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

6 May 2022

DISCLAIMER
This document is released on behalf of all TSOs of Nordic synchronous area only for the purposes of the public consultation on 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. This version of the methodology for the additional properties of FCR does not in any case represent a firm, binding or definitive TSOs' position on the content.

All TSOs of the Nordic synchronous area, taking into account the following:

Whereas

(1) This document is the common methodology developed by all Transmission System Operators within the Nordic synchronous area (hereafter referred to as "**TSOs**") for additional properties of FCR in accordance with Article 154(2) of Commission Regulation (EU) 2017/1485 establishing a guideline on electricity transmission system operation (hereafter referred to as "**SO Regulation**"). This methodology is hereafter referred to as "**Methodology**". The Methodology is an amended version of the methodology dated 18 June 2020 which was approved by the Nordic regulators in September 2020.

(2) The Methodology takes into account the general principles and goals set in the SO Regulation as well as Regulation (EC) No 943/2019 of the European Parliament and of the Council of 5 June 2019 on conditions for access to the network for cross border exchanges in electricity (hereafter referred to as **"Regulation (EC) No 943/2019"**). The goal of the SO Regulation/Regulation (EC) No 943/2019 is the safeguarding of operational security, frequency quality and the efficient use of the interconnected system and resources. Article 118(1)(b) of the SO Regulation sets for this purpose requirements for the TSOs to "*jointly develop common proposals for: […] additional properties of FCR in accordance with Article 154(2);"*

(3) Article 154(1) of the SO Regulation refers to Annex V of the SO Regulation for the properties/minimum technical requirements for FCR that shall be ensured by each reserve connecting TSO. Annex V of the SO Regulation defines the minimum technical requirements for FCR for the Nordic synchronous area:

Minimum accuracy of frequency measurement	*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	*10 mHz*
FCR full activation time	*30 s if system frequency is outside standard frequency range*
FCR full activation frequency deviation	*± 500 mHz*

(4) On top of the minimum technical requirements specified in Annex V of the SO Regulation, Article 154(2) of the SO Regulation gives the TSOs *"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"*. Article 154(2) of the SO Regulation further describes that this shall be done *"by means of a set of technical parameters and within the ranges in Article 15(2)(d) of Regulation (EU) 2016/631 and Articles 27 and 28 of Regulation (EU) 2016/1388. 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."*. This Methodology covers additional properties of FCR for the Nordic synchronous area (only) and shall be applied by the Nordic TSOs (only).

(5) 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;".*

(6) Articles 27 and 28 of Regulation (EU) 2016/1388 (*"network code on demand connection*") describes 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.

(7) The Nordic Frequency Containment Process (FCP) currently applies two types of Frequency Containment Reserves (FCR). FCR for normal operation (FCR-N) is used for continuous imbalances to keep the frequency within the ± 100 mHz range. In conjunction with a rapid frequency change to 49.90/50.10 Hz, FCR-N shall today be up regulated/down regulated within 2-3 minutes. The purpose of FCR-D upwards is to mitigate the impact of incidental disturbances once the frequency is below 49.90 Hz. FCR-D upwards shall be fully activated if the frequency stabilises at 49.50 Hz. In the event of a frequency drop to 49.50 Hz caused by a momentary loss, FCR-D upwards shall be fully activated within 30 seconds. The purpose of FCR-D downwards is to mitigate the impact of incidental disturbances once the frequency is above 50.10 Hz. FCR-D downwards shall be fully activated if the frequency stabilises at 50.50 Hz. In the event of a frequency increase to 50.50 Hz caused by a momentary loss, FCR-D downwards shall be fully activated within 30 seconds. 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.

(8) In regard to regulatory approval, Article 6(3) of the SO Regulation states:
"The proposals for the following terms and conditions or methodologies shall be subject to approval by all regulatory authorities of the concerned region, on which a Member State may provide an opinion to the concerned regulatory authority: […]
(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);

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

(10) 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 (1)(c) determining common load-frequency control processes and control structures, (1)(d) ensuring the conditions for maintaining operational security throughout the Union, (1)(e) ensuring the conditions for maintaining a frequency quality level of all synchronous areas throughout the Union and (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, FCR-D upwards and FCR-D downwards, 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.

(11) The TSOs together operate the Nordic synchronous system. Consequently, the TSOs and all the power consumers, generators, balance service providers and networks directly or indirectly connected to the TSOs' networks, influence the frequency quality level and experience the same frequency level. FCR-N, FCR-D upwards and FCR-D downwards will only be effective if all providers will provide the contracted amounts in accordance with their respective specifications.

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

SUBMIT THE FOLLOWING AMENDED METHODOLOGY TO ALL REGULATORY AUTHORITIES OF THE NORDIC SYNCHRONOUS AREA:

Article 1 - Subject matter and scope

1. The additional properties for FCR described in this Methodology are the common proposal of the TSOs in accordance with Article 154(2) of the SO Regulation. The Methodology applies solely to the Nordic synchronous area.

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

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

2. This Methodology is subject to approval in accordance with Article 6(3) of the SO Regulation.

Article 2 - Definitions and interpretation

1. For the purposes of the Methodology, the terms used shall have the meaning of the definitions included in Article 3 of the SO Regulation.

2. In this Methodology, unless the context requires otherwise:
   a) the singular indicates the plural and vice versa;
   b) the headings are inserted for convenience only and do not affect the interpretation of the Methodology; and
   c) any reference to legislation, regulations, directives, orders, instruments, codes or any other enactment shall include any modification, extension or re-enactment of it when in force.

Article 3 – FCR-N additional properties

1. The FCR-N regulation product is activated in the interval 49.9 Hz to 50.1 Hz. FCR full activation frequency deviation for FCR-N is ± 100 mHz. The activation within the interval 49.9 to 50.1 Hz must be proportional to the frequency deviation. At a system frequency of 50.0 Hz, 0% of the FCR-N capacity shall be activated. At system frequencies equal to or below 49.9 Hz, 100% of the FCR-N capacity shall be activated in the upward direction. Respectively, at system frequencies equal to or above 50.1 Hz, 100% of the FCR-N capacity shall be activated in the downward direction.

2. The dynamic response from FCR-N shall be tuned to suppress variations in the frequency with periodicity of 10 seconds and slower, with an emphasis around period times of 70 seconds. 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.

3. The deactivation behaviour of FCR-N shall fulfil the same requirements as stated for the activation behaviour in 2.

4. In addition to 2 and 3, the FCR-N response 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.

5. In case of a frequency deviation different than outlined in point 2, the FCR-N response shall be activated by applying the same time behaviour as for full activation and deactivation.

6. The dynamic properties of the FCR-N response shall act such that it contributes to stabilisation and damping of system frequency oscillations.

7. Prequalification requirements and tests specified and governed by the reserve connecting TSO shall confirm that the FCR-N product provided to the TSO complies with the requirements in paragraphs 1 to 6.

Article 4 – Dynamic FCR-D upwards additional properties

1. The Dynamic FCR-D upwards regulation product is activated in the interval 49.9 Hz to 49.5 Hz. The activation within the interval 49.9 to 49.5 Hz must be proportional to the frequency deviation. At a frequency of 49.9 Hz, 0% of the Dynamic FCR-D upwards capacity shall be activated, and at frequencies equal to or below 49.5 Hz, 100% of the Dynamic FCR-D upwards capacity shall be activated.

2. In conjunction with a system frequency change from 49.9 Hz to 49.0 Hz with a slope of -0.24 Hz/s, Dynamic FCR-D upwards shall be regulated upwards as follows:

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

    In the equations above,

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

    ΔP_{ss} (MW) is the steady state Dynamic FCR-D upwards activation at a frequency deviation of -500mHz

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

3. The Dynamic FCR-D upwards response shall be able to follow variations in the system frequency by activation and deactivation. The dynamic response shall provide continuous frequency control when the frequency is below the standard frequency range.

4. In case of an instantaneous frequency deviation different than outlined in point 2, the Dynamic FCR-D upwards response shall be activated by applying the same dynamic behaviour as in points 2 and 3 above.

5. The dynamic properties of the Dynamic FCR-D upwards response shall act such that it contributes to stabilisation and damping of system frequency oscillations.

6. Prequalification requirements and tests specified and governed by the reserve connecting TSO shall confirm that the Dynamic FCR-D upwards product provided to the TSO complies with the requirements in paragraphs 1 to 5.

Article 5 – Static FCR-D upwards additional properties

1. The Static FCR-D upwards regulation product is activated in the interval 49.9 Hz to 49.5 Hz. The activation within the interval 49.9 to 49.5 Hz must be proportional or close to proportional to the frequency deviation. At a frequency of 49.9 Hz, 0% of the Static FCR-D upwards capacity shall be activated, and at frequencies equal to or below 49.5 Hz, 100% of the Static FCR-D upwards capacity shall be activated.

2. In conjunction with a system frequency change from 49.9 Hz to 49.0 Hz with a slope of -0.24 Hz/s, Static FCR-D upwards shall be regulated upwards as follows:

    3. $|\Delta P_{7.5s}| \geq 0.86 \cdot |\Delta P_{ss}|$
    4. $|E_{7.5s}| \geq 3.2s \cdot |\Delta P_{ss}|$

    In the equations above,

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

    ΔP_{ss} (MW) is the steady state Static FCR-D upwards activation at a frequency deviation of -500mHz

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

    The delay before the response is initiated shall not exceed 2.5 seconds.

3. In case of an instantaneous frequency deviation different than outlined in point 2, the Static FCR-D upwards response shall be activated by applying the same dynamic behaviour as in points 2 above.

4. The dynamic properties of the Static FCR-D upwards response shall act such that it does not negatively affect stabilisation and damping of system frequency oscillations.

5. Prequalification requirements and tests specified and governed by the reserve connecting TSO shall confirm that the Static FCR-D upwards product provided to the TSO complies with the requirements in paragraphs 1 to 4.

Article 6 – Dynamic FCR-D downwards additional properties

1. The Dynamic FCR-D downwards regulation product is activated in the interval 50.1 Hz to 50.5 Hz. The activation within the interval 50.1 to 50.5 Hz must be proportional to the frequency deviation. At a frequency of 50.1 Hz, 0% of the Dynamic FCR-D downwards capacity shall be activated, and at frequencies equal to or above 50.5 Hz, 100% of the Dynamic FCR-D downwards capacity shall be activated.

2. In conjunction with a system frequency change from 50.1 Hz to 51.0 Hz with a slope of 0.24 Hz/s, Dynamic FCR-D downward shall be regulated downwards as follows:

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

    In the equations above,

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

ΔP_{ss} (MW) is the steady state Dynamic FCR-D downwards activation at a frequency deviation of 500mHz

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

3. The Dynamic FCR-D downwards response shall be able to follow frequency variations in the system frequency by activation and deactivation. The dynamic response shall provide continuous frequency control when the frequency is above the standard frequency range.

4. In case of an instantaneous frequency deviation different than outlined in point 2, the Dynamic FCR-D downwards response shall be activated by applying the same dynamic behaviour as in points 2 and 3 above.

5. The dynamic properties of the Dynamic FCR-D response shall act such that it contributes to stabilisation and damping of system frequency oscillations.

6. Prequalification requirements and tests specified and governed by the reserve connecting TSO shall confirm that the Dynamic FCR-D downwards product provided to the TSO complies with the requirements in paragraphs 1 to 5.

Article 7 – Static FCR-D downwards additional properties

1. The Static FCR-D downwards regulation product is activated in the interval 50.1 Hz to 50.5 Hz. The activation within the interval 50.1 to 50.5 Hz must be proportional or close to proportional to the frequency deviation. At a frequency of 50.1 Hz, 0% of the Static FCR-D downwards capacity shall be activated, and at frequencies equal to or below 50.5 Hz, 100% of the Static FCR-D downwards capacity shall be activated.

2. In conjunction with a system frequency change from 50.1 Hz to 51.0 Hz with a slope of -0.24 Hz/s, Static FCR-D downwards shall be regulated upwards as follows:

    5. $|\Delta P_{7.5s}| \geq 0.86 \cdot |\Delta P_{ss}|$
    6. $|E_{7.5s}| \geq 3.2s \cdot |\Delta P_{ss}|$

    In the equations above,

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

    ΔP_{ss} (MW) is the steady state Static FCR-D downwards activation at a frequency deviation of -500mHz

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

    The delay before the response is initiated shall not exceed 2.5 seconds.

3. In case of an instantaneous frequency deviation different than outlined in point 2, the Static FCR-D downwards response shall be activated by applying the same dynamic behaviour as in points 2 above.

4. The dynamic properties of the Static FCR-D downwards response shall act such that it does not negatively affect stabilisation and damping of system frequency oscillations.

5. Prequalification requirements and tests specified and governed by the reserve connecting TSO shall confirm that the Static FCR-D downwards product provided to the TSO complies with the requirements in paragraphs 1 to 4.

Article 8 – Additional properties on FCR providing units and groups with limited energy reservoirs

1. 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.

2. FCR-N provision from FCR providing units or groups with limited energy reservoirs (LER) shall be continuously available during the whole contractually agreed delivery period.

3. FCR-D provision from FCR providing units or groups with limited energy reservoirs (LER) shall be continuously available in normal state. As 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.

4. 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.

5. In case of a new disturbance during the recovery process an FCR providing unit or group shall be able to stop the recovery and start activation of the reserve with the available energy.

6. 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 depletion, and an Alert state Energy Management scheme (AEM) to limit the consequences of a reservoir depletion. 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.

7. 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 depletion has occurred. The Normal state Energy Management function shall be used to restore the reservoir level to the nominal value.

8. The FCR providing unit or group shall activate the Alert state Energy Management function when the reservoir level has drifted from the nominal level such that a severe risk of depletion has occurred. The Alert state Energy Management function shall be used to ensure that the FCR response does not fully and suddenly cease.

9. 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.

10. Use of energy management functions shall not interfere with the ability to provide FCR.

11. Prequalification requirements and tests specified and governed by the reserve connecting TSO shall confirm that the FCR product(s) provided to the TSO complies with the requirements in paragraphs 1 to 10.

Article 9 – Additional properties on minimum accuracy and resolution of measurements

1. The measurement accuracy for active power and frequency shall achieve the values stated in the below table, or better. The value shall include the total inaccuracy of instrument (measurement) transformer, measurement transducer and any other equipment in the measurement system.

Measured quantity	Category	Rated power	Accuracy
Active power	A	< 1.5 MW	$\pm 5\%$
	B	$1.5 - 10$ MW	$\pm 1\%$
	C+D	> 10 MW	$\pm 0.5\ \%$
System frequency	N/A	N/A	± 10 mHz

2. FCR providing units or groups of category C+D, which have been prequalified for the first time prior to the end of 2023, will be evaluated towards the accuracy requirements for category B in paragraph 1. The exemption in this paragraph shall continue to apply only until the next substantial change of the equipment.

3. The measurement resolution for active power and frequency shall achieve the values stated in the below table, or better.

Measured quantity	Resolution
Active power	0.01 MW or 0.025%
System frequency	5 mHz

4. Prequalification requirements and tests specified and governed by the reserve connecting TSO shall confirm that the FCR product(s) that is provided to the TSO complies with the requirements in paragraphs 1 to 3.

Article 10 – Publication and implementation

1. The relevant TSOs shall publish (in accordance with Article 8 of the SO Regulation) the Methodology without undue delay after the competent NRAs have approved the Methodology or a decision has been taken by the Agency for the Cooperation of Energy Regulators in accordance with Article 6 of the SO Regulation.

2. The TSOs shall start to implement the FCR additional properties as specified in this 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

3. 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. 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.

4. New FCR providing units and groups shall apply the new requirements immediately after implementation in national processes. The specific date will be communicated in advance by the relevant TSO.

5. Existing FCR providing units and groups shall have transitioned within a maximum of five years counted from the date of approval by the NRAs of the Synchronous Area.

6. When the existing prequalification is re-evaluated the evaluation shall be made towards the new requirements as stated in this Methodology.

7. The reserve connecting TSO shall be allowed to extend existing prequalifications to ensure a smooth transition. The extension shall be based on successful auditing based on the pre-existing requirements. The extension shall end at the latest at the date defined in point 5.

Article 11 - Language

The reference language for this Methodology shall be English. For the avoidance of doubt, where TSOs needs to translate this Methodology into national language(s), in the event of inconsistencies between the English version published by TSOs in Nordic Synchronous Area in accordance with Article 8(1) of the SO Regulation and any version in another language the relevant TSOs shall, in accordance with national legislation, provide the relevant national regulatory authority with an updated translation of the Methodology.