# Explanatory document for the amended Nordic synchronous area methodology for additional properties of FCR in accordance with Article 154(2) of the Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation

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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"**) 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 additional properties of Frequency Containment Reserves (FCR) for the Nordic synchronous area. Pursuant to Article 118(1)(b) of the SO Regulation, all Transmission System Operators in the Nordic Synchronous Area shall jointly develop common proposals for additional properties of FCR in accordance with Article 154(2) of the SO Regulation.

According to Article 6(3)(d)(iii) of the SO Regulation the proposal for additional properties of FCR in accordance with Article 154(2) shall be submitted for approval by the relevant national regulatory authorities (hereinafter "NRAs") no later than 14 September, 2018. The initial proposal[1] has been submitted for regulatory approval to all NRAs in the Nordic synchronous area by 14 September, 2018. In accordance with Article 6(6) of the SO Regulation the proposal has been 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 approved the proposal.

In accordance with article 153(2) of the SO Regulation, the Nordic TSOs need to implement FCR-D downwards. The additional properties of FCR-D downwards was not included in the initial version. The methodology was amended in 2020 where the additional properties of FCR-D downwards was added. The amended methodology has been approved by the NRAs on 21 September 2020.

This amended, third methodology (hereafter referred to as "**Methodology**") adds additional properties concerning dynamic performance and stability for FCR-N, FCR-D upwards and FCR-D downwards in accordance with Article 154(2) of the SO Regulation.

This document contains an explanation of the Methodology from all TSOs of the Nordic synchronous area (hereinafter **"TSOs"**). It is structured as follows. The legal requirements for the Methodology are presented in Chapter 2. Chapter 3 starts with describing the objective of the additional properties of FCR. Chapter 4 provides an overview of the existing situation. Chapter 5 explains the background and proposed amendments. The proposed additional properties of FCR 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)(b) and (2) of the SO Regulation constitutes the legal basis that the Methodology should take into account. Article 118 has the following content:

[1] 'Nordic synchronous area proposal for additional properties of FCR in accordance with Article 154(2) of the Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation', dated 10 September 2018.

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

*(b) additional properties of FCR in accordance with Article 154(2); […]*

*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 154(2) of the SO Regulation has the following content:

*" Article 154 FCR technical minimum requirements*

*[...]*

*2. All TSOs of a synchronous area shall have the right to specify, in the synchronous area operational agreement, common additional properties of the FCR required to ensure operational security in the synchronous area, by means of a set of technical parameters and within the ranges in Article 15(2)(d) of Commission Regulation No [2016/631 RfG] and Article 27 and 28 of Commission Regulation No [2016/1388 DCC]. Those common additional properties of FCR shall take into account the installed capacity, structure and pattern of consumption and generation of the synchronous area. The TSOs shall apply a transitional period for the introduction of additional properties, defined in consultation with the affected FCR providers.*

*[...]"*



(3) Article 154(1) and Annex V of the SO Regulation specify the minimum technical requirements for FCR that shall be ensured by each reserve connecting TSO:
*"Article 154 FCR technical minimum requirements*
*1. Each reserve connecting TSO shall ensure that the FCR fulfils the properties listed for its synchronous area in Table 1 of Annex V.*

*[...]"*

ANNEX V

FCR technical minimum requirements referred to in Article 154:

| | | |
|---|---|---|
| Minimum accuracy of frequency measurement | CE, GB, IRE and NE | 10 mHz or the industrial standard if better |
| Maximum combined effect of inherent frequency response insensitivity and possible intentional frequency response dead band of the governor of the FCR providing units or FCR providing groups. | CE | 10 mHz |
| | GB | 15 mHz |
| | IRE | 15 mHz |
| | NE | 10 mHz |
| FCR full activation time | CE | 30 s |
| | GB | 10 s |
| | IRE | 15 s |
| | NE | 30 s if system frequency is outside standard frequency range |
| FCR full activation frequency deviation. | CE | ±200 mHz |
| | GB | ±500 mHz |
| | IRE | Dynamic FCR ±500 mHz |
| | | Static FCR ±1000 mHz |
| | NE | ±500 mHz |

Table 1 FCR properties in the different synchronous areas

(4) Article 15(2)(d) of Regulation (EU) 2016/631 (*"network code on requirements for grid connection of generators"*) provides a number of requirements (ranges) that shall be met by Type C and Type D power-generating modules *"when frequency sensitive mode ('FSM') is operating"*. These include ranges of the "*Active power range related to maximum capacity"*, *"Frequency response insensitivity"*, *"Frequency response deadband"*, *"Droop"*, *"Active power frequency response capability"*, *"initial activation of active power frequency response"* and the requirement that "*(v) the power-generating module shall be capable of providing full active power frequency response for a period of between 15 and 30 minutes as specified by the relevant TSO."*. Furthermore, *"(vi) within the time limits laid down in point (v) of paragraph 2(d), active power control must not have any adverse impact on the active power frequency response of power-generating modules;"*.

(5) Articles 27 and 28 of Regulation (EU) 2016/1388 (*"network code on demand connection*") describe requirements for demand units to provide demand response services to system operators, including *"autonomously controlled demand response system frequency control"*. More specifically, Article 28 of Regulation (EU) 2016/1388 stipulates the *"specific provisions for demand units with demand response active power control, reactive power control and transmission constraint management"*. These provisions relate to operating capability across frequency ranges and voltage ranges, requirements related to receiving and executing instructions, controlling and adjusting power consumption, and requirements for maintaining the modification to power consumption.

(6) Article 6(3)(d)(iii) 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:*
*(iii) additional properties of FCR in accordance with Article 154(2).*



### 2.2 Interpretation and scope of the Methodology

The Nordic Frequency Containment Process (FCP) currently applies three products of Frequency Containment Reserves (FCR). FCR for normal operation (FCR-N) is used for continuous imbalances to stabilise the frequency within the ± 100 mHz range. Within this range, the dynamic response from FCR-N shall as a minimum suppress variations in the frequency with periodicity of 10 seconds and slower, with an emphasis around period times of 70 seconds. The dynamic response from FCR-N shall be such that it contributes to maintaining the system frequency within the standard frequency range.

The purpose of FCR for disturbance situations (FCR-D) is to mitigate the impact of incidental disturbances once the frequency is below 49.90 Hz or above 50.10 Hz. FCR-D upwards shall be fully activated if the frequency stabilises at 49.50 Hz and FCR-D downwards shall be fully activated if the frequency stabilises at 50.50 Hz. FCR-D must limit the instantaneous frequency deviation and provide dynamic frequency control outside the standard frequency range.

In the event of a frequency drop to 49.50 Hz or a frequency increase to 50.50 Hz which is caused by a momentary power shortage or surplus, FCR-D shall be fully activated within 30 seconds, if the frequency deviation remains, and in addition as a minimum regulate up or down according to the power and energy requirement. It has to be noted that the *FCR full activation frequency deviation* of ± 500 mHz and *FCR full activation time* of 30 seconds that are specified in Annex V of the SO Regulation only apply to FCR-D. Consequently, the TSOs specify the required FCR-N response as additional properties in this Methodology. The other two requirements in Annex V of the SO Regulation apply to both FCR-N and FCR-D.



## 3. Objective of additional properties of FCR

The objective of the additional properties of FCR is to complete the set of minimum requirements in Annex V of the SO Regulation for both FCR-N and FCR-D as required for secure operation of the Nordic synchronous area.

## 4. The existing situation

In this chapter, the existing requirements for FCR are presented. Since the Nordic TSOs apply three products of FCR, section 4.1 addresses FCR-N, section 4.2 addresses FCR-D upwards and section 4.3 addresses FCR-D downwards.

### 4.1 Frequency Containment Reserves for normal operation (FCR-N)

FCR-N is the momentarily available active power available for frequency regulation in the range of 49.9 – 50.10 Hz and which is activated automatically by the system frequency. Currently, FCR-N reserves shall be at least 600 MW at 50.00 Hz in the synchronous system. It shall be fully activated at f = 49.90/50.10 Hz (Δf = ±0.10 Hz). In conjunction with a rapid frequency change to 49.90/50.10 Hz, the reserve shall be up regulated/down regulated within 2-3 minutes.

### 4.2 Frequency Containment Reserves for upwards regulation in disturbance situations (FCR-D upwards)

FCR-D upwards is the momentarily available active power available for frequency regulation in the range of 49.90–49.50 Hz, which is activated automatically by the system frequency.

FCR-D upwards shall be activated at 49.90 Hz and shall be fully activated at 49.50 Hz. It shall increase linearly or close to linearly within a frequency range of 49.90-49.50 Hz.

In the event of a frequency drop to 49.50 Hz:

- 50 % of the FCR-D upwards shall be regulated upwards within 5 seconds.
- 100 % of the FCR-D upwards shall be regulated upwards within 30 seconds.

### 4.3 Frequency Containment Reserves for downwards regulation in disturbance situations (FCR-D downwards)

FCR-D downwards is the momentarily available active power available for frequency regulation in the range of 50.1–50.5 Hz, which is activated automatically by the system frequency.

FCR-D downwards shall be activated at 50.10 Hz and shall be fully activated at 50.50 Hz. It shall increase linearly or close to linearly within a frequency range of 50.10-50.50 Hz.

In the event of a frequency change to 50.50 Hz:

- 50 % of the FCR-D downwards shall be regulated downwards within 5 seconds.
- 100 % of the FCR-D downwards shall be regulated downwards within 30 seconds.

## 5. Proposed amendments

### 5.1 Background

The Nordic power system is undergoing rapid changes. The currently implemented technical requirements of FCR are not sufficient for the Nordic system anymore. The TSOs have thus been working on developing new technical requirements and prequalification tests since 2014. Extensive analysis work has been performed to create requirements that answer to the needs of the power system. The proposed additional properties aim to secure sufficient response from FCR to both stochastic imbalances and sudden disturbances in varying inertia conditions. The currently implemented requirements have been designed for a system with higher inertia than what is observed in the power system today. With lower inertia the system frequency changes become more rapid, which increases the demands on dynamic performance of FCR.

The proposed additional properties for FCR-N and FCR-D have been designed to fulfil the purpose of the respective product. FCR-N shall be able to stabilise the frequency in case of stochastic imbalances that are too fast to be handled with FRR. FCR-N shall also contribute to dampening the slow frequency oscillations that frequently occur in the Nordic power system due to properties of the system. FCR-D shall act fast enough to contain the instantaneous frequency deviation in the reference incident and contribute to dampening the oscillations immediately after the incident. FCR-D shall also be capable of responding to the fast stochastic imbalances in case the FCR-N volume is saturated.

In the development of the new technical requirements the TSOs have also considered that the proposed solution shall be feasible from a market perspective. The TSOs have considered the impact of the new requirements on the prequalified FCR volume in each country, and the requirements have been set at a level that meets two objectives: system security and functioning FCR markets.

Stakeholders have been involved in several phases of the work. In the project "Revision of the Nordic Frequency Containment Process" (2014-2017) there was a Nordic reference group with members from FCR providers, manufacturers and universities. Proof of concept tests of the new requirements were also carried out in cooperation with FCR providers during this time. In later phases of the work there have been national stakeholder activities and stakeholders have been invited to comment on the draft requirements. During autumn and winter 2021/2022 all TSOs were conducting a pilot phase where a large number of providers tested the new requirements with different kinds of assets, including consumption, production and energy storages. In March 2022 the TSOs conducted a common Nordic stakeholder workshop to present the outcome of the pilot and the revisions to the proposed new requirements in response to the gained experiences.



#### *5.1.1 Impact for the BSPs*

The new requirements aim to fulfil the needs of the TSOs whilst being adapted to the needs of the BSPs in a balanced matter with regard to operational security and socio-economic benefit. All requirements are technology neutral, with generalised requirements on the response and reserve provision rather than specific methods or equipment to implement. The requirements are designed to work with the existing market and operational processes, which means that the new requirements do not change how BSPs bid and sell FCR, but merely changes the required response when the FCR is activated.

Because the needs of the power system are changing, the requirements will be stricter and thus harder to fulfil than the currently implemented ones. Some of the existing FCR providing units or groups will be unable to meet the new requirements, or the new requirements will lead to a reduction in the capacity that they can provide. The determining properties for being able to prequalify are the ability to activate close to linearly, respond quickly and to contribute to dampening of oscillations in the systems. This can be related to the physical properties of the entities.

In the Nordics, FCR is provided by a very large range of different type of units, and the impact of the requirements will depend on the unit. Large share of the units needs to be retuned and some units are likely to require a governor modernization. For example, some hydro power units may struggle due to penstock dynamics limiting the ability to respond quickly without being unstable. Similarly, some demand response may struggle with the ability to provide FCR linearly and to follow frequency variations. This is a consequence the TSOs find unavoidable, whilst as the requirements are technology neutral as described, equal treatment of stakeholders is ensured.

For FCR-D, it was very difficult to find a balance between the toughness of the requirements and the market liquidity (= amount of capacity that qualifies with the proposed requirements) while ensuring that the needs of the power system are met, i.e., that security of supply is guaranteed. As a result of feedback from the stakeholders and pilot tests, the TSOs have put a lot of effort into making the requirements such that as much capacity as possible can qualify: the requirements were relaxed from the first drafts, a so called mode shifting concept for governors was introduced in the prequalification requirements, FCR-D static was introduced to allow participation of non-continuously controlled units, etc. With the proposed requirements, the TSOs believe that the power system needs, and market liquidity are balanced.

The TSOs have also assessed the required tests when prequalifying according to the requirements, to find a balance between the costs and time when conducting the tests while ensuring a sufficient level of validation that the requirements are fulfilled. Furthermore, the TSOs have significantly streamlined the prequalification requirements based on stakeholder feedback received on earlier drafts.

The TSOs have assessed the expected prequalified capacities from different technologies following the implementation of the requirements. The prequalified capacity from existing providers is expected to decrease. The total capacity is also determined by the number of providers as well as "new" technologies like solar, wind and batteries. The total volume might over time increase in general, even if the new requirements

might cause a reduction for a significant part of the existing individual units. The impact differs in countries due to major differences in the technology mix.

#### *5.1.2 Prequalification documents for stakeholders*

In addition to the new technical requirements, the TSOs have designed a set of prequalification requirements and tests to verify that all FCR providing units or groups comply with the technical requirements. All TSOs will implement the tests and evaluation criteria in their national prequalification processes according to Article 155(1). The TSOs have created a prequalification document for FCR providers and other relevant stakeholders. The document *Technical Requirements for Frequency Containment Reserve Provision in the Nordic Synchronous Area* describes both the technical requirements and the prequalification process on a detailed technical level. Draft versions of the above-mentioned document were published for stakeholder comments in 2017 and 2021 respectively. A third draft was prepared based on the experiences from the pilot phase, published for consultation prior to the Nordic stakeholder workshop in March 2022. The stakeholders had the possibility to discuss the draft during the workshop as well as provide comments afterwards.

In order to help with the tuning and the pre-qualification, the TSOs have developed a tuning guideline and a computer program that in an automated manner analyzes the compliance of the unit based on measurements from pre-qualification tests.

### 5.2 Changes in the Methodology

This section outlines the amendments to the methodology of 18 June 2020 that has been approved by the NRAs based on the NRAs position paper of 21 September 2020. The amendments are described in detail in Section 6.

Section 5.3 describes the proposed amendments concerning additional properties for FCR-N in article 3 of the Methodology. Section 5.4 describes the proposed amendments concerning additional properties for FCR-D upwards in article 4 (Dynamic FCR-D upwards) and article 5 (Static FCR-D upwards) of the Methodology. Section 5.5 describes the proposed amendments concerning additional properties for FCR-D downwards in article 6 (Dynamic FCR-D downwards, previously 4a) and article 7 (Static FCR-D upwards) of the Methodology.

The TSOs propose to add Article 8 on FCR providing entities with limited energy reservoirs as described in Section 5.6 and Article 9 on requirements on the measurements as described in Section 5.7. The aim is to complete the requirements as stated in Annex V and article 156 of the SO Regulation and to clarify the interpretation in relation to the different FCR products defined in this Methodology.

### 5.3 Changes in article 3 - Additional FCR-N properties

In accordance with Article 154(2) of the SO Regulation, all TSOs of a synchronous area shall have the right to specify common additional properties of the FCR required to ensure operational security in the synchronous area. Accordingly, the TSOs propose additional properties concerning dynamic performance and stability for FCR-N.

The additional requirements introduce a dynamic response requirement where FCR-N shall be tuned to suppress variations in the frequency with periodicity of 10 seconds and slower, with an emphasis around 70 second periods. The same behaviour shall apply for deactivation.

FCR-N shall be able to follow variations in the system frequency. As the system frequency is continuously varying, FCR-N must have a dynamic response that contributes to containing the frequency within the standard frequency range.

The additional requirements also introduce a stability term.

### 5.4 Changes in article 4 and 5 - Additional FCR-D upwards properties

In accordance with Article 154(2) of the SO Regulation, all TSOs of a synchronous area shall have the right to specify common additional properties of the FCR required to ensure operational security in the synchronous area. Accordingly, the TSOs propose additional properties concerning dynamic performance and stability for FCR-D.

The additional requirements introduce an energy and power requirement for activation of FCR-D upwards in addition to the full activation time.

FCR-D upwards shall be able to follow variations in the system frequency by activation and deactivation. FCR-D upwards must have a dynamic response that provides continuous frequency control when the frequency is below the standard frequency range. This is introduced in article 4 and is valid for Dynamic FCR-D upwards. Some units and groups are expected to not be able to fulfil this dynamic performance requirement. These units or groups will be covered by Static FCR-D upwards as introduced in article 5 of the Methodology

The additional requirements also introduce a stability term. The Dynamic FCR-D upwards response shall act such that it contributes to stabilisation and damping of system frequency oscillations, while Static FCR-D upwards response shall act such that it does not negatively affect stabilisation and damping of system frequency oscillations.

### 5.5 Changes in article 6 and 7 - Additional FCR-D downwards properties

In accordance with Article 154(2) of the SO Regulation, all TSOs of a synchronous area shall have the right to specify common additional properties of the FCR required to ensure operational security in the synchronous area. Accordingly, the TSOs propose additional properties concerning dynamic performance and stability for FCR-D.

The proposed requirements for FCR-D downwards mirror the proposed requirements for FCR-D upwards (see section 5.4 and 6.2).

### 5.6 New article 8 – Additional properties of FCR providing units and groups with Limited Energy Reservoirs

In accordance with Article 154(2) of the SO Regulation, all TSOs of a synchronous area shall have the right to specify common additional properties of the FCR required to ensure operational security in the synchronous area. Accordingly, the TSOs propose additional properties concerning entities with Limited Energy Reservoirs.

The additional properties clarify how the requirements in Article 156 of the SO Regulation shall be interpreted for the three FCR products defined within this Methodology as well as additional properties of the FCR provision necessary to ensure operational security of the Nordic synchronous area.

### 5.7 New article 9 – Additional requirements on minimum accuracy and resolution of measurements

In accordance with Article 154(2) of the SO Regulation, all TSOs of a synchronous area shall have the right to specify common additional properties of the FCR required to ensure operational security in the synchronous area. Accordingly, the TSOs propose additional properties concerning minimum accuracy and resolution on measurements.

The proposed additional properties complete the statements on minimum accuracy of measurements as specified in Annex V of the SO Regulation and constitutes of requirements on the FCR capabilities necessary to ensure operational security of the Nordic synchronous area.

# 6. Proposal for additional FCR properties

Together with the requirements in Annex V of the SO Regulation, the proposed additional properties for FCR-N, FCR-D upwards and FCR-D downwards in sections 6.1, 6.2 and 6.3 respectively, the proposed additional properties for entities with limited energy reservoirs in section 6.4, and the proposed additional properties for the measurement system in section 6.5, form a new set of requirements to meet the needs of the Nordic power system today and in the future.

## 6.1 Additional FCR-N properties

As discussed in section 2.2, for FCR-N, Annex V of the SO Regulation specifies the *Minimum accuracy of frequency measurement* and the *Maximum combined effect of inherent frequency response insensitivity and possible intentional frequency response dead band of the governor of the FCR providing units or FCR providing groups*. Conversely, for FCR-N, SO Regulation does not specify the *FCR full activation frequency deviation* and the *FCR-N full activation time*. These two properties will be deducted from existing requirements in section 6.1.1 and 6.1.2. Further, the SO Regulation does not specify other properties that are important for the Nordic power system. Hence, requirements on the dynamic properties of FCR-N are proposed as specified in 6.1.3. Section 6.1.4 describes the relation of the additional properties and the FCR prequalification process specified in Article 155 of the SO Regulation.

### *6.1.1 FCR full activation frequency deviation and proportional activation*

Since FCR-N is used for continuous imbalances to stabilise the frequency within the ± 100 mHz range, FCR-N shall be fully activated in the upward direction at f = 49.90 Hz and fully activated in the downward direction at f = 50.10 Hz. This means that the *FCR full activation frequency deviation* for FCR-N is ±100 mHz, which is proposed in Article 3(1) of the Methodology. Within the interval 49.9 to 50.1 Hz the activation shall be close to proportional to the frequency deviation.

The full activation frequency deviation is within the ranges in Article 15(2)(d) of Commission Regulation No [2016/631 RfG] and Article 27 and 28 of Commission Regulation No [2016/1388 DCC].

### *6.1.2 FCR-N activation and deactivation response*

The FCR-N response is proposed in Article 3(2) of the Methodology. The response from FCR-N shall be tuned to suppress variations in the frequency with periodicity of 10 seconds and slower, with an emphasis around of 70 second periods. This means that FCR-N shall activate approximately 63% of the final value in 60 seconds and approximately 95% of the final value in 3 minutes in response to a step change of ±100 mHz from 50.0 Hz in the system frequency.

The full activation time is within the ranges in Article 15(2)(d) of Commission Regulation No [2016/631 RfG] and Article 27 and 28 of Commission Regulation No [2016/1388 DCC].

In Article 3(3) of the Methodology it is proposed that the above mentioned response applies also for deactivation, i.e. the same requirements shall be fulfilled if the 100 mHz frequency change is from 49.9 to 50.0 Hz or 50.1 Hz to 50.0 Hz.

In case of a frequency deviation smaller than 100 mHz, the FCR-N response shall be activated by applying the same dynamic behaviour as for full activation and deactivation. This is proposed in Article 3(5) of the Methodology.

### 6.1.3 FCR-N dynamic properties

In addition to the activation and deactivation response in section 6.1.2, FCR-N shall be able to follow variations in the system frequency. As the system frequency is continuously varying, FCR-N must have a dynamic response that contributes to contain the frequency within the standard frequency range. This is proposed in Article 3(4) of the Methodology.

To ensure frequency stability of the Nordic power system, the properties of the dynamic FCR-N response shall act such that it contributes to stabilisation and damping of system frequency oscillations. This is proposed in Article 3(6) of the Methodology.

### 6.1.4 Confirmation of compliance

According to article 155(1) of the SO Regulation the prequalification process is a responsibility of each individual TSO. It is therefore proposed in Article 3(7) of the Methodology that compliance with the above-mentioned requirements is confirmed in the FCR prequalification process.

The TSOs have developed common Nordic prequalification documents which contain tests and evaluation criteria to be implemented by each TSO in the national prequalification process.

## 6.2 Additional FCR-D upwards properties

For FCR-D, Annex V of the SO Regulation specifies the *full activation frequency deviation* (±500 mHz) and the *full activation time* (30 seconds). However, the SO Regulation does not specify other requirements that are important for the Nordic synchronous area. These issues are addressed in section 6.2.1, 6.2.2 and 6.2.3. Section 6.2.4 describes the relation of the additional properties and the FCR prequalification process specified in Article 155 of the SO Regulation.

### 6.2.1 Activation between 49.90 and 49.50 Hz

FCR-D upwards is activated in the interval 49.9-49.5 Hz. Full activation at 49.5 Hz corresponds to the *full activation frequency deviation* of Annex V of the SO Regulation. The activation starts at 49.9 Hz, i.e. outside the standard frequency range where FCR-N is fully activated. The FCR-D upwards activation within the interval 49.9 to 49.5 Hz must be close to proportional to the frequency deviation. These properties are proposed in Article 4(1) of the Methodology.

### 6.2.2 Additional requirements on activation time

Additional requirements on the full activation time are proposed in Article 4(2) of the Methodology, for Dynamic FCR-D, and in Article 5(2), for Static FCR-D. In conjunction with a system frequency change from 49.9 Hz to 49.0 Hz with a slope of -0.24 Hz/s, FCR-D upwards shall be regulated upwards as follows:

1. $|\Delta P_{7.5\mathrm{s}}| \geq 0.86 \cdot |\Delta P_{ss}|$
2. $|E_{7.5\mathrm{s}}| \geq 3.2s \cdot |\Delta P_{ss}|$

In the equations above,

$\Delta P_{7.5\mathrm{s}}$ (MW) is the activated power 7.5 seconds after the start of a system frequency change

$\Delta P_{\mathrm{ss}}$ (MW) is the steady state FCR-D upwards activation at a frequency deviation of -500mHz

$E_{7.5\mathrm{s}}$ (MWs) is the activated net energy during the first 7.5 seconds of a system frequency change.

In addition, for Static FCR-D the delay before the response is initiated shall not exceed 2.5 seconds as described in Article 5(2).

In case of an instantaneous frequency deviation different to that stated in Article 4(2) and 5(2) respectively, the FCR-D upwards response shall be activated by applying the same dynamic behaviour as for full activation. This is proposed in Article 4(4) and 5(3) respectively, of the Methodology.

Compliance with Article 15(2)(d)(iii) of Commission Regulation No [2016/631 RfG] requires full activation linearly within 30 seconds. Especially at times of low inertia in the Nordic synchronous area a faster FCR-D response is required[2]. The TSOs consider it critical to implement requirements that ensure this response is delivered.

#### *6.2.3 FCR-D upwards dynamic properties*

The FCR-D upwards has two objectives: to limit the instantaneous frequency deviation and to provide dynamic frequency control outside the standard frequency range. The first objective is ensured when all of the dimensioned FCR-D upwards activates according to the requirements stated in section 6.2.2. The second objective can be met when a large enough share of the dimensioned FCR-D capacity has dynamic properties that allow continuous following of the system frequency variations equal to the requirements for Dynamic FCR-D. The TSOs consider it necessary to ensure dynamic activation and deactivation on a system level. However, the TSOs also consider it important to efficiently use technologies with different inherent properties, including such where the dynamic properties are lacking. This position is reflected in the introduction of Dynamic and Static version of FCR-D in Article 4 and 5 respectively of the Methodology. The dimensioning of Dynamic and Static FCR-D will be handled in such a way that enough of the dynamic capabilities are ensured on a system level. The requirements for this are defined in the separate methodology for Dimensioning of FCR per article 153 of the SO regulation, and further elaborated on in the corresponding explanatory document.

In addition to the full activation time in section 6.2.2, Dynamic FCR-D upwards response shall be able to continuously follow the dynamic frequency variations in the system frequency as introduced in Article 4(3). No corresponding requirement to continuously follow the dynamic frequency variations in the system frequency exists for Static FCR-D upwards.

To ensure frequency stability of the Nordic power system, the dynamic properties of the Dynamic FCR-D upwards response shall act such that it contributes to stabilisation and damping of system frequency oscillations. This is proposed in Article 4(5) of the Methodology. For Static FCR-D upwards, the dynamic properties of the response shall act such that it does not negatively affect stabilisation and damping of system frequency oscillations as proposed in Article 5(4).

#### *6.2.4 Confirmation of compliance*

According to article 155(1) of the SO Regulation the prequalification process is a responsibility of each individual TSO. It is therefore proposed in Article 4(6) and 5(5) of the Methodology that compliance with the above-mentioned requirements is confirmed in the FCR prequalification process.

The TSOs have developed common Nordic prequalification documents which contain tests and evaluation criteria to be implemented by each TSO in the national prequalification process.

### 6.3 Additional FCR-D downwards properties

Reference incidents in positive direction have similar but opposite effects on the system frequency as reference incidents in negative direction. For that reason, the proposed requirements for FCR-D downwards mirror the proposed requirements for FCR-D upwards (see section 6.2).

[2] to prevent for automatic Low Frequency Demand Disconnection in case of large instantaneous imbalances.

## 6.4 Additional properties on FCR providing units or groups with limited energy reservoirs

This section is intended to complement the provisions in Article 156 of the SO Regulation as well as provide guidance towards how that article shall be interpreted for the different FCR products defined within this Methodology.

### *6.4.1 Common properties for all FCR products provided from limited energy reservoirs*

An FCR providing unit or group with an energy reservoir that limits its capability to provide FCR shall activate its FCR for as long as the frequency deviation persists, unless its energy reservoir is exhausted in either the positive or negative direction. This statement corresponds to Article 156(8) of the SO Regulation and is implemented in Article 8(2) of the Methodology.

If the FCR providing unit or group has started a process to recover its energy reservoir, and a new disturbance occurs during the recovery process, the FCR providing unit or group shall be able to stop the recovery process and start activation of the reserve with the available energy. The FCR response shall thus not be hindered by the activation of a recovery process. This is reflected in Article 8(6) of the Methodology.

### *6.4.2 Properties for all FCR products on energy management functions*

FCR providing units or groups with an energy reservoir that limits its endurance for full activation to less than two hours must implement a Normal state Energy Management function (NEM) to limit the risk of a reservoir exhaustion, and an Alert state Energy Management scheme (AEM) to limit the consequences of a reservoir exhaustion. This is introduced in article 8(7) of the Methodology. FCR providing entities with an energy reservoir where the endurance for full activation exceeds two hours may implement the same energy management functions, or during prequalification propose other solutions of similar effect, to be approved by the reserve connecting TSO. FCR providing entities classified as LER which have an energy reservoir that is not replenished from the power grid may also suggest an alternative energy management solution with similar effect, to be approved by the TSO.

As described in article 8(8), the FCR providing unit or group shall activate the Normal state Energy Management function when the reservoir level has drifted from the nominal level such that an increased risk of exhaustion has occurred. The Normal state Energy Management function shall be used to restore the reservoir level to the nominal value.

During provision from an FCR providing unit or group with a Normal state Energy Management function, active power and energy shall be reserved from the unit or group to ensure proper functioning of the Normal state Energy Management function, in addition to the active power needed to ensure full availability of FCR provision itself. This is reflected in Article 8(10) of the Methodology.

The FCR providing entity shall activate the Alert state Energy Management function when the reservoir level has drifted from the nominal level such that a severe risk of exhaustion has occurred. The Alert state Energy Management function shall be used to ensure that the FCR response does not fully and suddenly cease in accordance with Article 8(9) of the Methodology.

Further, if the FCR providing unit or group is applying any form of energy management functions during operation those shall not interfere with the ability to provide FCR. This is stated in Article 8(11) of the Methodology.

### *6.4.3 Properties of FCR-N provided from limited energy reservoirs*

FCR-N provision from an FCR providing unit or group with limited energy reservoirs (LER) shall be continuously available during the whole contractually agreed delivery period. This is a clarification towards Article 156(9) of the SO Regulation where it is stated that each FCR provider shall ensure that the FCR from its FCR providing units or groups with limited energy reservoirs are continuously available during normal state. Since FCR-N is fully activated within the bounds of normal state it follows that FCR-N has to be

continuously available throughout the contractually agreed delivery period, to allow secure operation of the Nordic synchronous area. This position is reflected in Article 8(3) of the Methodology.

#### *6.4.4 Properties of FCR-D upwards and FCR-D downwards provided from limited energy reservoirs*

FCR-D upwards is active in the system frequency band 49.5-49.9 Hz, while FCR-D downwards is active in the band 50.1-50.5 Hz. Both of these bands can correspond to both normal state and alert state, depending on the amount of time within each respective frequency range. FCR-D may also be active in emergency state, which for the purpose of Article 8 of the Methodology shall be treated equally to alert state.

During operation in normal state FCR-D provision from units or groups with limited energy reservoirs (LER) shall be continuously available. From the point in time of triggering of alert state and during the alert state, FCR-D providing units or groups with limited energy reservoirs shall be able to fully activate FCR continuously for a time period in accordance with the methodology per article 156(10) of the SO Regulation. This position corresponds to Article 156(9) of the SO Regulation and is reflected in Article 8(4) of the Methodology.

Further, FCR-D providing units or groups with partially or fully depleted energy reservoirs shall restore full nominal capacity within 120 minutes of the allowed start of recovery. The recovery process shall be initiated and completed as soon as possible. This requirement is an adaptation of Article 156(13)(b) of the SO Regulation and includes a clarification that the article shall be applied for FCR-D only, as FCR-N shall be continuously available per Article 6(2) of the Methodology. This position is reflected in Article 8(5) of the Methodology.

#### *6.4.5 Confirmation of compliance*

According to article 155(1) of the SO Regulation the prequalification process is a responsibility of each individual TSO. It is therefore proposed in Article 8(12) of the Methodology that compliance with the above-mentioned requirements is confirmed in the FCR prequalification process.

The TSOs have developed common Nordic prequalification documents which contain tests and evaluation criteria to be implemented by each TSO in the national prequalification process.

### 6.5 Additional requirements on FCR minimum accuracy and resolution of measurements

As discussed in section 2.2, Annex V of the SO Regulation specifies the *Minimum accuracy of frequency measurement* and the *Maximum combined effect of inherent frequency response insensitivity and possible intentional frequency response dead band of the governor of the FCR providing units or FCR providing groups*. Conversely, Annex V of the SO Regulation does not specify the necessary resolution of frequency measurement nor corresponding values for the active power measurement of FCR providing units or groups. These are properties that are important for the Nordic power system to ensure the effectiveness of the other requirements defined within this Methodology. Hence, Article 9 of the Methodology introduces additional properties on measurements to complete the specification of Annex V.

#### *6.5.1 FCR minimum accuracy and resolution of measurements*

FCR providing units or groups shall be able to respond to small variations in the measured quantities. The accuracy and the resolution of the frequency and power measurements shall be sufficient to meet this objective and the measurements shall be such that the FCR activation can be verified. This position is reflected in Article 9(1) of the Methodology.

The active power measurement shall be such that it covers all active power changes as a result of the FCR activation. This position is reflected in Article 9(2) of the Methodology.

### *6.5.2 Confirmation of compliance*

According to article 155(1) of the SO Regulation the prequalification process is a responsibility of each individual TSO. It is therefore proposed in Article 9(3) of the Methodology that compliance with the above-mentioned requirements is confirmed in the FCR prequalification process.

The TSOs have developed common Nordic prequalification documents which contain tests and evaluation criteria to be implemented by each TSO in the national prequalification process.



## 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)(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; and
- Article 4(1)(h) contributing to the efficient operation and development of the electricity transmission system and electricity sector in the Union.

The Methodology contributes to these objectives by specifying the additional rules for FCR-N and FCR-D, which are key reserves that are used in the common Nordic load-frequency control processes. The additional properties are required to maintain the operational security by reducing the risk for automatic Low Frequency Demand Disconnection (LFDD) and for system blackouts due to under or over frequency. The additional properties balance the impact of both cost for FCR and outage risk and therefore ensure efficient operation of the electricity transmission system.

## 8. Timescale for the implementation

Additional properties for FCR-N, FCR-D upwards and FCR-D downwards - as approved by the Nordic NRAs on 21 September 2020 - have been implemented in the Nordic synchronous area. This section describes how the TSOs propose that the transition from the existing additional properties to the properties as described in this Methodology shall occur.

This part of the Methodology has been developed in consultation with affected providers in accordance with article 154(2) of the SO Regulation. The providers have commented that implementing the new requirements will require a significant amount of time and effort for existing units and groups that provide FCR.

As stated in Article 10(3) of the Methodology the TSOs shall start to implement the FCR additional properties as specified in the Methodology immediately after all of the following has concluded:

a. the approval by all NRAs of the Synchronous Area

b. the TSOs have finalised the prequalification procedures

This section of the Methodology is intended to ensure that the TSOs as well as the providers have a suitable preparation time prior to the proposed requirements entering into force. The time for reaching point b is limited to one year from the date of NRA approval as stated in Article 10(3) of the Methodology.

The transitional period for the implementation of additional properties of FCR by the existing affected FCR providers shall be five years counted from the date of approval by the NRAs of the Synchronous Area:

maximum one year for the TSOs to adapt their national processes and a total maximum of five years for the FCR providers to implement the FCR additional properties. This statement is intended to ensure that the existing providers are given at least four years to transition to the new technical requirements. In case the adaptation of the national processes for one or several of the TSOs conclude earlier than after one year, the providers will be given additional time to transition such that the end date of the transition always occur at a total maximum of five years after NRA approval. This statement is reflected in Article 10(3) of the Methodology.

The TSOs intend to keep their respective prequalification teams on high-alert for at least the first year after national implementations to ensure the efficiency of the prequalification procedures, and if needed introduce any necessary updates to the prequalification procedures. The TSOs will also monitor the effects of the implementation of the requirements as stated in this Methodology. Since the TSOs propose that the implementation into national processes shall take maximum one year from the date of approval, Article 10(3) thus includes the statement that the TSOs shall review the requirements of this Methodology within two years from the date of approval by the NRAs of the Synchronous Area, and evaluate if the experience from the implementation necessitates any adjustments to the requirements within this Methodology.

New FCR providing units and groups shall apply the new requirements immediately after implementation in the national processes. The specific date will be communicated in advance by the relevant TSO. This position is introduced in Article 10(4) of the Methodology.

Existing FCR providing units and groups shall have transitioned within a maximum of five years counted from the date of approval by NRAs of the Synchronous Area. Existing units and groups that at that date haven't already transitioned to the new requirements will then be re-evaluated towards the new requirements in accordance with article 155(6)(b) of the SO Regulation. This requirement is implemented in Article 10(5).

In case of an already existing prequalification which is re-evaluated in accordance with article 155(6) of the SO Regulation the evaluation shall be made towards the new requirements as stated in this Methodology. This is reflected in Article 10(6) of the Methodology.

The reserve connecting TSO shall be allowed to extend existing prequalifications to ensure a smooth transition from the existing requirements to the new requirements. The extension shall be based on successful auditing based on the existing requirements. The extension shall end at the latest within a maximum of five years after NRA approval of this Methodology. For some of the TSOs behind this Methodology many providers are up for reassessment in accordance with article 155(6) with many units at the same time, often at the beginning of the above described transitional period. This will for example happen at five years after entry into force of the SO Regulation in September 2023, where many previously not time-limited prequalifications now end. The intent of Article 8(8) of the Methodology is hence to allow the transition of the existing units and groups to the new requirements to be able to be spread out within the full extent of the proposed transitional period.

## 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 Methodology has been consulted in the period 6 May 2022 to 6 June 2022. The appendix to this document includes the views of stakeholders resulting from the consultations and explains if and how these views have been taken into account in the Methodology.

## Appendix: Results of Public Consultation

Article 11(3) of the SO Regulation states that: *"The TSOs responsible for developing the proposal for terms and conditions or methodologies shall duly take into account the views of stakeholders resulting from the consultations prior to its submission for regulatory approval. In all cases, a sound justification for including or not including the views resulting from the consultation shall be provided together with the submission of the proposal and published in a timely manner before, or simultaneously with the publication of the proposal for terms and conditions or methodologies."*. Table 1 lists the views of stakeholders on this proposal resulting from the consultations and explains if and how these views have been taken into account in the Methodology.

Table 1: Views of stakeholders resulting from the consultations and explains if and how these views have been taken into account in the Methodology.

| no. | Organisation | Comment | response TSOs |
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| 1 | Vattenfall AB | Sections 3 (7), 4 (6), 5 (5) and 6 (6) state "Prequalification requirements and tests specified and governed by the reserve connecting TSO…". We propose that “governed” is be removed because it opens up for the TSO to be allowed to control, for example, when the tests are to be carried out. We argue that it is sufficient for them to specify how the tests are to be carried out. | Comment acknowledged and did not result in a change of the proposal. The intention of the phrasing is to state that the TSOs govern the test procedure. The time of testing should be agreed with the relevant TSO. |
| 2 | Vattenfall AB | In sections 4 (2), 5 (2), 6 (2) and 7 (2) there are detailed quantitative minimum requirements for power and energy 7.5 s after step disturbance. This opens the way for the TSOs to later set quantitatively stricter requirements, but not for them to ease the requirements if this should prove to be possible / desirable. Vattenfall would advocate either more generally formulated requirements, or a formulation that stipulate that the TSOs must not tighten the requirements. Even if the latter alternative would lead to better long-term predictability, we believe that a more general formulation of requirements is preferable. | Comment acknowledged and did not result in a change of the proposal. The previous versions of the methodologies were used by the TSOs as a basis for the level of detail. The requirements are stated as a minimum allowed response, however changes to the actual numbers in the methodology will require a new approval by the NRAs. Hence, the TSOs can’t apply stricter requirements than stated in the methodology, without performing another process of consultations and application to the NRAs. |
| 3 | Vattenfall AB | Also regarding requirements for measurement accuracy and resolution, sec. 9 (1) and 9 (3), the level of detail is too high and cannot be motivated. Even though the requirements as such are reasonable, we do not see the rationale, nor benefit of fixing them in a legal document like this. | Comment acknowledged and resulted in a change of the proposal. The TSOs have reduced the level of detail in article 9. |
| 4 | Tvinn | Article 8 (3) is unclear to me. "As of triggering during the alert state, FCR-D providing units or groups with limited energy reservoirs shall be able to fully activate FCR continuously for a time period in accordance with the methodology per article 156(10) of the SO regulation" When is the Alert state activated? I have previously heard about alert state activating at SoC ~8%, but 8 (3) implies that the energy reservoir must sustain full activation for a time period during the alert state. And for the energy reservoir to be able to sustain full activation with an almost empty SoC creates over-dimensioned storages. | Comment acknowledged and did not result in a change of the proposal. The classification of system states is defined in Article 18 of the SO regulation, and alert state specifically in Article 18(2), which in turn is referring to ANNEX III. The text quoted from Article 8(3) of the proposal is an implementation of Article 156(9) of the SO regulation, and is intended to have the same meaning.<br><br>The threshold values for which the energy management functions shall activate are evaluated during prequalification, and are dependent on the type of storage, size, etc. They are separate from the definition of Alert state. The evaluation process will be explained in the prequalification documents. |
| 5 | Skellefteå Kraft AB | In general The TSOs want to have faster and stronger responses from FCR-D and we are little concerned how the future system will react to a rapid frequency drop in to the disturbance zone. Will these new set of rules make the system to overreact and hence cause additional problems? | Comment acknowledged and did not result in a change of the proposal. The new requirements are designed based on the needs of the Nordic power system. The new requirements are indeed more aggressive than the existing ones, since the power system demands faster response from FCR as the properties of the system are |

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| | | The future dimensional parameters for FCR-D may be bigger, caused by larger grid connections example large wind parks, and then we will have a larger amount of FCR-D in the system. And after five years when all the producers of FCR-D have aligned to the new rules the system response will be much faster and stronger when the frequency drops into the FCR-D zone. If then the incident causing the drop is small, compared to the amount of FCR-D, the system may overreact. In addition, how will the new product FFR work together with FCR-D? Will not an increase of FFR reduce the need for fast response from FCR-D?<br><br>Article 4 (2.1) Today (at least theoretical with a linear growth from 50 % at 5 seconds to 100 % at 30 seconds) it is good enough to reach 86 % after 23 seconds. This amendment suggest 86 % after 7,5 seconds which is 3 times faster than today and we are concerned that the system will overreact (se general comments). Another question is what is the point of having a tail of 14 % FCR-D between 7,5 seconds and 30 seconds? | changing. An important factor is decreasing inertia, which dictates the need for a faster response as the frequency rate of change will be higher. The new requirements also introduce a stability requirement to ensure stable responses, and performance requirements that meets the system demands also in the transient phase following a large incident.<br><br>The decreasing inertia is also the main reason for the requirement of minimum 86 % activation after 7.5 seconds. The speed is needed in the beginning, but not the full volume of the response. Hence, the remaining part of the activation can follow in a slower pace.<br><br>The TSOs acknowledge the concern for over-reactions to small events and have considered this in the design of the requirements. The intended mitigation is the deactivation and stability requirements of Dynamic FCR-D. These mitigations are missing from Static FCR D, which means that too large volumes of Static FCR-D might contribute to the stated harm. To limit the risks from Static FCR-D, the TSOs have proposed an additional requirement on Static FCR-D that states: “The delay before the response is initiated shall not exceed 2.5 seconds.”. This is needed as a large activation delay in combination with no requirement on deactivation and stabilisation of oscillations would be harmful in these situations. This is also the reason for mandating a minimum volume of Dynamic FCR-D, as proposed in the dimensioning proposal submitted in parallel to this proposal.<br><br>The FFR and FCR-D have been designed to work well in combination. The FFR need increases as the inertia decreases, dimensioned such that the result is that the FCR-D requirements can remain unaffected. The need for a fast response from FCR-D is thus unchanged as the FFR need increases. |
| 6 | Skellefteå Kraft AB | Article 4 (2.2) the demand for the net energy after 7,5 seconds to be bigger or equal to the energy with full activated FCR-D during 3,2 seconds leaves no or very little room for the active power drop that is a physical fact when you accelerate the power in a hydro turbine. This causes that the turbine has to compensate for the active power drop (energy loss) by reacting | Comment acknowledged and did not result in a change of the proposal. The requirements are based on the needs of the Nordic power system, and they are designed to be technology neutral as they only state the needed functional response of the reserve. The TSOs acknowledge that the new requirements are stricter than what |

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| | | even faster than stipulated in Article 4(2.1). We think this is a discriminatory rule against hydro and other producers who have units with high inertia. | has been applied historically, and that this will negatively affect the ability to contribute from some potential units. The TSOs however assess that this is unavoidable, as the needs of the power system are changing. Since the requirements are the same for all kinds of technologies, technology neutral, and based on the needs of the power system, the TSOs do not agree that the proposed requirements would be discriminatory to any kind of technology.<br><br>The negative energy contribution in the described case is not related to the inertia synchronized to the grid, but the inertia of the water. Hence, it is not seen as discriminatory to large synchronized generators. The energy requirement evaluates the performance of the FCR providing units and/or groups from power system point of view. Negative response is disadvantageous from the power system point of view, and TSOs view is that to treat everyone in equal terms, also the negative response should be accounted for when evaluating the response of the FCR providing units and/or groups. |
| 7 | Skellefteå Kraft AB | The TSOs want to have synchronous coupled inertia in the system and have introduced a new product, FFR, to meet the shortage of it in the system. These new harder performance rules for FCR-D will worsen this shortage. Today many hydro plant owners has an incitement to run the turbines on idle (or close to it) during night times or other times with very low energy prices because they can sell FCR-D to the market and the system gains from it with the free provide inertia. Tomorrow, if they are disqualified from the FCR-D market, when the energy prices are low a large amount of free inertia will be lost from the system as the hydro plants stops in these low price periods. By excluding large and heavy synchronous machines from the future market of FCR-D will not only leave a big and expensive hole to fill in the FCR-D market but it will also create a big and expensive hole to fill for compensating for the loss of (today free provided) inertia." | Comment acknowledged and did not result in a change of the proposal. The TSOs acknowledge that the inertia is decreasing, and that this leads to changing properties of the power system that needs to be mitigated. However, the inertia is handled in a different process in accordance with Article 39(3) of the SO regulation. The TSOs do not procure FCR to ensure additional inertia from the FCR providing units. The TSOs have however included a stability requirement to FCR-N and Dynamic FCR-D, to ensure that FCR is fit to handle situations where the inertia is decreasing. |
| 8 | Sympower | Sympower is an independent aggregator active, amongst others, in Finland, Sweden and Norway. We thank you for the opportunity to comment on the new technical requirements for Frequency Containment Reserve Provision in the Nordic Synchronous Area. Despite the explanatory document which helps us to better understand the reasoning behind modifications, we would like to share with you come | Comment acknowledged and did not result in a change of the proposal. The TSOs agree that all potential providers, including demand-side and aggregators, shall be allowed equal and non-discriminatory access to the FCR markets. The requirements have been designed to be technology neutral and non-discriminatory. The TSOs refer to the answer to comment 6 for a further elaboration. |

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| | | principles we would like to highlight, as well as some comments we have on the changes.<br><br>Principles to be kept in mind. Regulators and stakeholders have identified the importance of Demand-Side Flexibility (DSF) and independent aggregators in creating a resilient, reliable and sustainable grid. Most notably, in 2019 the European Union overhauled its energy policy framework by adopting the Clean Energy for all Europeans package. It includes the Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity, according to which:<br>• Demand Response can participate in all electricity markets.<br>• There should be no-discriminatory participation of demand-side Balance Service - Providers, including independent aggregators.<br>• No prior consent from third parties, including BRP suppliers is needed.<br>• Financial compensation shall not create a barrier to market entry.<br>Article 5.2 - speed requirements (page 7): The speed of the response is already dictated by equations 3 & 4, there is no need to impose additional speed requirements. Furthermore, this requirement limits Static resources to use allowed functionality in the more in-depth technical requirements (Mode shifting) that the dynamic reserves are allowed to use. It is therefore discriminatory. It also goes against 154-2-Explanatory Document for Nordic FCR additional properties proposal section 5.11.<br><br>Article 7.2 - speed requirements (page 8): The speed of response is already dictated by equations 5 & 6, there is no need to impose additional speed requirements. Furthermore, this requirement limits Static resources to use allowed functionality in the more in-depth technical requirements (Mode shifting) that the dynamic reserves are allowed to use. It therefore discriminatory. It also goes against 154-2-Explanatory Document for Nordic FCR additional properties proposal section 5.11. | The additional requirement on response delay for Static FCR-D in Article 5(2) and 7(2) of the proposal is introduced as larger delays for the activation of FCR can impact stability and worsen the consequences of over-reactions to smaller disturbances. Since Static FCR-D do not need to contribute to stabilisation and damping of oscillations, and do not have any deactivation requirement, a maximum delay is needed to mitigate the risks in relation to stability and over-reactions. The TSOs further refer to the answer to comment number 5.<br><br>Mode shifting is a possibility that has been introduced in the prequalification assessments to allow provision of Dynamic FCR-D from units that have slightly worse dynamic capabilities and thus some problems with fulfilling the performance and stability requirements for Dynamic FCR-D at the same time. These units are during prequalification allowed to not fully contribute to stabilisation and dampening of oscillations for the first 10 seconds of a large disturbance. This is in general not needed, as the oscillations that will occur will in general have a period of more than 10 seconds. The mode-shifting is thus a relaxation of the interpretation of the stability requirements in Article 4(5) and 6(5) of the proposal regarding Dynamic FCR D. The intention is to make it possible for more types of units to be prequalified for Dynamic FCR-D, including demand-side response, as the TSOs are aware of that the new requirements are significantly stricter than the previous ones. However, as the requirement to contribute to stability and dampening of oscillations does not exist for Static FCR-D, the TSOs find it difficult to follow the above argumentation, since there is no corresponding requirement to allow a relaxation from. The TSOs also would like to highlight that both Static and Dynamic FCR-D is possible to prequalify for using production, demand and energy storages. Finally, the TSOs also refer to the answer to comment 6 for a further discussion. In conclusion, the TSOs do not agree that any of the requirements are discriminatory. |

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| | | | Regarding the Explanatory document, it is stated in the comment that the requirements in the proposal are not in accordance with the statements of the Explanatory document, section 5.11. However, the Explanatory document does not have a section 5.11. The TSOs have not managed to identify what section the comment might be referring to and have not identified any contradictions. |
| 9 | Sympower | Article 9.1 (page 10): Often loads with flexible capacity do not have the need for such high accuracies in their local measurements. Impact of accuracy is far smaller than e.g. allowed variations in the response. Applying unnecessarily strict accuracy requirements would only add a hurdle for new and old providers. Although we understand the TSOs will reassess the accuracy requirements after gaining more experience, we would propose to increase the accuracy level by an extra 1 % (Category B: 2 % and C+D: 1.5 %). | Comment acknowledged and did not result in a change of the proposal. The level of detail of the requirements in the proposal has been reduced as a result of comment 3, but the TSOs intend to implement the requirements in the prequalification process as they were in the consultation version of the proposal. Accurate measurements are necessary to ensure and verify correct delivery of the services. The TSOs are aware of the potential difficulty for existing units to fulfil the measurement requirements, and have correspondingly included an exemption for existing units already providing these services. The TSOs further refer to comment 3. The TSOs intend to review the requirements during the transition period in accordance with Article 10(3) of the proposal, and will propose updates if any of the requirements is shown to be unnecessary restrictive. |
| 10 | Sympower | Article 10.4 - implementation of new requirements by new FCR providing units or groups (page 11): For a new/expanding provider of FCR, the requirements will be valid after less than 1 year after approval. This is little time to do development and testing to ensure a good system is in place for new requirements. We urge the TSO to communicate this early and potentially set the date 1 year after the approval to ensure development can be done properly and not rushed." | Comment acknowledged and did not result in a change of the proposal. A near final version of the requirements of this methodology was presented in March 2021, as a preparation for the pilot phase conducted during fall 2021. The final proposal of the requirements in this methodology was included in the prequalification document consulted in March 2022 and updated based on the comments in May 2022. Furthermore, the NRAs will assess the methodology, which could take up to at least 6 months. The TSOs thus conclude that the requirements will have been known for quite some time when the time comes for the potential approval. The specific date when the new requirements will be applied for new units or groups will be communicated in advance by the relevant TSO in accordance with Article 10(4) of the proposal. The TSOs will make the assessment of the needed time closer to the approval, but does not see that a period of 1 year will be needed for preparations. The assessment might be different if e.g. the NRAs would approve of the proposal much earlier than expected. |

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| 11 | UPM Energy Oy | UPM sees that when FCR requirements become more strict, it will lead to increasing need for investments and additional costs on current FCR providers. TSO's should consider the resource and trading efficiency. | Comment acknowledged and did not result in a change of the proposal. The TSOs are aware of the potential reduction of liquidity in the FCR markets and increased costs to be able to provide FCR. However, the requirements are designed to meet the system demands. The TSOs have put a lot of effort in maintaining the liquidity in the markets and also minimize the cost to be able to provide FCR while still meeting the system demands. This is further elaborated on in section 5.1 of the Explanatory document. |
| 12 | Statkraft Energi AS | CONSULTATION RESPONSE FROM STATKRAFT ENERGI AS AND STATKRAFT SVERIGE AB ON NORDIC TSOs' PROPOSAL ON FCR ADDITIONAL PROPERTIES<br><br>Statkraft supports the process of unifying the requirements for FCR in the Nordic power system, and we are generally pleased with the changes proposed in this consultation. The proposed methodology gives the Nordic TSOs some room for national adaptions. We fully support the need for some leeway to ensure that we are not unnecessarily limited by too stringent requirements not adapted to the specific conditions. At the same time, Statkraft is an actor delivering services in more than one Nordic country and for us it is important that the TSOs strive for harmonisation whenever possible.<br><br>We agree with the Nordic TSOs' goal that the proposed solutions should be feasible from a market perspective, and that the requirements have been set to ensure security of supply and the functioning of the FCR market. We also understand that the TSOs must set stricter requirements than they do today, even if it results in reduced ability to deliver FCR to the market compared to the current situation.<br><br>However, we want to point out that there is a trade-off for the power system between more accurate FCR and the ability for producers to offer FCR and other reserves, because the requirements not only impact our ability to offer FCR-services but may also limit our ability to offer other balancing services, such as aFRR and mFRR. Today, it is possible to have simultaneous delivery of FCR, automatic frequency restoration reserves (aFRR) and manual frequency restoration reserves (mFRR) from the same unit. This is possible because FCR can be delivered on the entire operating | Comment acknowledged and did not result in a change of the proposal. The TSOs agree that it can be useful for a provider to provide several services from the same unit at the same time. The comment is referring to a statement that FCR may only be delivered in the operational ranges for which the unit or group has been prequalified for. In turn, it is only possible to prequalify for operation ranges for which the unit or group actually fulfils the technical requirements of FCR. The TSOs are aware of that the new requirements in some instances might limit the operating range for which it is possible to provide FCR, and hence limit simultaneous delivery of FCR and FRR, since the FRR delivery can push the FCR delivery out of the prequalified range. However, the TSOs can't allow a unit to provide FCR outside the prequalified operating range as the response will not meet the demands of the power system anymore. The TSOs will assess the impact of the new requirements when more experience is gained, in accordance with Article 10(3) of the proposal, and re-evaluate the requirements if shown to be too restrictive. |

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| | | window of each unit. The proposed FCR requirements have the potential to significantly reduce the operating window in which FCR can be provided by a generating unit. With a reduced FCR window, e.g., mFRR bids cannot be offered to the same extent as today from a unit when there is an FCR bid contracted by the TSO, without breaching the rule that offered capacity in the different markets for primary-, secondary- and tertiary reserves shall not overlap for the same market time unit. Thus, the consequences of too strictly requirements may be lack of supply of reserves and unnecessarily high costs for grid users. | |
| 13 | Statkraft Energi AS | We support the proposal to give existing FCR-providing units up to five years to transition to the new requirements. However, it is unclear to us how this will work in practice during the transition period. Will qualified and not yet qualified units offer their services in the same market? Being in the same market, with the same market price, might make it less attractive to qualify before the end of the five-year period. While Statkraft believes that a five-year transition period might be sufficient, there may be limitations in the delivery capabilities in the supplier's market of turbine governors. The TSOs should therefore be flexible with regard to the duration of the transition period beyond the five-year limit. | Comment acknowledged and did not result in a change of the proposal. The TSOs believe that the transition period should not be longer than necessary, as the new requirements are needed to meet the demands of the Nordic power system. The TSOs highlight that the prequalification has to be re-evaluated every 5 years anyway, in accordance with Article 155(6) of the SO regulation. The providers thus need to plan to handle prequalifications with an interval of 5 years.<br><br>The actual prequalification process and the design of the FCR markets are a national matter, and the questions should be directed to the relevant TSO. For practical reasons, during the transition period both units and groups qualified towards the previous and the new requirements will provide FCR delivery in the same markets, but how this might affect the market design has to be handled nationally, as the markets are national. |
| 14 | Statkraft Energi AS | As we understand it, the TSOs will require a re-qualification process every five years, or in case of changes or modernization of the equipment or requirements. We understand the need for re-qualification following changes or modernization. For unchanged installations, we believe that a simplified re-qualification process could be used every other time (every tenth year), due to the potential costs related to personnel and altered production schedules following a full re-qualification. | Comment acknowledged and did not result in a change of the proposal. The reassessment requirement arises from Article 155(6) of the SO regulation. The TSOs plans to allow a reduced scope of the reassessment for unchanged units every other time, compared to full prequalification. This will be further described in the prequalification documents. |
| 15 | Statkraft Energi AS | The documentation provided in this consultation (or in the Nordic TSOs' previous consultation on the new technical requirements for FCR for the Nordic synchronous area including their summary of consultation responses) does not provide us with a sufficiently clear and specific description of information exchange and logging, including requirements | Comment acknowledged and did not result in a change of the proposal. The scope of this methodology does not cover the implementation of information exchange, especially the IT-technical aspects like time resolution, architecture, protocol, etc. The practical aspects of the information exchange are defined in Article 40 and |

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| | | for resolution and accuracy, architecture, and protocol use and implementation. A standard solution should be developed which can be reused for all FCR units. Statkraft has experience with similar data exchanges in the UK and can provide best practice examples of requirement documentation upon request. | onwards of the SO regulation, and is handled partially on a European level, partially on a national level. The relevant guidance must be requested from the relevant TSO.<br><br>The TSOs acknowledges Statkraft's offer to share experiences of best practices, and will upon request provide relevant contact information for the respective TSOs. |