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**METHODOLOGY FOR
DETERMINATION AND HARMONIZATION OF
NET TRANSFER CAPACITIES (NTC)**

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CONTENTS

	Page
Front page	1
Control list of revisions	2
Content	3
1. Purpose	4
2. Definitions and abbreviations	4
3. Reference documents	6
4. Mode of operation	6

1. PURPOSE

“Methodology for determination and harmonization of net transfer capacities (NTC)” defines the determination algorithm, the time schedules and responsibilities to determine, to harmonise with neighbouring interconnection partners and to provide to the market the values of bilateral net transfer capacities as well as the available capacities corresponding to the time intervals for which the auctions of interconnection capacities are organized.

The NTC values determined according to this methodology represent the maximum active power that can be commercially exchanged in a certain time interval between two electric power zones, while also observing the operational security standards for interconnected operation.

2. DEFINITIONS AND ABBREVIATIONS

2.1 Definitions

Total Transfer Capacity (TTC) – Maximum power that can be exchanged between two synchronously interconnected electric power zones, while observing the operational security standards applicable to each zone, under the assumption we perfectly know beforehand the network condition, the output structures and consumption values (ENTSO-E definition).

Transmission Reliability Margin (TRM) – Security margin taking into consideration the uncertainties in the calculated values of Total Transfer Capacity (TTC). The uncertainties in the calculated values of TTC, which should be covered by considering the TRM, come from:

- Unintentional deviations of physical flows of active power during the operation of the interconnected system, caused by the frequency - exchange power control;
- Emergency exchanges between TSO-s to cover unexpected power imbalances occurring in real time;
- Inaccuracies occurring in data metering and gathering;
- Uncertainties in the forecast of generation and consumption, almost insignificant deviations from the disconnection schedule.

Net Transfer Capacity (NTC) – Maximum power that can be exchanged between two electric power zones while observing the operational security standards applicable to each zone and the uncertainties relating to future network conditions and events in real time, obtained by deducting the security margin from the TTC (ENTSO-E definition): $NTC = TTC - TRM$.

Already Allocated Transfer Capacity (AAC) – All the allocated transfer rights, regardless whether they are exchange capacities or exchange schedules, depending on the allocation method (ENTSO-E definition); monthly and weekly auctions take into consideration the already allocated capacities, while the day-ahead and intra-day auctions consider the nominated exchange schedules.

Available Transfer Capacity (ATC) – Part of the NTC remaining available after each stage of allocation procedures for subsequent trading activities (ENTSO-E definition): $ATC = NTC - AAC$.

Emergency aid – Export for emergency circumstances guaranteed under bilateral agreements between interconnection partners (TEL, MAVIR, EMS, ESO EAD).

2.2 Abbreviations

BCE = Base case exchanges

TTC = Total Transfer Capacity

TRM = Transmission Reliability Margin

NTC = Net Transfer Capacity

AAC = Already Allocated Transfer Capacity

ATC = Available Transfer Capacity

DACF = Day-ahead congestion forecast

RET = Electricity transmission grid

SEN = Romanian Power System

TSO = Transmission and System Operator

DEN = National Power Dispatcher

SPO = Operational Planning Department

BPSN = Normal Diagram Planning Office

MAVIR = Transmission and System Operator from Hungary

EMS = Transmission and System Operator from Serbia

ESO EAD = Transmission and System Operator from Bulgaria

RO = Romania; BG = Bulgaria; RS = Serbia; HU = Hungary; UA = Western Ukraine (Burstyn Island); ME = Montenegro; MK = Macedonia; AL = Albania; GR = Greece; HR = Croatia; SL = Slovenia; BA = Bosnia-Herzegovina; IT = Italy; AT = Austria; SK = Slovakia; CZ = Czech Rep.; PL = Poland; FR = France; DE = Germany; SEE = South-Eastern Europe

SG CMMI = ENTSO-E WG Congestion management and market implementation

WG NMFT = ENTSO-E WG Network models and forecast tools

3. REFERENCE DOCUMENTS

- Bilateral NTC determination / border allocation agreements concluded with MAVIR, EMS, ESO EAD;
- Interconnection lines operation agreements;
- Organisation and Operation Regulation of the DEN;
- Technical Code of the Electricity Transmission Grid approved under Order 20 / 27.08.2004 of ANRE and completed by Order 35 / 06.12.2004 of ANRE;
- Commercial Code approved under Order 25 / 22.10.2004 of ANRE;
- Operational procedure "Allocation of SEN interconnection capacity with neighbouring electric power systems";
- The yearly disconnection plan for the transmission grid equipment;
- Yearly disconnection schedule for thermal power units;
- Yearly disconnection schedule for hydropower units;
- Coordinated disconnection schedule of the interconnected network in the southern region;
- Coordinated disconnection schedule of the interconnected network in the north-western region;
- ENTSO-E Rules and Regulations for NTC calculation;
- ENTSO-E directives on management of the congestions determined by cross-border exchanges;
- ENTSO-E "Operation Handbook";

4. MODE OF OPERATION

4.1 Determined interconnection capacities. Activities

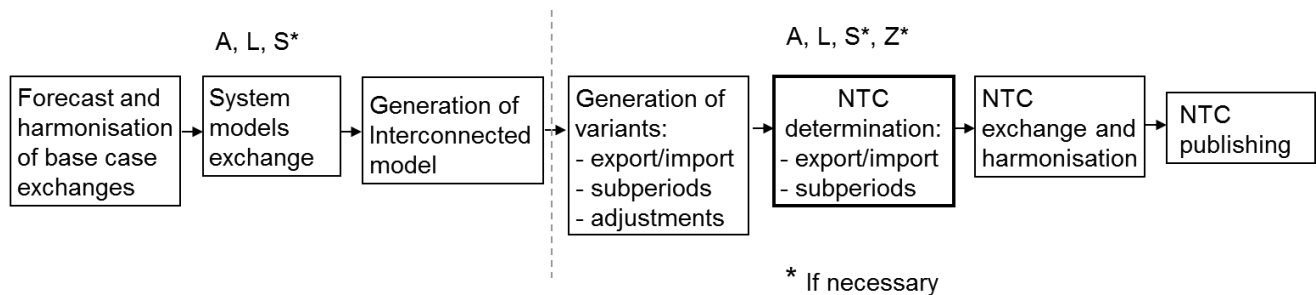
Firm net transfer capacities (NTC) are determined for all auction periods, to be supplied to the market : - Firm NTCs are determined for yearly and monthly auction periods, secured when the disconnection programs planned and coordinated within the SEN and the interconnection are under way;

- Depending on the sequence of disconnection programs, monthly NTC are calculated with weekly / daily resolution and provide also NTC values for the weekly, day-ahead and intra-day auctions during the respective month;
- The weekly NTC and the day-ahead NTC are re-calculated in case of significant unplanned disconnections, of significant deviations from the disconnection plan or of significant deviations from the forecasted output in large power plants;

Maximum seasonal (winter / summer) **indicative unsecured** capacities are also calculated, for normal network topology; the winter maximum capacities can optionally serve as maximum yearly ceiling for monthly auctions (if the partner requested it to be included in the agreement), but without guarantee that such a ceiling will be reached in the monthly calculated NTC values.

An indicative unsecured non-limitative yearly likely profile of the NTC in the SEN interconnection interface is also established, in order to provide additional indications to the market participants.

The diagram below indicates the sequence of activities associated to NTC determination and harmonisation.



4.2 Exchange of data

There are no dedicated exchanges made to determine the firm yearly NTC.

In order to calculate the firm monthly NTC the partners of south-eastern Europe exchange each month (within the CMMI SG):

- Forecasts of exchanges in the base monthly model, based on which a harmonised table for the region is developed;

- Forecasted models for the respective month based on which the common model of the region is developed;

To recalculate weekly / daily firm NTC, information for the respective week / day will be exchanged with respect to unplanned disconnections in the network, deviations from the monthly disconnection plans, significant differences regarding output in essential power plants etc.

If the information indicates significant differences from the monthly calculation circumstances, it will be used in order to update the monthly model or to adapt the current DACF model, depending on the partner agreements, and to recalculate the NTC of the respective week / day.

If there are no significant differences then the previously calculated NTC values are used for the respective week / day.

To calculate the maximum seasonal NTC, seasonal exchanges are performed similar to the monthly ones and a common seasonal model is achieved for the entire interconnected network (in the WG NMFT).

4.3 Schedules for data exchanges / NTC determination / harmonisation

4.3.1 Yearly schedule

The yearly firm NTC values and the maximum indicative unsecured NTC values for the following year will be determined and harmonised bilaterally between partners in the current year at least 2 weeks before the publication dates of yearly auctions- 31 October.

4.3.2 Monthly schedule

▪ In view of the data exchange, NTC values are calculated and harmonised for month M observing the following schedule:

▪ 15-20 of the month (M-2): exchange / harmonisation of forecasted balances for month M between the partners of SEE: RO, RS, ME, BG, HU, MK, GR, AL, BA, HR, SL, AT.

▪ 20-24 (M-2): exchange of system models forecasted for month M, in UCTE format; achieving the interconnected model;

Since there is no agreement with Ukraine Transelectrica also provides a model for Western Ukraine derived from the current DACF model, and the topology is modified using the coordinated withdrawal schedule for the north-western region.

- 25 (M-2) -3 (M-1): calculating the NTC;
- 5 (M-1): exchanging / harmonising the NTC;
- Provision to the market: upon completion of bilateral harmonisation processes;

4.3.3 Weekly schedule

In view of the data exchange the NTC values for week W are calculated and harmonised while observing the following schedule:

- Wednesday (W-1):
 - Data exchange: information about unplanned disconnections, deviations from the disconnection plans, significant differences about output in essential power plants;
 - If necessary, recalculation of the NTC;
- Thursday (W-1): NTC exchange and harmonisation; provision to the market.

4.3.4 Daily schedule

If it is agreed with the partners to recalculate the NTC for the day-ahead auction (D), the following schedule will be observed:

- D-2:
 - The latest information about unplanned disconnections, deviations from the disconnection plans, significant differences regarding output in essential power plants;
 - If necessary, modifying the DACF model and calculating/ exchanging/ harmonising the NTC;
- D-1: provision to the market;

4.4 Elaborating the interconnected model

4.4.1 Elaborating the monthly / seasonal model

Firm monthly NTC values and the maximum unsecured seasonal ones are calculating using monthly / seasonal calculation models including the model of the SEN and the external network model.

In accordance with the regulatory framework:

- The monthly calculation model is elaborated for the third Wednesday of the respective month, at 10:30 h CET (usually for the morning peak load);
- The seasonal calculation model is elaborated for the third Wednesday of January, respectively July, at 10:30 h CET.

The following stages will be carried out:

4.4.1.1 Elaborating the full model of the SEN

Elaborating the monthly / seasonal model of the SEN includes:

- Estimating the balance using the information about commercial demands and generation availabilities;
- Operative forecast of the consumption level using statistical databases and contractual information;
- Operative forecast of the load coverage using statistical databases, the yearly disconnection schedule of units and the current information;
- Identifying the SEN disconnection schedule in month M, using the yearly disconnection plan and the current information;
- Setting the variation limits of the output in power plants in order to increase / reduce exchanges based on the yearly disconnection plan of units and the current information;
- The above data should be endorsed by a competent person;

The maximum unsecured seasonal (winter / summer) NTC values are calculated using models with normal topology (including only long term disconnections).

4.4.1.2 Elaborating the reduced SEN model and data exchange

Interconnection partners exchange reduced models of their own systems, including the (400/220kV) transmission network and possibly areas of the 110 kV network significant for NTC calculation and provision of reactive control, with full or equivalent representation depending on the TSO's decision. Such process includes the following steps:

- Reducing the model to the 220-400 kV network and equivalents for significant 110 kV areas;
- Conversion into ENTSO-E format;
- Sending by e-mail to the partners from SG CMMI for their monthly calculations and to the WG ENTSO-E NMFT members for seasonal calculations;

For monthly calculations, if during month (M) several disconnection schedules significant for NTC calculations are implemented in SEN in different time periods, a list of disconnections specifying the time intervals will be also provided.

4.4.1.3 Elaborating the external network

4.4.1.3.1 For monthly calculations the external network is elaborated in the following stages:

a) Achieving the nearby external network (SEE), including:

- Receiving the models from SEE partners in ENTSO-E format,
- Conversion in autochthonous format;
- Connecting the models from SEE partners and the UA model,

or

- Receiving the interconnected SEE model from the TSO having the auction office role in the test for coordinated auction,
- Conversion in autochthonous format,
- Eliminating the reduced Romanian model;

b) Completing the nearby external network with a reduced model of the far ENTSO-E network, including:

- Selecting the most recent ENTSO-E model for Wednesday 10:30 h CET of the running month (DACF model from the ETSO server) or an appropriate seasonal model,
- Changing the topology of the countries at the interface with nearby area using the coordinated disconnection schedules;
- Reducing while keeping large generation nodes from FR, DE, PL, CZ and the 400/220 kV network from SK;
- Connecting to the nearby external network.

4.4.1.3.2 For seasonal calculations the external network is elaborated as follows:

- Receiving the ENTSO-E interconnected model from WG NMFT;
- Keeping the network from neighbouring (RS, BG, HU, WUA) and nearby (ME, MK, GR, AL, BA, HR, SL, AT, SK) countries and reducing the rest of the network while keeping the large generation nodes from FR, DE, PL, CZ, IT.
- Eliminating the reduced model of RO.

4.4.1.4 Elaborating the monthly / seasonal calculation model

The external network is connected to the full (complete) model of the SEN.

For monthly calculations, if several disconnection schedules significant for NTC calculations are implemented in the SEN or in the nearby interconnected network during different intervals in month (M), monthly sub-periods will be defined and models with different topologies will be elaborated for each sub-period.

4.4.2 Elaborating the weekly model

To recalculate the firm weekly NTC values the monthly calculation model (models) of the respective week will be updated or the interconnected DACF model will be adapted for the third Wednesday of week W-1, at 10:30 h CET, based on the information regarding the respective week.

4.4.3 Elaborating the daily model

In case the NTC recalculation is agreed with day-ahead auction partners (D), 1 day before the auction a model will be used by properly changing the topology in:

- The monthly model;
- The DACF model for the day-ahead of the auction (D-1), at 10:30 h CET, available on D-2, if both days are week-days or holidays, or the DACF model for the same day of the previous week otherwise.

Also the exchange of D-2 models can be agreed, as well as achieving the model of the interconnected network.

4.5 Determining the yearly and seasonal NTC

For yearly horizon, firm yearly bilateral NTC are determined for the market.

Also maximum unsecured NTC are calculated with indicative purpose.

An indicative unsecured non-limitative yearly likely profile of the NTC in the SEN interconnection interface is also established.

4.5.1 Determining the yearly firm bilateral NTC

The yearly firm bilateral NTC are provided on the market for yearly allocation and they represent the interconnection capacities that can be simultaneously used during the entire year, under all the yearly coordinated repair plans set within the SEN and the interconnection, without reductions and simultaneously providing the agreed TRM (100 MW) on each bilateral border.

Exception 1: Where just one border line exists between partners, the firm yearly NTC values are secured only as long as the line is in operation.

Exception 2: If along one border the parallel flows due to external transactions provide a permanent netting degree in one direction and the trend of exchanges in the area determines low use of the respective border both in N and N-1 in that direction, it is not necessary to simultaneously provide the TRM on that border in the respective direction.

Taking into account:

- The need to provide yearly firm NTC before elaborating the yearly disconnection plan of the SEN and the coordinated disconnection plans of the interconnection;
- Disconnections rescheduling during the year;
- The uncertainties in the output forecast in key points impacting NTC values (HPP Iron Gates + Djerdap, etc.)

The firm yearly NTC are determined:

- Usually based on the experience of the current and previous year regarding the simultaneous maintenance schedules on the interconnection and the exchange possibilities taking into consideration **the lowest monthly firm NTC values achieved in the last 12 months**.
- Making also additional calculations only if expecting:
 - Refurbishment plans in the next year that can lead to lower firm NTC values;
 - Significant commissioning (interconnection lines and substations etc.) in the period from the determination of yearly NTC and the beginning of the next year, which can lead to increased NTC values;

In such cases calculations can be made:

- Using models forecasted for the following year, simultaneously considering the critical refurbishment plans and the planned commissioning, as well as the maintenance schedules and outputs in significant points for which low monthly NTC values were achieved in the current and previous year;
- Using models derived from the monthly models of the current and previous year for which low monthly NTC values were achieved and simultaneously considering the critical refurbishment plans and planned commissioning (recommended).

4.5.2 Determining the maximum unsecured bilateral seasonal / yearly NTC

The maximum unsecured seasonal NTC values are only indicative; such values are published on the ENTSO-E site. The maximum yearly unsecured values are calculated using the winter seasonal model.

Calculations are made using the normal topology of the SEN and of the interconnected network, taking also into consideration the commissionings significant for the NTC value, which will take place in the following year.

The calculation methodology is similar with that provided in 4.6, but with the following specific aspects:

- Net transfer capacities are calculated, additionable only in partial interfaces RO/RS + BG, RO + BG/RS, HU/RO + RS, UA + HU/RO;
- Optimistic scenarios are considered, which use all SEN borders without reallocation to other borders;
- The simultaneous increase of exchanges between neighbouring systems is not considered;
- TRM of 100 MW / bilateral border and 200 MW / partial interface is considered.

The maximum unsecured NTC values are set taking also into account:

- The seasonal variation of the parallel summer / winter flows;
- The monthly NTC values achieved in the previous year and the NTC increase on borders in certain disconnection cases;
- The values obtained in partial interfaces by partners *i* in previous years.

The purpose is to indicate a credible ceiling for monthly auctions, which should provide realistic indications on the exchange possibilities, but should not impose a lower limit than the NTC values that will result from the monthly calculations of the next year.

4.5.3 Determining the yearly likely profile of the NTC

An indicative unsecured non-limitative yearly likely profile of the NTC in the SEN interconnection interface is also defined and published in order to provide additional indications to market participants.

Such profile is established:

- Usually based on experience, considering the average value of the monthly harmonised NTC profile in the last 12 months and taking into account the existing information about the period and effect of certain long term works, commissionings, seasonal protection settings, etc.
- Making additional calculations only if significant commissionings are foreseen during the following year.

4.6 Determining the firm bilateral monthly NTC

Firm monthly bilateral NTC values are provided to the market for monthly allocation of available capacities (ATC), and they are net transfer capacities that can be simultaneously used during the respective month for the monthly disconnection plan coordinated within the SEN and in the interconnection.

The calculation methodology was elaborated by SPO/DEN based on the ETSO/UCTE recommendations regarding interdependent exchanges within looped networks: if the interconnection capacities between several pairs of partners are interdependent, recommendations are to calculate the NTC between zones, in interfaces that include several bilateral borders.

4.6.1 Principles and calculation premises

- For commercial purposes TRANSELECTRICA provides firm bilateral NTC values that can be simultaneously used in the same export / import direction, with the security margin of

international interconnections (TRM) agreed under bilateral conventions without endangering system security.

- The following are taken into consideration:
 - At least the firm yearly NTCs are simultaneously used by all partners in the same direction;
 - 100 MW TRM are provided for each significant bilateral border;
 - Various assumptions on the source / destination of additional exchanges;
 - Eliminating the netting in the NTC calculation (however it can be accepted at allocation);
 - Common utilisation of interfaces by several partners;
 - Successive allocation of the capacity in several interfaces (RO->HU+HU->RS = RO ->RS, etc.);
 - The status and settings of protections / automations within SEN and interconnection;
- Preventive / post-event operational measures can be taken into consideration in the SEN and the interconnection, depending on the practice of the respective TSO and within the limits of technical-economic feasibility: re-dispatching, looping / unlooping, and exceptionally rescheduling certain disconnections if possible.
- Bilateral NTCs on SEN borders are determined in coordinated manner by calculating composite NTCs in SEN interconnection interface and other multilateral interfaces utilised jointly with the partners, which then are distributed on the bilateral borders.
This principle has been agreed with all partners from CMMI SG.
- The distribution of composite NTCs on bilateral borders is done taking into account several factors:
 - Directional limits;
 - The yearly firm bilateral and maximum NTC;
 - Agreements on NTC distribution: NTC RO+RS <-> HU 50%/50%; NTC RO + BG <-> RS 50%/50%;
 - Distribution of power flows;
 - Congestion revenues registered in previous months;
 - Bilateral NTC values proposed by partners, etc.
- TRM in composite interface is established taking into consideration:
 - Bilateral agreements: 100 MW TRM bilateral on each border;
 - Simultaneous utilisation of TRM on all significant borders;
 - Actual utilisation of border lines and critical contingencies;

- The effect of north- south parallel flows through the SEN;
- The emergency aid 100 MW export / 300 MW import.

For the interconnection interface of SEN the TRM provided is of:

300 MW for export (the RO-UA border is not significant)

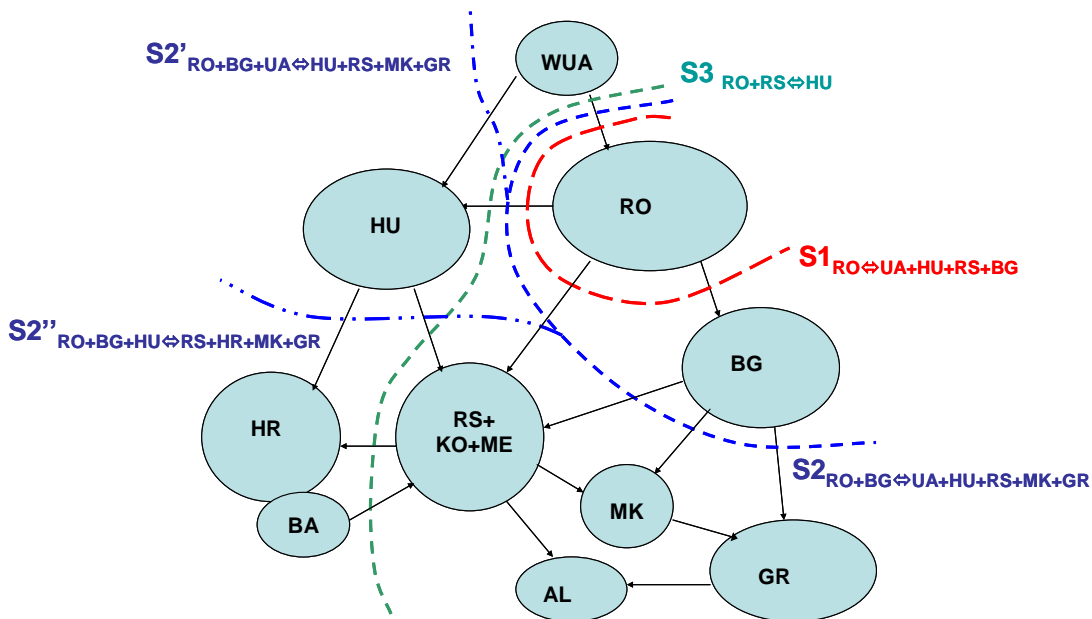
400 MW for import

200-400 MW export TRM is provided / verified in the RO+BG interface.

- In the months with several simultaneous and successive maintenance schedules calculations are made for month sub-periods and sets of NTC values (monthly profiles) are provided.

4.6.2 Multilateral interconnection interfaces

The figure below shows multilateral interconnection interfaces where bilateral exchanges are interdependent.



The composite monthly NTC are calculated in the SEN interface:

S1 (RO -> UA + HU + RS + BG and RO <- UA + HU + RS + BG)

and in other interconnection interfaces:

S2 (RO + BG -> UA + HU +RS + MK + GR)

S3 (RO + RS -> HU and RO +RS <- HU) *

* Only if one of the 400 kV OHL Arad-Sandorfalva or Arad-Nadab-Bekescsaba is unavailable, or in case of unavailability within substations Arad, Mintia.

4.6.3 Algorithm principle for TTC/ NTC calculation in an interface

- Checking on the calculation model: is N-1criterion observed?
 - **YES** \Rightarrow Available exchange capacity
Scenario of additional exchange m_{add}
 - Increasing the exchange in the interface using 50-100 MW steps;
 - Checking N-1criterion in every step;
 - The first significant violation in step k \Rightarrow **maximum additional exchange** $\Delta E_m \geq 0$ in step k-1
 - **NO** \Rightarrow The forecasted exchanges and the yearly secured NTC cannot be achieved simultaneously
Scenario of exchange reduction m_{red}
 - Reducing the exchange through the interface using 50-100 MW steps;
 - Checking N-1criterion in every step;
 - disappearance of significant violations in step k: \Rightarrow **minimum necessary reduction** $\Delta E_m < 0$ in step k

$$TTC_m = \Delta BCE + \Delta E_m; \quad NTC_m = TTC_m - TRM$$

interface

$$NTC = \text{MIN} \{NTC_m\}$$

- **Practical implementation of exchange increase / decrease in multilateral interfaces**
 - a) Exchange increase / decrease through the interface can be performed by means of:
 - Simultaneous increase / decrease of bilateral exchanges: $\Delta E = \sum \Delta E_i = \sum K_i \Delta E$

Example: additional exchange in SEN interface: $\sum E_{RO} \Rightarrow UA + HU + RS + BG$

0%+33%+33%+33%

0%+ 0%+100%+0% ; etc.

- Successive increases / decreases of bilateral exchanges

b) **The most pessimistic scenario** takes into consideration the risk of bilateral exchanges on all RO borders having common final destination because of successive allocations on several borders:

RO \Rightarrow RS + RO \Rightarrow HU \Rightarrow RS + RO \Rightarrow BG \Rightarrow RS + RO \Rightarrow UA \Rightarrow HU \Rightarrow RS

In such a case the exchange is increased through the interface in only one direction: $\sum E = \sum E_i$

c) If N-1 criterion has been satisfied on the calculation model then the exchange is further increased in the interface until N-1 is violated in terms of network loading limits (or reaching the maximum acceptable overload, which can be solved post-event, if need be).

If during such increase the maximum yearly NTC limits are reached, as included in the agreements for certain bilateral exchanges, but N-1 is satisfied, the exchanges with the other partners continue growing until N-1 is violated.

In case all bilateral exchanges reach the yearly maximum NTC (+TRM) but N-1 is satisfied, then the yearly maximum values can be renegotiated.

d) If N-1 is not satisfied in the calculation model, decreasing exchanges through the interface is continued until N-1 is satisfied.

If during such decrease the yearly firm limits of NTC are reached for certain bilateral exchanges, but N-1 is not satisfied, then exchanges with the other partners continue decreasing.

If the firm yearly NTC are reached in all exchanges but N-1 is still unsatisfied, additional preventive / corrective measures are necessary or / and declaring certain monthly NTC values lower than the capacities allocated yearly and reducing accordingly the transactions with the respective penalties.

▪ **The N-1 criterion** for NTC calculation includes at least:

- Tripping the interconnection lines between the SEN and neighbouring systems and between external neighbouring or nearby systems;
- Tripping certain lines and (auto)transformers from the transmission network of the SEN (400 kV & 220 kV), which are significant for NTC values;
- Tripping certain significant lines and (auto)transformers from the transmission network (400 kV) of neighbouring systems;
- Simultaneous tripping of certain double circuits of interconnection or internal lines (according to the RET code);

- Tripping the largest unit of the importing system (SEN: 1 unit of NPP Cernavoda).
- **Limits** taken into consideration when calculating the TTC:
 - 100% thermal line current; seasonal values are taken into consideration;
 - 100% admissible power of the (auto)transformers or
 - 105-120% if the respective TSO declares it possible to re-dispatch post-event;
 - 100-120% current transformers (depending on the TSO's practice);
 - 100% the current control of overload protections with 20 min time lag (RS, MK, ME) or
 - 105-110% if the respective TSO declares post-event re-dispatch is possible;
 - 90% / 80% of the power setting of automations with time lag 1s / 0.5 s;
 - 100% the setting of DASP automations (or acceptance of DASP action by the respective TSO);

Observance of the loading limits is verified:

- Within the SEN network,
- On the interconnection lines between the SEN and neighbouring systems and between neighbouring and nearby systems,
- On the elements of the 400 kV transmission network of neighbouring or nearby systems that can determine cascade tripping impacting the load, the interconnection and the stability of SEN.

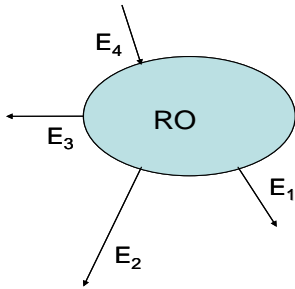
Taking into account the uncertainty regarding output structure, in general the possibility of voltage maintenance within the admissible limits is verified only for SEN N.

4.6.4 Calculation of composite NTC

4.6.4.1 Composite NTC in the SEN interface

Such are calculated in order to provide maximum utilisation of the interconnection interface of SEN under safe conditions. Calculations are made using models derived from the basic one.

- Starting point: the basic model of the SEE with forecasted BCE:

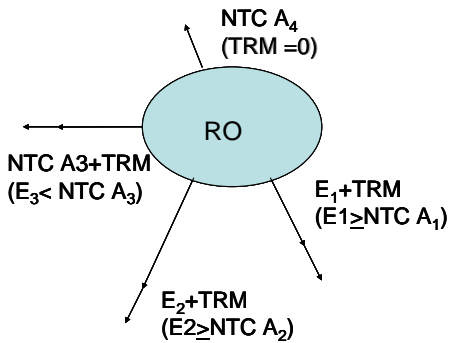


Base Model (10:30 CET)

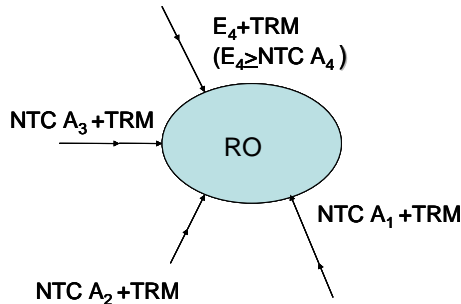
BCE'_i = forecasted exchanges: E1,E2,E3,E4

- Eliminating the netting and providing firm yearly NTC on all borders by generating 2 models with simultaneous exchanges in just one direction (export / import) on all borders:

Export Model



Import Model



$$BCE'_i = \text{Max} \left\{ \begin{array}{l} \text{forecasted export / import } (E_i) \\ \text{firm yearly export/import NTC } (NTC A_i) \end{array} \right\} + TRM$$

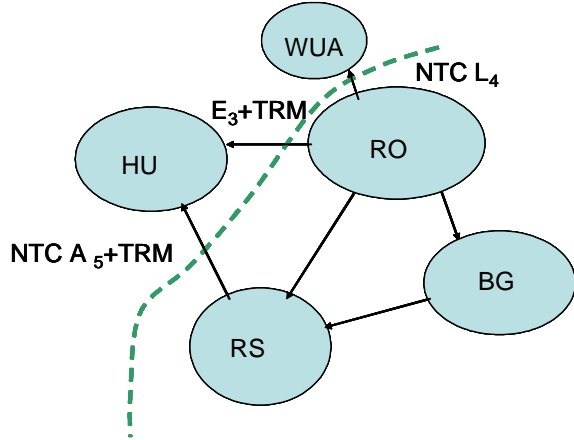
The maximum $\varnothing E'$ is calculated in the SEN interface (4.6.3)

$$\Rightarrow NTC_{RO} = BCE'_{RO} + \varnothing E' - 300 \varnothing \varnothing 400MW$$

4.6.4.2 Composite NTC in other interfaces

Such are calculated in order to optimise the distribution of the composite NTC in the SEN interface on bilateral borders so as to provide maximum utilisation of the interconnection interface of SEN while preserving safety conditions and maximising utilisation in other composite interfaces as well, including one or several SEN borders.

a) Composite NTC in the RO + RS => HU interface



**Export model
RO+RS=>HU**

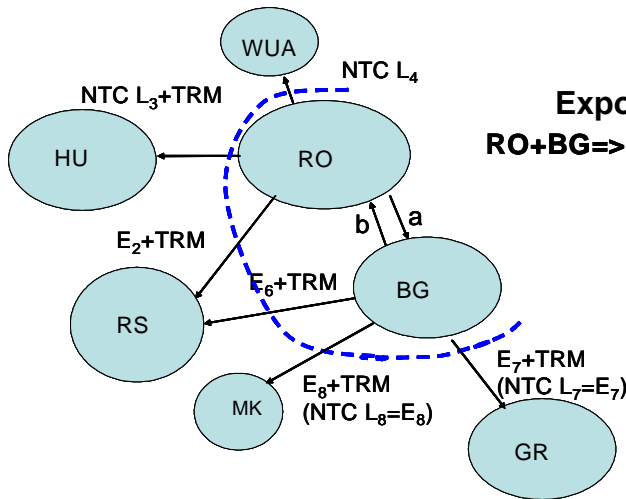
BCE"

The maximum \overline{E}'' is calculated through the RO + RS => HU interface (4.6.3)

$$NTC_{RO+RS=>HU} = BCE''_{RO+RS=>HU} + \overline{E}'' - 200 \text{ MW}$$

⇒ Distribution RO / RS 50% / 50% ⇒ $NTC_{RO+>HU}$

b) Composite NTC in the RO + BG => UA + HU + RS + MK + GR interface



**Export model
RO+BG=>UA+HU+RS+BG+MK+GR**

BCE"

- The maximum \overline{E}''' is calculated on the RO + BG => UA + HU + RS + MK + GR interface using 2 sub-models:

b1) RO => BG export, $E1''' \geq NTC A_{RO=>BG} + TRM$

Scenarios with additional export: RO + BG => RS 100% / 0%; 50% / 50%;

b2) BG => RO export, $E1''' = NTC_{A_{BG \Rightarrow RO}} + TRM$

Scenario with additional export: RO + BG => RS 50% / 50%;

- Premises of distribution on borders:
 - Monthly determined $NTC_{RO \Rightarrow HU + UA}$;
 - $NTC_{BG \Rightarrow MK + GR} = BCE_{BG \Rightarrow MK + GR}$ or information from BG, MK, GR

$$NTC_{RO+BG_{b1,b2}} = BCE'''_{RO+BG} + E'''_{b1,b2} - 300 \text{ [?] 400 MW}$$

$$NTC_{RO+BG} = \text{Min} \{ NTC_{RO+BG_{b1}}, NTC_{RO+BG_{b2}} \}$$

$$NTC_{RO+BG \Rightarrow RS} = NTC_{RO+BG} - NTC_{RO \Rightarrow HU} - NTC_{RO \Rightarrow UA} - NTC_{BG \Rightarrow MK} - NTC_{BG \Rightarrow GR}$$

⇒ RO / BG [?] 50% / 50% distribution ⇒ $NTC_{RO \Rightarrow RS}$

$$\Rightarrow NTC_{RO \Rightarrow BG} = NTC_{RO} - NTC_{RO \Rightarrow SR} - NTC_{RO \Rightarrow HU} - NTC_{RO \Rightarrow UA}$$

Notes:

- It is necessary to make calculation on sub-model b2) only if one of the 400 kV interconnection OHL is unavailable between BG and RS, MK, GR.
- If all the 400 kV interconnection OHL between BG and RS, MK, GR are operational then the RO quota from the composite $NTC_{RO+BG \Rightarrow RS}$ can be higher than 50%.
- If all the 400 kV interconnection OHL between BG and RS, MK, GR are operational, TEL determination of the $NTC_{RO+BG \Rightarrow RS}$ is impacted by the assumptions regarding $NTC_{BG \Rightarrow MK}$ and $NTC_{BG \Rightarrow GR}$ and it provides high uncertainty.

It is recommended to make with Bulgaria the exchange of proposed NTC values two days before the other partners provide the values (within the possible time), both for the RO/BG border and for the RO/UA, HU, RS, respectively BG/RS, MK, GR borders.

Thus NTC can be distributed on the bilateral borders of SEN so as:

- To reduce the risk of incomplete utilisation of the exchange capacity of SEN, by avoiding a too high NTC proposal on one SEN border, which also belongs to another composite interface with reduced exchange capacity;
- To coordinate the bilateral NTC in the composite RO+BG interface as well and to provide the desired safety degree for SEN and the area.

4.6.5 Maximising the NTC for the current topology of the network

The following means are used in order to maximise the firm NTC values:

- Yearly planning of disconnections;
- Coordinating between interconnection partners the disconnection plans for interconnection lines and internal elements impacting the NTC;
- Calculations for monthly sub-periods in case of significant successive disconnection plans;
- Recalculating the NTC / ATC when an unfavorable maintenance plan is re-scheduled and organising an additional auction for the respective time interval;
- Preventive / corrective measures within technical-economic feasibility limit:
 - Preventive/post-event generation re-dispatching;
 - Looping / unlooping the 110 kV network;
 - Automatic actions;
- Flexible current limits:
 - Admitting certain temporary overloads on the (A)T and CT;
 - Increasing the thermal limits in case of low temperatures.
- Accepting reduced TRM in the RO interface proportional with the TTC reduction, but providing at least TRM on just one bilateral border or the emergency aid (100 MW/ 300 MW for export / import).
- Rescheduling certain disconnections, within possibilities.

4.7 Recalculating the firm bilateral weekly NTC

This is performed only in case of significant deviations from the situation considered in the monthly calculations.

The same principles, algorithm and optimisation measures will be applied as during monthly calculations.

4.8 Recalculating the firm bilateral daily NTC

If it is agreed with the partners to currently recalculate the NTC for daily auctions, this will be performed only in case of significant deviations from the situation considered in the monthly and weekly calculation.

The same principles, algorithm and optimisation measures will be applied as during monthly and weekly calculations.

To maximise the use of NTC values agreed for the month / week / day level and depending on the bilateral agreements with neighbouring TSO-s, in D-1 the ATC for D day is determined as follows:

- The exchange schedules with hourly profile for D day, planned based on the yearly, monthly and weekly allocation of NTC values on both directions export-import, are netted,;
- The net exchange with the hourly profile obtained previously is subtracted from the NTC agreed for the month / week (values corresponding to the sub-period of the month / week that contains D day) (or recalculated daily) ;
- The ATC values with hourly profile for D day obtained after applying the steps above are offered on the market for allocation.

4.9 Intraday NTC

The intraday NTC is not recalculated; the NTC values agreed for the month / week (values corresponding to the sub-period of the month / week containing D day), stay valid or they are recalculated the day before, if need be.

The hourly ATC is determined as shown in 4.8.:

- The exchange schedules on each border with hourly profile for D day, planned based on the yearly, monthly, weekly and day-ahead allocation of NTC values on both directions export-import ,are netted;
- The ATC values with hourly profile are obtained by subtracting the previously calculated balance of hourly profile from the NTC values agreed for the month / week (/ day).

4.10 Exchange and harmonisation of NTC values

4.10.1 Endorsing the proposed NTC values in the interconnection interface of SEN

The person responsible for calculating / determining the NTC submits to the competent person (3) a proposal with the yearly NTC values / monthly NTC profile / weekly NTC values on the bilateral borders and in the SEN interface, while also indicating the calculation / determination premises, the provided TRM, the limiting contingencies / overloads and the operative preventive / post-event measures; at monthly and weekly level the significant disconnections will also be indicated .

Following discussions one variant is selected with minimum number of sub-periods.

4.10.2 Bilateral exchange of NTC values with partners

Until the date indicated in 4.3 TEL provides the partners with a proposal of firm bilateral NTC values; the yearly proposal also includes the maximum yearly non-firm indicative values.

For the monthly and weekly profile the proposal can provide:

- 2 monthly firm export and import NTC values for each border if:
 - It is not necessary to consider several sub-periods, or
 - The NTC values obtained for each sub-period are different by at most 50 MW;
- A monthly / weekly firm set of values (profile) for the export and import NTC if:
 - The disconnection plans determine significantly different NTC values.

Also the partners send to TEL a proposal of NTC values, before or after the TEL's proposal is provided.

The exchange takes place in form of letter addressed to the competent person from the neighbouring TSO, including a table with the yearly NTC values or the monthly/weekly NTC values or for monthly / weekly sub-periods, or the daily NTC values for the respective bilateral border.

The letter is signed by a competent person (3) and sent by fax and / or e-mail.

4.10.3 Harmonising the NTC values

Usually NTC values are harmonised at the lowest values for each direction.

After the bilateral exchange of NTC values explanations can be requested/ provided about the lowest value.

If the TSO with the system with critical contingency justifies a higher value by means of post-event measures, disconnection of certain automata, changing some protection settings, deficiencies of model reduction,, etc., the other TSO can increase the proposed value after proper check-ups.

The harmonisation is complete when one of the partners sends a set of values corresponding with the last values proposed by the other partner, and confirms harmonising the monthly NTC on the respective bilateral border.

Such harmonisation process takes place by means of fax or / and e-mail messages.