Capacity calculation methodology within the Baltic Capacity Calculation Region

Among:

AS “Augstsprieguma tīkls”
Elering AS
LITGRID AB
PSE S.A.
Svenska kraftnät
Fingrid Oyj

… …….. 2017
Vilnius, Riga, Tallinn, Helsinki, Stockholm, Warsaw

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1. GENERAL TERMS

1.1. The Capacity calculation methodology within the Baltic Capacity Calculation Region is required by Article 21 of the Commission Regulation (EU) 2015/1222 establishing a guideline on capacity allocation and congestion management (CACM Regulation).

1.2. Capacity calculation methodology within the Baltic Capacity Calculation (hereinafter referred to as "the Methodology") are set to define:

1.2.1. Cross-Zonal Capacity calculation, provision and allocation rules between Estonian and Latvian power systems;

1.2.2. Cross-Zonal Capacity calculation, provision and allocation rules between Lithuanian and Latvian power systems;

1.2.3. Cross-Zonal Capacity calculation, provision and allocation rules between Estonian and Finnish power systems;

1.2.4. Cross-Zonal Capacity calculation, provision and allocation rules between Lithuanian and Swedish power systems;

1.2.5. Cross-Zonal Capacity calculation, provision and allocation rules between Lithuanian and Polish power systems;

1.3. Cross-Zonal Capacities within the Baltic Capacity Calculation Region (hereinafter referred to as "Baltic CCR") shall be calculated using the coordinated Net Transmission Capacity approach in a way that facilitates the achievement of the following objectives:

1.3.1. Ensuring Operational Security of the interconnected power systems;

1.3.2. Ensuring that maximum Cross-Zonal Capacity between the power systems of the Baltic CCR is made available to the market;

1.3.3. Producing results in a transparent and replicable manner;

1.3.4. Ensuring non-discrimination in calculation of internal Cross-Zonal Capacities between the power systems of the Baltic CCR;

1.3.5. Ensuring that Cross-Zonal Capacities between the interconnected power systems of the Baltic CCR in day-ahead and Intraday Markets are provided and allocated in a most optimal and reasonable manner.

1.4. All the data exchange process and timing among TSOs and Coordinated Capacity Calculators is described in respective Coordinated Capacity Calculators Rules.

Until Coordinated Capacity Calculators are established and perform capacity calculation/coordination function, capacity calculation and coordination is performed by TSOs related to respective borders.

1.5. Methodologies described in the Methodology cover Cross-Zonal Capacity calculation (not for long term transmission rights allocation, for which more detailed methodology is developed according to Regulation 2016/1719 Article 10) for year, month and week ahead time horizons as well as Cross-Zonal Capacity calculation, provision and allocation for day-ahead and intraday time horizons.

1.6. Baltic CCR TSOs have made a feasibility study "Technical Feasibility of Flow-based Capacity Calculation in the Baltic States", which investigated the effectiveness of implementing the flow-based capacity calculation approach in the Baltic CCR. The study

has concluded, that, at current situation, the application of the capacity calculation methodology using the flow-based approach would not yet be more efficient compared to the coordinated net transmission capacity approach and assuming the comparable level of operational security in the Baltic CCR. Baltic CCR TSOs have shared the study and suggested flow-based implementation scenarios with competent regulatory authorities and have jointly requested the competent regulatory authorities to apply the coordinated net transmission capacity approach in regions and bidding zone borders following the Article 20(7) of CACM Regulation.

1.7. Though according to the Article 9(10) of CACM Regulation competent regulatory authorities have six months to take decision on the Methodology approval, Baltic CCR invite competent regulatory authorities to make decision with the aim to implement new Methodology already from the beginning of the year 2018.

2. DEFINITIONS

For the purposes of this Methodology, the following definitions shall have the following meaning:

2.1. **3rd Countries** – the Republic of Belarus and Russian Federation excluding Kaliningrad area.

2.2. **AAC** – the Already Allocated Capacity is the total amount of allocated transmission rights.

2.3. **AST** – AS "Augstsprieguma tīkls", Independent Transmission System Operator of the Republic of Latvia.

2.4. **ATC** – the Available Transmission Capacity of the designated Cross-Border Interconnections, which is available to the market after each phase of the transmission capacity allocation procedure.

2.5. **Baltic TSOs** – the transmission system operators for electricity of the Republic of Estonia, the Republic of Latvia and the Republic of Lithuania.

2.6. **Baltic CCR TSOs** – the transmission system operators for electricity of the Republic of Finland, Republic of Estonia, the Republic of Latvia and the Republic of Lithuania, the Republic of Poland, Sweden.

2.7. **Baltic CCR** - Capacity calculation region 9: Baltic. According to ACER decision on the electricity TSOs' proposal for Capacity Calculation Regions (18.11.2016) Baltic CCR shall include the Bidding Zone borders listed below: a) Estonia -Latvia (EE -LV), Elering AS and Augstsprieguma tikls; b) Latvia -Lithuania (LV -LT), Augstsprieguma tikis and LITGRID AB; and c) Estonia -Finland (EE -FI), Elering AS and Fingrid Oyj; d) Lithuania — Sweden 4 (LT-SE4), LITGRID AB and Svenska kraftnat; and e) Lithuania- Poland (LT-PL), LITGRID AB and PSE S.A.

2.8. **Baltic RSC** – Baltic Regional Security Coordinator is the entity formed by Baltic TSOs, for performing tasks related to Baltic regional coordination.

2.9. **Bidding Zone** – the largest geographical area (zone) within which market participants are able to exchange energy without capacity allocation.

2.10. **Rules on planning of electric energy and power exchange in the BRELL Loop** – the document, approved among Belarusian, Russian, Estonian, Latvian and Lithuanian system

operators, which defines annual, monthly, two days ahead, day ahead planning data extent and exchange procedure among BRELL TSOs.

2.11. **Instruction for parallel operation in the cross border interconnection (BRELL)** – the document approved among Belarusian, Russian, Estonian, Latvian and Lithuanian system operators that defines parallel power systems operation conditions in the Cross-Border Interconnection. It includes interconnection description, interconnection transfer capacities, interconnection normal and emergency state operations and system protection description.

2.12. **Methodical guidelines for stable operation in BRELL Power Loop** – the document, approved among Belarusian, Russian, Estonian, Latvian and Lithuanian system operators, which defines main system stability requirements to be taken into account by calculation of TTC in all BRELL Loop interconnections.

2.13. **BRELL Loop** – transmission networks of the power systems of the Baltic States, the Republic of Belarus and the Russian Federation (Central and North-Western parts).

2.14. **Capacity allocation** – the attribution of Cross-Zonal Capacity.

2.15. **Control Area** – A part of the interconnected electricity transmission system controlled by a single TSO.

2.16. **Critical Network Elements** – network elements that are taken into account in the capacity calculation process, limiting the amount of power that can be exchanged.

2.17. **Cross-Border Interconnection** – is a physical transmission link (e.g. tie-lines) which connects two power systems.

2.18. **Cross-Zonal Capacity** – the capability of the interconnected system to accommodate energy transfer between Bidding Zones.

2.19. **Day-Ahead Firmness Deadline** – the point in time after which Cross-Zonal Capacity becomes firm.

2.20. **CACM** – European Commission Regulation (EU) establishing a Guideline on Capacity Allocation and Congestion Management.

2.21. **Capacity calculator** - Coordinated Capacity Calculator of respective Capacity Calculation Region.

2.22. **Common Grid Model** – data set agreed between TSOs describing the main characteristic of the power system (generation, loads and grid topology) and rules for changing these characteristics during the capacity calculation process.

2.23. **Contingency List** – the list of contingencies to be simulated in the Contingency Analysis in order to test the compliance with the Operational Security Limits before or after a contingency took place.

2.24. **Contingency Analysis** – a computer based simulation of contingencies from the Contingency List.

2.25. **D-1** – the day prior to the day on which the energy is delivered.

2.26. **D-2** – the day before the day prior to the day on which the energy is delivered.

2.27. **Day-Ahead Market** – the market timeframe where commercial electricity transactions are executed the day prior to the day of delivery of traded products.

2.28. **Elering** – Elering AS, Transmission System Operator of the Republic of Estonia.

2.29. **Force Majeure** – any unforeseeable or unusual event or situation beyond the reasonable control of a TSO, and not due to a fault of the TSO, which cannot be avoided or overcome with reasonable foresight and diligence, which cannot be solved by measures which are from a technical, financial or economic point of view reasonably possible for the TSO, which has actually happened and is objectively verifiable, and which makes it impossible for the TSO to fulfil, temporarily or permanently, its obligations in accordance with CACM and/or this Methodology.

2.30. **Fingrid** – Fingrid Oyj, electricity transmission system operator of the Republic of Finland.

2.31. **Firmness** – a guarantee that Cross-Zonal Capacity rights will remain unchanged and that compensation is paid if they are nevertheless changed.

2.32. **Intraday Market** – the electricity market which operates for the period of time between Intraday Cross-Zonal Gate Opening Time and Intraday Cross-Zonal Gate Closure, where commercial electricity transactions are executed prior to the delivery of traded products.

2.33. **Litgrid** – LITGRID AB, electricity transmission system operator of the Republic of Lithuania.

2.34. **N-1 Situation** – the situation in the transmission system in which a contingency from the Contingency List has happened.

2.35. **Market Operator (MO)/Nominated electricity Market Operator (NEMO)** – the operator/-s of day-ahead and Intraday Markets in Baltic CCR.

2.36. **NTC** – coordinated Net Transmission Capacity of the designated Cross-Border Interconnections is the maximum Trading Capacity, which is permitted in transmission Cross-Border Interconnections compatible with Operational Security standards and taking into account the technical uncertainties on planned network conditions for each TSO.

2.37. **Operational Security Limits** – the acceptable operating boundaries: thermal limits, voltage limits, frequency, dynamic and steady state stability limits.

2.38. **Operational Security** – the transmission system capability to retain a normal state or to return to a normal state as soon and as close as possible, and is characterised by thermal limits, voltage constraints, short-circuit current, frequency limits and stability limits.

2.39. **Physical Congestion** – any network situation where forecasted or realised power flows violate the thermal limits of the elements of the grid and voltage stability or the angle stability limits of the power system.

2.40. **PSE** - PSE S.A., electricity transmission system operator of the Republic of Poland.

2.41. **Ramping rate** – rate of change of active power by HVDC system.

2.42. **Remedial Actions** – any measure applied by a TSO or several TSOs, manually or automatically, in order to maintain Operational Security.

2.43. **Shift Key** – means a method of translating a net position change of a given power system into estimated specific injection increases or decreases in the Common Grid Model. Shift Key is settled as generation, renewable generation and load.

2.44. **SvK –** Svenska kraftnät, electricity transmission system operator in Sweden.

2.45. **TRM** – Transmission Reliability Margin which shall mean the reduction of Cross-Zonal Capacity to cover the uncertainties within capacity calculation.

2.46. **TSO** – a transmission system operator for electricity.

2.47. **TTC** – Total Transfer Capacity of the designated Cross-Border Interconnections is the maximum transmission of active power, which is permitted in transmission Cross-Border Interconnections compatible with Operational Security standards applicable for each TSO.

2.48. **Trading Capacity** – the maximum available Cross-Zonal Capacity for trade in Day-Ahead Market and Intraday Market.

2.49. **Baltic synchronous area** – power systems of Lithuanian, Latvian and Estonian which are synchronously interconnected with IPS/UPS power systems.

2.50. **Nordic synchronous area** – synchronously interconnected power systems of Eastern Denmark, Sweden, Finland and Norway

2.51. **Continental Europe synchronous area** – synchronous area in which Poland power system synchronously operates.

3. OPERATIONAL SECURITY LIMITS, CONTINGENCIES AND ALLOCATION CONSTRAINTS

3.1. Contingency Analyses shall be performed with respect of Operational Security Limits applied in Control Areas of Baltic CCR TSOs. Operational Security Limits include thermal limits, voltage limits, frequency, dynamic and steady state stability limits and are agreed among TSOs of respective synchronous areas.

3.2. Contingency Analysis is performed at least for those contingencies which are agreed among Baltic TSOs in the Contingency Lists. Contingency Lists shall be agreed and provided among Baltic TSOs and provided to Capacity calculator for capacity calculation.

3.3. Allocation constraints are result of capacity calculation process and are technically limited by: thermal limits, voltage limits, frequency, dynamic and steady state stability limits, (see 6.2) as well as balancing constraints (see 3.4).

3.4. Balancing constraints are determined for the systems where central dispatch market model applied, where the TSO acts as the balance responsible party for the whole control area and procures reserves in an integrated scheduling process run after the day ahead market closure. These constraints reflect, in general, the ability of generators to increase generation (potential constraints in export direction) or decrease generation (potential constraints in import directions), subject to technical constraints of individual generating units as well as required minimum necessary reserve for (respectively) up or down regulation in the whole system. Distribution of balancing constraints on relevant interconnections of given system is applied by PXs taking into consideration actual bids of market participants and thus is realized optimally from overall social welfare point of view. Balancing constraints are determined based on a power balance of a given central dispatch system day ahead and continuously updated intraday according to evolution of power balance situation.

4. GENERATION SHIFT KEYS

4.1. Proportional Generation Shift Key strategy shall be normally applied in Baltic CCR. However shifting strategy per power system area shall be the responsibility of each involved TSO, which has to be communicated with other TSOs and Capacity calculator before

commencing TTC calculation process in case of deviation from proportional GSK strategy. The TSOs shall exchange Shift Keys for generation and renewable generation and also provide it to Capacity calculator.

4.2. For NordBalt and LitPol link from Baltic synchronous area and European Continental side (PSE) side the shifting strategy shall be performed in the way to evaluate most critical impact (rank GSK strategy) for system security.

4.3. GSK strategy applied in Nordics is described in details in Nordic CCR Capacity Calculation Methodology.

4.4. Capacity calculator and TSOs shall apply Load Shift Key whenever the GSK shall not be sufficient for determination of TTC.

5. REMEDIAL ACTIONS

Relevant TSOs shall provide relevant Capacity Calculators with information on available and applicable remedial actions that shall be used in capacity calculation process, e.g. information on available emergency power reserves and available balancing reserves, change of power flow in HVDC links.

6. TOTAL TRANSFER CAPACITY (TTC) CALCULATION METHODOLOGY

6.1. Total Transfer Capacity (TTC) Calculation for cross-borders with AC interconnectors in Baltic TSOs control area

6.1.1. The Cross-Border Interconnection TTC assessment for AC interconnectors shall follow the methodological principles in the Methodical guidelines for stable operation in BRELL Loop, as well as in national regulations and standards implemented and agreed in the Instruction for parallel operation in the Cross-Border Interconnections between TSOs involved, while taking into account the intra- and intersystem Operational Security.

6.1.2. Methodical guidelines for stable operation in BRELL Loop is used as a basis and reviewed by TSOs, for ensuring the collective secure operation with neighboring interconnected TSOs.

6.1.3. The Cross-Border Interconnection TTC shall be determined by proceeding Contingency Analysis with respect of Operational Security Limits of BRELL Loop and Control Area of Baltic TSOs.

6.1.4. Contingency Analysis is performed at least for those contingencies which are agreed among Baltic TSOs in the Contingency List. Contingency List shall be agreed and provided among Baltic TSOs and to Capacity calculator.

6.1.5. Critical Network Elements list of Control Area of Baltic TSOs shall be provided among Baltic TSOs and to Capacity calculator.

6.1.6. The cross-border TTC calculation shall be carried out by using as input the following mutually coordinated data and information:

6.1.6.1 Base case - Common Grid Model, which includes power transmission equipment model of BRELL Loop and scenario describing net positions for each of Control Area of Baltic TSOs and Russian/Belarusian power systems, valid for given calculation purposes;

6.1.6.2 Generation, renewable generation and load Shift Key;

6.1.6.3 Critical Network Elements;

6.1.6.4 Outage cases;

6.1.6.5 Contingency List;

6.1.6.6 Remedial Actions;

6.1.6.7 Operational Security Limits.

6.1.7. The shifting strategy per power system area shall be the responsibility of each involved Baltic TSO, which has to be communicated with other TSOs and Capacity calculator before commencing TTC calculation process. The TSOs shall exchange Shift Keys for generation and renewable generation and also provide it to Capacity calculator. The shifting strategies used in calculations are mentioned in Section 4 of this Methodology.

6.1.8. TSOs and Capacity calculator shall apply load Shift Key whenever the generation shift shall not be sufficient for determination of TTC.

6.1.9. Determining the TTC values, TSOs and Capacity calculator can take into account ambient temperatures for different seasonal periods within Control Area as well as actual emergency power reserves within Control Area of Baltic TSOs and in Russian/Belarusian power systems to ensure Operational Security.

6.1.10. If during capacity validation process neighbouring TSOs determine different TTC values for the same Cross-Border Interconnection, the lowest value shall be used as a coordinated value.

6.2. Total Transfer Capacity (TTC) Calculation for cross-borders with HVDC interconnectors

6.2.1. TTC for each cross-border that consists solely of HVDC connections is limited by the sum of ratings of HVDC interconnectors that connect the relevant Bidding Zones. In order to define TTC limitation related to adjacent AC networks, Contingency Analyses based on N-1 criterion (i.e. a loss of any single element of power system) shall be performed using Common Grid Models. While performing Contingency Analyses after applying of N-1 criteria following limits shall be not exceed:

- thermal limits, that correspond to the relevant ambient temperature, of network elements, i.e. the maximum amount of electric current that a given network element can conduct without sustaining damage or being in violation of safety requirements

- voltage limits in network nodes, i.e. maximum and minimum voltage levels permitted at given network node in order to prevent equipment damage or voltage collapse respectively;

- rotor angle stability limits related to the ability of the synchronously interconnected system to return to stable state of operation after any disturbance.

6.2.2. Maximum permissible capacity on HVDC interconnector shall be limited when there is lack of available power reserves to replace the failure of the HVDC interconnector.

6.2.3. While relevant party is performing Contingency Analysis according to 6.2.1. it is checked if

maximum capacity for each link for each direction could be provided to the market. If Contingency Analysis reveals that network security is not assured when the HVDC interconnectors are fully loaded in any direction, then capacity on the relevant cross-border on relevant direction is reduced until network parameters are within permissible limits during the analysis.

6.2.4. The TTC on relevant HVDC interconnector is the minimum capacity value that is the outcome of the Contingency Analyses that are performed by the relevant parties on each side of the relevant interconnector.

6.2.5. For Baltic CCR TSOs The cross-border TTC calculations shall be carried out by using as input the following data and information:

6.2.4.1 Common Grid Model, which includes:

- power transmission equipment model of BRELL Loop and scenario describing net positions for each of Control Area of Baltic TSOs and Russian/Belarusian power systems, valid for given calculation purposes (For Baltic TSOs);
- Model of Polish power system from European merging function, supplemented with 110kV subtransmission grid and scenario describing PSE net position, valid for given calculation purposes, shall be used for calculations;
- Models of Nordic power systems from European merging function shall be used for calculations.

6.2.4.2 Generation, renewable generation and load Shift Key;

6.2.4.3 Critical Network Elements;

6.2.4.4 Planned Outages;

6.2.4.5 Contingency List;

6.2.4.6 Remedial Actions;

6.2.4.7 Operational Security Limits.

6.2.6. Contingency Analyses are performed at least for those contingencies which are agreed among respective TSOs in the Baltic CCR in the relevant Contingency List. Contingency List shall be agreed and provided among respective TSOs and to relevant Capacity calculator.

6.2.7. Critical Network Elements list of Control Area of respective TSOs shall be provided among respective TSOs in the Baltic CCR and to relevant Capacity calculator.

6.2.8. The shifting strategy shall be performed in the way to evaluate most critical impact for system security.

6.2.9. TSOs and Capacity calculator shall apply load Shift Key whenever the generation shift shall not be sufficient for determination of TTC.

6.2.10. If HVDC interconnector LitPol Link is connected with entire power system by only one 330 kV tie line Alytus-Gardinas, in this case TTC is defined in coordination with Belarus power system operator.

6.2.11. TTC of cross-border Estonia-Finland is the sum of permissible capacities on HVDC links Estlink 1 and Estlink 2. When there is a need to limit the capacities on the links according to

paragraph 6.2.2., the links are limited in minimal possible combination – meaning the maximum possible capacity is given to the market.

7. TRANSMISSION RELIABILITY MARGIN (TRM) CALCULATION METHODOLOGY

7.1. The TRM is a capacity margin needed for secure operation of interconnected power systems considering the planning errors, including the errors due to imperfect information from 3rd Countries at the time the transfer capacities have been computed.

7.2. TRM calculation methodology is covering Cross-Border Interconnections between Lithuanian and Latvian power systems as well as between Latvian, Russian and Estonian power systems.

7.3. TSOs shall define the size of the TRM for each individual Cross-Border Interconnections according to the methodology described in this Section 7 of this Methodology.

7.4. For HVDC interconnectors TRM value is 0 MW.TRM for HVDC can be applied only after bilateral agreement and coordination among adjacent TSO's.

TRM determination

7.5. Statistical data

For determining of the TRM values for each Cross-Border Interconnection, the statistical data of planned and factual power flows for aforementioned interconnections is used with the time step of 1 minute. If there are no archive data with the time step of 1 minute, then smallest time step, which is available in the archive data, can be used. For intraday, day-ahead, weekly and monthly planning phases TRM calculation uses statistical archive data from last month, but in cases, where topology changes or other network conditions have substantial impact to power flows compared to last month, the data from last week or last day is used.

The used data set is combined from fact deviations from the plan. For TRM calculation the data from time series, which had deviations that increase the risk of exceeding TTC, which is permitted in particular Cross-Border Interconnection, that is positive deviation values, shall be used. Deviations shall be calculated as difference between Cross-Border Interconnection actual power flows and planned power flows.

In yearly planning phase, the average TRM value of last 12 months is used.

7.6. TRM determination approach

TRM shall be determined as the arithmetic average value plus standard deviation. Arithmetic average value of the deviation is determined for the above statistical data set and added to the same data set standard deviation:

$$TRM = \frac{\sum_{i=1}^{n} X_i}{n} + \sqrt{\frac{\sum_{i=1}^{n} (X_i - \overline{X})^2}{n-1}} \quad (1)$$

where:

X_i – data sets of the i-th element, defined as deviation of factual power flow from planned power flow over Cross-Border Interconnections;

$\overline{X}$ – arithmetic average value of Xi $\frac{\sum_{i=1}^{n} X_i}{n}$;

n – number of elements in the data set.

TRM shall be rounded to the nearest multiple of 50.

7.7. In case if factual power flows or planned power flows over Cross-Border Interconnection are smaller than the TTC value and the Capacity calculator can foresee with high certainty, that such situation for next planning period is unchanged, then TRM value of 0 MW for aforementioned interconnection can be used.

7.8. When TRM calculation using time periods that are defined in Article 7.5 of this Methodology does not produce results that are in line with Operational Security, then Capacity calculator can increase the TRM until all Operational Security limits are met.

8. COORDINATED NET TRANSMISSION CAPACITY (NTC) AND AVAILABLE TRANSMISSION CAPACITY (ATC) CALCULATION METHODOLOGY

NTC and ATC calculation methodology for each Baltic CCR border is given below.

Normally, NTC and ATC calculation process is following:

- TSOs and Capacity calculator calculates NTC value calculated for Day-Ahead Market;
- NEMO provide Day-Ahead Market results respecting NTCs and allocation constraints;
- ATC value is calculated for Intraday Market.

In case if NEMO doesn't provide Day-Ahead Market results in scheduled time, initial ATC values cannot be calculated. In such case ATC values equal to "0" (zero) shall be provided to Intraday Market. According to Article 9.1.2. of this Methodology, ATC capacities shall be reassessed after fall-back procedure is applied by NEMO.

On HVDC Interconnections, maximum Ramping Rate restrictions are applied during day-ahead and Intraday Market (information on Ramping Rate values available on ENTSO-E Transparency platform). Maximum Ramping Rate restriction indicates the maximum possible rate of active power change for sequential trading periods. The restrictions imply that trade plans on all HVDC connections cannot be changed with more than the predetermined maximum Ramping Rate restriction from one trading period to the next. Ramping restrictions are taken into account in the Day-Ahead Market algorithm in a way that maximizes the economic gain of buyers and sellers. Capacities available for trading during Intraday Market depend not only on maximum trading capacities provided by TSOs/ Capacity calculators, but also on AACs for consecutive previous and following trading periods.

During intraday trading process ATC values, apart from changes coming from NTC updates, shall be adjusted automatically by respective market operator/market platform after each trade affecting respective border. Value of ATC adjustment (increase or decrease) shall be equal to commercial flow over respective border as the result of trade. The same refers to

allocation constraints, which, apart from changes coming from their updates, shall be adjusted automatically by respective market operator/market platform after each trade affecting respective power system. Volume of this adjustment (increase of decrease) shall be equal to the change of net position of a given power system as the result of trade.

In Baltic CCR rules for efficiently sharing the power flow capabilities of Critical Network Elements among different Bidding Zone borders are not needed, as there is no such Critical Network Element/-s in Baltic CCR that would clearly and in majority cases influence power flow capabilities of several borders at once. Therefore, there is no sharing of the power flow capabilities of Critical Network Elements between Bidding Zone borders and this Methodology doesn't contain the rules for efficiently sharing the power flow capabilities of Critical Network Elements among different Bidding Zone borders.

8.1 Trading Capacity Calculation Rules Between Estonian and Latvian Power Systems

Mathematical description of NTC calculation

8.1.1 Estonia-Latvia Cross-Border Interconnection is the Cross-Border Interconnection between Estonian, Russian and Latvian power systems, for which common TTC is calculated. Equation (2) of Section 8.1.2 is used when no capacity is being allocated for trading between Russian and Latvian power systems.

8.1.2 NTC value for Estonia-Latvia Cross-Border Interconnection shall be calculated using following equation:

$$NTC = \min(((TTC_1 + \sum_{i=1}^{n} K_i \cdot P_i) - TRM);\ TTC_2 - TRM) \quad (2)$$

where:

TTC_1 – Total Transfer Capacity after N-1 Situation has occurred from actual power system network status according to Instruction for parallel operation in the Cross-Border Interconnection between Estonian, Russian and Latvian power systems. The value of TTC_1 is independent on influence of ambient temperatures – values at 0 (zero) temperature shall be used;

TTC_2 – Total Transfer Capacity value for actual power system network status, according to Instruction for parallel operation in the Cross-Border Interconnection between Estonian, Russian and Latvian power systems. The value of TTC_2 is dependent from the influence of ambient temperature of particular capacity calculation time period to transmission line conductors;

P_i – amount of assured emergency power reserves for respective power system *i* taking into account operational security of all Baltic CCR and interconnected AC power systems;

n – number of power systems;

K_i – reserve power distribution coefficients considering location of the assured emergency power reserve P_i and down regulation according to Table 1 of this Methodology;

TRM – TRM value calculated according to the methodology described in Article 7 of this Methodology.

8.1.1. In case if during capacity validation process neighbouring TSOs determine different NTC values for the same Cross-Border Interconnection the lowest value shall be used as a coordinated value.

Intraday Available Transmission Capacity calculation

8.1.3 Actual D-1 Common Grid Model shall be updated with Baltic TSO's day-ahead trading results and new BRELL Loop power flow calculations shall be performed.

8.1.4 In case if Russia D-1 planning stage data is not available, TSOs and Capacity calculator shall take into account Russia D-2 planning stage data. New intraday ATC values shall be coordinated as soon as Russia D-1 planning stage data are available.

8.1.5 ATC values for Estonia-Latvia Cross-Border Interconnection are calculated as follows:

8.1.5.1 If direction of ATC, for which calculation is performed, corresponds to direction of $AAC_{Day\text{-}ahead}$:

$$ATC = MIN(NTC_{coord} - P_{PF}; NTC_{coord.} - AAC_{Day\text{-}ahead} + TRM_{coord.}) \quad (3)$$

8.1.5.2 If direction of ATC, for which calculation is performed, does not correspond to direction of $AAC_{Day\text{-}ahead}$:

$$ATC = NTC_{coord} - P_{PF} \quad (4)$$

where:

$NTC_{coord.}$ – coordinated Net Transmission Capacity in the particular Cross-Border Interconnections;

P_{PF} – calculated power flow in the particular Cross-Border Interconnections performed with actual D-1 Common Grid Model;

$AAC_{Day\text{-}ahead}$ – Already Allocated Capacity in the particular Cross-Border Interconnections after day-ahead trading;

$TRM_{coord.}$ – coordinated TRM value from coordinated TTC and NTC values.

ATC value in formula (4) is calculated considering that the TSOs and Capacity calculator shall, as far as technically possible, net the capacity values of any power flows in opposite directions over congested interconnection line in order to use that line to its maximum capacity.

8.1.6 In case if during capacity validation process neighbouring TSOs determine different ATC values for the same Cross-Border Interconnection the lowest value shall be used as a coordinated value.

8.1.7 Reserve power distribution coefficients (see Table 1 of this Methodology) in controlled cross-borders show the impact of power exchange program between two power systems on the loading of controlled Cross-Border Interconnections. Reserve power distribution coefficients in controlled Cross-Border Interconnections of BRELL Loop are determined using BRELL grid model that includes power systems of Belarus, Russia (North-West power system), Estonia, Latvia, Lithuania, Ukraine and Kaliningrad area. In order to determine reserve power distribution coefficients, power flows have been modelled by increasing generation in exporting power system and symmetrical decreasing of generation in consuming power system. Reserve power distribution coefficients are being coordinated among all BRELL Loop power systems.

8.1.8 Values of reserve power distribution coefficients used according to availability of appropriate amount of down regulation reserves. Amount of down regulation reserves in percentage is

evaluated as proportion of available down regulation reserves on one cross-border side to available amount of assured emergency power reserves from another cross-border side.

Table 1. Reserve power distribution coefficients

Amount of down regulation power (%)	Cross-Border Interconnections	Reserves location			
		Lithuania	Latvia	Belarus	Estonia
100	Estonia-Russia → Latvia	0,62	0,74	0,45	
100	Latvia →Russia-Estonia				0,74
50	Estonia-Russia → Latvia	0,48	0,60	0,31	
50	Latvia →Russia-Estonia				0,52
0	Estonia-Russia → Latvia	0,34	0,45	0,16	
0	Latvia →Russia-Estonia				0,29

8.2 Trading Capacity Calculation Rules Between Lithuanian and Latvian Power Systems

Mathematical description of NTC calculation

8.2.1 TSOs and Capacity calculator calculate NTC values for Lithuania-Latvia Cross-Border Interconnection, taking into account assured emergency power reserves for TSOs to ensure readiness for normal operation after N-1 Situation has occurred, by using following formula:

$$NTC = (TTC_1 + \sum_{i=1}^{n} K_i \cdot P_i) - TRM \quad (5)$$

where:

$$(TTC1 + \sum_{i=1}^{n} K_i \cdot P_i) \leq TTC \quad (6)$$

where:

TTC_1 – Total Transfer Capacity after N-1 Situation has occurred from actual power system network status according to Instruction for parallel operation in the Lithuania-Latvia Cross-Border Interconnection;

P_i – amount of assured emergency power reserves for respective power system *i* taking into account operational security of all Baltic CCR and interconnected AC power systems;

K_i – reserve power distribution coefficients considering location of the assured emergency power reserve P_i and down regulation according to Table 2 of this Methodology;

n – number of power systems;

TTC – Total Transfer Capacity in actual power system network status according to Instruction for parallel operation in the Lithuania-Latvia Cross-Border Interconnection;

TRM – Transmission Reliability Margin calculated according to the methodology described in Section 7 of this Methodology.

8.2.2 In case if during capacity validation process neighbouring TSOs determine different NTC values for the same Cross-Border Interconnection the lowest value shall be used as a coordinated value.

Intraday Available Transmission Capacity calculation

8.2.3 Actual D-1 Common Grid Model shall be updated with Baltic TSO's day-ahead trading results and new BRELL Loop power flow calculations shall be performed.

8.2.4 In case if Russia D-1 planning stage data is not available, TSOs and Capacity calculator shall take into account Russia D-2 planning stage data. New intraday ATC values shall be calculated and coordinated as soon as Russia D-1 planning stage data is available.

8.2.5 ATC values for Latvia-Lithuania Cross-Border Interconnection are calculated as follows:

8.2.6 TSOs and Capacity calculator calculate intraday ATC values for Lithuania-Latvia Cross-Border Interconnection as follows:

In direction to Lithuania:

If direction of ATC, for which calculation is performed, corresponds to direction of $AAC_{day-ahead}$:

$$ATC = MIN(NTC - P_{PF}; NTC - AAC_{day-ahead} + TRM) \quad (7)$$

If direction of ATC, for which calculation is performed, does not correspond to direction of $AAC_{day-ahead}$:

$$ATC = NTC - P_{PF} \quad (8)$$

In direction to Latvia:

ATC in direction to Latvia is calculated taking into account possible worst case of Intraday Market trade, that increase Physical Congestion of Cross-Border Interconnections:

$$ATC_{Elbas\ LT->LV} = MIN(NTC - P_{PF}; NTC - AAC_{day-ahead}+TRM; (NTC_{coord} - P_{PF})_{EE->LV}) \quad (9)$$

where:

NTC – coordinated Net Transmission Capacity in the particular Cross-Border Interconnection;

P_{PF} – calculated power flow in the particular Cross-Border Interconnections performed with actual D-1 Common Grid Model;

$AAC_{day-ahead}$- Already Allocated Capacity in the particular Cross-Border Interconnection after day-ahead trading;

TRM – coordinated TRM value from coordinated TTC and NTC values;

$(NTC_{coord} - P_{PF})_{EE->LV}$ – calculated remaining capacity after Day-ahead trade by taking into account power flow calculation in Estonia-Latvia Cross-Border Interconnection in direction from Estonia to Latvia.

ATC value in formula (8) of these Rules is calculated considering that the TSOs and Capacity calculator shall, as far as technically possible, net the capacity values of any power flows in opposite directions over congested interconnection line in order to use that line to its maximum capacity.

8.2.7 In case if during capacity validation process neighbouring TSOs determine different ATC values for the same Cross-Border Interconnection the lowest value shall be used as a coordinated value.

8.2.8 Reserve power distribution coefficients (see Table 2 of this Methodology) in controlled cross-borders show the impact of power exchange program between two power systems on the loading of controlled Cross-Border Interconnections. Reserve power distribution

coefficients in controlled Cross-Border Interconnections of BRELL Loop are determined using BRELL grid model that includes power systems of Belarus, Russia (North-West power system), Estonia, Latvia, Lithuania, Ukraine and Kaliningrad area. In order to determine reserve power distribution coefficients, power flows have been modelled by increasing of generation in exporting power system and symmetrical decreasing of generation in consuming power system. Reserve power distribution coefficients are being coordinated among all BRELL Loop power systems.

8.2.9 Values of reserve power distribution coefficients used according to availability of appropriate amount of down regulation reserves. Amount of down regulation reserves in percentage is evaluated as proportion of available down regulation reserves on one cross-border side to available amount of assured emergency power reserves from another cross-border side.

Table 2. Reserve power distribution coefficients

Amount of down regulation power (%)	Cross-Border Interconnections	Reserves location			
		Lithuania	Latvia	Belarus	Estonia
100	Latvia→Lithuania	0,88		0,72	
100	Lithuania→ Latvia		0,88		0,62
50	Latvia→Lithuania	0,61		0,44	
50	Lithuania→ Latvia		0,72		0,46
0	Latvia→Lithuania	0,34		0,16	
0	Lithuania→ Latvia		0.55		0,29

8.3 Trading Capacity Calculation Rules Between Estonian and Finnish Power Systems

8.3.1 TTCs on cross-border Estonia-Finland are validated and calculated by respective TSOs and Capacity calculators on both sides of the interconnector using CGMs that represent the AC-networks of observable areas of synchronous areas that each belong to.

8.3.2 Trading Capacity is defined according to formula NTC=TTC-TRM in each side of HVDC link.

8.3.3 NTC between Finland and Estonia that is allocated to the market is calculated according to formula:

$$NTC_{FI\text{-}EE} = \min (FI\ NTC_{FI\text{-}EE};\ EE\ NTC_{FI\text{-}EE}) \quad (10)$$

where:

FI $NTC_{FI\text{-}EE}$ – NTC between FI and EE Bidding Zones, determined by restrictions of Nordic synchronous area,

EE $NTC_{FI\text{-}EE}$ – NTC between FI and EE Bidding Zones, determined by restrictions of Baltic synchronous area.

Intraday capacity allocation procedure

8.3.4 The available capacity after the Day-Ahead Market results is offered to the Intraday Market in line with actual operational conditions. The intraday capacity can be

influenced by changed TTC caused by changes in prognosis, topology, and in maintenance plans.

8.3.5 Intraday Trading Capacity on cross-border Estonia-Finland is allocated according formula:

$$ATC_{FI\text{-}EE} = NTC_{FI\text{-}EE} - AAC_{FI\text{-}EE} \quad (11)$$

where:

$NTC_{FI\text{-}EE}$ – NTC between FI and EE Bidding Zones,

$AAC_{FI\text{-}EE}$ – Already Allocated Capacity in the Finland-Estonia interconnection for relevant time period,

8.4 Trading Capacity Calculation Rules Between Lithuanian and Swedish Power Systems

8.4.1 TTCs on cross-border Lithuania-Sweden are checked and calculated by respective TSOs and Capacity calculators on both sides of the interconnector using CGMs that represent the AC-networks of observable areas of synchronous areas that each belong to.

8.4.2 Trading Capacity is defined according to formula NTC=TTC-TRM in each side of HVDC link.

8.4.3 NTC between Sweden and Lithuania that is allocated to the market is calculated according to formula:

$$NTC_{SE\text{-}LT} = \min (SE\ NTC_{SE\text{-}LT}; LT\ NTC_{SE\text{-}LT}) \quad (12)$$

where:

SE $NTC_{SE\text{-}LT}$ – NTC between SE and LT Bidding Zones, determined by restrictions of Nordic synchronous area;

LT $NTC_{SE\text{-}LT}$ – NTC between SE and LT Bidding Zones, determined by restrictions of Baltic synchronous area.

Intraday capacity allocation procedure

8.4.4 The available capacity is reassessed after the Day-Ahead Market and offered to the Intraday Market in line with actual operational conditions. The intraday capacity can be influenced by changed TTC caused by changes in prognosis, topology, and in maintenance plans.

8.4.5 Matched trading capacity on cross-border Lithuania-Sweden is allocated according formula:

$$ATC_{LT\text{-}SE} = \min (LT\ NTC_{LT\text{-}SE}; SE\ NTC_{LT\text{-}SE}) - AAC \quad (13)$$

where:

LT $NTC_{LT\text{-}SE}$ – NTC between LT and SE Bidding Zones, determined by restrictions of Baltic synchronous area;

SE $NTC_{LT\text{-}SE}$ – NTC between LT and SE Bidding Zones, determined by restrictions of Nordic synchronous area;

AAC – Already Allocated Capacity in the Lithuania-Sweden interconnection.

8.5 Trading Capacity Calculation Rules Between Lithuanian and Polish Power Systems

8.5.1 TTC on cross-border Lithuania-Poland are checked and calculated by respective TSOs and Capacity calculators on both sides of the interconnector using on Lithuanian side Baltic CGMs that represent the AC-networks of observable area and on Polish side Polish IGM supplemented by subtransmission 110 kV grid.

8.5.2 Trading Capacity is defined according formula NTC=TTC-TRM in each side of HVDC link by respective TSO's and Capacity calculator.

8.5.3 The matched NTC are defined according to the following formulas taking into account the losses depending on the direction and number of the circuits of Elk Bis-Alytus 400 kV line in operation:

<u>For direction from Lithuania to Poland (Settlement Point in Elk Bis 400 kV):</u>

8.5.4 Two circuits of Elk Bis-Alytus 400 kV line in operation:

$$NTC_{LT\text{-}PL} = \min (PL\ NTC_{LT\text{-}PL}; LT\ NTC_{LT\text{-}PL}; 488\ MW) \quad (14)$$

8.5.5 One circuit of Elk Bis-Alytus 400 kV line in operation:

$$NTC_{LT\text{-}PL} = \min (PL\ NTC_{LT\text{-}PL}; LT\ NTC_{LT\text{-}PL}; 485\ MW) \quad (15)$$

where:

PL $NTC_{LT\text{-}PL}$ – NTC between LT and PL Bidding Zones, determined by restrictions of Continental Europe synchronous area, if calculated NTC between LT and PL Bidding Zones is less than 50 MW, then PL $NTC_{LT\text{-}PL}$ shall be set to 0 MW;

LT $NTC_{LT\text{-}PL}$ – NTC between LT and PL Bidding Zones, determined by restrictions of Baltic synchronous area, if calculated NTC between LT and PL Bidding Zones is less than 50 MW, then LT $NTC_{LT\text{-}PL}$ shall be set to 0 MW;

488 MW – technical capacity of the Link in Settlement Point ($NTC_{SettlementPoint}$) when both circuits of Elk Bis-Alytus line are in operation (i.e. decreased the 500MW input power of BtB by technical losses of HVDC converter, two circuits of 400kV line and shunt reactors);

485 MW – technical capacity of the Link in Settlement Point ($NTC_{SettlementPoint}$) when one circuit of Elk Bis - Alytus line is in operation (i.e. decreased the 500MW input power of BtB by technical losses of HVDC converter, one circuit of 400kV line and shunt reactors).

<u>For direction from Poland to Lithuania (Settlement Point in Alytus 330kV):</u>

8.5.6 Two circuits or one circuit of Elk Bis-Alytus 400 kV line in operation:

$$NTC_{LT\text{-}PL} = \min (PL\ NTC_{LT\text{-}PL}; LT\ NTC_{LT\text{-}PL}; 492\ MW) \quad (16)$$

where:

PL $NTC_{LT\text{-}PL}$ – NTC between LT and PL Bidding Zones, determined by restrictions of Continental Europe synchronous area, if calculated NTC between LT and PL Bidding Zones is less than 50 MW, then PL $NTC_{LT\text{-}PL}$ shall be set to 0 MW;

LT $NTC_{LT\text{-}PL}$ – NTC between LT and PL Bidding Zones, determined by restrictions of Baltic

synchronous area , if calculated NTC between LT and PL Bidding Zones is less than 50 MW, then LT $NTC_{LT\text{-}PL}$ shall be set to 0 MW;

492 MW – technical capacity of the Link in Settlement Point ($NTC_{SettlementPoint}$) when both circuits or one circuit of Elk Bis - Alytus line are in operation (i.e. decreased the 500MW input power of BtB by technical losses of HVDC converter).

Intraday capacity calculation procedure

8.5.7 The available capacity is reassessed after the Day-Ahead Market and offered to the Intraday Market in line with actual operational conditions. The intraday capacity can be influenced by changed TTC caused by changes in prognosis, topology, and in maintenance plans.

8.5.8 The available transfer capacity $ATC_{LT\text{-}PL}$, shall be calculated:

For direction from Lithuania to Poland (Settlement Point in Elk Bis 400 kV):

8.5.9 Two circuits of Elk Bis-Alytus 400 kV line in operation:

$$ATC_{LT\text{-}PL} = \min (PL\ NTC_{LT\text{-}PL}; LT\ NTC_{LT\text{-}PL}; 488\ MW) - AAC_{Day\ ahead} \quad (17)$$

8.5.10 One circuit of Elk Bis-Alytus 400 kV line in operation:

$$ATC_{LT\text{-}PL} = \min (PL\ NTC_{LT\text{-}PL}; LT\ NTC_{LT\text{-}PL}; 485\ MW) - AAC_{Day\ ahead} \quad (18)$$

For direction from Poland to Lithuania (Settlement Point in Alytus 330kV):

8.5.11 Two circuits or one circuit of Elk Bis-Alytus 400 kV line in operation:

$$ATC_{LT\text{-}PL} = \min (PL\ NTC_{LT\text{-}PL}; LT\ NTC_{LT\text{-}PL}; 492\ MW) - AAC_{Day\ ahead} \quad (19)$$

where:

PL $NTC_{LT\text{-}PL}$ – NTC between LT and PL Bidding Zones for Intraday Market, determined by restrictions of Continental Europe synchronous area, if calculated NTC between LT and PL Bidding Zones is less than 50 MW, then PL $NTC_{LT\text{-}PL}$ shall be set to 0 MW;

LT $NTC_{LT\text{-}PL}$ – NTC between LT and PL Bidding Zones for Intraday Market, determined by restrictions of Baltic synchronous area, if calculated NTC between LT and PL Bidding Zones is less than 50 MW, then LT $NTC_{LT\text{-}PL}$ shall be set to 0 MW;

488 MW – technical capacity of the Link in Settlement Point ($NTC_{SettlementPoint}$) when both circuits of Elk Bis-Alytus line are in operation (i.e. decreased the 500MW input power of BtB by technical losses of HVDC converter, two circuits of 400kV line and shunt reactors);

485 MW – technical capacity of the Link in Settlement Point ($NTC_{SettlementPoint}$) when one circuit of Elk Bis - Alytus line is in operation (i.e. decreased the 500MW input power of BtB by technical losses of HVDC converter, one circuit of 400kV line and shunt reactors);

492 MW – technical capacity of the Link in Settlement Point ($NTC_{SettlementPoint}$) when both circuits or one circuit of Elk Bis - Alytus line are in operation (i.e. decreased the 500MW input power of BtB by technical losses of HVDC converter);

$AAC_{Day\text{-}ahead}$ – Already Allocated Capacity in the Lithuania-Poland interconnections after day-ahead trading.

9 INTRADAY CAPACITY (ATC) REASSESSMENT FREQUENCY

9.1 Reassessment of Intraday capacity value (ATC) shall be performed every time if any of the following situations occur:

9.1.1 Changes in topology of transmission network - unplanned outages or unplanned (earlier) returning to operation of network elements that affect transmission capacities;

9.1.2 Day-Ahead Market results update, e.g. in case of fall-back procedure applied by NEMO.

9.1.3 Major changes in generation plans as a result of renewable generation forecasts changes;

9.2 Reasons for reassessment - changes in topology of transmission network, as well as update of Day-Ahead Market results affect operational conditions of power systems, therefore ATC reassessment shall be performed in order to ensure operations security of power systems.

10 CROSS-ZONAL CAPACITY VALIDATION METHODOLOGY

10.1 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 Capacity calculators in accordance with Articles 27 to 31 of CACM.

10.2 Each TSO may reduce Cross-Zonal Capacity during the validation of Cross-Zonal Capacity referred to in Article 10.1 for reasons of Operational Security.

10.3 CACM Article 26.2 (rule for splitting the correction of Cross-Zonal Capacity) is not included in this methodology due to the fact that splitting of capacities among borders of Baltic CCR is not performed.

11 CAPACITY CALCULATION FALLBACK PROCEDURE

11.1 If Cross-Zonal Capacities cannot be calculated by Capacity calculator, Capacity calculator informs respective TSOs on inability to calculate capacities. Then respective TSOs calculate and coordinate capacities for respective Cross-Border Interconnections among themselves and provide coordinated capacities to Capacity calculator.

12 PROVISION AND ALLOCATION OF TRADING CAPACITY

12.1 Baltic CCR TSOs provide calculated and validated Trading Capacities and allocation constraints for relevant trading time frames to MO for subsequent capacity allocation through implicit auctioning carried out by MO.

12.2 Trading Capacities within the Baltic CCR are provided and allocated, subject to allocation constraints, in day-ahead and intraday time frames – Day Ahead Market and Intraday Market.

12.3 Trading Capacities for Intraday Market on cross-border Lithuania-Poland are not being provided and allocated until agreement among PSE and Litgrid on operation of Intraday Market on Lithuania-Poland cross-border will be concluded. After starting of Intraday Market on cross-border Lithuania-Poland capacity shall be calculated according rules described in clauses 8.5.7-8.5.11.

Provision and allocation of Trading Capacity between Baltic CCR power systems

12.4 Trading Capacities provided for trade between the Baltic CCR Bidding Zones are equal to the offered capacities calculated according to the Section 8 of this Methodology, and which is subsequently allocated through the implicit auctioning following the trading rules established by the MO, subject to allocation constraints.

13 FIRMNESS

13.1 After the Day-ahead Firmness Deadline, all Cross-Zonal Capacity and allocation constraints are firm for day-ahead capacity allocation unless in case of Force Majeure or Emergency Situation.

13.2 The Day-ahead Firmness Deadline is 60 minutes before Day-Ahead Gate Closure Time unless there is other deadline included in “All TSOs’ Proposal for the day-ahead firmness deadline (DAFD) in accordance with Article 69 of the Commission Regulation (EU) 2015/1222 of 24 July 2015 establishing a Guideline on Capacity Allocation and Congestion Management”.

13.3 After the Day-ahead Firmness Deadline, Cross-Zonal Capacity which has not been allocated may be adjusted for subsequent allocations, subject to allocation constraints.

13.4 Intraday Cross-Zonal Capacity is firm as soon as it is allocated, subject to allocation constraints, unless in case of Force Majeure or Emergency Situation.