Supporting document for the Nordic Capacity Calculation Region's 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

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Abbreviations:

AAC	Already allocated capacity
CCC	Coordinated capacity calculator
CCM	Capacity calculation methodology
CCR	Capacity calculation region
CGM	Common grid model
CNE	Critical network element
CNTC	Coordinated net transmission capacity
FB	Flow-based
F_{max}	Maximum flow on a CNE
GSK	Generation shift key
HAR	Harmonised allocation rules
IGM	Individual grid model
LT	Long term
LTTR	Long term transmission right
NTC	Net transfer capacity
PTDF	Power transfer distribution factor
PTR	Physical transmission right
RA	Remedial action
RAM	Remaining available margin
RM	Reliability margin
RSC	Regional security coordinator
SAP	Single allocation platform
TTC	Total transfer capacity
TSO	Transmission system operator
Legal documents:	
CACM Regulation	Commission regulation (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management Guideline
FCA Regulation	Commission regulation (EU) 2016/1719 of 26 September 2016 establishing a guideline on forward capacity allocation
SO Regulation	Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation
Balancing Regulation	Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing
Regulation (EC) 714/2009	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
Transparency Regulation	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

1 Introduction and executive summary

This document is the supporting document for the Nordic Capacity Calculation Methodology (CCM) in accordance with FCA GL. The document describes the CCM proposal for the long-term timeframe for the Nordic Capacity Calculation Region (CCR). The intention of this document is to provide explanation, background, and motivation on the proposed legal text on CCM. This is done for each of the articles in the legal proposal.

On January 16, 2019, the Transmission System Operators (TSOs) of the CCR Nordic[1] and the Norwegian TSO will submit after consultation with stakeholders a common proposal for the CCM in accordance with Article 10 of the Commission Regulation (EU) 2016/1719 establishing a guideline on forward capacity allocation (FCA Regulation) to the Regulatory Authorities (NRAs) of the CCR Nordic[2] and the Norwegian Regulatory Authority[3].

The proposal is subject to approval by all the NRAs of CCR Nordic[4].

1.1 Proposal for the Capacity Calculation Methodology

With regard to the FCA Regulation Article 10(1), the Nordic TSOs are proposing to introduce a CCM for the long-term timeframes. In accordance to FCA Regulation Article 10(2), the capacity calculation approach for the long-term timeframe shall be either a coordinated net transmission capacity (CNTC) approach or a flow-based (FB) approach in a case where the requirements laid down in Article 10(5) of the FCA Regulation are fulfilled. According to the FCA Regulation Article 10(3) the CCM shall be compatible with the CCM established for the day-ahead and intraday timeframes pursuant the Article 21(1) of the CACM Regulation.

The FCA Regulation article 10(5) states that the TSOs may jointly apply for a flow-based (FB) approach if the TSOs concerned are able to demonstrate that the application of the CCM using the FB approach would lead to increased efficiency in the capacity calculation region with the same level of system security.

The FCA Regulation Article 10(4) states that the uncertainty associated with the long-term capacity calculation time frames shall be taken into account when applying a security analysis based on multiple scenarios and using capacity calculation inputs, the capacity calculation approach referred to in Article

1 *Svenska kraftnät, Fingrid, and Energinet.*

2 *The Swedish Energy Markets Inspectorate (Ei), The Danish Utility Regulator (DUR), and The Finnish Energy Authority (EV).*

3 *The Norwegian Water Resources and Energy Directorate (NVE).*

4 *Until Regulation 2015/1222 applies in Norway, NVE and Statnett are not formally part of the process. NVE, will however follow the process and may approve the proposed CCM from Statnett according to national legislation.*

21(1)(b), and the validation of cross-zonal capacity referred to in Article 21(1)(c) of the CACM Regulation. Another option is to apply a statistical approach based on historical cross-zonal capacity for day-ahead and intraday timeframes if it can be demonstrated to increase the efficiency of the CCM, better take into account the uncertainties, and increase economic efficiency with the same level of operational security.

Proposed approaches for the long-term timeframes

The Nordic TSOs propose to implement a CNTC approach based on operational security analysis for the long-term timeframes.

The Nordic TSOs acknowledge that further work is needed to implement all features in capacity calculation required by the FCA Regulation; to apply proper Common Grid Models (CGM) in calculations, to make the CCM robust and reliable before go-live, and to confirm that the implemented CCM approach can deliver results in line with the current NTC approach, showing benefits of the CCM approach. During this process, the transparency towards stakeholders will be ensured.

1.2 Capacity calculation process

Long-term cross-zonal capacities are calculated for all bidding zone borders in the CCR Nordic. The capacity calculation process has to be distinguished from the capacity allocation process, which takes place at the single allocation platform. Long-term capacities are given for allocation only for those bidding zone borders with long-term transmission rights. In practice it is only for the DK1-DK2 bidding zone border. The result of the capacity calculation process is to be used as an input to the capacity allocation process taking into account harmonized allocation rules and the methodology for splitting long term cross-zonal capacity in accordance with the Article 16 of the FCA Regulation. This document is a detailed proposal covering the capacity calculation process. How this process relates to the adjacent processes before ending up with an actual allocation of capacity, is described in this section.

The capacity calculation process will be coordinated among TSOs. This means that individual grid models (IGMs) prepared by each TSO will be merged into a single European grid model. This Common Grid Model (CGM) will include relevant parts of European grids with forecasted production and consumption patterns for each long-term scenario. For the yearly timeframe this currently implies 8 scenarios and for the monthly time frame 2 scenarios, where the capacities will be defined. Capacities will be calculated at the CCR level by applying the CGM. Each TSO will validate the results of the capacity calculation before the capacities are published. Figure 1 shows this coordinated capacity calculation process.

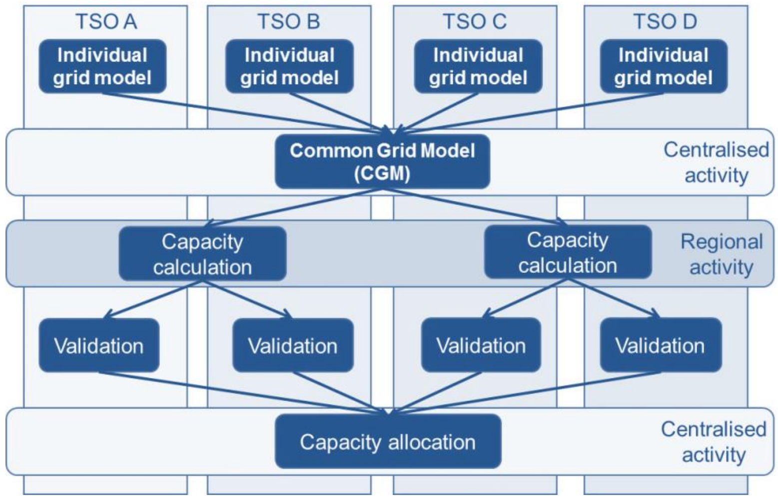

Figure 1 Coordinated capacity calculation process

Figure 1 illustrates whether the respective actions are performed on a TSO, a CCR region, or an European level. The actions requiring the most coordination and harmonization are the building of the CGM followed by the actual capacity calculation and the allocation. Capacity calculation shall be done on a CCR level.

IGMs are built on a TSO level using grid information, and forecasts for production and consumption. Furthermore, the validation of capacity calculation results is performed at the TSO level, as the TSOs are the responsible parties for network security and can best assess the quality and correctness of the capacity calculation results and they are liable for the power system operation.

2 Legal requirements and their interpretation

This chapter contains a description of the relevant legal references in the FCA Regulation including some interpretative guidance.

The legal framework also needs to be interpreted in order to formulate a legally sound proposal on the CCM, to define the scope of this proposal, and to make the proposal implementable.

The passage four of **the preamble of the FCA Regulation** should be taken into account to properly interpret the articles stated further below:

> *"(4) Long-term capacity calculation for the year- and month-ahead market time frames should be coordinated by the transmission system operators (hereinafter 'TSOs') at least at regional level to ensure that capacity calculation is reliable and that optimal capacity is made available to the market. For this purpose, TSOs should establish a common grid model gathering all the necessary data for the long-term capacity calculation and taking into account the uncertainties inherent to*

the long-term time frames. The coordinated net transmission capacity based approach should apply to calculate and allocate long-term cross-border capacities. The flow-based approach might be applied where cross-zonal capacities between bidding zones are highly interdependent and the approach is justified from an economic efficiency point of view."

Definitions in Article 2 of the CACM Regulation shall apply in accordance with the **Article 2 of the FCA Regulation**. The most important definitions for the CCM, extracted from Article 2 of the CACM Regulation, are as follows:

"7. 'operational security limits' means the acceptable operating boundaries for secure grid operation such as thermal limits, voltage limits, short-circuit current limits, frequency and dynamic stability limits;

8. 'coordinated net transmission capacity approach' means the capacity calculation method based on the principle of assessing and defining ex ante a maximum energy exchange between adjacent bidding zones;

9. 'flow-based approach' means a capacity calculation method in which energy exchanges between bidding zones are limited by power transfer distribution factors and available margins on critical network elements;

10. 'contingency' means the identified and possible or already occurred fault of an element, including not only the transmission system elements, but also significant grid users and distribution network elements if relevant for the transmission system operational security;

11. 'coordinated capacity calculator' means the entity or entities with the task of calculating transmission capacity, at regional level or above;

12. 'generation shift key' means a method of translating a net position change of a given bidding zone into estimated specific injection increases or decreases in the common grid model;

13. 'remedial action' means any measure applied by a TSO or several TSOs, manually or automatically, in order to maintain operational security;

14. 'reliability margin' means the reduction of cross-zonal capacity to cover the uncertainties within capacity calculation;"

Furthermore, each proposal shall meet the general objectives as outlined in **Article 3 of the FCA Regulation**:

"This Regulation aims at:

(a) promoting effective long-term cross-zonal trade with long-term cross-zonal hedging opportunities for market participants;

(b) optimising the calculation and allocation of cross-zonal capacity;

(c) providing non-discriminatory access to long-term cross-zonal capacity;

(d) ensuring fair and non-discriminatory treatment of TSOs, NEMOs, the Agency, regulatory authorities and market participants;

(e) respecting the need for a fair and orderly forward capacity allocation and orderly price formation;

(f) ensuring and enhancing the transparency and reliability of information on forward capacity allocation;

(g) contributing to the efficient long-term operation and development of the electricity transmission system and electricity sector in the Union; "

As a general point, all methodologies and proposals developed under the FCA Regulation should align with the objectives of the FCA Regulation as set out in Article 3. More specifically, **Article 4(8) of the FCA Regulation** requires that:

"The proposal for terms and conditions or methodologies shall include a proposed timescale for their implementation and a description of their expected impact on the objectives of this Regulation."

Article 9 of the FCA Regulation sets requirements for market timeframes to be followed in drafting the CCM:

"All TSOs in each capacity calculation region shall ensure that long-term cross-zonal capacity is calculated for each forward capacity allocation and at least on annual and monthly time frames."

Article 10 of the FCA Regulation sets deadlines for the CCM proposal and defines specific requirements that the CCM Proposal for CCR Nordic should take into account:

"1. No later than six months after the approval of the common coordinated capacity calculation methodology referred to in Article 9(7) of Regulation (EU) 2015/1222, all TSOs in each capacity calculation region shall submit a proposal for a common capacity calculation methodology for long-term time frames within the respective region. The proposal shall be subject to consultation in accordance with Article 6.

2. The approach used in the common capacity calculation methodology shall be either a coordinated net transmission capacity approach or a flow-based approach.

3. The capacity calculation methodology shall be compatible with the capacity calculation methodology established for the day-ahead and intraday time frames pursuant to Article 21(1) of Regulation (EU) 2015/1222.

4. The uncertainty associated with long-term capacity calculation time frames shall be taken into account when applying:

(a) a security analysis based on multiple scenarios and using the capacity calculation inputs, the capacity calculation approach referred to in Article 21(1)(b) and the validation of cross-zonal capacity referred to in Article 21(1)(c) of Regulation (EU) 2015/1222; or

(b) a statistical approach based on historical cross-zonal capacity for day-ahead or intraday time frames if it can be demonstrated that this approach may:

(i) increase the efficiency of the capacity calculation methodology;

(ii) better take into account the uncertainties in long-term cross-zonal capacity calculation than the security analysis in accordance with paragraph 4(a);

(iii) increase economic efficiency with the same level of system security.

5. All TSOs in each capacity calculation region may jointly apply the flow-based approach for long-term capacity calculation time frames on the following conditions:

(a) the flow-based approach leads to an increase of economic efficiency in the capacity calculation region with the same level of system security;

(b) the transparency and accuracy of the flow-based results have been confirmed in the capacity calculation region;

(c) the TSOs provide market participants with six months to adapt their processes.

6. Where a security analysis based on multiple scenarios is applied for developing the capacity calculation methodology in a capacity calculation region, the requirements for the capacity calculation inputs, the capacity calculation approach and the validation of cross-zonal capacity as provided for in Article 21(1) of Regulation (EU) 2015/1222, except Article 21(1)(a)(iv) where relevant, shall apply.

7. When developing the capacity calculation methodology, the requirements for the fallback procedures and the requirement provided for in Article 21(3) of Regulation (EU) 2015/1222 shall be taken into account."

NRAs of CCR Nordic approved the common coordinated capacity calculation methodology on 16 July 2018. All TSOs of CCR Nordic shall submit a proposal for a common capacity calculation methodology for long-term time frames no later than 16 January 2019 to the NRAs of CCR Nordic.

The CNTC approach shall be the approach used in the CCM for the long-term capacity calculation timeframes. TSOs may jointly apply the FB approach for long-term capacity calculation time frames if the conditions set in Article 10(5) are fulfilled.

Where the security analysis based on multiple scenarios is applied the requirements for capacity calculation inputs, the capacity calculation approach and the validation of cross-zonal capacity as provided for Article 21(1) of the CACM Regulation shall apply (except Article 21(1)(a)(iv)). Article 21(1) of the CACM Regulation sets the following requirements:

"1. The proposal for a common capacity calculation methodology for a capacity calculation region determined in accordance with Article 20(2) shall include at least the following items for each capacity calculation time-frame:

(a) methodologies for the calculation of the inputs to capacity calculation, which shall include the following parameters:

(i) a methodology for determining the reliability margin in accordance with Article 22;

(ii) the methodologies for determining operational security limits, contingencies relevant to capacity calculation and allocation constraints that may be applied in accordance with Article 23;

(iii) the methodology for determining the generation shift keys in accordance with Article 24;

(iv) the methodology for determining remedial actions to be considered in capacity calculation in accordance with Article 25.

(b) a detailed description of the capacity calculation approach which shall include the following:

(i) a mathematical description of the applied capacity calculation approach with different capacity calculation inputs;

(ii) rules for avoiding undue discrimination between internal and cross-zonal exchanges to ensure compliance with point 1.7 of Annex I to Regulation (EC) No 714/2009;

(iii) rules for taking into account, where appropriate, previously allocated cross-zonal capacity;

(iv) rules on the adjustment of power flows on critical network elements or of cross-zonal capacity due to remedial actions in accordance with Article 25;

(v) for the flow-based approach, a mathematical description of the calculation of power transfer distribution factors and of the calculation of available margins on critical network elements;

(vi) for the coordinated net transmission capacity approach, the rules for calculating cross-zonal capacity, including the rules for efficiently sharing the power flow capabilities of critical network elements among different bidding zone borders;

(vii) where the power flows on critical network elements are influenced by cross-zonal power exchanges in different capacity calculation regions, the rules for sharing the power flow capabilities of critical network elements among different capacity calculation regions in order to accommodate these flows.

(c) a methodology for the validation of cross-zonal capacity in accordance with Article 26."

According to Article 21(1) of the CACM Regulation, the proposal shall define methodologies for the calculation of the inputs to the capacity calculation, a detailed description of the capacity calculation approach, and a methodology for the validation of cross-zonal capacity. Cross-zonal is understood to refer to cross bidding zone borders, regardless of whether these borders are within a Member State or between Member States.

Generally, all cross-zonal capacities in CCR Nordic are allocated in day-ahead and intraday market coupling; only on one border physical transmission rights (PTRs) for a forward timeframe are allocated. This implies that only for this bidding zone border previously allocated capacities have to be considered during long-term capacity calculation.

Article 21(1)(b)(iv) of the CACM Regulation requires to set rules on the adjustment of power flows on critical network elements (CNEs) or of cross-zonal capacity due to remedial actions (RAs) in accordance with Article 25 of the CACM Regulation. Article 25 of the CACM Regulation requires that at least RAs without cost – such as change of grid topology or other measures under TSOs' control – have to be taken into account in the capacity calculation. The effects of the application of these RAs, shall be taken into account and for the CNTC approach it boils down to an adjustment of the cross-zonal capacity.

Article 21(1)(b)(vi) of the CACM Regulation requires to set the rules for calculating cross-zonal capacity including the rules for efficiently sharing the power flow capabilities of CNEs among the different bidding zones for the CNTC approach. If interdependency of cross-zonal capacities exists between bidding zones, the rules to model this interdependency have to be defined and then applied in the CNTC approach.

Article 21(1)(b)(vii)of the CACM Regulation requires, in cases where the power flows on CNEs are influenced by cross-zonal power exchanges in different CCRs, to set the rules for sharing the power flow capabilities of CNEs among different CCRs in order to accommodate these flows. Generally, the CCRs have been configured to minimize the influence of different CCRs to CNEs in a CCR. This influence can occur especially in CCRs, which reside at the same synchronous area requiring cooperation between neighboring coordinated capacity calculators (CCCs) regarding exchanging and confirming information on interdependency with the relevant regional CCCs and defining together rules to take these interdependencies into account.

Article 10(7) of the FCA Regulation requires that the CCM shall include a fallback procedure for the case when the initial capacity calculation does not lead to any results. This fallback procedure shall be developed for long-term capacity calculation timeframes.

Article 11 of the FCA Regulation sets requirements to the reliability margin (RM) methodology, which is part of the CCM in accordance with Article 21(1)(a)(i) of the CACM Regulation:

> *" The proposal for a common capacity calculation methodology shall include a reliability margin methodology which shall meet the requirements set out in Article 22 of Regulation (EU) 2015/1222."*

Article 22 of the CACM Regulation sets the following requirements:

> *"1. The proposal for a common capacity calculation methodology shall include a methodology to determine the reliability margin. The methodology to determine the reliability margin shall consist of two steps. First, the relevant TSOs shall estimate the probability distribution of deviations between the expected power flows at the time of the capacity calculation and realised power flows in real time. Second, the reliability margin shall be calculated by deriving a value from the probability distribution.*
>
> *2. The methodology to determine the reliability margin shall set out the principles for calculating the probability distribution of the deviations between the expected power flows at the time of the capacity calculation and realised power flows in real time, and specify the uncertainties to be taken into account in the calculation. To determine those uncertainties, the methodology shall in particular take into account:*
>
> *(a) unintended deviations of physical electricity flows within a market time unit caused by the adjustment of electricity flows within and between control areas, to maintain a constant frequency;*
>
> *(b) uncertainties which could affect capacity calculation and which could occur between the capacity calculation time-frame and real time, for the market time unit being considered.*
>
> *3. In the methodology to determine the reliability margin, TSOs shall also set out common harmonised principles for deriving the reliability margin from the probability distribution.*
>
> *4. On the basis of the methodology adopted in accordance with paragraph 1, TSOs shall determine the reliability margin respecting the operational security limits and taking into account uncertainties between the capacity calculation time-frame and real time, and the remedial actions available after capacity calculation.*
>
> *5. For each capacity calculation time-frame, the TSOs concerned shall determine the reliability margin for critical network elements, where the flow-based approach is applied, and for cross-zonal capacity, where the coordinated net transmission capacity approach is applied."*

Article 12 of the FCA Regulation sets requirements to the methodologies for operational security limits and contingencies, which is part of the CCM in accordance with Article 21(1)(a)(ii) of the CACM Regulation:

> *"The proposal for a common capacity calculation methodology shall include methodologies for operational security limits and contingencies which shall meet the requirements set out in Article 23(1) and (2) of Regulation (EU) 2015/1222."*

Article 23 of the CACM Regulation sets the following requirements:

"1. Each TSO shall respect the operational security limits and contingencies used in operational security analysis.

2. If the operational security limits and contingencies used in capacity calculation are not the same as those used in operational security analysis, TSOs shall describe in the proposal for the common capacity calculation methodology the particular method and criteria they have used to determine the operational security limits and contingencies used for capacity calculation.

Operational security limits mean, in accordance with Article 2(7) of the CACM Regulation, the acceptable operating boundaries for secure grid operation such as thermal limits, voltage limits, short-circuit current limits, frequency and dynamic stability limits. The list consists of the limits applied currently in the operational security analysis. Operational security limits are the same for CGM scenarios (e.g. minimum and maximum voltage and frequency limits, damping limits for voltage or rotor angle stability) and may be updated when ambient conditions (e.g. temperatures) or voltage/current ranges of devices connected to the grid (e.g. maximum currents, lowest voltages) change. Furthermore, guiding principles are needed to ensure that all TSOs in the CCR Nordic are using the same definitions when submitting operational security limits to the CCC. TSOs have to be transparent on the application of these operational security limits. These operational security limits will be applied to define maximum flows across CNEs or bidding zone borders.

Contingency means, in accordance with Article 2(10) of the CACM Regulation, the identified and possible or already occurred fault of an element, including not only the transmission system elements, but also significant grid users and distribution network elements if relevant for the transmission system operational security.

The contingencies shall be the same as those for the security analysis in accordance with the SO Regulation, generally meeting all N-1 situations, and thus there is no need to describe the particular method and criteria to be used to determine contingencies used in the long-term capacity calculation.

Article 13 of the FCA Regulation sets requirements to the generation shift key (GSK) methodology, which is part of the CCM in accordance with Article 21(1)(a)(iii) of the CACM Regulation:

"The proposal for a common capacity calculation methodology shall include a methodology to determine generation shift keys which shall meet the requirements set out in Article 24 of Regulation (EU) 2015/1222. "

Article 24 of the CACM Regulation sets the following requirements:

"1. The proposal for a common capacity calculation methodology shall include a proposal for a methodology to determine a common generation shift key for each bidding zone and scenario developed in accordance with Article 18.

2. The generation shift keys 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 common grid model.

That forecast shall notably take into account the information from the generation and load data provision methodology."

GSK means, in accordance with Article 2(12) of the CACM Regulation, a method of translating a net position change of a given bidding zone into estimated specific injection increases or decreases in the CGM.

A common GSK shall be developed for each bidding zone and scenario. GSKs will be used to translate a change in net positions into specific nodal injections in the CGM to reflect best the forecasted change in generation or load within a bidding zone.

Article 14 of the FCA Regulation sets requirements to the methodology for RAs in capacity calculation, which is part of the CCM in accordance with Article 21(1)(a)(iv) of the CACM Regulation:

"If remedial actions are taken into account in the long-term capacity calculation, each TSO shall ensure that those remedial actions are technically available in real time operation and meet the requirements set out in Article 25 of Regulation (EU) 2015/1222."

Article 25 of the CACM Regulation sets the following requirements:

"1. Each TSO within each capacity calculation region shall individually define the available remedial actions to be taken into account in capacity calculation to meet the objectives of this Regulation.

2. Each TSO within each capacity calculation region shall coordinate with the other TSOs in that region the use of remedial actions to be taken into account in capacity calculation and their actual application in real time operation.

3. To enable remedial actions to be taken into account in capacity calculation, all TSOs in each capacity calculation region shall agree on the use of remedial actions that require the action of more than one TSO.

4. Each TSO shall ensure that remedial actions are taken into account in capacity calculation under the condition that the available remedial actions remaining after calculation, taken together with the reliability margin referred to in Article 22, are sufficient to ensure operational security.

5. Each TSO shall take into account remedial actions without costs in capacity calculation.

6. Each TSO shall ensure that the remedial actions to be taken into account in capacity calculation are the same for all capacity calculation time-frames, taking into account their technical availabilities for each capacity calculation time-frame."

RA means, in accordance with Article 2(13) of the CACM Regulation, any measure applied by a TSO or several TSOs, manually or automatically, in order to maintain operational security. RAs can be applied also in the capacity calculation phase, where each TSO shall individually define the available RAs to be taken into account to meet the objectives under Article 3 of the FCA Regulation.

RAs without costs (such as grid topology change, phase shifter actions, system protection schemes[5]) shall be taken into account in the long-term capacity calculation.

Each TSO has to coordinate the use of RAs, to be taken into account in the capacity calculation, with other TSOs in the same CCR. RAs can be taken into account in the long-term capacity calculation on the condition that the RAs available after the capacity calculation are sufficient to ensure operational security.

The RAs to be taken into account in capacity calculation shall be the same for all long-term capacity calculation timeframes (from annual to monthly timeframe), taking into account their technical availabilities for each long-term capacity calculation timeframe.

Article 15 of the FCA Regulation sets requirements to a cross-zonal capacity validation methodology, which is part of the CCM in accordance with Article 21(1)(c) of the CACM Regulation:

> *"The proposal for a common capacity calculation methodology shall include a cross-zonal validation methodology which shall meet the requirements set out in Article 26 of Regulation (EU) 2015/1222."*

Article 26 of CACM Regulation sets the following requirements:

> *"1. Each TSO shall validate and have the right to correct cross-zonal capacity relevant to the TSO's bidding zone borders or critical network elements provided by the coordinated capacity calculators in accordance with Articles 27 to 31.*
>
> *2. Where a coordinated net transmission capacity approach is applied, all TSOs in the capacity calculation region shall include in the capacity calculation methodology referred to in Article 21 a rule for splitting the correction of cross-zonal capacity between the different bidding zone borders.*
>
> *3. Each TSO may reduce cross-zonal capacity during the validation of cross-zonal capacity referred to in paragraph 1 for reasons of operational security.*
>
> *4. Each coordinated capacity calculator shall coordinate with the neighbouring coordinated capacity calculators during capacity calculation and validation.*
>
> *5. Each coordinated capacity calculator shall, every three months, report all reductions made during the validation of cross-zonal capacity in accordance with paragraph 3 to all regulatory*

[5] *Please note that system protection schemes might bring a cost when they are activated.*

authorities of the capacity calculation region. This report shall include the location and amount of any reduction in cross-zonal capacity and shall give reasons for the reductions.

6. All the regulatory authorities of the capacity calculation region shall decide whether to publish all or part of the report referred to in paragraph 5."

3 Motivation for the articles in the CCM proposal

This chapter presents explanations of the proposed CCM articles. The aim of the chapter is to provide for a motivation for the content of each of the articles and the thinking that lies behind.

3.1 Article 2: Definitions and interpretation

This article draws upon the definitions already included in other legal texts, so no new definition on individual concepts has been included.

3.2 Article 3: Methodology for determining reliability margin (RM)

For the long-term timeframes, the reliability margin is set to zero. The uncertainty related to the capacity calculation is captured by applying different scenarios. Including a non-zero RM might "double count" uncertainty, thereby unnecessarily reducing capacity.

3.3 Article 4: Methodology for determining operational security limits

In the long-term capacity calculation in accordance with Article 10(6) of the FCA Regulation, where the security analysis based on multiple scenario is applied, the requirement as provided for in Article 21(1) of the CACM Regulation shall apply.

Thus according to the CACM Regulation Article 21.1(a) (ii), operational security limits, contingencies and allocation constraints are three features described as part of the long-term capacity calculation:

> "*the methodologies for determining operational security limits, contingencies relevant to capacity calculation and allocation constraints that may be applied in accordance with Article 23".*

The following subsections give more details how these issues are taken into account in the long-term capacity calculation.

Operational security limits

In long-term capacity calculation the definitions set in the CACM Regulation shall apply in accordance with Article 2 of the FCA Regulation. Thus Article 2(7) of the CACM Regulation shall apply, where operational security limits are defined as follows:

> *"'operational security limits' means the acceptable operating boundaries for secure grid operation such as thermal limits, voltage limits, short-circuit current limits, frequency and dynamic stability limits."*

Boundaries for secure grid operation are independent of whether the CNTC or FB approach is applied.

The list of operational security limits consists of limits applied in the operational security analysis. All operational security limits shall, however, be respected both during the normal operation and in application of the N-1 criterion when defining allowed power flows across the power system. The list of operational security limits may change in the future when the characteristics of the power system will change due to foreseen change towards sustainable electricity system.

Thermal limits are limits on the maximum power carried by transmission equipment due to heating effect of electricity current flowing through the equipment, and depend on the physical structure of the equipment and the voltage level. Ambient conditions like temperature, wind and the duration of overload will influence the limit. Larger power flows may be allowed for a short period of time. Thermal limits define the maximum allowed power flow on the specific equipment, unless other more restricting limits (e.g. voltage or dynamic stability limits) exist.

Voltage limits for each substation and its equipment are defined in kVs. Both maximum and minimum limits for voltages are defined. The voltage limits are based on voltage ranges as defined in the connection network codes. Power flows across the power system have an effect on the voltages; increasing power flows decrease voltages. The minimum voltage limit defines for each operational situation the maximum allowed power flows in the transmission grid to avoid too low voltages and the disconnection of the equipment by the protection systems.

Short-circuit current limits are defined for each substation and its equipment in kAs. Both minimum and maximum limits for short-circuit currents are defined. The minimum limit is important for selective operation of protection devices, so that faults can be timely and selectively cleared. The maximum limit is set to ensure that devices connected to the grid can withstand induced fault currents. These limits do not influence the allowed power flows in the AC grid, but are there to ensure the functioning of protection systems and that devices connected to the grid can withstand fault currents and that the probability of cascading faults beyond the N-1 criterion is minimized.

Frequency stability limits are based on frequency ranges set in the connection network codes and in the SO Regulation. Frequency stability limits are taken into account during dynamic stability studies to see if the limits would have affected the allowed power flows on the transmission grid. It is foreseen that these limits will have more effect in the future system operation, due to changes in the generation mix.

Dynamic stability limits consist of voltage and rotor angle stability limits. For voltage stability studies, the voltage limits during the fault in the power system and after clearance of the fault shall be studied to define the allowed power flows within the power system, respecting the voltage limits. For rotor angle stability studies, the power flow and generator rotor angle oscillations are studied for each operational situation to define the allowed power flows within the power system with predefined damping coefficients for power and rotor angle oscillations. The magnitude of oscillations and their damping depends on the structure of the power system and the power flows across the power system.

The acceptable operating boundary for secure grid operation is defined by a maximum flow on a CNE ($F_{u,max}$, $u \in \{T,V,DV,DD\}$), that is monitored in the operational security analyses and in real time operation defined as a MW limit for maintaining the voltage and short circuit current level, frequency and dynamic stability within its limits.

T = Thermal
V = Voltage, Static
DV = Voltage, dynamic
DT = Transient stability
DD = Damping

Figure 2 shows an example of how $F_{u,max}$ will be defined and how it relates to the F_{max} on a CNE.

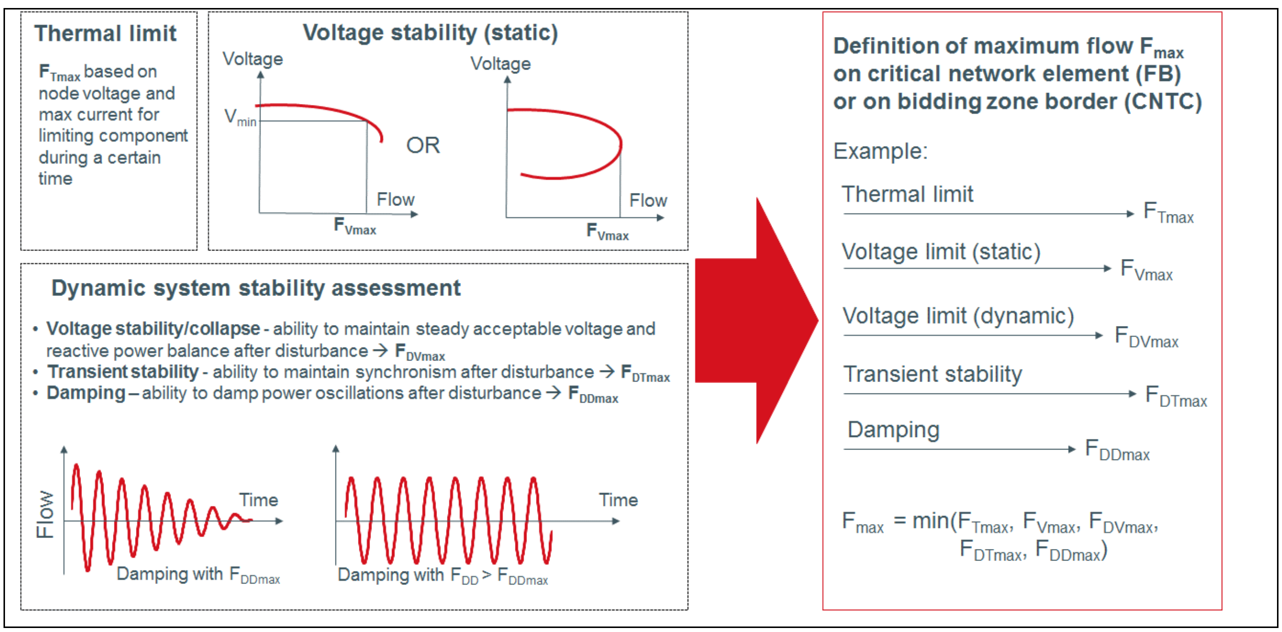

Figure 2: Definition of maximum flow (F_{max}) for CNEs

Generally, the $F_{u,max}$ are found by performing network analyses on a relevant grid model, currently the TSOs' local grid models adjusted by the relevant grid topology, and considering an N-1 situation. The CGM will be used when sufficient data quality and performance is secured within this model.

3.4 Article 5: Methodology for determining contingencies relevant to capacity calculation

A contingency is commonly understood to be something that might possibly happen in the future that causes problems or makes further arrangements necessary. In the electricity system, contingencies are potential incidents or faults in the system that TSOs need to be prepared for. For this to be the case, a certain amount of redundancy must be built into the power system. If the power system can withstand one incident without the loss of system functionality, the power system is compliant with the N-1 criterion. If two simultaneous incidents occur in the power system, without affecting the users of the transmission system it fulfills the N-2 criterion. When doing long-term capacity calculation, one normally does not model all possible contingencies, but a relevant set having cross-zonal relevance is chosen. It is the responsibility of the TSOs to specify which contingencies shall be considered by the CCC during the long-term capacity calculation.

When specifying the contingencies for the long-term capacity calculation, the TSOs apply the same contingencies as used in the operational security analysis.

3.5 Article 6: Methodology for determining generation shift keys (GSK)

The GSKs define how a net position change, both positive and negative, in a bidding zone is distributed to each node (generator unit or load point) in the CGM during the long-term capacity calculation. In this context the general term GSKs is used for both generation and load, as load is perceived as negative generation.

In long-term capacity calculation, each TSO shall apply for a given bidding zone the same GSK strategy as applied for the day-ahead timeframe. For the day-ahead capacity calculation time frame, eight different GSK strategies (1-8), plus one custom strategy (0), have been developed for the CCR Nordic, each providing different bidding zone characteristics. The TSO may select one of the eight strategies for each bidding zone, or provide a custom GSK strategy with individual GSK factors for each load and generator unit in the CGM.

In general, the GSK strategies include power plants and loads that are sensitive to market changes and flexible in changing the electrical power output/input. This mainly includes hydro, coal, oil, and gas units. Generators and loads that are likely to be shifted receive a high GSK factor. Non-flexible units, such as e.g. nuclear, wind, solar or run-of-river, receive a GSK factor of zero.

Table 1 shows the properties of the GSK strategies developed for the day-ahead time frame and to be applied in long-term capacity calculation. The GSK factors are normalized for each bidding zone and then defined in a dimensionless factor. For example, one production unit may have a GSK factor corresponding to its installed capacity (MW) and, normalized, this factor may equal 0.03. This means that 3% of the total NP change is handled by the unit.

Table 1 GSK strategies in method proposal

Strategy number	Generation	Load	Comment
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	Flat GSK factors of all generators, independently of the size of the generator unit
5	P_g	0	Generators participate relative to their current power generation (MW)
6	P_g	P_l	Generators and loads participate relative to their current power generation or load (MW)
7	0	P_l	Loads participate relative to their power loading (MW)
8	0	1.0	Flat GSK factors for all loads, independently of size of load

k_g : GSK factor [pu] for generator *g*

k_l : GSK factor [pu] for load *l*

P_g : Current active generation [MW] for generator *g*

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

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

P_{load}: Current active load [MW] for load *l*

The TSOs provide the GSK strategy to be used in the long-term capacity calculation for each bidding zone and the time period for which it is valid.

3.6 Article 7: Methodology for determining remedial actions (RAs) to be considered in capacity calculation

Taking non-costly RAs into account is straight forward; it increases the available transmission capacity at no cost. Non-costly RAs will therefore by default be taken into account if available. Unlike the DA and ID CCM, costly RAs will not be taken into account as this is not possible in a long term perspective as the availability of resources are not known month and year in advance.

For long term capacity calculation the objective is not to allocate capacity, only to give indications of the amount of cross-zonal trading possibilities. For bidding zone borders with PTRs (de facto only DK1-DK2) an actual allocation can be relevant, in case the holders of PTRs actually nominate capacity. However, the effect of increasing capacity by including costly RA will probably be zero as the splitting methodology in accordance Article 16 of FCA will limit the amount of long term transmission rights (LTTRs) below the level of cross-zonal capacity calculated by the FCA CCM, both with and without costly RA.

3.7 Article 8: Mathematical description of the applied capacity calculation approach with different capacity calculation inputs

On a high level, the CNTC computation is built up of two steps:

1. The assessment of a linear security domain
2. The extraction of a CNTC domain from this linear security domain.

The assessment of a linear security domain follows the same steps as the FB capacity calculation as proposed by the Nordic CCR for their DA and ID capacity calculation. The linear security domain is defined by PTDFs and RAMs. More details can be found in the supporting document for the DA and ID CCM that the Nordic TSOs published on the Nordic RSC website: https://nordic-rsc.net/wp-content/uploads/2018/08/supp.pdf.

In the second step, the CNTC values are to be assessed that can be provided to the market without jeopardizing the operational security of the grid. Or in other words: a set of CNTC values needs to be determined that respects the linear security domain that has been assessed based on the CGM, GSKs, CNEs, contingencies, and operational security limits.

Example

Imagine a CNE being impacted with 25% by an exchange from bidding zone A to B. Or in other words, if we exchange 100 MW from bidding zone A to B, the CNE would be loaded with 25 MW.

If the RAM (Remaining Available Margin; the capacity available for the market) on this CNE equals 200 MW, and we would assign the full 200 MW to be used by a commercial exchange from bidding zone A to B, this would imply a TTC(A->B) = 200/0.25 = 800 MW.

If we would assign the 200 MW to be used by commercial exchanges on several bidding zone borders, a rule is needed to do this, as explained in the text below.

Graphically, this could be visualized as the determination of a box within the linear security domain, as depicted in Figure 3.

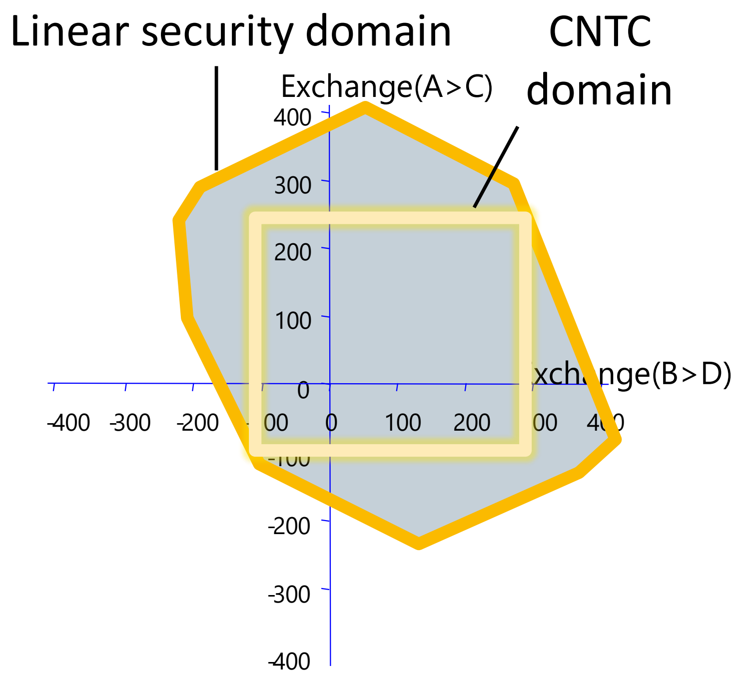

Figure 3 CNTC domain extracted from the linear security domain

It is clear from Figure 3, that the CNTC domain depicted is not the only box that fits within the linear security domain; one can "draw" many that would fit in the linear security domain. Therefore a rule needs to be determined to do so.

In the CWE region - where this approach is applied to extract CNTC values from the FB domain - the rule is based on an equal sharing of a CNE's RAM between the electrical borders that are loading the CNE. In the Nordics, an optimization-based approach is being developed to determine the CNTC values. The optimization is formulated in the legal document as follows (please note that we refer to TTC instead of CNTC here; indeed, the linear security domain is one without taking reliability margins into account, so that it is the total transfer capacity that is being extracted).

Maximize $f(TTC)$

Subject to

$$g(\sum_n TTC^n * PTDF_j^n) \leq h(RAM_j) \qquad \forall j \in \{All\ CNEs\}$$

Where:

f = a function

g = a function

h = a function

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

j = reference to a CNE

Where the objective function is a maximization of a function of the TTC values to be computed (e.g. a sum of the TTC values). The inequality constraints of the optimization indicate that the TTCs need to be determined in such a way that no overloads in the system are created (i.e. to determine a box within the linear security domain). The inequality constraints are however formulated in a way that both the left-hand and right-hand side of the constraint are functions as well. Indeed, this is to build in some flexibility in the optimization (the problem is ”relaxed”), for example to allow for overloads in those directions where the market is not expected to end up (i.e. to allow the box to stick out of the linear security domain), as depicted in Figure 4.

This with the objective to assess the largest TTC values possible, without jeopardizing the operational security.

The TTC values assessed per bidding zone border are transferred into cross-zonal capacity (CZC) values by the following step, where the already-allocated capacity (AAC) and the reliability margin (RM) are subtracted from the TTC:

$CZC = TTC - AAC - RM$

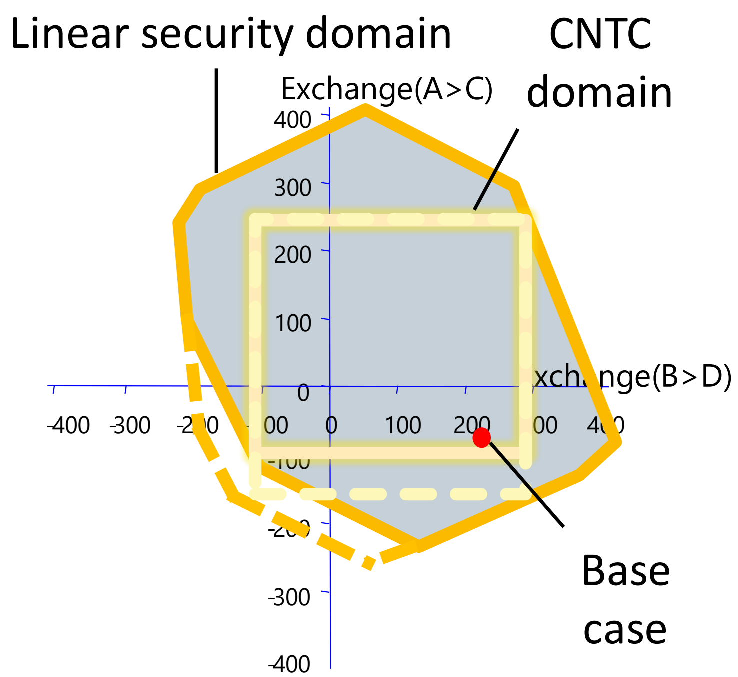

Figure 4 The optimization problem can be relaxed to make the CNTC domain larger, e.g. by allowing the CNTC domain to exceed the linear security domain in those "corners" where the market is not expected to end up

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

The intention is to calculate long term capacity on a monthly and yearly basis. There can be two situations where already allocated capacity needs to be taken into account. Firstly, if LTTRs are allocated on a bidding zone border, the calculation of monthly capacity shall take into account that yearly capacity might already be allocated as LTTRs. Secondly, cross-zonal capacity might be used for the exchange of ancillary services in case this is assessed to provide higher social value than utilizing the capacity in the day ahead or intraday market (provided that the exchange of reserves is within the legal mandate). The amount of capacity allocated for ancillary services shall be deducted from the long term capacity to be foreseen for LTTRs and the day ahead / intraday market.

3.9 Article 10: Rules on the adjustment of power flows on critical network elements or of cross-zonal capacity due to remedial actions

RAs as defined in Article 7 shall be taken into account in the capacity calculation to increase cross-zonal capacity in the long-term timeframe.

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

The rule for efficiently sharing the power flow capabilities of CNEs among different bidding zone borders is part of the description as provided in section 3.7. Indeed, it is the optimization-based approach, to extract the CNTC domain from a linear security domain, that takes care of this.

3.11 Article 12: Rules for sharing the power flow capabilities of CNEs among different CCRs

The CCR Nordic is adjoining to the Hansa CCR and the Baltic CCR. When the CCC performs LT capacity calculation the adjoining bidding zones in the Hansa CCR and the Baltic CCR should be taken into account. This is done by using CGMs and relevant information from these adjoining bidding zones in coordination with the neighbouring CCC(s). If there is difference in the cross-zonal capacity on the bidding zone border to the adjoining CCR, the lower value shall apply in the capacity calculation.

3.12 Article 13: Scenarios to take into account uncertainty associated with long-term capacity calculation time frames

TSOs will take the uncertainty associated with long-term capacity calculation time frames into account applying the security analysis for multiple scenarios. The scenarios used shall be defined in accordance with Article 3 of the CGM methodology for long-term capacity calculation time frames, which has been developed in accordance with Article 18 of FCA Regulation. Article 3 states that each TSO shall by default use the following scenarios for the year-ahead capacity calculation time frame:

- Winter Peak, 3rd Wednesday of January current year, 10:30h (indicative target period: first quarter);
- Winter Valley, 2nd Sunday of January current year, 03:30h (indicative target period: first quarter);
- Spring Peak, 3rd Wednesday of April current year, 10:30h (indicative target period: second quarter);
- Spring Valley, 2nd Sunday of April current year, 03:30h (indicative target period: second quarter);
- Summer Peak, 3rd Wednesday of July previous year, 10:30h (indicative target period: third quarter);
- Summer Valley, 2nd Sunday of July previous year, 03:30h (indicative target period: third quarter);
- Autumn Peak, 3rd Wednesday of October previous year, 10:30h (indicative target period: fourth quarter);
- Autumn Valley, 2nd Sunday of October previous year, 03:30h (indicative target period: fourth quarter).

For the month-ahead capacity calculation time frame, each TSO shall by default use the following scenarios:

- Peak, 3rd Wednesday of the same month during the previous year, 10:30h; and
- Valley, 2nd Sunday of the same month during the previous year, 03:30h.

Furthermore, Article 3 of the CGM methodology for long-term time frames sets the principles to be applied by each TSOs, when building scenarios for long-term time frames. These principles address the forecasted situation for grid topology, how to take into account structural data changes for relevant scenario(s), operational limits, forecast for generation and load, forecasted net position for each bidding zone and forecasted flow for each HVDC interconnection.

3.13 Article 14: Methodology for the validation of cross-zonal capacity

The TSOs are legally responsible for the cross-zonal capacities and they have to validate the calculated cross-zonal capacities before the CCC can send the cross-zonal capacities for publication and allocation. According to Article 15 in FCA the proposal for a common capacity calculation methodology shall include a cross-zonal validation methodology:

> *"The proposal for a common capacity calculation methodology shall include a cross-zonal validation methodology which shall meet the requirements set out in Article 26 of Regulation (EU) 2015/1222."*

Hence the requirements for cross-zonal validation methodology of the FCA should also meet the requirements of the cross-zonal capacity validation methodology of CACM.

Article 26 paragraph 1 of CACM reads:

> *"Each TSO shall validate and have the right to correct cross-zonal capacity relevant to the TSO's bidding zone borders or critical network elements provided by the coordinated capacity calculators in accordance with Articles 27 to 31."*

The validation of cross-zonal capacities will be performed by each TSO to ensure the cross-zonal capacities on its bidding zone border(s) of the capacity calculation process – executed by the CCC - will respect operational security requirements. The CCC will coordinate with neighboring CCCs during the validation process.

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. The TSOs will consider the operational security limits and the CGM to perform the validation, but may also consider additional CNEs, grid models, and other relevant information. The TSOs may use, but are not limited to use, the tools developed by the CCC for operational security analysis. The TSOs might also employ validation tools not available to the CCC.

Article 26 paragraph 3 *of* CACM states:

> *"Each TSO may reduce cross-zonal capacity during the validation of cross-zonal capacity referred to in paragraph 1 for reasons of operational security."*

The TSOs shall reduce the cross-border capacity if the calculated cross-zonal capacities would allow the capacity allocation process to create a result that could put operational security at risk.

Article 26 paragraph 4 *of* CACM states:

> *"Each coordinated capacity calculator shall coordinate with the neighboring coordinated capacity calculators during capacity calculation and validation."*

The CCC will provide information on reductions or increases in cross-zonal capacity to the neighboring CCC.

Any information on increased or decreased cross-zonal capacity from neighbouring coordinated capacity calculators will be provided to the TSOs. The TSOs may then apply the appropriate reductions or increases of cross-zonal capacities according to Article 26 of the CACM Regulation.

If the TSOs find error(s) in cross-zonal capacity provided for validation, the relevant TSO(s) provide new information to the CCC for recalculation and the CCC will recalculate the capacities. The recalculated capacities will be send for validation. As time is not as critical as for the DA timeframe, recalculations are executed until no errors are found.

3.14 Article 15: Fallback procedure for the case where the initial capacity calculation does not lead to any results

In case the initial capacity calculation does not lead to any results, the CCC will perform a new capacity calculation if the time allows. Compared to the DA and ID timeframe the capacity calculation is not as time critical and in normal cases the CCC will have time to recalculate the LT cross-zonal capacity.

If the CCC is not able to perform long-term capacity calculation, each TSO shall individually calculate the long term cross-zonal capacity on its bidding zone borders. For borders involving more than one TSO the lower value shall be applied.

In the unlikely event that none of the CCC or the individual TSOs manages to calculate long term cross-zonal capacity, the results from the most recent long-term capacity calculation for the relevant long-term time frame shall be applied.

3.15 Article 16: Monitoring data to the national regulatory authorities

If the NRAs in the Nordic CCR request technical and statistical information related to this CCM, this information should be made available for them. Monitoring data shall be provided to the NRAs in CCR Nordic as a basis for supervising a non-discriminatory and efficient Nordic capacity calculation and congestion management. Any data requirements mentioned in this article should be managed in line with confidentiality requirements pursuant to national legislation, if applicable.

3.16 Article 17: Publication of data

The TSOs are legally responsible for aiming at ensuring and enhancing the transparency and reliability of information to the national regulatory authorities and market participants. This article describes what shall be published in accordance with Article 3(f) of the FCA Regulation and in addition to the data items and definitions in accordance with Transparency Regulation.

Article 3(f) of the FCA Regulation specifies: why the information should be published, and the subparagraph d) states:

> *(d) ensuring fair and non-discriminatory treatment of TSOs, the Agency, regulatory authorities and market participants;*

The purpose of publishing data is to give market participants and other stakeholders relevant and appropriate information on transmission capacity. With such information the market participants will have trust in the market and are supposed to be able to act rationally in the markets. This is done by publishing on a regular basis and as soon as possible information for each forward capacity allocation, and at least on annual and monthly time frame, including the following items:

1. CZC for each bidding zone border
2. all components of the CZC, i.e. TTC, AAC, and RM, for each bidding zone border;

Any data requirements mentioned above should be managed in line with confidentiality requirements pursuant to national legislation, if applicable.

The final, exhaustive and binding list of all publication items, metrics and indicators etc. may be adjusted by the NRAs in CCR Nordic based on dialogue with TSOs and Nordic stakeholders.

3.17 Article 18: Capacity calculation process

This Article presents a graphical overview that depicts the roles and entities involved, and the input and output data in the capacity calculation process for the long-term timeframe, but also the process in case a TSO allocates LTTRs on a bidding zone border (for now only, Energinet on the DK1-DK2 bidding zone border). Figure 5 shows the roles of the entities involved, and input and output data, in the capacity calculation process for the long-term time frame. HAR means Harmonised Allocation Rules in accordance with Article 51 of the FCA Regulation. Article 16 of the FCA Regulation refers to the methodology for splitting cross-zonal capacities for different LT timeframes.

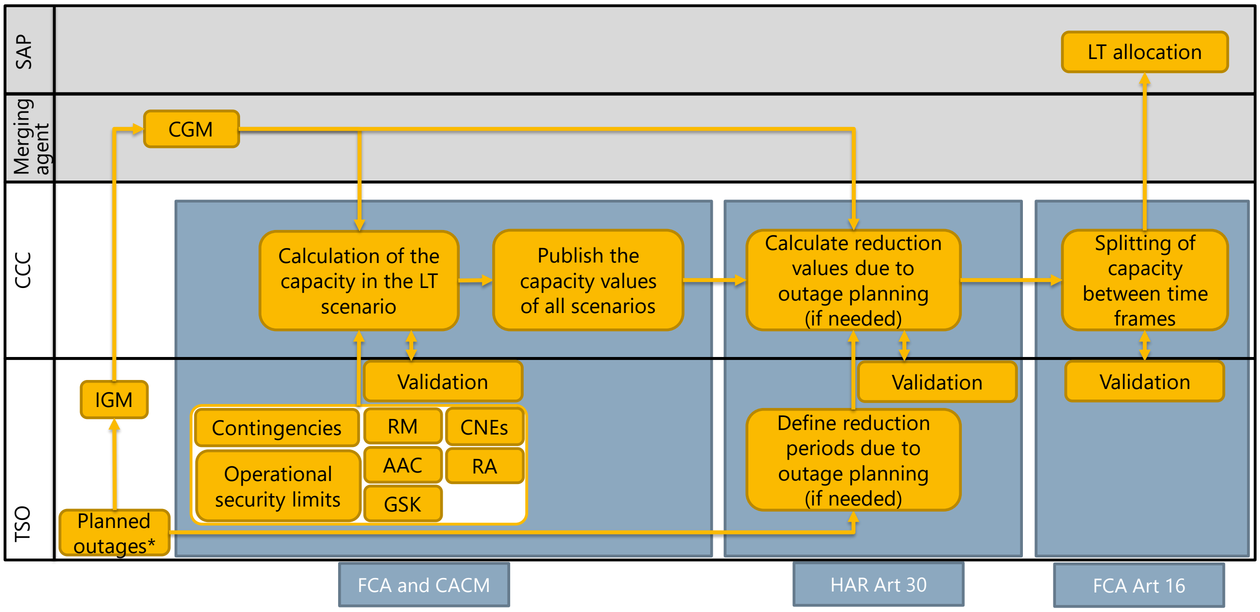

Figure 5 Roles of the entities involved, and input and output data, in the capacity calculation process for the long-term time frame. SAP means Single Allocation Platform, and the Merging agent delivers the CGM. LT means long-term and HAR means Harmonised Allocation Rules in accordance with Article 51 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.

As indicated by the asterisk in the box "Planned outages" in Figure 5, 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. This means for example that an outage, planned to start in January and to end in March, is included in the February CGM.

This methodology covers the activities of FCA CCM as illustrated in the left part of the picture. The HAR Article 30 and FCA article 16 applies only to those TSOs where LTTRs are allocated. The figure illustrates that the splitting of capacity in different time frames uses the capacity calculated in accordance with the FCA CCM proposal as an input.

3.18 Article 19: Publication and Implementation

This article describes the conditions and provisions on publication and implementation of the LT CCM. When the LT CCM is approved by NRAs or ACER, the TSOs should publish the CCM on their homepages without undue delay.
The LT CCM will be implemented on all bidding zone borders within the CCR Nordic after the CGM methodology, the Single Allocation Platform, and the CCC are implemented in the CCR Nordic. Before the LT CCM can be put in operation it needs to be tested so it fulfils the Go-Live criteria in order to ensure efficient, secure, and reliable system operation.