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Implementation of European Processes in the Operational Activities of EMS JSC

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Professional article

Highlights

- This paper examines the coordinated processes taking place at the level of European Transmission System Operators, as well as the key changes currently being implemented in the operational activities of EMS JSC
- Particular emphasis is placed on the two most important processes, namely coordinated security analysis and coordinated transmission capacity calculation
- A technical framework has been established for defining a region for coordinated capacity calculation in South-Eastern Europe
- The paper also assesses the ability of the Serbian Transmission System Operator to fulfil its regulatory obligation to allocate transmission capacity in accordance with the MACZT methodology

Abstract

At the level of ENTSO-E and across Europe, processes are under way that directly impact the Serbian power sector and the day-to-day operations of the Transmission System Operator. Two key ENTSO-E processes — coordinated security analysis and coordinated transmission capacity calculation — are implemented in a coordinated manner. Within the framework of transmission capacity calculation, two methodological approaches are applied: the Net Transfer Capacity (NTC) method and the flow-based method. This paper presents the regulatory process of EMS JSC joining the European capacity calculation regions — CORE and the South-Eastern Europe (SEE) region — with particular emphasis on the challenges faced by EMS JSC in this context. Furthermore, the fundamental concepts of coordinated processes are outlined, which will be implemented partly within the Transmission System Operator and partly through the regional coordination centres. Irrespective of the transmission capacity calculation methodology applied at different stages, compliance with the rule requiring the allocation of 70% of the capacity of critical network elements is mandatory. The paper presents preliminary results regarding compliance with this requirement, bearing in mind that its implementation is obligatory under the Energy Law.

Keywords

**ENTSO-E, MACZT (*Margin Available for Cross-Zonal Trade*),
RCC (*Regional Coordination Centre*), TSO (OPS)**

Note:
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1. REGULATORY FRAMEWORK

The new legislative framework, through which European regulation has been transposed, has introduced a new reality in operational planning and management of the transmission system.

According to the decision of the Ministerial Council of the Energy Community (Energy Community, EnC), adopted on 15 December 2022 regarding the transposition of European regulations related to the electricity sector into the legislative frameworks of all Energy Community members, EnC countries undertook the obligation to complete the transposition into national legislation by the end of 2023.

The regulations in question include the CEP (Clean Energy Package) regulations: 2019/942, 2019/943 and 2019/941, as well as five network codes (SOGL, ER, CACM, FCA and GL EB). This represents a significant step towards integrating the Republic of Serbia into the single European electricity market.

In this way, European network codes have become a binding obligation, unlike the earlier "early implementation" of network codes which allowed a certain degree of discretion.

One of the key obligations of the contracting parties of the Energy Community within the process of transposing European regulation is the definition of regions for the implementation of coordinated activities such as security analyses and capacity calculations.

The main provisions relating to the daily activities of Transmission System Operators include the establishment of operational security regions and regions for the calculation of transmission capacities.

Another important element in coordinated transmission capacity calculations is related to the fulfilment of the criterion of "allocation of 70% of transmission capacity" or the MACZT criterion. This requirement may lead to situations where security issues must be resolved over shorter time horizons such as the intraday timeframe and the timeframe close to real time.

In addition, congestion management is expected to be addressed through redispatching and counter-trading mechanisms, which may have significant operational and financial implications.

2. COORDINATED REGIONAL PROCESSES

This paper does not address the political connotations related to the definition of regions, but rather focuses solely on technical parameters.

The definition of operational security regions (Security Operational Region – SOR) has existed for several decades in South-Eastern Europe, primarily as a response to the need for coordinated planning of outages on annual, monthly and weekly time horizons.

This practice arose from the necessity of mutual coordination of activities among the Transmission System Operators, particularly with regard to key 400 kV, 220 kV and interconnection transmission lines.

Later, this approach became institutionalised through the establishment of Regional Coordination Centres (RCC), which expanded the scope of coordination to other planning activities, such as:

1. System modelling across various time horizons: intraday, day-ahead, two-days-ahead, weekly, monthly and yearly horizons. These activities include the preparation of individual models as well as a common grid model of the interconnected system, which represents the basis for all planning activities.
2. Coordination of operational security and verification of compliance with the security criteria N-1 and N-x, where security coordination centres play the dominant role.
3. Coordination of regional and ENTSO-E short-term adequacy assessments (Short-term Adequacy – STA).
4. Coordination of operational outage planning for all relevant network elements at the ENTSO-E level (Operational Planning Coordination – OPC).

JSC EMS participates in the creation of the Common Grid Model (CGM), which serves as the basis for all calculations related to transmission system security and transmission capacity calculations.

The creation of a common pan-European model is carried out on a rotational basis by all European regional coordination centres. The unified model is used throughout Europe and within our region.

Such a jointly generated model is used in analyses at the level of the entire ENTSO-E network, including the region in which JSC EMS operates, thereby ensuring coordinated planning and operational security of the system.

When it comes to regional coordination of security in South-Eastern Europe, which includes both European Union member states and non-EU countries, a European approach and a dynamic scheduling of activities are applied. The objective is to identify potential critical situations already during the day-ahead planning stage and to take corrective measures in a timely manner.

Countries within European security regions have implemented a highly complex coordinated security process that is carried out within precisely defined time intervals.

Transmission System Operators are required to submit their network models (IGM) for the following day by 18:00. The creation of the common grid model (CGM) is completed within the following hour, after which a

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regional operational security analysis (Cross-Regional Operational Security Assessment – CROSA) is performed. If overloads are identified, corrective measures must be applied and new network models created, followed by another coordinated operational security analysis, known as CCROSA (Coordinated Cross-Regional Operational Security Assessment).

This operational regime requires planning activities to extend into the afternoon shift, often until 22:00. Each phase of the process is accompanied by teleconferences in which both Transmission System Operators and regional coordination centres actively participate.

In our region, in cooperation with SCC (Security Coordination Centre), the most important activities are carried out, representing an introduction to the full implementation of the CROSA process, as described below.

The preparation of the D-1 models is performed by 18:00, followed by the merging of the common grid model and the execution of security analyses.

Coordination teleconferences are organised on a daily basis between 20:00 and 22:00, based on the conducted security analyses, in order to review and, if necessary, apply corrective measures ("remedial actions"). These actions may have no financial impact, but may also include measures that entail operational financial costs.

A prerequisite for the full implementation of the CROSA process is the definition of Operational Security Regions (SORs). At the ENTSO-E level, SOR frameworks have been defined (Figure 1), within which all functionalities prescribed by regulation are carried out in a coordinated manner in cooperation with other TSOs and Regional Coordination Centres: Central, Baltic, Nordic, IU, South West (SW), GRIT and South East (SE).

Figure 1. Initial definition of Operational Security Regions

The transposition of European Union regulation is currently ongoing. In the case of the Energy Community region, the SOR is in the process of being redefined. It is expected that the future definition of SOR will be aligned with the definition of regions for transmission capacity calculation.

3. CAPACITY CALCULATION REGIONS

In Europe, regions for coordinated transmission capacity calculation, known as Capacity Calculation Regions (CCR), have already been defined. Each of these regions has developed its own methodologies adapted to the specific characteristics of the region.

Currently defined CCRs include: Baltic region, Central Europe, CORE region, Greece–Italy region, Hansa region, Northern Italy region, Nordic region, SEE region (South-Eastern Europe), SWE region (South-Western Europe).

Within the Energy Community countries, the process of regulatory transposition is ongoing, and the regions for transmission capacity calculation are being defined at the level of Energy Community member states.

As an alternative to the so-called "default" solution, which was initially proposed by the Ministerial Council, and due to the atypical characteristics of certain Energy Community countries, an alternative solution is being implemented. This solution envisages the integration of trading zones into two existing European regions or CCRs.

Figure 2 shows the Central Europe region and the South-Eastern Europe region, to which Serbia is expected to be connected in the near future. Under this arrangement: JSC EMS, the Serbian Transmission System Operator, CGES, the Montenegrin Transmission System Operator and NOS BiH, the Transmission System Operator of Bosnia and Herzegovina, would join the CE/CORE region, while other Transmission System Operators from Energy Community countries would join the SEE European region.

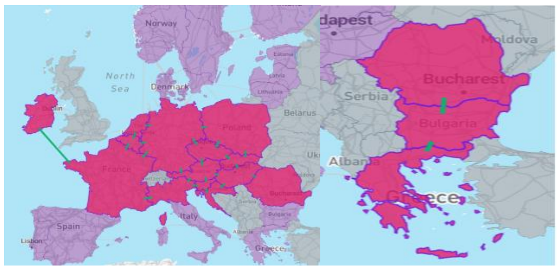

Figure 2. Overview of CCR regions in Central Europe and South-Eastern Europe

Figure 3. Definition of capacity calculation regions

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This solution has already been implemented. There are several technical indicators confirming the justification of such a division, some of which are the following:

- Analysis of several major disturbances that occurred over the last twenty years, which affected the entire synchronous area, showed system separations in Croatia, Hungary, Serbia and Romania. This revealed weak points that must be analysed in a coordinated manner.

- It is important to establish coordinated transmission capacity calculations based on power flows or through the use of coordinated NTC (Net Transfer Capacity) as a transitional solution. This would avoid uncontrolled power flows (loop flows), which are one of the main sources of insecurity in the transmission network.

- The effect of achieving 70% capacity allocation, since the impacts of flows that are not controlled and originate from other zones must also be taken into account. Currently, within JSC EMS a strong influence of planned commercial flows on the Hungary–Romania border can be observed, while physical flows are closed through the transmission network of Serbia. The flow pattern is shown in Figure 4 for an atypical day during which there was a significant northbound transit, due to extremely high electricity generation from solar sources in Greece.

There are also strong influences of power flows from the South-Eastern Europe region on flows within the CORE region. For example:

- the 400 kV transmission line Ugljevik – Mitrovica has a PTDF (Power Transfer Distribution Factor) influence of up to 13% on the CORE region

- the 400 kV transmission line Trebinje – Lastva also has an influence of up to 13%

This demonstrates that there is a strong interaction between different CCR regions, which must be considered in order to calculate available transmission capacities as accurately as possible.

For these reasons, the currently predefined Shadow SEE CCR region is being reconfigured. An alternative solution is being developed in which: JSC EMS, CGES and NOSBiH would join the CE / CORE region.

Under this arrangement, daily capacity calculations would be performed using the flow-based method, where each individual network element is analysed under the most critical contingency scenarios.

From both technical and regulatory perspectives, the most optimal solution would be to define the entire continental Europe as a single flow-based capacity calculation region (flow-based CCR).

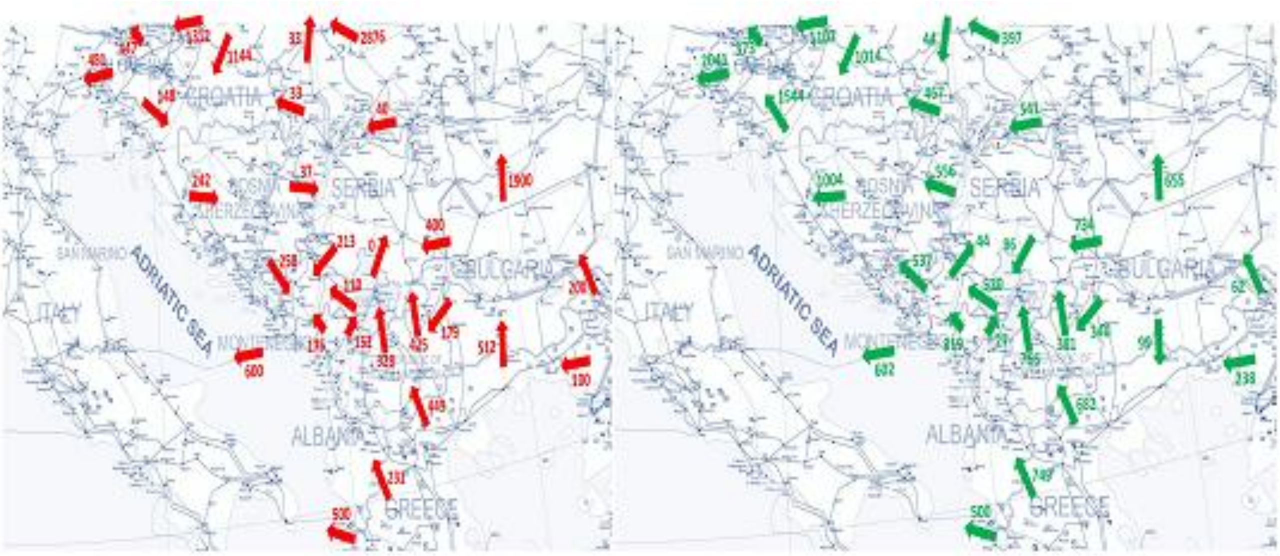

Figure 4. Scheduled exchanges and physical flows at regional borders on 9 February 2025 at 11:30

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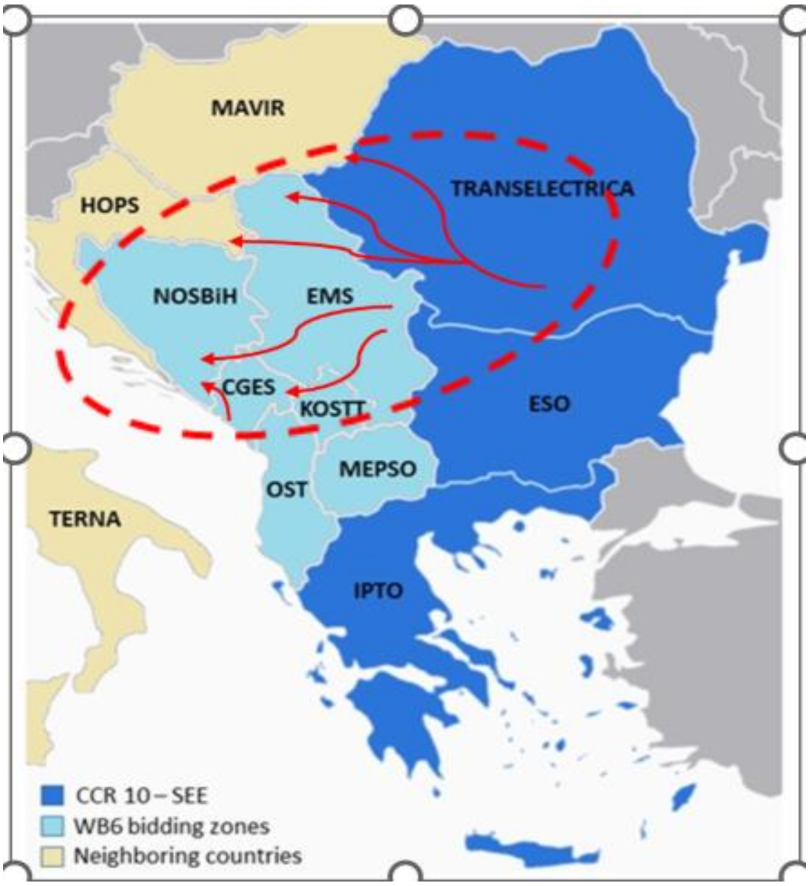

Figure 5. Impact of cross-border exchanges between the CORE region and Balkan countries

4. METHODOLOGY FOR APPLYING MACZT AS AN INDICATOR OF CROSS-BORDER CAPACITY AVAILABILITY

ACER (the Agency for the Cooperation of Energy Regulators) has developed a Recommendation for determining the minimum available capacity between bidding zones (Margin Available for Cross-Zonal Trade – MACZT), which provides the basis for calculating available capacities between bidding zones and ensures a harmonised and transparent approach across all countries in the region:

“Recommendation No 01/2019 of the European Union Agency for the Cooperation of Energy Regulators of 08 August 2019 on the Implementation of the Minimum Margin Available for Cross-zonal Trade Pursuant to Article 16(8) of Regulation (EU) 2019/943”.

The Margin Available for Cross-Zonal Trade (MACZT) is used as a technical indicator of the availability of the transmission network for cross-border electricity exchanges. The application of MACZT enables the linkage between the physical constraints of the transmission system and cross-border power flows, with the aim of identifying structural and operational factors affecting the level of available capacities.

MACZT is determined and monitored for the Critical Network Element with Contingency (CNEC). For each analysed time horizon and critical network element, MACZT represents a measure of the physical capacity of the transmission network made available for cross-border trade.

MACZT is defined as the sum of the margin obtained through coordinated cross-border capacity calculation and the impact of flows not included in the coordinated capacity calculation:

$$\boldsymbol{MACZT_i = MCCC_i + MNCC_i}\ , \tag{1}$$

where index i denotes the limiting critical network element with contingency.

The Margin from Coordinated Capacity Calculation (MCCC) represents the portion of the margin available for cross-border trade that results from coordinated cross-border capacity calculation within the defined coordination region.

MCCC reflects the impact of cross-border exchanges on critical network elements that are jointly planned and calculated by multiple Transmission System Operators in accordance with agreed methodologies within the same coordination region.

In the case of applying the coordinated NTC approach, MCCC is calculated as the sum of the products of positive PTDF values of the critical network element and the net transfer capacities of individual oriented cross-border directions:

$$\boldsymbol{MCCC_i = \textstyle\sum_b pPTD\,F_{i,b} \cdot NTC_b}\ , \tag{2}$$

where:

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1. $pPTDF_{i,b}$ represents the positive value of the PTDF factor of critical network element i in the direction of the corresponding oriented cross-border direction b,
2. NTC_b represents the net transfer capacity determined in the capacity calculation process for cross-border direction b for the considered time horizon.

Equation (2) therefore includes all cross-border directions within the analysed coordination region.

In this way, MCCC represents the portion of available margin that is directly controlled by coordinated capacity planning and largely reflects the efficiency of the cross-border capacity calculation process within the coordination region (CCR).

The Margin from Non-Coordinated Capacity Calculation (MNCC) represents the portion of the margin that reflects the impact of flows not included in the coordinated capacity calculation, i.e. flows originating from exchanges outside the coordination region (CCR).

This component includes the impact of:

1. flows that are not subject to regional coordinated calculation,
2. net positions of bidding zones not included in the coordinated capacity calculation.

MNCC is determined based on relevant PTDF values and corresponding net exchanges/positions that cause physical power flows in the network, which Transmission System Operators cannot directly optimise within the coordinated capacity calculation framework.

MNCC is often a negative component, as non-coordinated flows may additionally load critical network elements and reduce the margin available for cross-border trade.

The application of the MACZT methodology enables quantification of the total margin available for cross-border trade and separation of its components into coordinated (MCCC) and non-coordinated (MNCC) parts.

The analysis of these components shows that limitations in cross-border capacity availability do not arise solely from the capacity calculation process, but are largely conditioned by physical constraints of the transmission network.

The part related to physical network congestion will be described in detail in Chapter 6 of this paper, which refers to the obligation of the TSO to develop an Action Plan.

5. PRELIMINARY ASSESSMENT OF COMPLIANCE WITH THE MACZT CRITERION (70% ALLOCATED CAPACITY)

JSC EMS has been implementing elements of coordinated calculations of available transmission capacities for more than a decade at the level of South-Eastern Europe, in cooperation with Transmission System Operators from the region. The main joint activities include the harmonisation of totals, exchange of monthly individual models, and the creation of a unified common grid model on which calculations are performed according to the Net Transfer Capacity (NTC) methodology. Coordination is carried out on the basis of agreements between TSOs in accordance with an annual calendar.

With the introduction of Regional Coordination Centres (RCCs), capacity calculation processes have been elevated to a significantly higher level, particularly in terms of time horizons and methodological accuracy. Our regional RCC – SCC – performs weekly calculations of NTC values for all bidding zones of operators using its services.

With the introduction of the network code "Guideline on Capacity Allocation and Congestion Management (CACM)", which has been transposed into national legislation through the "Regulation establishing guidelines for capacity allocation and congestion management", day-ahead and intraday calculations must be performed within RCCs using a flow-based methodology. In certain cases, the temporary application of the NTC methodology is allowed, provided that operators demonstrate that the flow-based approach would not be more efficient, assuming an identical level of system security.

In both methodological approaches to transmission capacity calculation, it is necessary to fulfil the rule of "70% allocated capacity", also referred to as the MACZT rule.

The new Energy Law precisely defines the obligation to fulfil this criterion for both methodological approaches.

For borders between bidding zones where the harmonised Net Transfer Capacity (NTC) methodology is applied, Transmission System Operators are required to ensure that at least 70% of the capacity of the identified critical element is made available for cross-border trade, provided that security criteria for the defined contingency list are satisfied.

For borders between bidding zones where flow-based capacity calculation is applied, the minimum capacity corresponds to the margin available for flows resulting from exchanges between bidding zones for each critical network element. This margin must amount to 70% of the capacity, while the remaining 30% may be used for reliability margins, loop flows and internal flows.

JSC EMS analysed the obligation to fulfil the 70% capacity allocation criterion even before the new Energy Law entered into force and timely procured a TNA tool with the required performance characteristics. Preliminary analyses conducted by JSC EMS for 2024 and partially for 2025 indicate that the level of compliance with the MACZT criterion (70% allocated capacity for cross-border trade) ranges from 30% to 70% of MACZT, relative to the capacity calculated by JSC EMS.

However, the harmonised (final) NTC value also depends on calculations performed by neighbouring Transmission System Operators, since the lower of the two proposed values is adopted at each border. Furthermore, JSC EMS has been transparently monitoring KPI (Key Performance Indicators) for several years. It is often observed that, during bilateral harmonisation of transmission capacities, the neighbouring TSO was the cause of the lower final harmonised value that was subsequently allocated.

Nevertheless, all countries – both EU Member States and non-EU countries – are required to comply with the

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prescribed rule, and therefore all TSOs will strive to achieve the required 70% allocated capacity.

Table I presents an estimate of compliance with the MACZT criterion based on average allocated capacities over the last three years for selected borders. The principle applied was to adopt either the higher value of the average directional capacity or the value from 2024. The percentage of compliance, relative to winter limits, ranges from 28% to 49%.

Table I – Percentage of compliance with the MACZT criterion based on average allocated NTC values

	Agreed NTC	Maximum capacity	% of current value	MACZT 70%
RS-HU	644	1329	49	70
RS-RO	543	1770	31	70
RS-BG	392	1511	26	70
RS-MK	583	1329	44	70
RS-ME	306	868	35	70
RS-BA	539	1931	28	70
RS-HR	500	1502	33	70

The paper also presents results obtained if MACZT calculations are performed according to the defined ENTSO-E methodology, rather than based on average allocated transmission capacities. First, the principle of assessing the MACZT criterion is presented, followed by aggregated results of compliance for several months in 2025 and 2024.

In Table II, April 2025 is analysed, providing an example where the MACZT criterion is fulfilled, reaching 75% on the critical element – the 400 kV transmission line Porţile de Fier– Đerdap – under contingency scenarios involving outages of several critical 400 kV lines: Bor 2 – Đerdap, Bor 2 – Niš 2, Pančevo 2 – PRP Čibuk and Drmno – PRP Čibuk.

Table II – MACZT values for NTC calculation from Bulgaria and Romania towards Serbia

Critical outage	Critical branch	MACZT [%]
OHL 400 kV Bor 2 - Djerdap	OHL 400 kV Portile de Fier - Djerdap	74
OHL 400 kV Bor 2 - Nis 2		83
OHL 400 kV Pancevo 2 - SS Cibuk		75
OHL 400 kV SS Drmno - SS Cibuk		74

The EMS proposal for the composite NTC at the border RS → BG + RO was 1900 MW, while the NTC target required to achieve 70% capacity ranged from 1596 MW to 1801 MW.

In the opposite direction, BG + RO → RS, a MACZT value of 69% was achieved when JSC EMS proposed a composite NTC of 1900 MW. In order to reach the 70% MACZT criterion, the offered NTC would need to be 1928 MW. The results are shown in Table III.

Table III – MACZT values for NTC calculation from Bulgaria and Romania towards Serbia

Critical outage	Critical branch	MACZT [%]
TR 1 400/110 Bor 2	TR 2 400/110 Bor 2	69
TR 2 400/110 Bor 2	TR 1 400/110 Bor 2	69

An example from June 2024 was analysed for the border RS → HR, BA, where compliance with the criterion was 57%, while EMS proposed a composite NTC of 1200 MW. Already at an NTC value of 843 MW, overloading occurs on the critical branch – the 220 kV line Obrenovac – Valjevo 3 – in the contingency scenario involving outage of the 400 kV line RP Mladost – Sremska Mitrovica. To achieve the 70% MACZT criterion, an allocation of as much as 1524 MW would be required, which would result in significant loading of the critical element. The results are presented in Table IV.

Table IV – MACZT values for NTC calculation from Serbia towards Croatia and Bosnia and Herzegovina

Critical outage	Critical branch	MACZT [%]
OHL 400 kV SS Mladost - S. Mitrovica	OHL 220 kV Obrenovac - Valjevo 3	57

In the opposite direction, HR, BA → RS, the outage of the Trebinje – Lastva transmission line leads to overloading of the 220 kV line Višegrad – Požega, while the proposed NTC is 900 MW, resulting in a compliance level of 61%. The results are shown in Table V.

Table V – MACZT values for NTC calculation from Croatia and Bosnia and Herzegovina towards Serbia

Critical outage	Critical branch	MACZT [%]
OHL 400 kV Trebinje - Lastva	OHL 220 kV Višegrad - Požega	61

It can be observed that, in order to achieve the required 70% condition, the transmission network is often heavily loaded. In such cases, the issue would need to be resolved in real time through redispatching, which has financial implications.

The paper also presents MACZT calculations that consider critical network elements for several representative months in 2024 and 2025. It should be noted that the estimates were based on EMS proposals obtained from calculations in accordance with ENTSO-E methodology. The values that were actually allocated were generally reduced due to neighbouring TSOs during the harmonisation process, where the principle is to adopt the minimum of the two proposed values.

The aggregated results are presented in Tables VI–IX.

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Table VI – MACZT compliance analysis for July 2024

July-24	At a critical step		NTC target [MW]	EMS's suggestion	
	NTC calculated [MW]	MACZT[%]		NTC [MW]	MACZT [%]
RS -> HU	1137	68	1278	800	55
HU -> RS	762	52	1115.2	800	54
RS -> BG + RO	2282	114	1104	1100	70
BG + RO -> RS	1245	45	1832	1400	56
RS -> BA + HR	1345	74	1256	900	49
BA + HR -> RS	454	53	610	900	73
RS -> ME + MK	1808	61	1984	1300	51
ME + MK -> RS	624	35	1358	1300	68

Table VII – MACZT compliance analysis for April 2025

April-24	At a critical step		NTC target [MW]	EMS's suggestion	
	NTC calculated [MW]	MACZT[%]		NTC [MW]	MACZT [%]
RS -> HU	682	14.7	2642	1000	24
HU -> RS	/	/	/	/	/
RS -> BG + RO	1723	64.6	1596	1900	83
BG + RO -> RS	1432	52	1928	1900	69
RS -> BA + HR	945	21	2600	1200	36
BA + HR -> RS	1044	50	1250	1200	67
RS -> ME + MK	1723	57.7	1794	1300	52
ME + MK -> RS	1263	63.7	1390	900	65

Table VIII – MACZT compliance analysis for June 2024

June-24	At a critical step		NTC target [MW]	EMS's suggestion	
	NTC calculated [MW]	MACZT[%]		NTC [MW]	MACZT [%]
RS -> HU	997	58	1156	900	55
HU -> RS	1742	81	1563	1000	53
RS -> BG + RO	1469	53	2145	800	29
BG + RO -> RS	1456	55	1930	800	42
RS -> BA + HR	843	33	1524	1200	57
BA + HR -> RS	1056	65	1634	900	61
RS -> ME + MK	1374	57	1473	1300	55
ME + MK -> RS	1526	76	1377	1400	68

Table IX – MACZT compliance analysis for August 2024

August-24	At a critical step		NTC target [MW]	EMS's suggestion	
	NTC calculated [MW]	MACZT[%]		NTC [MW]	MACZT [%]
RS -> HU	1262	54	1420	700	31
HU -> RS	1024	47	1626	700	35
RS -> BG + RO	/	/	/	/	/
BG + RO -> RS	1013	39	1865	700	22
RS -> BA + HR	1413	51.75	1945	1000	34
BA + HR -> RS	886	57	1126	1000	63
RS -> ME + MK	973	44.4	1594	1300	55
ME + MK -> RS	676	35	1389	1300	67

Several assumptions were adopted in EMS calculations:

- the results are presented using values calculated by JSC EMS with the intention of allocating all available capacity to the electricity market; however, the final allocated values are harmonised with neighbouring TSOs and adopted according to the "lower value acceptance" criterion
- the values presented in the paper refer to monthly calculations, but are higher at the daily level, since daily NTC calculations and harmonisation are performed for several borders, resulting in higher network utilisation
- the calculation must include coordination between capacity calculation regions and must be carried out on the European common grid model in order to minimise non-coordinated power flows from other zones.

6. ACTION PLAN AND STRUCTURAL CONGESTION IN THE TRANSMISSION NETWORK

Regulation (EU) 2019/943 on the internal electricity market requires Transmission System Operators to make at least 70% of available transmission capacity on interconnections relevant for cross-border trade available to market participants.

This Regulation was incorporated into the Energy Community by a Decision of the Ministerial Council on 15 December 2022. Article 15 of the Regulation stipulates that contracting parties must gradually increase available capacities along a linear trajectory so that a minimum of 70% is reached by 31 December 2027.

Until that date, if structural congestion exists, countries must adopt Action Plans for its elimination, while also increasing cross-border capacity each year. Therefore, the 70% rule becomes binding from the end of 2027, and until then, contracting parties of the Energy Community must progressively align their capacities through action plans and reporting.

The new Energy Law provides the national legal and institutional framework enabling the implementation and gradual alignment with the requirements of Regulation (EU) 2019/943 and other regulations arising from the "Clean Energy for All Europeans" package.

Amendments to the Energy Law ("Službeni glasnik RS", No. 145/2014, 95/2018 – other law, 40/2021 and 94/2024), adopted on 21 November 2024 and entering into force on 29 November 2024, introduced for the first time provisions into the national legal framework that transpose the key principles of Regulation (EU) 2019/943 on the internal electricity market.

According to paragraph 9 of Article 164 of the Energy Law, the Transmission System Operator is required to ensure an annual increase of available transmission capacities along a linear trajectory between bidding zones, until the minimum values defined in accordance with Article 165a of the Energy Law are reached. Minimum transmission capacity levels must be achieved no later than 31 December 2027.

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Low or variable MACZT values indicate the existence of constraints in the transmission network that are not solely a consequence of the cross-border capacity calculation process, but are also conditioned by the physical configuration of the network, the capacities of individual network elements, and the distribution of flows within the system. For this reason, MACZT analysis represents the starting point for identifying structural congestion in the transmission network.

Therefore, in order to define effective and sustainable measures within the Action Plan, it is necessary to identify and analyse structural congestion in the transmission network, i.e. permanent or recurring network constraints that lead to a reduction of MACZT and limit the availability of cross-border capacities.

Based on technical analyses and reports prepared by Elektromreža Srbije, structural congestion has been identified in the transmission system of the Republic of Serbia, representing constraints in providing available transmission capacity for cross-border electricity trade. These constraints are not limited only to the Serbian transmission system but also include elements of neighbouring systems, given the high level of interconnection and their combined impact on power flows in the South-Eastern Europe region:

1. interconnection with Bosnia and Herzegovina (Bajina Bašta – Požega – Višegrad): limitations due to thermal capacity and insufficient automation of flow control
2. interconnection with Montenegro (Pljevlja – Bistrica)
3. 400 kV transmission line Đerdap – Portile de Fier
4. 400/110 kV transformer in substation Smederevo 3
5. 400 kV transmission line Đerdap – Drmno
6. 400/110 kV transformer in substation Bor 2
7. 220 kV transmission line Obrenovac – Belgrade 3
8. 400 kV transmission line Pančevo 2 – Belgrade 20
9. 220/110 kV transformer in substation Sremska Mitrovica 2

The Action Plan defines the planned measures for reducing identified structural congestion in the transmission system. The planned measures include:

- network development and optimization
- network expansion
- coordinated transmission capacity calculation
- reserves in the network for redispatching
- coordination of corrective measures

These measures are grouped into two main areas of action:

1. network development and optimisation – covering the first two measures
2. enhancement of congestion management – covering the remaining three measures

The development and optimisation of the transmission network, as well as the schedule for implementing these measures, are defined in the JSC EMS Development Plan. The improvement of congestion management will be carried out at the regional level in cooperation with RCCs, which, together with TSOs, will implement coordinated activities.

7. DEVELOPMENT AND OPTIMISATION OF THE TRANSMISSION NETWORK

In order to adequately address future challenges, including new requirements defined in Article 16(8) of the Regulation on the electricity market, sustainable expansion of network infrastructure represents one of the key prerequisites for reliable and efficient system operation.

The transmission network is continuously developing, and within the cyclical planning process future needs are regularly identified and appropriate measures are defined to meet them. JSC EMS has legally prescribed obligations aimed at ensuring the sustainable development of the transmission system of the Republic of Serbia.

Through its medium-term and long-term development strategy, JSC EMS plans significant investments in the refurbishment of existing infrastructure and the construction of new transmission capacities over the next ten- and twenty-year periods.

These infrastructure projects will improve the reliability of supply to transmission system users and increase cross-border capacities for electricity exchange, which is of major international (regional) importance.

Planned international projects in which JSC EMS participates, considered within the pan-European Ten-Year Network Development Plan (TYNDP package), as shown in the following figure, will contribute to increasing transmission capacities at as many as six borders of the Republic of Serbia.

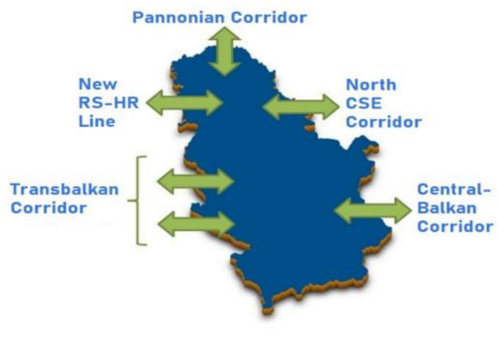

Figure 7. Overview of main transmission corridors and dominant power flow directions in the Serbian power system and the region

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In accordance with the Energy Development Strategy of the Republic of Serbia, development plans of the generation and distribution systems, and the business strategy of JSC EMS, investments in electricity transmission infrastructure are directed towards the following objectives:

- increasing the operational security of the transmission system and the reliability of supply to transmission system users, which is also a legal obligation of JSC EMS
- increasing cross-border transmission capacities of the Republic of Serbia that have regional and pan-European significance
- balanced, sustainable and timely development of the transmission system with the aim of integrating new conventional and renewable energy sources, as well as customer facilities
- development of the electricity market at both national and regional levels

In accordance with the provisions of the Energy Law of the Republic of Serbia, JSC EMS adopts a development plan for the next ten-year period at least once every two years.

According to Article 111 of the Serbian Energy Law of 2024, the necessary network development projects are summarised in Network Development Plans, which are prepared every two years by the Transmission System Operator JSC EMS and must be approved by the regulatory authority.

A strong and reliable network is a key factor in achieving the minimum capacity required to be made available for cross-border trade, in accordance with Article 16(8) of the Regulation.

The Ten-Year Network Development Plan is updated annually and aims to increase transmission capacity, reduce network congestion and facilitate the achievement of objectives. Measures to achieve these goals include reinforcement and optimisation of the existing network, as well as the development of new infrastructure.

A strong and reliable network is a key factor in achieving the 70% criterion defined by the Regulation. In the coming years, reinforcement or optimisation of several existing transmission lines and substations is planned.

In accordance with Article 15(1) of the Regulation on the electricity market, the Action Plan must include provisions related to monitoring its implementation. Monitoring is essential to ensure that the planned measures for increasing cross-border capacity and reducing structural congestion are actually implemented in line with the defined linear trajectory, without compromising the operational security of the power system.

8. CONCLUSION

After defining and establishing the operational framework of regions for coordinated transmission capacity calculation, calculations will be performed at the regional level within RCCs in a coordinated manner, initially for the day-ahead and intraday time horizons. By applying a flow-based methodological approach, the loading of each network element is analysed individually.

Through coordinated flow-based calculations within RCCs, transmission capacity domains will be defined in a more transparent manner, and only after market transactions will it become clear whether critical network elements exist and which ones they are. During the calculations, compliance with the 70% requirement is considered for each critical element from the predefined contingency list.

This will represent a challenge both for planning and for real-time operation, where critical congestion situations in the network must be resolved through redispatching or counter-trading, both of which entail financial implications.

Experience from European countries that have already implemented the 70% rule shows that TSOs, in order to allocate 70% of capacity, may operate in regimes where network overloads occur. This raises the question of whether this rule leads to “insecurity of the 70% rule”. Additionally, questions remain as to whether sufficient potential for counter-trading exists.

In the calculation and validation of transmission capacities, potential corrective measures (“remedial actions”) are also taken into account, which must be implemented in real time when their feasibility is in question.

Within JSC EMS, structural congestion has been identified, and in accordance with this, an Action Plan has been developed to eliminate the identified network constraints. JSC EMS is required to ensure an annual increase of transmission capacities along a linear trajectory between bidding zones until the minimum value is reached, no later than the end of 2027.

By defining the Action Plan, JSC EMS is provided with additional time to fully comply with the MACZT criterion and to further strengthen transmission infrastructure.

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BIOGRAPHIES

Marija Đorđević was born in 1972 in Serbia. She graduated from the Faculty of Electrical Engineering, University of Belgrade, in 1997. She obtained her MSc degree in 2003 at the same faculty and her PhD in the field of energy in 2013 at the University of Belgrade. She is currently the Head of the Centre for Operational Planning and Analysis of Transmission System Operation. Her areas of interest include short-term planning and operation analysis, market aspects, and the implementation of European regulations in the Serbian power system.

Srđan Mladenović was born in 1982 in Kruševac, where he completed his primary and secondary education. He graduated from the Faculty of Electrical Engineering, University of Belgrade, in 2010. He has been employed at Elektromreža Srbije for over 15 years, where he has progressed through various professional roles. He currently works as Head of the Department for Planning and Analysis of Transmission System Operation.

Ivana Stamenić was born in 1993 in Užice. She completed her primary and secondary education in Bajina Bašta. She graduated in 2016 from the Faculty of Electrical Engineering, University of Belgrade, Department of Power Engineering. She completed her Master's academic studies in 2017 at the same faculty. Since 2018, she has been employed at Elektromreža Srbije, currently holding the position of Head of the Unit for Transmission System Operation Planning.

Branko Šumonja was born in 1969. He graduated from the Faculty of Electrical Engineering, University of Belgrade, majoring in Power Engineering. Since 1998, he has been working in the Serbian energy sector, initially in Electric Power Industry of Serbia and later in Elektromreža Srbije since its establishment in 2005. He has gained extensive experience in transmission system management, from NDC dispatcher to various managerial positions in operation and planning of the transmission system. He currently holds the position of Director of the Transmission System Operation Directorate.

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Implementacija evropskih procesa u operativni rad EMS AD

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Stručni rad

Ključne poruke

- Ovaj rad razmatra koordinisane procese koji se odvijaju na nivou evropskih operatora prenosnih sistema i glavne promene koje se sprovode u operativnom radu EMS AD
- Opisana su dva najbitnija procesa i to koordinisana sigurnost i koordinsani proračuni prenosnih kapaciteta
- Date su tehničke osnove za definisanje regionâ za koordinisani proračun kapaciteta u regionu Jugoistočne Evrope
- Sagledane su mogućnosti srpskog operatora prenosnog sistema da ispuni regulatornu obavezu dodele prenosnog kapaciteta prema MACZT metodologiji

Kratak sadržaj

Na nivou ENTSO-E i Evrope odvijaju se procesi koji direktno utiču na elektroenergetski sektor Srbije i svakodnevni rad Operatora prenosnog sistema. Dva ključna procesa u okviru ENTSO-E – koordinisana analiza sigurnosti i koordinisani proračuni prenosnih kapaciteta – sprovode se na usklađen način. U okviru proračuna prenosnih kapaciteta primenjuju se dva metodološka pristupa: NTC i flow-based metod. Ovaj rad prikazuje regulatorni proces priključenja EMS AD evropskim regionima za proračun kapaciteta – CORE i SEE regionu – uz poseban osvrt na izazove sa kojima se EMS AD suočava u ovom kontekstu. Takođe, predstavljeni su osnovni koncepti koordinisanih procesa, koji će se delom realizovati unutar Operatora prenosnog sistema, a delom kroz regionalne koordinacione centre. Bez obzira na primenjenu metodologiju proračuna prenosnih kapaciteta u različitim fazama, neophodno je ispuniti pravilo dodele 70% kapaciteta kritičnog elementa. U radu su prikazani preliminarni rezultati ispunjenja ovog pravila, uzimajući u obzir da je njegova primena obavezna u skladu sa Zakonom o energetici.

Ključne reči

ENTSO-E, MACZT (*Margin Available for Cross-Zonal Trade*), RCC (*Regional Coordination Centre*), TSO (OPS)

Napomena:
Ovaj članak predstavlja proširenu, unapređenu i dodatno recenziranu verziju rada „*Koordinisani procesi u EMS AD u skladu sa najnovijom evropskom regulativom*" (https://doi.ub.kg.ac.rs/doi/cigre37-c5-08/), nagrađenog u Studijskom komitetu STK-C5 *Tržište električne energije i regulacija,* na 37. Savetovanju CIGRE Srbija, 26-30. maja 2025.

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