping periods and/or maximum ramping rates for power generating modules and/or demand units;

(b) obligations on individual ramping starting times for power generating modules and/or demand units within the LFC block; and

(c) coordination of the ramping between power generating modules, demand units and active power consumption within the LFC block.”

- (3) Article 6(3)(e)(i) 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:

(i) ramping restrictions for active power output in accordance with Article 137(3) and (4);

2.2 Interpretation and scope of the Proposal

Article 137(3) of the SO Regulation provides the TSOs with the right to determine common restrictions for the active power output of that HVDC interconnector. These restrictions may impact both operation of the HVDC interconnectors and market exchanges over these interconnectors. Since Article 137(3) of the SO Regulation excludes applicability of the restrictions for imbalance netting, frequency coupling as well as cross-border activation of FRR and RR over HVDC interconnectors, the TSOs consider that only wholesale energy markets (day-ahead, intraday etc.) shall be affected by the restrictions.

Since the Nordic synchronous area only consists of one LFC block, the HVDC interconnectors to other LFC blocks are always HVDC interconnectors to other synchronous areas. The restrictions for the active power output of HVDC interconnectors between synchronous areas as referred to in Article 137(1) and (2) of the SO Regulation shall therefore be the same as the restrictions for the active power output of the HVDC interconnectors that are proposed in this Proposal.

Article 137(4) of the SO Regulation provides the TSOs with the right to determine ramping restrictions for power generating modules and demand units. Article 137(4)(a) and (b) allow defining obligations for power generating modules and/or demand units while Article 137(4)(c) allows the TSOs to actively coordinate between generating modules, demand units and active power consumption within the LFC block.

3. Objective of ramping restrictions for active power output

The objective of the ramping restrictions for active power output is to balance momentary generation, consumption and exchange over HVDC interconnectors and by that limit large FRCE and frequency deviations. This will contribute to that the frequency and FRCE quality target parameters are fulfilled. Consequently, the specified restrictions are required to ensure secure and efficient operation of the electricity transmission system.

4. The existing situation

In this chapter, the existing ramping restrictions for active power output are presented. Section 4.1 describes the existing ramping restrictions for HVDC interconnectors and section 4.2 describes the existing ramping restrictions for production plans. Section 4.3 describes the existing possibilities for the TSOs to coordinate ramping between production plans. Ramping of consumption is currently not restricted nor coordinated.

4.1 Existing restrictions for HVDC interconnectors

The trading plans on the HVDC interconnectors between the Nordic LFC block and other LFC blocks can potentially change so much from one hour to the next that the changes in power flows at the change of hours must be restricted to manage balance regulation and to stay within system security limits. Restrictions are placed on the gradient for change in flow and on changes to the trading plans from one hour to the next in the energy market. Table 1 provides an overview of these restrictions for the existing HVDC cables. The TSOs apply different ramping periods on the HVDC interconnectors.

Table 1: Existing restrictions for HVDC interconnectors

HVDC link	from	to	maximum gradient for change in flow (MW/min)	maximum changes to the trading plans from one hour to the next(MW)
Baltic Cable	Sweden (SE4)	Germany	30	600
Estlink 1	Finland	Estonia	30	600
Estlink 2	Finland	Estonia	30	
Great Belt	Denmark (DK1)	Denmark (DK2)	30	600
Kontek	Denmark (DK2)	Germany	30	600
Konti-Skan 1	Sweden (SE3)	Denmark (DK1)	30	600
Konti-Skan 2	Sweden (SE3)	Denmark (DK1)		
Skagerrak 1	Norway (NO2)	Denmark (DK1)	30	600 ¹
Skagerrak 2	Norway (NO2)	Denmark (DK1)		
Skagerrak 3	Norway (NO2)	Denmark (DK1)		
Skagerrak 4	Norway (NO2)	Denmark (DK1)		
NordBalt	Sweden (SE4)	Lithuania	30	600
NorNed	Norway (NO2)	Netherlands	30	600
SwePol	Sweden (SE4)	Poland	30	600
Vyborg	Finland	Russia	30	600

4.2 Existing ramping restrictions for production plans

The TSOs apply a ramping restriction on BRPs representing power generating modules in Finland, Norway and Sweden when their hourly production plan changes more than 200 MW at hour shift. In this case BRPs need to reschedule their plan with quarterly steps 15 minutes before hour shift, at hour shift and 15 minutes after hour shift in order to adjust the plans to better correspond to the consumption pattern. In Norway, the steps can be applied 30 minutes before the hour shift until 30 minutes after the hour shift. The detailed terms and conditions are specified on national level. This obligation is not relevant in Denmark East due to the physical characteristics for production.

4.3 Coordinate ramping of production plans

Based on the planning information and real-time information, each TSO assesses the impact of ramping around hour shifts from a national perspective. In addition, Svenska kraftnät and Statnett assess whether the changes in production plans in the Nordic area and the HVDC exchange around hour shift will impact the system frequency in a way that cannot be entirely handled by control centres in the minutes before and after

¹ This sum limitation will be re-examined during implementation of the new Nordic balancing model.

operating hour. If so there is a need to advance or delay parts of planned production steps at the hour shift. The power schedules may be changed from 30 minutes before hour shift till 30 minutes after the hour shift.

This coordination is mainly important during morning and evening hours and also around day shift. If the changes in the production plans are deemed to be too high, the TSOs make a coordinated plan on how to level out these changes by an agreement with BRPs that represent power generating modules to reschedule the production. In situations with congestions, there is also a need to decide in which order the rescheduling should take place. E.g. in case of close to congestion on Hasle from Norway to Sweden it may be wise to start with increased production in Sweden/Finland 15 minutes before hour shift and decreased production in Norway in the first 15 minutes after the hour shift². The volumes to be shifted after the hour might be reassessed closer to the hour shift if something unplanned occurs that would interfere with the initial plan.

5. Outlook

The restrictions for HVDC ramping discussed in section 4.1 above were determined on the basis that the total change for the Nordic synchronous system at one hour shift should not exceed an acceptable maximum level and this total level was evenly distributed on individual HVDC interconnectors. Recent and future development with increased number of HVDC connections, changed flow pattern and the introduction of an ISP of 15 minutes requires that the limits, ramping periods and the methodology to determine these limits are re-evaluated in the new Nordic balancing model development process. In the same process, the restrictions and coordination of production plans discussed in section 4.2 and 4.3, will be assessed.

It is envisaged that the ramping restrictions on HVDC will have to be modified before the implementation of the 15 min ISP or the commissioning of the new HVDC cables.

6. Proposal for ramping restrictions

6.1 Overview

Momentary imbalances result from the momentary difference between generation and import on one side, and export and demand on the other side. It shall be noted that a balanced ISP does not mean that system balance exists in every moment. A major reason for this is the difference in behaviour between generation and demand: Generation units tend to ramp quickly to their new set-point at the beginning of the ISP and keep their generation stable over the ISP. Conversely, demand increases linearly. The difference between the generation ramp and the consumption increase creates the momentary imbalance within the ISP and accordingly results in a FRCE. The effect is similar for import/export vs. generation. Also here there may be a mismatch between the quickly changing generation units and the gradually ramping HVDC interconnectors. It must be noted that these imbalances represents substantial volumes.

The mechanism that is described above is particularly present in the Nordic synchronous area because of the abundance of fast ramping hydro generators that increase their production in large steps during the morning hours to catch up with the increasing demand and increasing export (or decreasing import) on HVDC interconnectors with large aggregated exchange capacity. The opposite happens in the evening. It is clearly the size of the steps between the ISPs that are important.

In order to limit the momentary imbalance (and FRCE), the Nordic TSOs apply a number of measures. Some of these measures intend to mitigate consequences of the momentary imbalance (e.g. aFRR) and others try to prevent for them. Two of the latter ones are included in this proposal.

All TSOs' measures together result in the Nordic LFC's FRCE quality and consequently the Nordic synchronous area's frequency quality. Since all measures affect each other and measures cannot be seen

² In Norway and Sweden, it is sometimes possible to reschedule production steps within the hour if there are available production changes to reschedule

independently from each other, identifying the individual effect of one of the measures is difficult, if possible. The Nordic TSOs consider that – at this moment – they do not have another choice than applying all the measures. By relying on all these measures, the Nordic frequency quality during the previous eight years was in between the Nordic aim (not more than 10,000 minutes per year outside the standard frequency range) and the limit set by the SO Regulation (15,000 minutes per year outside the standard frequency range). The TSOs expect that development in some of the measures, like expected larger aFRR volumes, will lead to an improved FRCE quality. Consequently, the TSOs do neither propose to relax the existing ramping restrictions nor enhance the restrictions now. I.e. the proposed ramping restrictions are determined as per current restrictions. The justification of these ramping restriction is that these ramping restrictions are required for achieving the current frequency quality level and that relaxing them will reduce the Nordic frequency quality.

The existing ramping restrictions for HVDC interconnectors and production plans (see sections 3, 4.1 and 4.2) and the existing possibilities for the TSOs to coordinate ramping between production plans (see section 4.3) limit large FRCE and frequency deviations and contributes to that the frequency and FRCE quality target parameters will be fulfilled. Consequently, the TSOs conclude that it is required to keep the existing ramping restrictions and coordination possibilities. Therefore, the TSOs propose the same ramping restrictions and coordination possibilities as currently applied.

This results in the following text for Article 3 and 4 of the Proposal:

Article 3 – Ramping restrictions for the active power output of HVDC interconnectors

In order to fulfil the FRCE target parameters for the LFC block as referred to in article 128 of the SO Regulation, the following ramping restrictions apply:

1. For the NorNed, Estlink 1, Estlink 2, Vyborg, Konti-Skan, Kontek, Great Belt, Baltic Cable, NordBalt, SwePol Link and Skagerrak HVDC interconnectors the maximum gradient for change in flow is 30 MW/min;
2. The changes to the trading plans from one hour to the next in the energy market shall be not more than 600 MW on each of the following HVDC interconnectors: NorNed, Estlink, Vyborg, Kontek, Great Belt, Baltic Cable, NordBalt, SwePol Link, Skagerrak and Konti-Skan;
3. The changes to the trading plans from one hour to the next in the energy market shall be not more than 600 MW for the sum of the Skagerrak and Konti-Skan HVDC interconnectors;
4. In accordance with Article 137(3) of the SO Regulation, the restrictions in paragraph 1 to 3 shall not apply for imbalance netting, frequency coupling as well as cross-border activation of FRR and RR over HVDC interconnectors.

Article 4 – 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

In order to fulfil the FRCE target parameters for the LFC block as referred to in article 128 of the SO Regulation, the following ramping restrictions apply:

1. When the hourly production plan of balance responsible parties representing power generating modules in Finland, Norway and Sweden changes more than 200 MW at hour shift, these balance responsible parties need to reschedule their plan with quarterly steps 15 minutes before hour shift, at hour shift and 15 minutes after hour shift in order to adjust the plans to better correspond to the consumption pattern. In Norway, the steps can be applied 30 minutes before the hour shift until 30 minutes after the hour shift. This obligation is not relevant in Denmark East due to the physical characteristics for production;
2. In case that planned production changes and planned HVDC exchanges around hour shift will impact the frequency in a way that cannot be entirely handled by control centres in the minutes before and

after operating hour, the TSOs are allowed to request balance responsible parties that represent power generating modules to advance or delay parts of planned production steps at the hour shift. The power schedules may be changed from 30 minutes before hour shift till 30 minutes after the hour shift.

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

The Proposal 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 Proposal serves the objectives to:

- Article 4(1)(c) determining common load-frequency control processes and control structures;
- Article 4(1)(d) ensuring the conditions for maintaining operational security throughout the Union;
- Article 4(1)(e) ensuring the conditions for maintaining a frequency quality level of all synchronous areas throughout the Union.

The Proposal contributes to these objectives by specifying ramping restrictions for HVDC interconnectors and production plans. These ramping restrictions are required to maintain the operational security by reducing the risk for automatic Under Frequency Load Shedding (UFLS) and for system blackouts due to under or over frequency. Furthermore, the ramping restrictions are required to maintain the frequency quality level of the synchronous areas involved.

8. Timescale for the implementation

The TSOs shall implement the Proposal not later than when Nordic LFC block operational agreement enters into force in accordance with Article 119 of the SO Regulation.

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.”*

The original proposal (sent to the NRAs by 14 September 2018) has been consulted in the period 1 July to 15 August 2018. The appendix to the explanatory document that has been sent together with the original proposal includes the views of stakeholders resulting from these consultations and explains if and how these views have been taken into account in the original proposal.