Explanatory document to Capacity calculation methodology within the Baltic Capacity Calculation Region by Article 20(2) of the Commission Regulation (EU) 2015/1222 establishing a guideline on capacity allocation and congestion management

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1 INTRODUCTION

The Commission Regulation (EU) 2015/1222 establishing a guideline on Capacity Calculation and Congestion Management (CACM Regulation) foresees to develop and implement a common Day Ahead and Intraday Capacity Calculation Methodology (DA ID CCM) per Capacity Calculation Region.

Baltic CCR TSOs submitted the proposal for the Baltic DA ID CCM on 3rd of October 2018, which the Baltic CCR NRAs approved at the end of 2018.

Three Baltic countries plan to synchronize with Continental Europe Synchronous Area (CESA) in the first quarter of 2025. In addition, considering Baltic CCR NRAs decision on 29th of January 2021, Baltic CCR NRAs encourage the Baltic CCR TSOs to develop a new DA ID CCM in parallel with the new Long Term Capacity Calculation Methodology (LT CCM) proposal, where applicable following the guidance in ACER's decision on the LT CCM and submit a new DA ID CCM proposal to Baltic CCR NRAs in accordance with CACM Regulation article 9(13).

Considering these circumstances, Baltic CCR TSOs provide new updated Baltic DA ID CCM for Baltic CCR NRAs approval including requested changes considering Baltic states synchronization with CESA and proposing new principles which will be considered during the update of Baltic LT CCM. In this explanatory document Baltic CCR TSOs will explain the changes included in the proposal for Baltic DA ID CCM compared to the previous version of Baltic DA ID CCM document.

2 SYNCHRONIZATION WITH CESA

Baltic states synchronization with CESA has legal and technical aspects. Legal aspects relevant for Baltic DA ID CCM development covers changes for currently existing operational agreements. Technical synchronisation aspects, related to Baltic area and relevant for Baltic DA ID CCM are explained in Section 7. New DA ID CCM is developed and planned to be implemented by the time Baltic states are synchronized with CESA when new principles will be applied.

Baltic states currently are operating in different synchronous area called BRELL (Belarus, Russia, Estonia, Latvia and Lithuania). Key operational and organizational principles within common synchronous area of BRELL are set out in an agreement between TSOs of Belarus, Russia, Estonia, Latvia and Lithuania. This agreement also covers capacity calculation and coordination principles between parties as well as other relevant operational aspects for system operations. As Baltic states operate in the same BRELL synchronous area, they must apply common principles set out in aforementioned agreement.

Considering from operational point of view in terms of legal aspects which are relevant to DA ID CCM key difference of new version of DA ID CCM is that references to BRELL agreement are eliminated. This agreement will be no longer relevant for Baltic TSOs as they will operate in CESA. New DA ID CCM sets out principles for capacity calculation in accordance with CACM Regulation. This allows to be fully compliant with EU regulations and full integration with EU capacity coordination processes and markets.

3 COORDINATED NTC CAPACITY CALCULATION APPROACH APPLICATION

Coordinated NTC approach as per CACM Regulation article 21(1)(b)iv is foreseen to be applied by Baltic CCR TSOs in new updated Baltic DA ID CCM. This decision is consistent with the previous version of DA ID CCM where the same method is foreseen to be applied.

Key factors determining coordinated NTC approach adoption in Baltic DA ID CCM are Baltic TSOs electrical grid configuration and desynchronization from BRELL network. Baltic TSOs networks are distributed radially, which allows to better anticipate and manage flows, as there are no possibilities for loop flows to appear. Therefore, varying net positions of each bidding zone results in direct flows on cross borders and there are no loop flows impact for Baltic TSOs networks. In addition, as Baltic TSOs will be desynchronized from BRELL network, there will no longer be any impact from third countries and no loop flows induced by any of third country party network net position variation.

As a result, Baltic states synchronous operation with CESA allows to operate network better by accurately planning flows on cross borders. Therefore, the coordinated NTC approach allows for an optimal use of the transmission infrastructure while maintaining a high level of system security as well as for efficient grid operation for each Baltic TSO. This method allows efficiently determine and coordinate cross border flows in Baltic region by disregarding any impact from third countries or other system operators.

3.1 TTC CALCULATION

Net Transmission Capacity (NTC) determines maximum allowable cross border power exchanged between bidding zones. It is equal to Total Transfer Capacity (TTC) reduced by Transmission Reliability Margin (TRM).

TTC will be calculated using Common Grid Model (CGM) according to CACM Regulation article 28(5) and article 29(8)a by evaluating system security analyses and analysed maximum possible exchanges between bidding zones. CGM usage allows to fulfil general requirements of CACM Regulation and efficiently integrate into EU TSOs processes after Baltic TSOs synchronization with CESA.

3.2 TRM CALCULATION

TRM will be calculated by considering netted planned and actual power flow deviations on cross border and adding one standard deviation. This calculation will be done for data set, covering last 12 months period. TRM recalculation and update is foreseen at least every month. In addition, TRM will be calculated and applied for each cross border interconnection direction. On top of that, for the initial period of synchronization with CESA, data for calculation will not be available, therefore, for one month period it is foreseen to apply fixed TRM values for cross borders. After that, TRM will be calculated based on available data and recalculated every month by adding additional data set, until 12 months data set is available.

3.3 NTC CALCULATION

NTC as an initial input for market will be calculated as usual by considering TTC and TRM values. TTC will be reduced by TRM and NTC value will be obtained.

4 CAPACITY ALLOCATIONS BEFORE DAY AHEAD MARKET

4.1 BALANCING CAPACITY ALLOCATIONS

In parallel with the implementation of new DA ID CCM, the Baltic TSOs shall establish common Baltic capacity market for FCR, aFRR and mFRR reserves. As a result of common procurement of given reserves, the Baltic TSOs foresee the need to allocate cross-border capacities of Baltic TSO internal AC cross-border for the exchange and sharing of FRR (aFRR and mFRR) capacities to ensure access of necessary balancing capacities to each Baltic TSO. The capacity allocated for the exchange of balancing capacity and sharing of reserves is determined in accordance with the applicable methodology according to Electricity Balancing Guideline (EBGL) article 38. Cross-zonal capacity in the Baltic CCR is expected to be allocated for the exchange of balancing capacity and sharing of reserves either according to the market-based allocation process (described in EBGL article 41) or the co-optimized process (described in EBGL article 40). In 2025, the market-based process is implemented in the Baltic CCR. The timeline of replacing the market-based process with the co-optimized one is not known and related to significant uncertainty.

The market-based process according to EBGL article 41 allocate cross-zonal capacity to the exchange of balancing capacity and sharing of reserves by comparing the actual value of allocating capacity for balancing capacity with the forecast value of giving the capacity for the day-ahead market and maximising the actual welfare of the balancing capacity market and the forecast welfare for the day-ahead market. The co-optimized process allocates cross-zonal capacity for both balancing capacity and the day-ahead market by comparing the actual value of allocating capacity for balancing capacity with the actual value of giving the capacity for the day-ahead market and maximising the relevant social welfare.

The allocation of balancing capacity affects the capacity that can be given to the day-ahead and intraday markets. The abbreviation of the allocation of balancing capacity in the developed Baltic DA ID CCM is AABC (Already Allocated Balancing Capacity). The available capacity for the day-ahead is calculated by subtracting the AABC from the calculated NTC. Following is a generic example where the ATC (Available Transfer Capacity) is calculated for the direction from area A to area B:

$$ATC_{DA,\ A>B} = NTC_{A>B} - AABC_{A>B};$$

This follows the same principle how intraday capacities are calculated – by taking into account the previous markets allocations. The ATC for intraday from area A to B can be calculated as follows:

$$ATC_{ID\ A>B} = NTC_{ID\ A>B} – AABC_{A>B} – AAC_{A>B} + AAC_{B>A}$$

For the intraday the day-ahead allocations need to be taken into account in both directions to reflect the final ATC. This cannot be applied for AABC, as the AABC becomes available only for the balancing timeframe and cannot be netted in previous market timeframes.

4.2 LONG TERM CAPACITY ALLOCATIONS

Baltic CCR TSOs do not have any long-term physical allocation processes developed for Baltic CCR cross-border capacities. Relevant Baltic CCR TSOs have set up financial transmission rights on EE-FI and EE-LV cross-borders, but the financial transmission rights do not allocate any physical capacities and do not affect any following market timeframes.

5 LITHUANIA – SWEDEN CROSS BORDER CAPACITY CALCULATION

Updated Baltic DA ID CCM contains updated proposal regarding Lithuania - Sweden HVDC interconnection capacity determination. For capacities proposal from Nordic side, it is foreseen to align principles with Nordic DA ID CCM. This includes updates for capacity determination including additional coefficients to the formula. Coefficient alpha represents outage situation and regulates possible maximum capacity value. This coefficient could have ranged value from 0 to 1. This coefficient depends on outage situation on Swedish electrical network as shown on formula below:

$$TTC_{I,\ A>B} = A_I \cdot P_{I,\ MAX\ THERMAL}$$

Capacity, given to DA market is foreseen to be reduced in case there are capacity allocations from other markets. This is foreseen in order to have possibility to allocate capacity for balancing purposes in case such service between Baltics and Sweden will be established. In addition, formulas for ATC are amended by representing Already Allocated Capacity (AAC) with direction indexes to represent cross border capacities allocations more accurately for specific border and direction as shown in example formula below:

$$SE\ ATC_{SE>LT} = TTC_{SE>LT} - AAC_{SE>LT} + AAC_{LT>SE}$$

6 INTRADAY CAPACITY CALCULATION DIFFERENCES

Capacity calculation for intraday timeframe will be performed on D-1 (day-ahead) CGMs with included day-ahead trading results. After Baltic CCR will sever its over head line connections with BRELL power grid and synchronize with CESA, the Baltic grid will remain as radial network, there would be no loop flow impact on any EE-LV or LV-LT cross borders. Meaning that power reserve distribution coefficients that were used in current capacity calculation in BRELL would be rendered useless. And keeping in mind that Baltic CCR grid after synchronisation with CESA will be radial, planned flow is foreseen to be equal to market flow.

In the new DA ID CCM the evaluation against actual flow is removed meaning that the capacity calculation formulas will remain consistent when calculating capacity values for either direction.

ID capacity calculation for both directions will be done according to the two formulas bellow:

$$ATC_{ID\ A>B} = NTC_{ID\ A>B} - AABC_{A>B} - AAC_{A>B} + AAC_{B>A}$$

$$ATC_{ID\ B>A} = NTC_{ID\ B>A} - AABC_{B>A} - AAC_{B>A} + AAC_{A>B}$$

It would be important to mention that the AABC included in these two formulas that is already allocated capacity for balancing market will be allocated to the positive-corresponding direction while regular AAC allocations will be allocated to both directions.

where:

$ATC_{ID\ A>B}$; $ATC_{ID\ B>A}$ – Available Transfer Capacity given to the ID electricity market in direction from areas A>B and B>A.

$NTC_{ID\ A>B}$; $NTC_{ID\ B>A}$ – coordinated Net Transmission Capacity relevant for intraday timeframe for the Cross-Border Interconnections in direction from areas A>B and B>A.

$AAC_{A>B}$; $AAC_{B>A}$ – Already Allocated Capacity for the Cross-Border Interconnections in direction from areas A>B and B>A after previous capacity allocation phases.

$AABC_{A>B}$; $AABC_{B>A}$ – Already allocated capacity for balancing market in accordance with Baltic CCR methodology for EB GL article 38 in direction from areas A>B and B>A.

7 LITHUANIA - POLAND SYNCHRONOUS CONNECTION WITH CESA CAPACITY CALCULATION

Considering circumstances, that three Baltic countries are planning synchronous operation with CESA via 400 kV overhead double circuits line, the permitted power flow on the interface will be very important factor influencing safe and reliable Baltic power system operation. Synchronous Baltics power system operation via relatively weak interface with CESA insist, that LT-PL cross border TTC determination shall be performed in specific way and requires depth stability analysis assessment.

In the new DA ID CCM is defined, that LT-PL cross border TTC determination shall be performed by evaluating:

- static stability,
- transient stability,
- oscillatory stability,
- frequency stability.

To define LT-PL cross border TTC, power flow limits will be calculated for each type of stabilities mentioned above.

TTC limitations resulting from static stability will be based on power flow calculations by applying N-1 outages after which bus voltages and lines loading shall be maintain within permissible limits.

TTC limitation resulting from transient stability criteria will be calculated based on Critical Fault Clearing Time Calculations by applying three phase symmetrical faults.

TTC limitation resulting from oscillatory stability criteria will be calculated based on small signal stability analysis. From small signal stability point of view Baltic power systems behaves as small power system connected by a not very strong connection to a much on larger system. Main aspects of small signal stability analysis to check sufficiency of the damping of inter-area oscillations. TTC values should ensure save power transfers in the interconnector in case of N-1 situation. Any power deficit/surplus in Baltic power systems during synchronous operation with CESA will result in changed power flow in the interconnection line, due to instantaneous inertial response of the large CESA system and FCR response of the synchronous machines. In the conditions in which:

- BSPS export power to CESA and there is outage of power demand (including HVDC link operating in direction to Nordics), or
- BSPS import power from CESA and there is outage of power infeed (including HVDC link operating in direction to BSPS or synchronous generator),

power transfer in the interconnection line will be increased. The increased power transfer should not exceed safe transfer limits from small signal stability point of view. Therefore, TTC values for relevant direction shall be defined by applying the following approach:

- power flow limit based on small signal stability criteria in direction to Lithuania shall be calculated considering security limits based on small signal stability criteria and possible loss of biggest infeed in Baltic power systems,
- Power flow limit based on small signal stability criteria in direction to Poland shall be calculated considering security limits based on small signal stability criteria and possible loss of biggest demand in BSPS.

Reliable and robust small signal stability analysis is taxing and challenging. Proper power flow and dynamic models of the entire synchronous area are required. Preparation of such a model for certain time horizon is demanding, as it means collecting and adjusting data from different sources, model fine-tuning and validation. Therefore, calculation from small signal stability perspective will be performed not on a daily basis, but only after significant change in Baltic power systems grids.

TTC limitations resulting from frequency stability will be based on calculations covering transition of Baltic power systems to island operation. Due to the fact that Baltic power system is a relatively small high Rate of Change of Frequency (RoCoF) is expected when BSPS switches to island mode operation with high exchange of power between Baltic power systems and CESA and therefore principals for TTC calculation must consider relevant dynamics of the frequency control process. Frequency stability calculation will be performed considering the following assumptions:

1. following system resources impacting frequency response will be evaluated:
    a. free control capacities of HVDC links,
    b. free control capacities of battery energy storage systems,
    c. free control capacity of FCR resources,
    d. amount of power demand connected to the power system,
    e. system inertia.
2. Two security criteria related to frequency stability will be considered:
    a. RoCoF,
    b. zenith and nadir of frequency (max and min value of frequency).

Transmission capacity of LT-PL cross border interconnection shall not exceed any of above mentioned stabilities limits. TTC for LT-PL cross border shall be the minimum of static, transient, oscillatory and frequency stability limits. NTC will be determined by taking into account TRM as described in paragraph 3.32.

8 IMPLEMENTATION TIMESCALE

Baltic DA ID CCM is updated considering changes due to Baltic TSOs synchronisation with CESA. This new methodology will replace operational agreements with third countries regarding capacity calculation and secure grid operation. Therefore, CACM Regulation based methodology is foreseen to be fully implemented in order to have legal framework for capacity calculation rules and terminating any existing rules with third countries. Because of this, Baltic DA ID CCM is foreseen to be implemented by the moment Baltic states TSOs are synchronised with CESA.