
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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All TSOs of the Nordic Capacity Calculation Region, taking into account the following:

Whereas

- (1) This document describes a common methodology developed by all Transmission System Operators (hereafter referred to as “TSOs”) of the Nordic Capacity Calculation Region (hereafter referred to as “CCR Nordic”) 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 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”).
- (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"), 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”).
- (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 sets requirements for the TSOs to cooperate on 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”).
- (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 up to a year ahead, so-called long term capacity calculation (LT CC). The objective of providing LT capacity is two-fold. Firstly, market participants in the power market aim at forecasting future DA pricing of the different bidding zones, acting 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, as this information has an impact on demand and supply of electricity and hence the DA pricing. Secondly, the calculation of LT capacity will act as input to the issuing of LT transmission rights on bidding zone borders where LT transmissions rights are implemented (currently only DK1-DK2). Thus, the calculation of LT capacity will also provide capacity for hedging purposes.
- (5) This CCM takes into account the Common Grid Model (hereafter referred to as “CGM”) methodology and assumes that the CGM developed accordingly, is available in order to execute capacity calculation for the long-term time frame. Thus the frequency of the reassessment of long-term capacity depends on the availability of the CGM for the long-term timeframe. Eight scenarios shall be created within the CGM for the year-ahead capacity calculation, and two scenarios for the month-ahead capacity calculation.
- (6) This CCM follows the definitions of the Flow Based approach and the Coordinated Net Transmission Capacity approach according to Article 2(8) and 2(9) in the CACM Regulation.
- (7) This CCM also takes into account also specific situations in the Nordic power system such as dynamic and voltage stability.

- (8) This CCM takes into account that not all bidding zone borders in CCR Nordic apply long-term transmission rights, implying that 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.
- (9) Article 4(8) of 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 (points (10) to (15) of this Whereas Section).
- (10) 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).
- (11) 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 the CNTC approach to provide cross-zonal capacities, that are calculated in a more coordinated manner, to market participants. Moreover, optimisation of capacity calculation is secured based on coordination between Nordic TSOs, hereby applying a CGM and a Coordinated Capacity Calculator.
- (12) 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-term time frame. The CCM enables TSOs to provide market participants with the same reliable information on cross-zonal capacities for long-term 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 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.
- (13) The CCM does not hinder an efficient long-term operation in CCR Nordic 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 constraints into consideration, will support efficient pricing in the forward markets and forecasts of long-term cross-zonal capacity, providing the right signals from a long-term perspective.
- (14) The CCM contributes to the objective of respecting the need for a fair and orderly forward capacity allocation and price formation (Article 3(e) of the FCA Regulation) by making available in due time the cross-zonal capacity to be released in the long-term time frame and forward markets, where appropriate.
- (15) 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 contributes to maximisation of long-term cross-zonal capacity provided for forward capacity allocation as long-term transmission rights and

maximisation of cross-zonal capacity forecasts for borders not offering long-term transmission rights.

- (16) 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.
- (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:

TITLE I

General

Article 1

Subject matter and scope

1. The CCM is the common methodology of TSOs in CCR Nordic in accordance with Article 10(1) of the FCA Regulation.
2. This CCM applies solely to the CCR Nordic as defined in accordance with Article 15 of the CACM Regulation.
3. This CCM covers the capacity calculation methodologies for the long-term time frame, where cross-zonal capacity shall be calculated for each forward capacity allocation and at least on annual and monthly time frames.

Article 2

Definitions and interpretation

1. For the purposes of the Proposal, the terms used shall have the meaning given to them in Article 2 of Regulation (EC) 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 Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation (hereafter referred to as "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 Nordic in accordance with Article 20(2) of the CACM Regulation.
2. In this CCM, unless the context requires otherwise:
 - a) the singular indicates the plural and vice versa;
 - b) headings are inserted for convenience only and do not affect the interpretation of this CCM; 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.
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 "TSO" shall refer to 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 the FCA Regulation.

TITLE 2

Calculation of the inputs to capacity calculation for the long-term time frame

Article 3

Methodology for determining reliability margin

1. The reliability margin shall be set to zero if no long term transmission rights are issued on a bidding zone border.
2. When long term transmission rights are implemented on a bidding zone border, the reliability margin shall be set to the reliability margin value assessed in the DA capacity calculation on that border.

Article 4

Methodology for determining operational security limits

1. The TSOs 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 shall provide the operational security limits to the CCC to be used in the capacity calculation.
2. All operational security limits shall be respected both during the normal operation and in application of the N-1 criterion.

Article 5

Methodology for determining contingencies relevant to capacity calculation

The TSOs shall apply the same contingencies as in the operational security analysis. These contingencies shall be defined in accordance with Article 33 of the SO Regulation. Each TSO shall provide these contingencies to the CCC to be used in the capacity calculation.

Article 6

Methodology for determining generation shift keys (GSKs)

1. 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.

2. Each TSO shall apply for a given bidding zone the same GSK strategy it has selected for the day-ahead timeframe in accordance with Article 7 of the capacity calculation methodology developed in CCR Nordic in accordance with Article 20(2) of the CACM Regulation.
3. The TSOs shall provide the selected GSK strategy for the CCC to be used in the capacity calculation for each bidding zone and the market time units for which the GSK strategy shall be valid.

Article 7

Methodology for determining remedial actions (RAs) to be considered in capacity calculation

1. Each TSO shall define RAs to be applied in capacity calculation. The relevant RAs shall be coordinated between TSOs, clearly described, and communicated to other TSOs and the CCC.
2. 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).
3. Costly RAs shall not be taken into account in capacity calculation.
4. The TSOs shall regularly and at least once a year review the application of RAs in the capacity calculation in accordance with Article 27(4)(c) of the CACM Regulation.

TITLE 3

Detailed description of the capacity calculation approach for long-term time frame

Article 8

Mathematical description of the applied capacity calculation approach with different capacity calculation inputs

1. The capacity calculation approach for the long-term time frame shall be a CNTC approach. The capacity calculation shall follow the process as presented in Article 18.
2. Inputs to the CNTC approach shall be a linearized security domain based on:
 - a) CGM representing the forecasted state of the power system for the long-term time frame;
 - b) GSKs in accordance with Article 6;
 - c) Contingencies in accordance with Article 5; and
 - d) Operational security limits in accordance with Article 4.
3. The linearized security domain is defined by a PTDF matrix and a vector of Remaining Available Margins.
4. The PTDF matrix is a linearized description of how the net position in each bidding zone impacts the flow on the CNEs when power is extracted in a designated slack node (for each synchronous area). PTDFs shall be 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 described in this Article.
 - 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;
 - ii. The resistance of the power system series elements are neglected (zero); and
 - iii. The difference between the voltage angles of adjoining nodes is small

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

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

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.

5. 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

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

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.

6. The zone-to-zone PTDF 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:

$$PTDF_j^{A \rightarrow B} = PTDF_j^A - PTDF_j^B$$

Where:

$PTDF_j^{A \rightarrow B}$ = Sensitivity of transmission element j to injection in bidding zone A and extraction in bidding zone B;

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

$$RAM_j = F_{max_j} + RA_j - F'_{ref_j}$$

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.

- a) 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.
- b) RA shall be the RAs to increase RAM and defined in accordance with Article 7.
- c) 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:

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

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.

- d) When a negative RAM is calculated but not applied in capacity allocation, the RAM value shall be set to zero and the potential constraint shall be managed by RA.

8. 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

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

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

TSOs shall take into account in the capacity calculation RAs as defined in Article 7 to increase the cross-zonal capacity for the long-term time frame.

Article 11

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

1. The rules for efficiently sharing CNE capacity on different borders are defined by the function $f(TTC)$ and the constraints in Article 8(8).
2. Cross-zonal capacity for each bidding zone border "n" shall be calculated as:

$$CZC^n = TTC^n - AAC^n - RM^n$$

where TTC^n 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

Rules for sharing the power flow capabilities of CNEs among different CCRs

1. Adjoining bidding zones in neighbouring CCRs shall be taken into account in the capacity calculation in CCR Nordic. Cross-zonal capacities on bidding zone borders between CCR Nordic and neighbouring CCRs shall be calculated using CGMs and relevant information from these adjoining bidding zones in coordination with the neighbouring CCCs.
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
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 applying scenarios as defined in Article 3 of the CGM methodology developed in accordance with Article 18 of FCA regulation.
2. The capacity values, resulting from the capacity calculation for each scenario, shall be published.

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

Article 14
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) to ensure that the results of regional calculation 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.
2. If TSOs find errors in cross-zonal capacity provided for validation, the relevant TSOs provide new information to the CCC for recalculation. The CCC shall redo the calculation and send the recalculated cross-zonal capacities for revalidation. Recalculations are executed until no errors are found.
3. Each CCC shall report all reductions made during the validation of cross-zonal capacity to all NRAs of the Nordic CCR. This report shall include the location and amount of any reduction in cross-zonal capacity and shall give reasons for the reductions.
4. The CCC shall coordinate with the neighbouring CCCs during the capacity calculation and validation.

TITLE 5
Miscellaneous

Article 15
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, CCC tries to solve the problem and perform long-term capacity calculation again if time allows to make such calculation.
2. If CCC is not able to perform long-term capacity calculation in accordance with Article 15(1), each TSO shall individually calculate the cross-zonal capacity for relevant long-term time frames for its bidding zone borders and the smaller value calculated for each bidding zone border by neighbouring TSOs shall be applied.
3. 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
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 in the CCR Nordic.
2. Monitoring data shall be provided to the NRAs in the CCR Nordic as a basis for supervising a non-discriminatory and efficient capacity calculation in CCR Nordic.
3. Any data requirements mentioned above should be managed in line with confidentiality requirements pursuant to national legislation.

Article 17
Publication of data

1. The TSOs shall, in compliance with national legislation and in accordance with Article 3(f) of the FCA Regulation, and in addition to the data items and definitions of Transparency Regulation, publish the following on a regular basis and as soon as possible:
Information for each forward capacity calculation, on each scenario, and in accordance with article 9 of the FCA Regulation, at least on annual and monthly time frames, which shall include the following:
 - a) CZC for each bidding zone border;
 - b) all components of the CZC, i.e. TTC, AAC, and RM, for each bidding zone border.
 - c) PTDFs and RAMs
2. The data shall be published for annual capacity calculation, one week before the yearly allocation process but no later than 15 December, for all months of the following year.
3. The data shall be published for monthly capacity calculation, two working days before the monthly allocation process for all days of the following month.
4. The data, obtained from the capacity calculation on a timeframe different than referred to in Article 17(2) and 17(3), shall be published in due time.
5. The above mentioned publication requirements are without prejudice to confidentiality requirements pursuant to national legislation.

Article 18
Capacity calculation process

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.

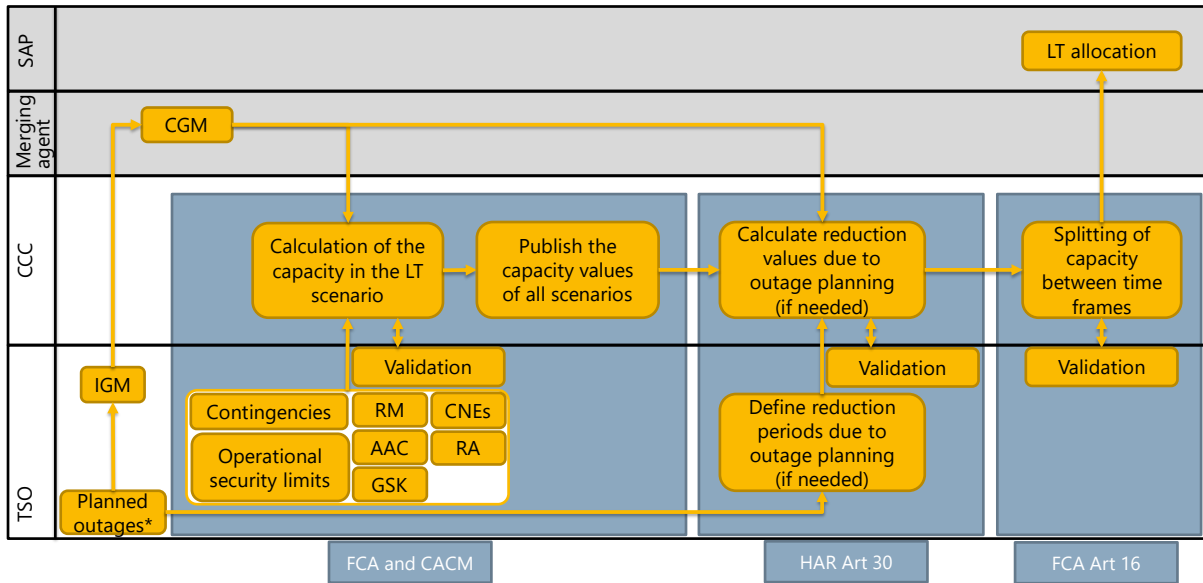


Figure 1. Roles of the entities involved, and input and output data, in the capacity calculation process for the long-term time frame. SAP means Single Allocation Platform, and the Merging agent delivers the CGM. LT means long-term and HAR means Harmonised Allocation Rules in accordance with Article 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.

TITLE 6 Final provisions

Article 19 Publication and Implementation

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.
2. The TSOs shall implement the CCM on all bidding zone borders within the CCR Nordic after the CGM methodology developed in accordance with Article 18 of the FCA 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 the CCR Nordic. Before the long-term capacity calculation methodology can be put in operation, the following criteria need to be met:
 - 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 Language

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.