~~All TSOs' of the Nordic Capacity Calculation Region proposal for capacity calculation methodology in accordance with Article 10(1) of Commission Regulation (EU) 2016/1719 of 26 September 2016 establishing a guideline on forward capacity allocation~~

~~16 January 2019~~

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~~Table of Contents~~

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~~All TSOs~~ACER Decision on Nordic LT CCM: Annex I

Long-term capacity calculation methodology of the Nordic ~~Capacity Calculation Region, taking into account the following:~~ capacity calculation region

in accordance with Article 10(1) of Commission Regulation (EU) 2016/1719 of 26 September 2016 establishing a guideline on forward capacity allocation

~~XX~~ 30 October 2019

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Contents

Whereas

~~(2)~~(1) This document describes a common methodology developed by all Transmission System Operators (hereafter referred to as "TSOs") of the Nordic ~~Capacity Calculation Region~~capacity calculation region (hereafter referred to as "~~CCR~~ Nordic CCR") as defined in accordance with Article 15 of Commission Regulation (EU) 2015/1222 establishing a guideline on Capacity Allocation and Congestion Management (hereafter referred to as the "CACM Regulation") regarding a capacity calculation methodology for ~~Capacity Calculation~~ (hereafter referred to as "CCM") in accordance with Article 10 of the Commission Regulation 2016/1719 (hereafter referred to as the "FCA Regulation").

~~(4)~~(2) This CCM takes into account the general principles, goals and other methodologies set in the FCA Regulation, CACM Regulation, Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation (hereafter referred to as "SO Regulation"), Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity (hereafter referred to as "Regulation (EU) 2019/943") and Regulation (EC) No 714/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the network for cross~~-~~ border exchanges in electricity (hereafter referred to as "Regulation (EC) No 714/2009").~~—~~

~~(6)~~(3) The goal of the FCA Regulation is the coordination and harmonisation of cross-zonal capacity calculation and capacity allocation in the forward markets~~, and it~~. It sets requirements for the TSOs to cooperate ~~on~~at the level of capacity calculation regions (hereinafter referred to as "CCRs~~"),~~") on a pan-European level and across bidding zone borders. The FCA Regulation also sets rules for establishing capacity calculation methodologies based either on the coordinated net transmission capacity approach (hereafter referred to as "CNTC approach") or on the flow-based approach (hereafter referred to as "FB approach").

~~(8)~~(4) This CCM is the implementation of the rules set out in the FCA regulation with the aim of providing the concrete methodology for calculating ~~capacity~~cross-zonal capacities up to a year ahead~~, so called~~ of delivery, i.e. long~~-~~-term capacity calculation (LT CC). The objective of ~~providing LT capacity~~calculating long-term cross-zonal capacities is two-fold. Firstly, market participants in the ~~power~~electricity market aim at forecasting ~~future~~ the day ahead (DA~~-pricing of~~) prices in the different bidding zones, ~~acting~~and these forecasts are serve as an input to the strategies for operation and investment decisions. The goal of LT CC is to provide the market participants with the information of expected ~~capacity between bidding zones~~cross-zonal capacities, as this information has an impact on demand and supply of electricity and hence the DA ~~pricing~~prices. Secondly, the calculation of ~~LT capacity will act~~long-term cross-zonal capacities allows to allocate these capacities as ~~input to the issuing of LT~~long-term transmission rights on bidding zone borders where ~~LT transmissions~~regulatory authorities have decided that these rights are ~~implemented (currently only DK1-DK2). Thus, the calculation of LT capacity will also~~needed to provide ~~capacity for hedging purposes.~~ sufficient opportunities to hedge against the prices within and between bidding zones in accordance with the FCA Regulation

~~(10)~~(5) This CCM takes into account the ~~Common Grid Model~~common grid model (hereafter referred to as "CGM") methodology and ~~assumes~~requires that the CGM ~~developed accordingly,~~ is available ~~in order to execute~~ for each scenario and each long-term capacity calculation ~~for the long-term~~ time frame~~. Thus the frequency of the reassessment of~~ in order to execute long-term capacity ~~depends on the availability of the CGM for~~ calculation. Thus, the long-term ~~timeframe.~~capacity

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calculation time frames, the number of scenarios for each time frame and the CGMs established pursuant to the CGM methodology need to be fully aligned. Eight scenarios ~~shall~~are to be created within the CGM for the year-ahead capacity calculation, and two scenarios for the month-ahead capacity calculation.

~~(12)~~(6) This CCM follows the definitions of the ~~Flow Based approach and the Coordinated Net Transmission Capacity~~FB approach according to Article 2(~~8) and 2(~~9) ~~in~~of the CACM Regulation.

~~(14)~~(7) This CCM also takes into account ~~also~~ specific situations in the Nordic power system such as dynamic and voltage stability.

~~(16)~~(8) This CCM takes into account that not all bidding zone borders in the Nordic CCR ~~Nordic apply~~will allocate long-term transmission rights~~, implying that a~~. A separate legal document covering the methodology for splitting of long-term cross zonal capacity, in a coordinated manner between different long-term time frames, ~~shall be developed by the affected TSOs. The legal status of the separate methodology for splitting of long term cross zonal capacity shall be distinguished from the legal status of this methodology. The methodology for splitting of long term cross zonal capacity only applies to the Danish bidding zone border (currently DK1-DK2) where long term transmission rights have been introduced.~~is to be developed by the concerned TSOs that allocate long-term transmission rights.

~~(18)~~(9) Article 4(8) of the ~~FCA~~Commission Regulation (EU) 2016/1719 of 26 September 2016 establishing a guideline on forward capacity allocation (the 'FCA Regulation') requires that the expected impact of the CCM on the objectives of the FCA Regulation is described. The impact is presented ~~below (~~in points (10) to (~~15) of this Whereas Section).~~17) below.

~~(20) The CCM contributes to and does not in any way hamper the achievement of the objectives of Article 3 of the FCA Regulation. In particular, the CCM serves the objectives of optimising the calculation and allocation of long term cross zonal capacity (Article 3(b) of the FCA Regulation), providing non discriminatory access to long term cross zonal capacity (Article 3(c) of the FCA Regulation), respecting the need for a fair and orderly forward capacity allocation and orderly price formation (Article 3(e) of the FCA Regulation), ensuring and enhancing the transparency and reliability of information on forward capacity allocation (Article 3(f) of the FCA Regulation) and contributing to the efficient long term operation and development of the electricity transmission system and electricity sector in the Union (Article 3(g) of the FCA Regulation).~~

~~(22)~~(10) The CCM serves the objective of optimising the calculation and allocation of long-term cross-zonal capacity in accordance with Article 3(b) of the FCA Regulation since the CCM is ~~using~~applying the ~~CNTC~~flow based approach to ~~provide~~calculate cross-zonal capacities~~, that are calculated~~ in a ~~more~~ coordinated manner~~, to market participants.~~. This approach by default optimises the use of transmission infrastructure as it maximises the economic surplus when allocating cross-zonal capacities. Moreover, optimisation of capacity calculation is ~~secured based on~~also achieved with the coordination between the transmission system operators of the Nordic CCR (Nordic TSOs~~, hereby~~) and applying a ~~CGM and a Coordinated Capacity Calculator~~common grid model and common capacity calculation by the coordinated capacity calculator.

~~(24)~~(11) The CCM serves the objective of transparency and reliability of information (Article 3(f) of the FCA Regulation) as ~~the CCM determines the main principles and main processes for the long-~~

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~~term time frame. The CCM enables TSOs to provide~~it provides market participants with the ~~same~~ reliable information on long-term cross-zonal capacities for forecasting the day-ahead prices and for long-term capacity allocation and ~~for forecasting and~~ cross-zonal risk hedging purposes~~ in a transparent way~~. To facilitate transparency, the TSOs should publish data to the market on a regular basis to help market participants ~~to~~ evaluate the capacity calculation process and long-term cross-zonal capacity forecasts. The TSOs should engage stakeholders in dialogue to specify necessary and useful data to this effect. ~~The publication requirements are without prejudice to confidentiality requirements pursuant to national legislation.~~

~~(26)~~(12) The CCM does not hinder an efficient long-term operation in ~~CCR~~the Nordic CCR and adjacent CCRs, and the development of the transmission system in the European Union (Article 3(g) of the FCA Regulation). The CCM, by taking most important ~~grid~~network constraints into consideration, will support efficient pricing in the forward markets and forecasts of long-term cross-zonal ~~capacity~~capacities, providing the right signals from a long-term perspective.

~~(28)~~(13) The CCM contributes to the objective of respecting the need for a fair and orderly ~~forward capacity allocation and~~ price formation in the long-term time frames (Article 3(e) of the FCA Regulation) by making available in due time the cross-zonal ~~capacity to be released~~capacities available in the long-term time frame and forward markets, where appropriate.

~~(30)~~(14) The CCM contributes to non-discriminatory access to long-term cross-zonal capacity (Article 3(c) of the FCA Regulation). ~~Application of non-costly RAs~~Taking into account the remedial actions in capacity calculation contributes to the maximisation of long-term cross-zonal capacity provided for forward capacity allocation as long-term transmission rights and the maximisation of cross-zonal capacity forecasts for borders not ~~offering~~allocating long-term transmission rights.

~~(32) Rules for avoiding undue discrimination are only relevant when allocation of cross-zonal capacity in a long-term time frame takes place, hence this is considered only relevant for TSOs allocating long-term transmission rights.~~

(15) The CCM contributes to effective long-term cross-zonal trade with long-term cross-zonal hedging opportunities for market participants (Article 3(a) of the FCA Regulation) by providing market participants the opportunities to acquire long-term transmission rights where such rights are needed as decided by the competent regulatory authorities. It also provides market participants the information on forecasted cross-zonal capacities, which can be used for pricing the long-term hedging products.

(16) The CCM does not discriminate any TSO and market participants as it provides equal rights and obligations to all Nordic TSOs and equal rights to all market participants. The CCM is deemed to have no impact on the Agency and regulatory authorities. This CCM is therefore compliant with the objective referred to in Article 3(d) of the FCA Regulation.

~~(34)~~(17) In conclusion, the CCM contributes to the general objectives of the FCA Regulation to the benefit of market participants and electricity end consumers.

~~**SUBMIT THE FOLLOWING CCM TO ALL REGULATORY AUTHORITIES OF THE CCR NORDIC:**~~

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(18) In accordance with Article 10(5) of the FCA Regulation, the CCM applies the flow-based approach to capacity calculation. In capacity calculation regions characterised by meshed networks and physically interdependent bidding zone borders, the flow-based approach by default leads to an increase in economic efficiency with the same level of system security. This is because, when a network element, which is considered in capacity calculation as critical network element is significantly impacted by cross-zonal exchanges on two or more bidding zone borders (which makes those borders interdependent), then it is by default more efficient that requests for cross-zonal exchanges on these interdependent borders equally compete for the capacity of such critical network element. This competition between borders is the intrinsic advantage of the flow based approach compared to the coordinated net transmission capacity ('NTC') approach. In the latter approach, the capacity of such critical network elements needs to be first split into portions reserved for each of the interdependent borders and then converted into NTC values for each border. These NTCs are then allocated independently on each interdependent border, which essentially limits the competition between interdependent borders for the capacity of such critical network elements. Lack of competition between borders for the capacity of network elements, which these borders are significantly impacting inevitably, leads to loss of economic efficiency in allocating the capacity of such network elements.

(19) This methodology provides a transition period for the allocation of long-term cross-zonal capacities based on flow-based parameters. Until the single allocation platform ('SAP') is not able to allocate cross-zonal capacities using the flow based parameters, the Nordic TSOs may convert the flow-based parameters resulting from the application of the flow-based approach into available transfer capacities ('ATC') for each bidding zone border to be used for long-term capacity allocation by the SAP. This transition period also provides sufficient time to Nordic TSOs to meet other requirements for introducing the flow-based approach pursuant to Article 10(5) of the FCA Regulation. This includes ensuring transparency and accuracy of the flow-based results before implementation and providing market participants with six months to adapt their processes.

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TITLE ~~I~~
1 - General provisions

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Article 1
. Subject matter and scope

1. ~~The~~This CCM is the common methodology of TSOs in ~~CCR~~ Nordic CCR in accordance with Article 10(1) of the FCA Regulation.

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~~3.~~2. This CCM applies solely to the ~~CCR~~ Nordic CCR as ~~defined~~determined in accordance with Article 15 of the Commission Regulation (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management (the 'CACM ~~Regulation.~~Regulation').

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~~5.~~3. This CCM covers the capacity calculation methodologies for the long-term time frame, where cross-zonal ~~capacity~~capacities shall be calculated for each forward capacity allocation and at least on annual and monthly time frames.

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Article 2
. Definitions and interpretation

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1. For the purposes of the ~~Proposal~~methodology, the terms used shall have the meaning given to them in Article 2 of Regulation (EC) No 714/2009 ~~of the European Parliament and of the Council of 13 July 2009 on conditions for access to the network for cross-border exchanges in electricity and repealing Regulation (EC) no 1228/2003~~, Article 2 of the ~~Commission Regulation (EU) 2016/1719 of 26 September 2016 establishing a guideline for forward capacity allocation (hereafter referred as "~~FCA Regulation~~")~~,, Article 2 of the ~~Commission Regulation (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management (hereafter referred to as "~~CACM Regulation~~")~~,, Article 3 of the Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation (~~hereafter referred to as "SO Regulation"),~~the 'SO Regulation'), Article 2 of the Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing ~~(hereafter referred to as "Balancing Regulation"),~~, and Article 2 of Commission Regulation (EU) No 543/2013 of 14 June 2013 on submission and publication of data in electricity markets and amending Annex I to Regulation (EC) No 714/2009 of the European Parliament and of the Council ~~(hereafter referred to as "Transparency Regulation")~~ and Article 2 of the capacity calculation methodology developed in ~~CCR~~the Nordic CCR in accordance with Article 20(2) of the CACM Regulation. In addition, the following definitions, abbreviations and notations shall apply:

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1. 'ATC' means the available transmission capacity on bidding zone borders, which is the transmission capacity that remains available after the deduction of eventual previously allocated capacities and which respects the physical conditions of the transmission system;

2. 'CCC' means the coordinated capacity calculator, as defined in Article 2(11) of the CACM Regulation, of the Nordic CCR, unless stated otherwise;

3. 'CCR' means the capacity calculation region as defined in Article 2(3) of the CACM Regulation;

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4. 'CGM' means the common grid model as defined in Article 2(2) of the CACM Regulation and means a CGM established in accordance with the common grid model methodology, pursuant to Article 18 of the FCA Regulation;

5. 'CNE' means a critical network element;

6. 'combined dynamic constraint' means a limit on the sum of power flows on a set of network elements or partial flows on a set of network elements for the purpose to respect dynamic stability limits;

7. 'cross-zonal network element' means a network element located on the bidding zone border or connected in series to such network element transferring the same power (without considering the network losses);

8. 'F_0' means the linear approximation of a flow in the reference net position on a CNEC or allocation constraint in a situation without any cross-zonal exchanges;

9. 'F_{max}' means the maximum flow on a CNEC or combined dynamic constraint;

10. 'F_{RA}'means the flow for increasing the RAM on a CNEC or combined dynamic constraint due to remedial actions taken into account in capacity calculation;

11. F_{ref}' means the reference flow on a CNEC or combined dynamic constraint;

12. 'GSK' means the generation shift key as defined in Article 2(12) of the CACM Regulation;

13. 'HVDC network element' means a high voltage direct current network element;

14. 'IGM' means the individual grid model as defined in Article 2(1) of the CACM Regulation for the long-term time frames;

15. 'I_{max}' means the maximum admissible current of a CNE or CNEC;

16. 'Nordic CCR' means the Nordic capacity calculation region as determined pursuant to Article 15 of the CACM Regulation;

17. 'internal network element' means a network element, which is not cross-zonal;

18. 'NP' or 'NP' means a net position of a bidding zone, which is the net value of generation and consumption in a bidding zone;

19. 'previously allocated cross-zonal capacities' means the long-term capacities which have already been allocated in previous (yearly and/or monthly) time frames;

20. 'PTDF' or '$PTDF$' means a power transfer distribution factor;

21. 'RA' means a remedial action as defined in Article 2(13) of the CACM Regulation;

22. 'RAM' or 'RAM' means a remaining available margin on a CNEC or combined dynamic constraint;

23. 'reference net position' or 'reference exchange' means a position of a bidding zone or an exchange over HVDC interconnector assumed within the CGM;

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24. ‘reliability margin’ or ‘F_{RM}’ means the reliability margin as defined in Article 2(14) of the CACM Regulation;

25. ‘slack node’ means the single reference node per synchronous area used for determination of the PTDF matrix, i.e. shifting the power infeed of generators up results in absorption of the power shift in the slack node. A slack node remains constant for each scenario;

26. ‘zone-to-slack $PTDF$’ means the PTDF of a commercial exchange between a bidding zone and the slack node;

27. ‘zone-to-zone $PTDF$’ means the PTDF of a commercial exchange between two bidding zones;

28. the notation x denotes a scalar;

29. the notation $\vec{x}$ denotes a vector;

30. the notation $\mathbf{x}$ denotes a matrix.

2. In this CCM, unless the context requires otherwise:

(a) ~~a)~~ the singular indicates the plural and vice versa;

(b) ~~b)~~ any reference to the long-term capacity calculation, long-term capacity calculation process or the long-term capacity calculation methodology shall mean a common long-term capacity calculation, common long-term capacity calculation process and common long-term capacity calculation methodology respectively, which is applied by all Nordic TSOs in a common and coordinated way on all bidding zone borders of the Nordic CCR;

(c) the table of content and the headings are inserted for convenience only and do not affect the interpretation of this CCM; and

(d) ~~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.

~~4.~~3. For the sake of clarity, this CCM does not affect TSOs' right to delegate their task in accordance with ~~the~~ Article 62 of the FCA Regulation. In this CCM ~~"~~, the reference to a TSO~~"~~ shall ~~refer to~~mean the Transmission System Operator or to a third~~-~~party, whom the TSO has delegated task(s) to, in accordance with the FCA Regulation, where applicable. However, the delegating TSO shall remain responsible for ensuring compliance with the obligations ~~under~~pursuant to the FCA Regulation.

TITLE 2
~~Calculation~~ Description of ~~the inputs to~~ capacity calculation ~~for the long-term time frame~~inputs

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Article 3
. Methodology for determining reliability margin

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1. ~~The~~ Each Nordic TSO shall provide to the CCC for each CNEC and combined dynamic constraint, and each long-term capacity calculation time frame the reliability margin to be used in the long-term capacity calculation.

2. The uncertainty in long-term capacity calculation shall be taken into account by the application of different scenarios in long-term capacity calculation pursuant to Article 17. For this reason, the reliability margin for long-term capacity calculation shall be set to zero ~~if no long term transmission rights~~for all CNECs and combined dynamic constraints and for all long-term capacity calculation time frames.

Article 4. Methodology for determining critical network elements and contingencies relevant to capacity calculation

1. Each Nordic TSO shall define a list of CNEs, which are ~~issued~~fully or partly located in its own control area, and which can be, *inter alia*, overhead lines, underground cables and transformers. All cross-zonal network elements shall be defined as CNEs, whereas only those internal network elements, which are defined pursuant to paragraphs 5 to 7 shall be defined as CNEs. Until 30 days after the approval of the proposal pursuant to paragraph 5, all internal network elements may be defined as CNEs.

2. Each Nordic TSO shall define a list of proposed contingencies used in operational security analysis in accordance with Article 33 of the SO Regulation, limited to their relevance for the set of CNEs as defined in paragraph 1 and pursuant to Article 23(2) of the CACM Regulation. The contingencies of a Nordic TSO shall be located within the observability area (as defined in Article 3(2)(48) of the SO Regulation) of that Nordic TSO. This list shall be updated at least on a yearly basis and in case of topology changes in the grid of the Nordic TSO, pursuant to Article 22. A contingency can be, *inter alia*, an unplanned outage of:

    (a) a line, a cable, or a transformer;

    (b) a busbar;

    (c) a generating unit;

    (d) a load; or

    (e) a set of the such network elements.

3. Each Nordic TSO shall establish a list of CNEs associated with a contingency (CNECs) by associating the contingencies established pursuant to paragraph 2 with the CNEs established pursuant to paragraph 1 following the rules established in accordance with Article 75 of the SO Regulation. Until such rules are established and enter into force, the association of contingencies to CNEs shall be based on each TSO's operational experience. An individual CNEC may also be established without a contingency.

4. Each Nordic TSO shall provide to the CCC for each long-term capacity calculation time frame and each scenario a list of CNECs established pursuant to paragraph 3.

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5. No later than eighteen months after the implementation of this methodology in accordance with Article 24(2), all Nordic TSOs shall jointly develop a proposal for amendment of this methodology in accordance with Article 4(12) of the FCA Regulation, which shall improve this methodology by including the method for assessing the economic efficiency of including internal network elements (combined with the relevant contingencies) in the long-term capacity calculation. This proposal shall be submitted by the same deadline to all regulatory authorities of the Nordic CCR ('Nordic regulatory authorities') for approval.

6. The methodology referred to in paragraph 5 shall define a process by which TSOs continuously analyse and identify internal network elements on which congestions are most efficiently addressed with long-term capacity calculation, taking into account other alternative measures for managing congestions on internal network elements, such as:

   (a) application of RA;

   ~~1.~~(b) reconfiguration of bidding ~~zone border.~~zones;

   (c) ~~When long term transmission rights are implemented on a bidding zone border,~~investments in network infrastructure combined with one or the ~~reliability margin~~two above; or

   (d) any combination of (a), (b) and (c).

~~2.~~7. The methodology referred to in paragraphs 5 and 6 shall ~~be set to the reliability margin value assessed in the DA~~also ensure that TSOs take into account different timescales needed to implement alternative solutions such that including internal network elements in capacity calculation ~~on that border~~is allowed only until the alternative solution(s), which are identified as more efficient, can be implemented.

8. ~~**Article 4**~~
The Nordic TSOs shall regularly review and update the application of the methodology for determining CNECs as defined in Article 22.

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Article 5. Methodology for determining operational security limits

1. ~~The TSOs~~Each Nordic TSO shall provide to the CCC for each CNEC, each long-term capacity calculation time frame and each scenario the operational security limits, which are needed by CCC to calculate the maximum flow on CNECs in accordance with Article 29(7)(c) of the CACM Regulation. For each of the operational security limit defined pursuant to paragraph 2, the concerned TSO shall specify the CNEC(s) to which these limits should be applied and translated into maximum flow on CNECs.

~~1.~~2. Each Nordic TSO shall apply the same operational security limits as in the operational security analysis. These limits shall be defined in accordance with Article 25 of the SO Regulation. ~~Each TSO~~The TSOs shall provide ~~the~~these operational security limits to the CCC ~~to be used~~ in the ~~capacity calculation.~~following format describing a specific power system physical property:

(a) ~~All operational security~~thermal limits shall be ~~respected both during~~ expressed in maximum admissible current (Imax) with the ~~normal operation~~unit of Ampere;

(b) voltage limits shall be expressed in nominal voltage (per unit);

~~2.~~(c) frequency limits shall be expressed in Hertz; and ~~in application of the N-1 criterion.~~

(d) ~~**Article 5**~~ ~~**Methodology for determining contingencies relevant**~~dynamic stability limits shall be expressed in (i) per unit for voltage stability and (ii) damping for electromechanical oscillations.

The maximum admissible current representing thermal limit according to ~~**capacity calculation**~~

3. ~~The TSOs shall apply the same contingencies as in the operational security analysis. These contingencies~~paragraph 2(a) shall be defined as follows:

(a) the maximum admissible current representing thermal limits shall be defined as fixed limit for each scenario representing the ambient conditions of this scenario.

(b) when applicable, the maximum admissible current representing thermal limits shall be defined as a temporary current limit of the CNE in accordance with Article ~~33~~25 of the SO Regulation. ~~Each TSO shall provide these contingencies~~A temporary current limit means that an overload is only allowed for a certain finite duration. As a result, various CNECs associated with the same CNE may have different Imax values.

(c) the maximum admissible current representing thermal limits shall represent only real physical properties of the CNE and shall not be reduced by any security margin.

4. TSOs shall regularly review and update operational security limits in accordance with Article 22.

Article 6. Methodology for allocation constraints

1. In case operational security limits cannot be transformed efficiently into maximum flow on specific CNECs pursuant to Article 5, the Nordic TSOs may transform them into allocation constraints and provide them to the CCC to be used in the ~~capacity calculation.~~ long-term capacity calculation. For this purpose, the Nordic TSOs may use the combined dynamic constraint, which limits the sum of power flows on a set of network elements, for the purpose to respect the dynamic stability limits.

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These TSOs shall provide to the CCC the maximum flow (F_{max}) for each defined combined dynamic constraint and the information on which network elements are combined into such combined dynamic constraint.

2. ~~**Article 6**~~
Allocation constraints pursuant to paragraph 1 may be used during a transition period of two years following the implementation of this methodology in accordance with Article 24(2). During this transition period, the concerned Nordic TSOs shall calculate the value of each combined dynamic constraint by performing a dynamic stability analysis in accordance with Article 38 of the SO Regulation at least on an annual basis and updated on a monthly basis, if relevant. The concerned Nordic TSOs shall publish the results and the underlying analysis.

3. In case the concerned Nordic TSOs cannot find and implement a more efficient solution than the applied combined dynamic constraint, they may, by eighteen months after the implementation of this methodology in accordance with Article 24(2), together with all other Nordic TSOs, submit to the Nordic regulatory authorities a proposal for amendment of this methodology in accordance with Article 4(12) of FCA Regulation. Such a proposal shall include the following:

    (a) the technical and legal justification for the need to continue using the combined dynamic constraint indicating the underlying operational security limits and why they cannot be transformed efficiently into maximum flow on specific CNECs;

    (b) a detailed methodology to calculate the values of the combined dynamic constraints.

    In case such a proposal has been submitted by all Nordic TSOs, the transition period referred to in paragraph 2 shall be extended until the decision on the proposal is taken by the Nordic regulatory authorities.

4. TSOs applying allocation constraints shall regularly review and update the application of allocation constraints in accordance with Article 22.

Article 7. Methodology for determining generation shift keys ~~(GSKs)~~

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1. Each Nordic TSO shall provide to the CCC for each of the bidding zone under its responsibility, each long-term capacity calculation time frame and each scenario, the GSK to be used in the long-term capacity calculation.

~~1.~~2. GSKs shall define how a net position change in a given bidding zone shall be distributed to each production and load unit in that bidding zone in the CGM. These GSKs shall represent the best forecast of the relation of a change in the net position of a bidding zone to a specific change of generation or load in the CGM for each scenario. The forecast shall take into account the information received in accordance with Article 10 and Article 12 of the generation and load data provision methodology developed by all TSOs in accordance with Article 17 of the FCA Regulation.

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1. Each TSO shall apply for a given bidding zone and the ~~same~~given scenario one of the GSK ~~strategy it has selected for the day-ahead timeframe~~ strategies listed below.

Strategy number	Generation	Load	Description/comment

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0	k_g	k_l	Custom GSK strategy with individual set of GSK factors for each generator unit and load for each market time unit for a TSO
1	$\max\{P_g - P_{min}, 0\}$	0	Generators participate relative to their margin to the generation minimum (MW) for the unit
2	$\max\{P_{max} - P_g, 0\}$	0	Generators participate relative to their margin to the installed capacity (MW) for the unit
3	P_{max}	0	Generators participate relative to their maximum (installed) capacity (MW)
4	1.0	0	Equal GSK factors for all generators, independently of the size of the generator unit
5	P_g	0	Generators participate relative to their expected power generation (MW)
6	P_g	P_l	Generators and loads participate relative to their expected power generation or loading power (MW)
7	0	P_l	Loads participate relative to their expected loading power (MW)
8	0	1.0	Equal GSK factors for all loads, independently of their expected size of loading power

where

k_g: GSK factor [pu] for generator g

k_l: GSK factor [pu] for load l

P_g: Active power generation [MW] for generator g contained in CGM

P_{min}: Minimum active generator output [MW] for generator g

P_{max}: Maximum active generator output [MW] for generator g

P_l: Active power load [MW] for load l contained in CGM

2. Within eighteen months after the implementation of this methodology in accordance with Article ~~7 of the capacity calculation methodology developed in CCR~~24(2), all Nordic TSOs shall develop a proposal for amendment of this methodology in accordance with Article ~~20(~~24(12) of the ~~CACM~~FCA Regulation~~.~~, which shall further harmonise the generation shift key methodology. This proposal shall be submitted by the same deadline to the Nordic regulatory authorities for approval. The proposal shall at least include:

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(a) ~~The TSOs shall provide~~ the ~~selected GSK strategy~~criteria and metrics for defining the ~~CCC to be used in the capacity calculation~~efficiency and performance of GSKs and allowing for ~~each bidding zone and the market time units~~quantitative comparison of different GSKs; and

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(b) a harmonised generation shift key methodology combined with, where necessary, rules and criteria for ~~which~~TSOs to deviate from the harmonised generation shift key methodology.

3. TSOs shall regularly review and update the application of the ~~GSK strategy shall be valid.~~ generation shift keys in accordance with Article 22.

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Article ~~7~~ 8. Methodology for determining remedial actions ~~(RAs)~~ to be considered in capacity calculation

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1. Each TSO shall define ~~define RAs~~explicit RAs to be ~~applied~~taken into account in capacity calculation and provide them to CCC for each long-term capacity calculation time frame and each scenario. The relevant ~~RAs~~RAs shall be coordinated between TSOs, clearly described, and communicated to other TSOs ~~and the CCC~~.

2. ~~Each~~The RAs referred to in paragraph 1 shall be used for increasing the long-term cross-zonal capacities while ensuring operational security.

~~2.~~3. When defining RAs pursuant to paragraph 1, each TSO shall take into account only available non-costly ~~RAs in capacity calculation to allow for an increase in cross-zonal capacity in line with the equation in Article 8(7).~~RA.

~~4. Costly RAs shall not be taken into account in capacity calculation.~~

4. In accordance with Article 25(6) of the CACM Regulation and Articles 10(3) and 14 of the FCA Regulation, the RAs taken into account in the long-term capacity calculation shall also be included in the capacity calculation of the day-ahead and intraday time frame to the extent that they are still expected to be available at the time of day-ahead capacity calculation.

5. When TSO(s) is unable to define explicitly the RAs to be taken into account in capacity calculation due to uncertainty of their actual availability in real-time, but is able to evaluate the approximate adjustment of flows on critical network elements or combined dynamic constraints due to RAs by taking into account the statistics and probability of the availability of RAs, it may provide to the CCC the minimum F_{RA} that needs to be respected when calculating the F_{RA} in accordance with Article 13. When determining this minimum F_{RA}, TSOs may also take into account other (costly or non-costly) remedial actions.

~~3.~~6. The TSOs shall regularly ~~and at least once a year~~ review and update the application of ~~RAs~~RAs taken into account in the long-term capacity calculation in accordance with Article ~~27(4)(e) of the CACM Regulation~~22.

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Article 9. Previously allocated cross-zonal capacities

Each Nordic TSO shall provide to the CCC for each Nordic biding zone border and for each long-term capacity calculation time frame the previously allocated cross-zonal capacities.

TITLE 3 ~~Detailed description~~ - Description of the capacity calculation ~~approach for long-term time frame~~process

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Article 8
~~Mathematical description~~10. Description of the applied capacity calculation approach with different capacity calculation inputs

1. The capacity calculation ~~approach~~process for the long-term time frame shall ~~be a CNTC~~use the flow-based approach.

2. The capacity calculation process for the long-term time frame is shown in Figure 1. The figure identifies the roles of the entities involved, and the input and output data in the capacity calculation process.

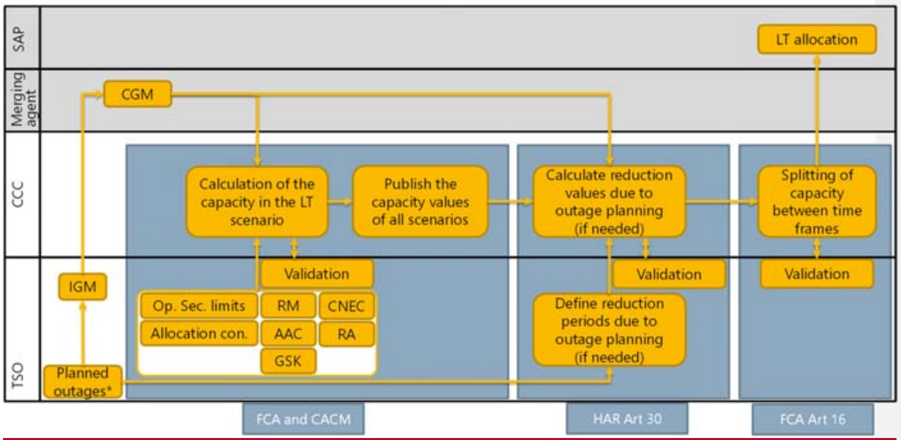

Figure 1. Roles of the entities involved, and input and output data, in the capacity calculation process for the long-term time frame. SAP means single allocation platform and the merging agent delivers the CGM. LT means long-term and HAR means harmonised allocation rules, in accordance with Article 51 of the FCA Regulation.
** Only when the outages cover the entire time period being represented by the IGM / CGM, it is modelled in the IGM / CGM and thus taken into account in the capacity calculation process.*

~~1.~~3. The capacity calculation process shall ~~follow the process as presented in Article 18.~~use the following capacity calculation inputs:

~~1. Inputs to the CNTC approach shall be a linearized security domain based on:~~

~~c)~~(a) ~~CGM~~CGMs representing the forecasted ~~state~~states (i.e. scenarios) of the power system for the long-term time frame;

~~d)~~(b) ~~GSKs~~the reliability margins in accordance with Article ~~6~~3;

~~e)~~(c) ~~Contingencies~~the individual TSOs' lists of CNECs in accordance with Article ~~5; and~~4;

~~f)~~(d) ~~Operational~~the operational security limits in accordance with Article ~~4.~~ 5;

~~1. The linearized security domain is defined by a PTDF matrix and a vector of Remaining Available Margins.~~

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(e) the allocation constraints in accordance with Article 6;

(f) the GSKs in accordance with Article 7;

(g) the remedial actions in accordance with Article 8; and

(h) the previously allocated cross-zonal capacities in accordance with Article 9.

4. The capacity calculation process shall be performed by the CCC and shall provide the following capacity calculation results to be validated by each Nordic TSO:

(a) Calculation of the PTDF matrix, where each factor in the matrix, $PTDF_j^A$, represents the percentage of 1 MW injected in bidding zone A, and extracted from a defined slack node, that will appear on the CNEC or combined dynamic constraint j in accordance with Article 11; and

(b) Calculation of the RAM for each CNEC and combined dynamic constraint, which shall be the amount of transmission capacity available for capacity validation and determined in accordance with Article 15.

5. The PTDF matrix ~~is~~ and RAM vector shall form flow-based parameters describing the available transmission capacity between relevant bidding zones to be validated by capacity validation.

Article 11. Description of the calculation of power transfer distribution factors

1. As a first step in the long-term capacity calculation process, the CCC shall merge the individual lists of CNECs provided by all Nordic TSOs in accordance with Article 4(3) into a single list, which shall constitute the initial list of CNECs.

1. In accordance with Article 29(3)(a) of the CACM Regulation, the CCC shall calculate the impact of a ~~linearized description of how~~change in the bidding zones net position ~~in each bidding zone impacts the flow~~ on the ~~CNEs when power~~ power flow on each CNEC of the initial list of CNECs and on each combined dynamic constraint. This influence is ~~extracted in a designated slack node (for each synchronous area). PTDFs shall be~~ called the zone-to-slack $PTDF$ (i.e. $PTDF_{z2s}$). This calculation is performed by applying the CGM and the GSKs defined in accordance with **Error! Reference source not found.**~~Article 7~~.

2. The zone-to-slack $PTDFs$ are calculated by ~~applying an AC load flow analysis software tool to the CGM with the simplifications necessary to create a linear approximation (DC load flow analysis) as~~first calculating the node-to-slack $PTDFs$ (i.e. $PTDF_{n2s}$) for each node defined in the GSKs. These node-to-slack $PTDFs$ are derived by varying the injection of a relevant node in the CGM and recording the difference in power flow on every CNEC (expressed as a percentage of the change in injection) or on combination of network elements in case of combined dynamic constraint. These node-to-slack $PTDFs$ are translated into zone-to-slack $PTDFs$ by multiplying the share of each node in the GSK with the corresponding node-to-slack $PTDFs$ and summing up these products per bidding zone. This calculation is mathematically described ~~in this Article.~~ as follows:

~~a) PTDFs shall be calculated to represent the power system state after the contingency or disconnections, taking into account RAs.~~
~~b) PTDFs shall be calculated with the following assumptions:~~
~~i. The magnitude of voltage in each node is 1 pu;~~
~~i. The resistance of the power system series elements are neglected (zero); and~~
~~i. The difference between the voltage angles of adjoining nodes is small~~

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~~c) Taking into account these simplifications in load flow analysis, the PTDFs can be calculated for all nodes and transmission elements as:~~

$$\cancel{PTDF_j^{\alpha} = B_j * (Zbus_{i,\alpha} - Zbus_{k,\alpha})}$$

~~Where $PTDF_j^{\alpha}$ is the sensitivity for the transmission element "j" connecting the nodes "i" and "k" for the power injection in node "α" that is taken out at the defined slack node. B_j is susceptance between the nodes "i" and "k" of the grid element "j", $Zbus_{i,\alpha}$ and $Zbus_{k,\alpha}$ refers to elements in the bus impedance matrix.~~

~~3. The nodal PTDFs as calculated under Article 8(4) shall be aggregated to one PTDF value for the whole bidding zone applying GSK factors for weighting each node as follows~~

$$\cancel{PTDF_j^{A} = \sum_{\alpha} GSK^{\alpha} PTDF_j^{\alpha}, \quad \text{and} \quad \sum_{\alpha} GSK^{\alpha} = 1}$$

~~Where:~~

~~$PTDF_j^{A}$ = Sensitivity of transmission element j to injection in bidding zone A and extraction in the designated slack node;~~

~~$PTDF_j^{\alpha}$ = Sensitivity of transmission element j of injection in node α and extraction in the designated slack node;~~

~~GSK^{α} = The weight of node α on the PTDF of bidding zone A.~~

~~The zone-to-zone PTDF~~ $$\mathbf{PTDF}_{\mathrm{z2s}} = \mathbf{PTDF}_{\mathrm{n2s}}\,\mathbf{GSK}_{\mathrm{n2z}}$$

Equation 2

with

$\mathbf{PTDF}_{z2s}$	matrix of zone-to-slack PTDFs (columns: bidding zones; rows: CNECs and combined dynamic constraints)
$\mathbf{PTDF}_{n2s}$	matrix of node-to-slack PTDFs (columns: nodes; rows: CNECs and combined dynamic constraints)
$\mathbf{GSK}_{n2z}$	GSK in a form of matrix containing the shares of each node in the net positions of the corresponding bidding zones (columns: bidding zones; rows: nodes; sum of each column equal to one)

3. The impact of HVDC network elements on the bidding zone borders within the Nordic CCR shall be taken into account by defining the connecting nodes of such HVDC network element as separate virtual bidding zones. The zone-to-slack PTDFs calculated for these virtual bidding zones are equal to node-to-slack $PTDFs$ for the connecting nodes of the HVDC network element, whereas these nodes are not included in the summing up of products for real bidding zones as referred to in paragraph 3.

4. The zone-to-slack $PTDFs$ as calculated above can also be expressed as zone-to-zone $PTDFs$ (i.e. $PTDF_{z2z}$). A zone-to-slack $PTDF_{A,l}$ represents the influence of a variation of a net position of bidding zone A on a CNEC l and assumes a commercial exchange between a bidding zone and a slack node. A zone-to-zone $PTDF_{A\to B,l}$ represents the influence of a variation of a commercial exchange from ~~one bidding zone to another on a CNE. The zone-to-zone PTDF can be linked to the zone-to-slack PTDF as follows:~~

$$\cancel{PTDF_j^{A\to B} = PTDF_j^{A} - PTDF_j^{B}}$$

~~Where:~~

4. ~~$PTDF_j^{A \to B}$ = Sensitivity of transmission element j to injection in bidding zone A and extraction in~~ bidding zone A to bidding zone B~~;~~ on CNEC l. The zone-to-zone $PTDF_{A \to B,l}$ can be derived from the zone-to-slack $PTDFs$ as follows:

~~4. The RAM shall provide the capacity available for allocation for each CNE j. The RAM shall be calculated as follows:~~

$$\cancel{RAM_j = F_{max\,j} + RA_j - F'_{ref\,j}}$$

~~Where F_{max} is the maximum allowed physical flow on a CNE, RA is the impact of RAs, and F'_{ref} is the reference flow at zero net position in the linearized flow calculation applying computed PTDFs.~~

~~) F_{max} shall be calculated by an AC load flow analysis and, where appropriate, a dynamic analysis using the CGM or regional model to ensure the secure grid operation, in accordance with Article 32 of the SO Regulation.~~

~~) RA shall be the RAs to increase RAM and defined in accordance with Article 7.~~

~~) F'_{ref} shall be the reference flow at zero net position in the linearized flow calculation applying the computed PTDFs. For each CNE "j", the $F'_{ref,j}$ shall be defined as follows:~~

$$\cancel{F'_{ref,j} = F_{ref,j} - \textstyle\sum_A PTDF_j^A \cdot NP^A}$$

~~where $F_{ref,j}$ is the flow on the CNE "j" in the base case, NP^A is the net positions in bidding zone "A" in the base case, and $PTDF_j^A$ are the $PTDF$ values for this CNE "j". F'_{ref} may be positive and shall be subtracted from the RAM or negative and shall be added to the RAM.~~

$$PTDF_{A \to B,l} = PTDF_{A,l} - PTDF_{B,l}$$

Equation 3

5. The cross-zonal exchange over HVDC network elements on the bidding zone borders of the Nordic CCR is modelled as a bilateral exchange in capacity allocation, and is constrained by the physical impact that this exchange has on all CNECs considered in the final flow-based domain used in capacity allocation.

6. The maximum zone-to-zone $PTDF$ of a CNEC (i.e. $PTDF_{z2zmax,l}$) is the maximum influence that any cross-zonal exchange in the Nordic CCR has on the respective CNEC, including exchanges over HVDC network elements:

$$PTDF_{z2zmax,l} = max\left(\max_{A \in BZ}(PTDF_{A,l}) - \min_{A \in BZ}(PTDF_{A,l})\right)$$

Equation 4

with

$PTDF_{A,l}$	zone-to-slack $PTDF$ of bidding zone A on a CNEC l
BZ	set of all Nordic bidding zones (including virtual bidding zones)
$\max_{A \in BZ}(PTDF_{A,l})$	maximum zone-to-slack PTDF of Nordic bidding zones on a CNEC l
$\min_{A \in BZ}(PTDF_{A,l})$	minimum zone-to-slack PTDF of Nordic bidding zones on a CNEC l

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Article 12. Definition of the final list of CNECs for long-term capacity calculation

After the calculation of maximum zone-to-zone $PTDFs$ calculated in accordance with Article 11(7), the CCC shall remove from the initial list of CNECs at least those CNECs for which the maximum zone-to-zone $PTDF$ is not higher than 5%. The remaining CNECs shall constitute the final list of CNECs.

Article 13. Rules on the adjustment of power flows on critical network elements due to RA

1. The RAs taken into account in Nordic long-term capacity calculation aim to increase cross-zonal capacities. These RAs are not interdependent in the sense that they would increase cross-zonal capacity on some CNECs or combined dynamic constraints and decrease it on others. For these reasons, all RAs provided by TSOs shall be applied and no optimisation of RAs is necessary.

2. As the outcome of the application of RA, the CCC shall calculate for each CNEC of the final list of CNECs and each combined dynamic constraint the increase of flow on such CNEC or combined dynamic constraint due to the application of RA. This flow for increasing the RAM on each CNEC shall be expressed as F_{RA}. In case TSO(s) provided to CCC a minimum F_{RA} pursuant to Article 8(5), the CCC shall adjust the calculated F_{RA} such that it is not lower than the minimum value provided by TSO(s).

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Article 14. Rules for taking into account previously allocated cross-zonal capacities

1. The CCC shall take into account the previously allocated cross-zonal capacities such that the calculation of the RAM takes into account the flows resulting from previously allocated cross-zonal capacities in accordance with Article 29(7)(c) of the CACM Regulation.

2. The flows resulting from previously allocated cross-zonal capacities in accordance with Article 29(7)(c) of the CACM Regulation shall be calculated for each CNEC by multiplying the volumes of previously allocated cross-zonal capacities with the positive zone-to-zone $PTDFs$, i.e:

$$F_{AAC} = max(0, PTDF_{z2z}) \cdot \overrightarrow{AAC}$$

Equation 5

with

F_{AAC}	flows resulting from previously allocated cross-zonal capacities for each CNEC and combined dynamic constraint
$PTDF_{z2z}$	zone-to-zone PTDFs calculated in accordance with Article 11(5)
$\overrightarrow{AAC}$	previously allocated cross-zonal capacities

Article 15. Description of the calculation of available margins on critical network elements before validation

1. The CCC shall use voltage limits, frequency limits and dynamic stability limits provided by TSOs to calculate for each relevant CNEC the respective I_{max} representing these limits. Subsequently, the CCC shall calculate the final I_{max} for each CNEC which shall be the lowest of all values of I_{max} calculated by the CCC or provided by TSOs for each specific CNEC.

2. The CCC shall use the final I_{max} of each CNEC calculated pursuant to paragraph 1 to calculate F_{max} for each CNEC, which describes the maximum admissible active power flow on a CNEC. F_{max} of a CNEC shall be calculated by the given formula:

$$F_{max} = \sqrt{3} \cdot I_{max} \cdot U \cdot cos(\varphi)$$

Equation 6

with

F_{max}	maximum admissible flow of a CNE
I_{max}	maximum admissible current of a CNE
U	voltage for a CNE as defined in paragraph 3
$cos(\varphi)$	power factor as defined in paragraph 3

3. The voltage U referred to in paragraph 2 shall be the average voltage on two connecting nodes of a CNE included in a CNEC resulting from the load-flow calculation on the CGM and shall not be lower than the 95% of the reference voltage of that CNE. The power factor cos(φ) referred to in paragraph 2 shall be the average power factor on two connecting nodes of a CNE included in a CNEC resulting from the load-flow calculation on the CGM and shall not be lower than 0.95.

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4. The CCC shall calculate the reference flow (F_{ref}) for each CNEC and combined dynamic constraint, which is the active power flow on a CNEC or combined dynamic constraint calculated with the CGM. In case of a CNEC or combined dynamic constraint without contingency, F_{ref} is simulated by directly performing the load-flow calculation on the CGM, whereas in case of a CNEC with contingency or combined dynamic constraint, F_{ref} of such CNEC or combined dynamic constraint is simulated by first applying the contingency of this CNEC or combined dynamic constraint, and then performing the load-flow calculation.

5. The CCC shall calculate for each CNEC the linear approximation of a flow in a situation without any cross-zonal exchanges (F_0) as follows:

$$\vec{F}_0 = \vec{F}_{ref} - PTDF \cdot \overrightarrow{NP}_{ref}$$

Equation 7

with

$\vec{F}_0$	linear approximation of a flow in the reference net position on a CNEC or combined dynamic constraint in a situation without any cross-zonal exchanges
$\vec{F}_{ref}$	reference flows on all CNECs and combined dynamic constraints
$PTDF$	matrix of power transfer distribution factors
$\overrightarrow{NP}_{ref}$	net position of bidding zone (including virtual bidding zones) in the reference commercial situation

The net positions ($\overrightarrow{NP}_{ref}$) of virtual bidding zone include injections of the connecting nodes of the HVDC network elements, whereas the net positions of real bidding zones are excluding the injections of those connecting nodes.

6. Subsequently, the CCC shall calculate the RAM before validation for each CNEC and combined dynamic constraint as follows:

$$\overrightarrow{RAM}_{bv} = \vec{F}_{max} + \vec{F}_{RA} - \vec{F}_{RM} - \vec{F}_0 - \vec{F}_{AAC}$$

Equation 8

with

$\overrightarrow{RAM}_{bv}$	remaining available margin before validation
$\vec{F}_{max}$	maximum flow on all CNECs and combined dynamic constraints
$\vec{F}_{RA}$	flow for increasing the RAM on a CNEC or combined dynamic constraints due to remedial actions taken into account in capacity calculation
$\vec{F}_{RM}$	flow for reliability margin for all CNECs and combined dynamic constraints

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$\vec{F}_0$ linear approximation of a flow in the reference net position on a CNEC or combined dynamic constraint in a situation without any cross-zonal exchanges

$\vec{F}_{AAC}$ flows resulting from previously allocated cross-zonal capacities for all CNECs and combined dynamic constraints

~~a)~~ When ~~a negative RAM is calculated but not applied in capacity allocation,~~ the RAM value calculated pursuant to paragraph 6 is negative it shall be set to zero and the potential ~~constraint~~ congestion resulting from negative RAM shall be managed by ~~RA.~~

~~5. The maximum allowed power exchange on each bidding zone border TTC^n (where $TTC^n \in TTC$, and TTC is a vector of maximum allowed power exchange on all bidding zone borders) shall be calculated as:~~

~~Maximize $f(TTC)$~~

~~Subject to~~

$$\cancel{g_j\left(\sum_n TTC^n * PTDF_j^n\right) \leq h_j(RAM_j) \qquad \forall j \in \{All\ CNEs\}}$$

~~Where:~~

~~f = a function defining the weight for each border in the optimization~~
~~g_j = a function defining the weight of each trade in the total flow on CNE j~~
~~h_j = a function defining the scaling of CNEs in non relevant market directions~~
~~TTC^n = maximum allowed power exchange on bidding zone border n~~
~~TTC = a vector of maximum allowed power exchanges for all borders~~
~~$PTDF_j^n$ = zone-to-zone PTDF for bidding zone border n~~

~~Article 9~~
~~Rules for taking into account previously allocated cross-zonal capacity~~

~~Cross-zonal capacities shall be reduced, where appropriate, by the amount of previously allocated capacities for nominated Physical Transmission Rights (PTRs). In case previously allocated capacity is bigger than CZC on a bidding zone border, defined in accordance with Article 11(2), the relevant TSO(s) shall provide zero cross-zonal capacity for the capacity allocation and use RAs to ensure operational security.~~

~~Article 10~~
~~Rules on the adjustment of power flows of cross-zonal capacity due to RAs~~

7. ~~TSOs shall take into account in the capacity calculation RAs as~~ the application of RA, which may include other remedial actions than the ones defined ~~in Article 7 to increase the cross-zonal capacity for the long-term time frame.~~ pursuant to Article 8.

~~Article 11~~
~~Rules for calculating cross-zonal capacity, including rules for efficiently sharing power flow capabilities of CNEs among different bidding zone borders~~

~~0. The rules for efficiently sharing CNE capacity on different borders are defined by the function $f(TTC)$ and the constraints in Article 8(8).~~

~~0. Cross-zonal capacity for each bidding zone border "n" shall be calculated as:~~

$$\cancel{CZC^n = TTC^n - AAC^n - RM^n}$$

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~~where *TTC*" is the maximum allowed power exchange of active power between adjoining bidding zones respecting *N-1* criteria and operational security limits taking into account RAs, rules for undue discrimination and rules for efficiently sharing the power flow capabilities of CNEs among different bidding zone borders, *AAC* refers to previously allocated capacity, and *RM* refers to reliability margin as defined in Article 3.~~

~~Article 12~~
Article 16. Rules for sharing the power flow capabilities of CNEs among different CCRs

1. ~~Adjoining bidding zones~~To take into account the impact of exchanges in neighbouring CCRs on the CNECs and combined dynamic constraints within the Nordic CCR, the CCC shall ~~be taken into account~~ calculate the cross-zonal exchanges or cross-zonal capacities on the bidding zone borders of these neighbouring CCRs by performing all steps in ~~the~~long-term capacity calculation ~~in CCR Nordic. Cross-zonal capacities on~~ by assuming that bidding zone borders ~~between CCR~~ of neighbouring CCRs are part of the Nordic ~~and neighbouring CCRs~~ CCR and thereby the impact of exchanges on bidding zone borders outside the Nordic CCR on the CNECs within the Nordic CCR shall be calculated ~~using CGMs and relevant information from these adjoining bidding zones~~as well.

2. The flow-based parameters calculated for bidding zone borders outside the Nordic CCR shall be part of the final flow-based parameters as referred to in Article 18(4).

~~1.~~3. The CCC shall submit flow-based parameters, or the ATC values in ~~coordination with the neighbouring CCCs~~case of transitional solution pursuant to Article 19, calculated for bidding zone borders of neighbouring CCRs to the CCCs of these CCRs. The flow-based parameters or the ATC values may limit capacity allocation on the bidding zone borders of those CCRs if such limitations are allowed within the long-term CCM governing capacity calculation within those CCRs.

~~2. If there is difference in the cross-zonal capacity on the bidding zone border to the neighbouring CCR, the lower value of the cross-zonal capacity shall be used for the capacity allocation.~~

Article ~~13~~
17. Scenarios to take into account uncertainty associated with long-term capacity calculation time frames

1. Uncertainty associated with long-term capacity calculation time frames shall be taken into account by applying scenarios as defined in Article 3 of the CGM methodology developed in accordance with Article 18 of the FCA ~~regulation~~Regulation.

~~3.~~1. The ~~capacity values~~flow-based parameters, resulting from the long-term capacity calculation for each scenario, shall be published.

TITLE 4
~~Methodology for the~~ Description of capacity validation ~~of cross-zonal capacity for long-term time frame~~

Article ~~14~~ 18. Methodology for the validation of cross-zonal capacity

1. Each TSO shall perform the validation of cross-zonal capacities on its bidding zone border(s~~)~~), defined by the flow-based parameters on its CNECs and combined dynamic constraints, to ensure that the results of regional calculation and allocation of cross-zonal capacity will ensure operational security. When performing the validation, the TSOs shall consider operational security, taking into account new and relevant information obtained during or after the most recent capacity calculation.

~~3.~~2. If TSOs find errors in cross-zonal capacity provided for validation, the relevant TSOs shall provide ~~new information~~ updated capacity calculation inputs to the CCC for recalculation~~.~~ of cross-zonal capacities. The CCC shall ~~redo the~~repeat calculation with updated capacity calculation inputs and send the recalculated cross-zonal capacities for ~~revalidation.~~another validation. Recalculations ~~are~~shall be executed until no errors are found.

3. RAM_{bv} calculated in accordance with Article 15(5) may be adjusted during the validation by applying individual validation adjustment (IVA) to take into account relevant information known at the time of validation in accordance with paragraph 1. IVA can be a positive value indicating reduction of cross-zonal capacities or negative value indicating increase of cross-zonal capacities.

4. The individual validation adjustment may be done in the following situations:

   (a) an occurrence of an exceptional contingency or forced outage as defined in Article 3(39) and Article 3(77) of the SO Regulation;

   (b) a mistake in input data, that leads to an wrong estimation of cross-zonal capacity from an operational security perspective; and/or

   (c) when TSO(s) is unable to define exact RAs to be taken into account in capacity calculation due to uncertainty of their actual availability in real-time, but is able to evaluate the approximate adjustment of flows on critical network elements or combined dynamic constraints due to RAs by taking into account the statistics and probability of the availability of RAs.

5. The final flow-based parameters available for capacity allocation shall be the PTDF calculated pursuant to Article 11(4) and the RAM calculated as follows:

$$\overrightarrow{RAM} = \overrightarrow{RAM_{bv}} - \overrightarrow{IVA}$$

Equation 9

with

$\overrightarrow{RAM}$	final remaining available margin

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$\overrightarrow{RAM}_{bv}$ remaining available margin before validation

$\overrightarrow{IVA}$ individual validation adjustment

6. Each application of IVA needs to be justified by the TSOs applying it, by reporting on the need to apply IVA, and the rationale behind the value of IVA, towards the CCC and other TSOs.

~~4.~~7. Each CCC shall report all reductions made during the validation of cross-zonal capacity to all ~~NRAs of the~~ Nordic ~~CCR~~regulatory authorities. This report shall include the location and amount of any reduction ~~in~~of cross-zonal ~~capacity~~capacities and shall give reasons for the reductions.

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~~6.~~8. The CCC shall coordinate with the neighbouring CCCs during the capacity calculation and validation.

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TITLE 5
- Miscellaneous

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~~Article 15~~
Article 19. Transitional solution for calculation and allocation of long-term cross-zonal capacities

1. Until the Single Allocation Platform ('SAP') in accordance with Article 49 of the FCA Regulation is able to support the allocation of cross-zonal capacities based on flow-based parameters, the CCC shall transform the final flow-based parameters as referred to in Article 17(4) into available transmission capacity ('ATC') values on bidding zone borders of the Nordic CCR and bidding zone borders of neighbouring CCRs if the latter are included in capacity calculation pursuant to Article 16. For each scenario, one set of ATC values shall be calculated.

2. The available transfer capacity ATC^n (where $ATC^n \in ATC$, and ATC is a vector of maximum allowed power exchange on all bidding zone borders) shall be calculated as:

$$\text{Maximize } f(\overrightarrow{ATC})$$

$$\text{Subject to}$$

$$g_j\left(\sum_n ATC^n * PTDF_j^n\right) \leq h_j(RAM_j) \qquad \forall j \in \{All\ CNEs\ and\ allocaiton\ constraints\}$$

Equation 10

with

f	a function defining the weight for each border in the optimisation
g_j	a function defining the weight of each trade in the total flow on CNE j
h_j	a function defining the scaling of CNEs in non-relevant market directions
ATC^n	maximum available power exchange on bidding zone border n
$\overrightarrow{ATC}$	a vector of maximum available power exchanges for all borders
$PTDF_j^n$	zone-to-zone PTDF for bidding zone border n

3. Two months before the application of this transitional solution, the Nordic TSOs shall publish the exact values and parameters of the functions f, g and h, including their description, purpose and effect and update this publication at least two months before any change affecting the results of the calculation pursuant to paragraph 2.

4. No later than eighteen months after the implementation of this methodology in accordance with Article 24(2), all Nordic TSOs shall jointly develop a proposal for amendment of this methodology in accordance with Article 4(12) of the FCA Regulation, which shall improve this methodology by

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including the description and definition of the functions referred to in paragraph 3. This proposal shall be submitted by the same deadline to all Nordic regulatory authorities for approval.

Article 20. Fallback procedure if the initial capacity calculation does not lead to any results

1. In case the initial capacity calculation does not lead any results, the CCC ~~tries~~shall try to solve the problem and perform long-term capacity calculation again if time allows to make such calculation.

~~3.~~2. If the CCC is not able to perform long-term capacity calculation in accordance with ~~Article 15(~~paragraph 1~~), each TSO shall individually calculate the cross-zonal capacity~~, TSOs shall bilaterally agree on ATC values for the relevant ~~long-term time frames for its bidding zone borders and the smaller value calculated for each bidding zone border by neighbouring~~time frame(s). The Nordic TSOs shall ~~be applied.~~ commonly coordinate and validate these bilaterally agreed ATC values.

~~When calculations in accordance with Article 15(1) and Article 15(2) do not lead to any results, the results from the most recent long-term capacity calculation for the relevant long-term time frame shall be applied.~~

~~Article 16~~

Article 21. Monitoring data to the ~~national~~ regulatory authorities

1. All technical and statistical information related to this CCM shall be made available upon request to the ~~NRAs~~relevant regulatory authorities in the ~~CCR~~ Nordic CCR.

~~3.~~2. Monitoring data shall be provided to the ~~NRAs~~relevant regulatory authorities in the ~~CCR~~ Nordic CCR as a basis for supervising a non-discriminatory and efficient capacity calculation in ~~CCR~~the Nordic CCR.

~~5.~~3. Any data requirements mentioned above should be managed in line with confidentiality requirements pursuant to national legislation.

Article ~~17~~ 22. Reviews and updates~~Publication of data~~

1. ~~The TSOs shall, in compliance with national legislation~~Based on Article 3(f) of the FCA Regulation and in accordance with Article ~~3(f) of the FCA Regulation, and in addition to the data items and definitions of Transparency~~27(4) of the CACM Regulation, ~~publish the following on a regular basis and as soon as possible:~~ ~~Information for each forward~~all TSOs shall regularly and at least once a year review and update the key input and output parameters listed in Article 27(4)(a) to (d) of the CACM Regulation.

2. If any of the long-term capacity calculation~~, on each scenario, and in accordance with article 9~~ inputs pursuant to Articles 3, 4, 5, 6, 7 and 8 need to be updated based on this review, the Nordic TSOs shall publish the changes at least 1 month before their implementation.

3. Any changes of parameters listed in Article 27(4) of the CACM Regulation shall be communicated to market participants, all Nordic regulatory authorities and the Agency.

4. The Nordic TSOs shall communicate the impact of any change of parameters listed in Article 27(4)(d) of the CACM Regulation to market participants, all Nordic regulatory authorities and the Agency. If any change leads to an adaption of the methodology, the Nordic TSOs shall make a proposal for amendment of this methodology according to Article 4(12) of the FCA Regulation.

Article 23. Publication of data~~, at least~~

~~0.~~ In accordance with Article 3(f) of the FCA Regulation aiming at ensuring and enhancing the transparency and reliability of information to all Nordic regulatory authorities and market participants, all Nordic TSOs and the CCC shall regularly publish the data on ~~annual and monthly time frames, which shall include the following:~~
~~) CZC for each bidding zone border;~~
~~) all components of the CZC, i.e. TTC, AAC, and RM, for each bidding zone border.~~
~~) PTDFs and RAMs~~

1. ~~The~~ the long-term capacity calculation process pursuant to this methodology as set forth in paragraph 2 on a dedicated online communication platform where capacity calculation data for the whole Nordic CCR shall be published~~.~~. To enable market participants to have a clear understanding of the published data, all Nordic TSOs and the CCC shall develop a handbook and publish it on this communication platform. This handbook shall include at least a description of each data item, including its unit and underlying convention.

2. The Nordic TSOs and the CCC shall publish at least the following data items (in addition to the data items and definitions of Commission Regulation (EU) No 543/2013 on submission and publication of data in electricity markets):

   (a) final flow-based parameters for each scenario pursuant to Article 18(4);

   (b) in case of application of transitional solution pursuant to Article 19 for each scenario the ATC values for all bidding zone borders in Nordic CCR calculated pursuant to Article 19;

   (c) the following additional information for each scenario:

      i. maximum and minimum possible net position of each bidding zone;

      ii. maximum possible bilateral exchanges on all Nordic bidding zone borders;

      iii. names of CNECs (with geographical names of substations where relevant and separately for CNE and contingency) and combined dynamic constraints of the final flow-based parameters and the TSO defining them;

      iv. for each CNEC of the final flow-based parameters, the EIC code of CNE and Contingency;

      v. for each CNEC of the final flow-based parameters, the method for determining I_{max} in accordance with Article 5(3);

      vi. detailed breakdown of RAM for each CNEC of the final flow-based parameters: final I_{max}, U, F_{max}, F_{RA}, F_{RM}, F_{ref}, F_0, F_{AAC} and IVA;

vii. detailed breakdown of the RAM for each combined dynamic constraint: F_{max}, F_{RA}, F_{RM}, F_{ref}, F_0, F_{AAC} and IVA;

viii. information about the individual validation reductions:

- the identification of the CNEC;
- in case of reduction due to individual validation, the TSO invoking the reduction;
- the volume of reduction (IVA);
- the detailed reason(s) for reduction, including the operational security limit(s) that would have been violated without reductions, and under which circumstances they would have been violated;

ix. for each RA taken into account in long-term capacity calculation:

- type of RA;
- location of RA;
- whether the RA was curative or preventive;
- if the RA was curative, a list of CNEC identifiers describing the CNECs to which the RA was associated;
- the provided minimum F_{RA} pursuant Article 8(5) including the underlying statistics;

x. the forecast information contained in the CGM:

- vertical load for each Nordic bidding zone and each TSO;
- production for each Nordic bidding zone and each TSO;
- for each Nordic bidding zone and each TSO;
- reference net positions of all bidding zones in the synchronous area Nordic and reference exchanges for all HVDC network elements within the synchronous area Nordic and between the synchronous area Nordic and other synchronous areas.

3. Individual Nordic TSO may choose not to identify the CNEC concerned and specify its location when publishing the information referred to in paragraph 2(c) if it is classified as sensitive critical infrastructure protection related information in their Member States as provided for in point (d) of Article 2 of Council Directive 2008/114/EC of 8 December 2008 on the identification and designation of European critical infrastructures and the assessment of the need to improve their protection. In such a case, the withheld information shall be replaced with an anonymous identifier, which shall be stable for each CNEC across all long-term capacity calculation time frames, as well as day-ahead and intraday time frames. The anonymous identifier shall also be used in the other TSO communications related to the CNEC and when communicating about an outage or an investment in infrastructure. The information about which information has been withheld pursuant to this paragraph shall be published on the communication platform referred to in paragraph 1.

4. Any change in the identifiers shall be publicly notified at least one month before its publication.

5. If a TSO provides evidence to its national regulatory authority that the provision of anonymised stable identifiers is not sufficient to prevent the identification of network elements, and is therefore not compliant with national legislation, they can be exempted from the requirements of stable identifiers pursuant to Paragraphs 3 and 4.

5. The data shall be published as soon as available and no later than:

   ~~1.~~(a) for annual capacity calculation, one week before the yearly allocation process ~~but no later than~~or 15 December, for all months of the following year~~.~~;

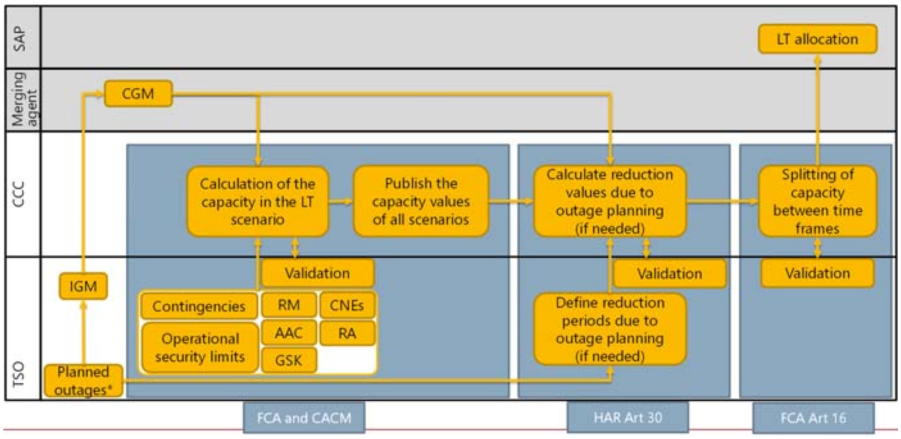
   ~~2.~~(b) ~~The data shall be published~~ for monthly capacity calculation, two working days before the monthly allocation process for all days of the following month~~.~~;

~~3.~~ ~~The~~for data~~,~~ obtained from the capacity calculation on a ~~timeframe~~time frame different than referred to in ~~Article 17(2(~~a) and ~~17(3), shall be published in due time.~~

~~3. The above mentioned publication requirements are without prejudice to confidentiality requirements pursuant to national legislation.~~

   (c) ~~**Article 18**~~ ~~**Capacity calculation**~~(b), 5 working days before the relevant allocation process.

~~1. The capacity calculation process for the long-term time frame is shown in Figure 1. The figure identifies the roles of the entities involved, and the input and output data in the capacity calculation process.~~



~~*Figure 1. Roles of the entities involved, and input and output data, in the capacity calculation process for the long-term time frame.* SAP means Single Allocation Platform, and the Merging agent delivers the CGM. LT means long-term and HAR means Harmonised Allocation Rules *in accordance with Article 51 of the FCA Regulation.*~~
~~** Only when the outages cover the entire time period being represented by the IGM / CGM, it is modelled in the IGM / CGM and thus taken into account in the capacity calculation process.*~~

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6. The Nordic regulatory authorities may request additional information to be published by the TSOs. For this purpose, all Nordic regulatory authorities shall coordinate their requests among themselves and consult it with stakeholders. Each Nordic TSO may decide not to publish the additional information, which was not requested by its competent regulatory authority.

TITLE 6
- Final provisions

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Article ~~19~~
24. Publication and Implementation

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1. The TSOs shall publish the CCM without undue delay after ~~all NRAs in the CCR Nordic have approved the CCM or~~ a decision has been taken by the Agency ~~for the Cooperation of Energy Regulators~~ in accordance with Article 4(~~9), Article 4(~~10)~~, and Article (11~~) of the FCA Regulation regarding the methodology.

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2. The Nordic TSOs shall implement ~~the CCM on all bidding zone borders within the CCR Nordic after the CGM~~this methodology ~~developed~~ no later than 12 months after the capacity calculation methodology for the Nordic CCR in accordance with Article ~~18~~20 of the ~~FCA~~CACM Regulation~~, the Single Allocation Platform in accordance with Article 48 of the FCA Regulation and the coordinated capacity calculator in CCR Nordic~~ has been ~~set up in accordance with Article 21(2) of the FCA Regulation, are~~ implemented ~~in~~for both the ~~CCR~~day-ahead and intraday time frame.

~~2.~~3. The implementation process, which shall start with the entry into force of this methodology and finish before the deadline pursuant to paragraph 2, shall consist of an internal parallel run during which the Nordic~~. Before~~ TSOs shall test the operational process for the long-term capacity calculation inputs, the long-term capacity calculation ~~methodology can be put in operation,~~process and the ~~following criteria need to be met:~~long-term capacity validation and develop the appropriate IT tools and infrastructure.

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~~a) Long-term capacity calculation methodology fully developed, and tested;~~
~~b) proven to be efficient, at the same level of system security;~~
~~c) proven to not decrease system security, at the same level of efficiency; and~~
~~d) reliable in producing capacity calculation parameters and results.~~

Article ~~20~~
25. Language

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The reference language for this CCM shall be English. For the avoidance of doubt, where TSOs need to translate this CCM into their national languages, in the event of inconsistencies between the English version published by TSOs in accordance with Article 4(13) of the FCA Regulation and any version in another language, the relevant TSOs shall be obliged to dispel any inconsistencies by providing a revised translation of this CCM to their relevant national regulatory authorities.

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Annex I: The need for dynamic allocation constraints

Operational security limits are thermal limits, voltage limits, short-circuit current limits, frequency and dynamic stability limits. The thermal limits of network elements are easily monitored during capacity calculation and system operation. The restrictions are mainly given by the ambient temperature and the design of the network elements, whereas the loading after a contingency is relatively easily calculated. The assumption in such calculations is that the electricity system remains relatively stable after the contingency.

However, operational security is also impacted by the dynamic stability of the electricity system, which includes voltage stability and electromechanical oscillations. This affects the power system as a whole, not just one or a few network elements. The Nordic CCR need to consider dynamic stability closely mainly due to the distances in Nordic CCR being large (both physically and electrically) which increase the likelihood of both voltage collapse and electromechanical oscillations.

Another example which is closely monitored in Sweden is related to voltages in the network. Large amounts of electricity transferred through long transmission lines consumes significant amount of reactive power, which is mostly compensated by generators. This is the case in Sweden where most of the production is located in the north, and consumption in the south. Large transmission lines from SE1 and SE2 transfer power to SE3 and SE4. Eleven lines are connecting SE3 (Stockholm area) and SE2 and these are referred to as CUT2.

The voltage limit on CUT2 can vary depending on the dispatch situation (i.e. which generators are in operation) and planned outages. Generators operate in different operation modes and with varying reactive power producing capabilities and they contribute to voltage control differently. In case of a contingency where reactive power consumption increases or reactive power producing capabilities are reduced, the electricity system may end up in situation where reactive power sources are depleted. This could further reduce the voltage and result in a voltage collapse. Voltage collapses can lead to large-scale blackouts, such as those which occurred in Sweden in 1983 and 2003. To prevent this, the power flow through the corridor (CUT2) and possible contingencies need to be studied together. The variables used to monitor the voltage limits are the active power flow through the north-south corridors. From these, the maximum possible flow that can be transferred on all the lines together without leading to a voltage collapse after a contingency is calculated and used as an operational security limit in the dispatch centre. It is not possible to study the voltage problems by only looking at a subset of the 11 lines connecting SE2 and SE3. They must be monitored together.

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