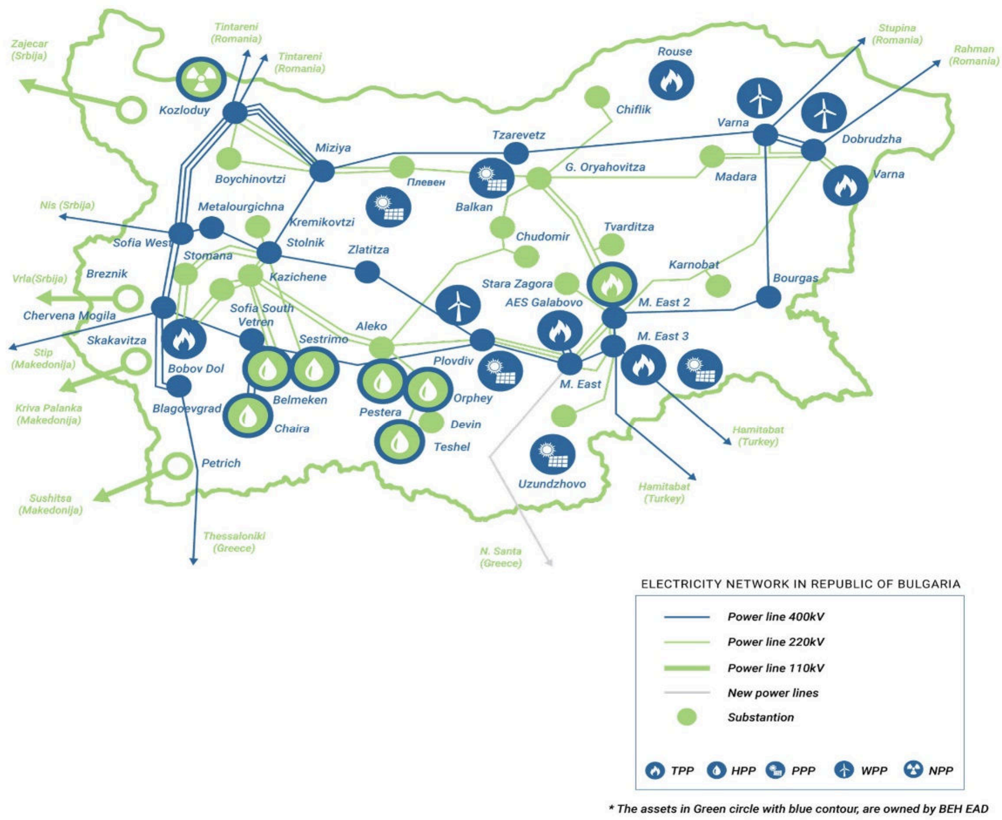
REPUBLIC OF BULGARIA

MINISTRY OF ENERGY

NATIONAL ACTION PLAN FOR RISK-PREPAREDNESS IN THE ELECTRICITY SECTOR OF THE REPUBLIC OF BULGARIA



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Contents

LIST OF ABBREVIATIONS USED

NPP	Nuclear Power Plant
IO	Island operation with certain consumer units
UFLS	Underfrequency Load Shedding
ADCS	Automatic Dispatch Control System
AAR	Automatic activation of reserve
AR	Automatic reactivation
OP	Overvoltage protection with reactive power control
HPP	Hydroelectric power plant
RES	Renewable energy source
CCGT	Combined cycle gas turbine power plant
DTS	Dispatch training system
SANS	State Agency for National Security
EC	European Commission
ESO	Elektroenergien Sistemen Operator EAD (Electricity System Operator)
EPS	Electric Power system
EU	European Union
EDC	Electricity Distribution Company
EDN	Electricity Distribution Network
ENTSO-E	European network of transmission system operators
ICT	Information and communication technologies
EWRC	Energy and Water Regulatory Commission
ME	Ministry of Energy
MI	Ministry of the Interior
NEK	National Electricity Company
NDMH	National Disaster Management Headquarters
DSO	Distribution System Operator
TSO	Transmission System Operator
OES	Operator of Essential Service
PSHPP	Pumped Storage Hydropower Plant
FSPP	Fire safety and protection of the population
ESCR	Electric System Control Rules (the Grid Code)
RCM	Resolution of the Council of Ministers
SDU	Specialized Dispatch Unit
TPP	Thermal Power Plant
TDC	Territorial Dispatch Centre
TP	Transformer Station
NDC	National Dispatch Centre

APIH	Action Plan Implementation Headquarters
SCADA/EMS	Dispatch Control System/Real Time

BACKGROUND

Pursuant to article 10 of the Regulation (EU) 2019/941 on establishing "Risk-preparedness plan" (RPR) in the electricity sector (Regulation (EU) 2019/941), a working group determined by order No. E- РД-16-580/ 23.08.2021 of the Minister of energy has developed Risk-preparedness plan in the electricity sector of Bulgaria (the "Plan").

The Plan consists of set of crisis scenarios developed under article 7 of Regulation (EU) 2019/941, and namely 14 scenarios falling in 7 categories: cyberattack, physical attack, insider threat, natural disasters and extreme weather conditions, technical breakdown, fuel shortages and political crises. All of these scenarios are related to events that occur with relatively short notice periods.

The Risk Preparedness Plan in the Electricity Sector contained in this document sets out the procedures to be followed by the actors in the electricity sector during crisis situations, in order to minimize disruption caused by to the customers.

The following markers have been adopted to identify the risk criteria:
the conditions that may affect the security of electricity supply;

- quantification of impacts;
- likelihood of a crisis;
- the duration of the crisis;
- impact scale;
- the ability to reallocate and reserve resources to ensure security of supply.

Based on the above markers, the following risk criteria have been adopted:

- Risk criterion N-1 - in accordance with Art. 3 of Regulation (EU) 2017/1485: no violation of the N-1 criterion in any case.
- Assessment of adequacy of resources according to probability of occurrence as measured by:
- Expected energy not supplied, EENS < 0,007 % (the annual percentage of energy that the power generation system cannot supply for consumption);
- Loss of load expectation, LOLE < 8 h (the annual hours for which the electricity generation system cannot secure the consumption).
- Cybersecurity: Impact Assessment < Critical or Disaster.

Based on the above, a "crisis in electricity supply" can be defined as a state of:

- significant shortage of electricity or inability to deliver it to customers caused by lack of energy resources (EENS>= 0.007% and LOLE>=8 hours);
- significant shortage of electricity or inability to deliver it to customers caused by failure of technical infrastructure(violation of N-1 criterion);

- Cyberattack leading to interruption of electricity supply.

The plan also covers the preventive and mitigating measures to be taken that will help avoid crises from occurring. The roles of the different stakeholders, communication procedures and the schedule for regular system testing are also included in the plan. The key procedures which are to be applied in such crises are detailed in the EPS Recovery Plan after major accidents (Recovery Plan) and The Protection Plan of the Bulgarian EPS (Protection Plan), drafted by the electricity transition system operator in implementation of the Rules for the management of the electric power system (EPS), adopted on the basis of Art. 83, para. 1, item 4 of the Energy Act (EA).

Apart from the undertaken preventive and preparedness measures in order to avoid of or to prepare for the crises, like grid developments plans, there are also, many other special measures connected with different types of crisis scenarios. These measures include the preparation done respecting the opportunity of extreme weather conditions and the annual report for prediction of adequacy in winter in this respect (Winter Outlook Report - WOR), developed by ENTSO-E; cybersecurity precautions; technical standards and infrastructure maintenance standards. The Plan contains summaries of the types of measures that are currently implemented in the Bulgarian electric power system (EPS). The general approach to demand management and load shedding rotation that can be used to prevent or during a crisis event is also presented.

Regulation (EU) 2019/941 sets out the requirements for each EU country to ensure that there are consistent plans in place to prevent, prepare for and manage crisis events that could lead to disruption of electricity supply to customers. These events may include, for example, extreme weather conditions or technical failures.

As part of the work required under Regulation (EU) 2019/941, the Ministry of Energy is cooperating with ESO EAD to develop a set of potential "crisis" scenarios, as well as with the electricity distribution companies (EDCs) where electricity supply outage is possible on the territory of the Republic of Bulgaria, and to assess the risk level associated with each scenario. The scenarios focus on events that occur relatively suddenly and for which the system must be prepared.

It should be noted that in the framework of its daily function to ensure security of supply in Bulgaria, the transmission system operator has specific procedures in place for dealing with emergencies, and the plans presented here are largely based on existing measures. The purpose of this specific plan is to meet the requirements of the cited Regulation (EU) 2019/941; to bring this information into a uniform European format so that potential crisis scenarios at national and regional level can be identified, assessed and subsequently managed in an improved and coordinated way.

The electricity distribution companies (EDCs) in the country apply all measures and procedures related to the organization and management of the processes of electricity supply to customers connected to the electricity distribution network (EDN). These companies interact with all other entities in the field of energy according to pre-regulated protocols or on the basis of legislative documents. Interact with the Ministry of Energy (ME), Energy and Water Regulatory Commission (EWRC), Elektroenergien sistemen operator EAD (ESO EAD), National Electric Company (NEK EAD) - Hydro Power Plants Enterprise (NEK – HPPs), RES producers connected to the EDN.

In the event of crises, they act according to procedures designed in advance which are activated until solving the challenges occurred. The main principles of these procedures are related with occupational safety and minimizing the number and duration of outages in the power supply to customers. The electricity companies in the country have signed a memorandum of mutual assistance in case of massive crises and extreme increase of incidents at either company, when the respective company is not able to remedy all the accidents that have occurred in its licensed territory within 48 hours.

Pursuant to Art. 2, item 16 of the Regulation, Bulgaria is part of the South-East Europe region with a regional coordination centre SELENE CC, which includes the TSOs of the following member states:

- Bulgaria;
- Greece;
- Italy;
- Romania (member of CCR Core region, but TSO uses SELENE CC services, as a bordering country).

1. NATIONAL ELECTRICITY CRISIS SCENARIOS

The identification of national electricity crisis scenarios is based on proposals discussed in the Working Group under order No. Е-РД-16-580/ 23.08.2021 of the Minister of Energy, after consultations with the stakeholders, in accordance with Article 7, section 2 of the Regulation (EU) 2019/941.

In accordance with Article 7, section 3 of the Regulation (EU) 2019/941 concerning the identification of national electricity crisis scenarios, 31 regional electricity crisis scenarios identified by ENTSO-E (listed in Table 1.1 below) were taken into account.

Table 1. 1. Overview of regional electricity crisis scenarios according to ENTSO-E

1	Cyberattack - elements connected with the electricity network
2	Cyberattack - elements that are not connected with the electricity network.
3	Sabotage - critical infrastructure
4	Sabotage - control centres
5	Threat on key officers
6	Insider attack

7	Solar storm
8	Volcanic eruption
9	Storm
10	Cold spell
11	Rainfall and flooding
12	Winter weather conditions
13	Fossil fuels shortage (including natural gas)
14	Nuclear fuel shortage
15	Local technical failure
16	Multiple accidents caused by extreme weather conditions
17	Failure of IT/COM systems for work in real time
18	Multiple simultaneous accidents
19	Failure of the active power control mechanism in the EPS
20	Human error
21	Unwanted energy flows
22	Equipment damage
23	Strikes, unrest, industrial action
24	Industrial/nuclear accident
25	Manipulation of the electricity market
26	Unusual and large errors in the estimation of energy production from RES
27	A pandemic
28	Hot wave
29	Dry period
30	Earthquake
31	Wildfire

In order to determine the conditions that could shape and affect the security of supply of the interconnected EPS of Bulgaria in the period December 2022 - December 2027, each of the member institutions of the working group prepared, based on Chapter II of the Regulation, its proposal with at least 15 risk factors aligned with the regional crisis scenarios of ENTSO-E (table 1.1), in accordance with their experience in developing a list of risks for their area of responsibility. In this context, participating parties contributed to the development of the risk list by identifying:

- forecast conditions that they believe may facilitate the materialization of these risks;

- the description of the initial state of the system for each crisis scenario; the period or annual periods during which they believe a given crisis scenario will occur;
- the type of cargo affected;
- the expected duration of the crisis scenario;
- the description of the potential consequences of the crisis scenario.

The Working group examined and discussed the proposals made for crisis scenarios in the Electricity sector. The scenarios identified using the conducted analyses were further evaluated based on their significance for the security of electricity supply. To establish their significance, their national risk profile was taken into account. The methodology for allocating the national risk profile is based on the ENTSO-E methodology, according to Article 5 of the Risk Preparedness Regulation. This means that each scenario was assessed based on its probability and its possible impact on the security of electricity supply. The probability, as described for the various scenarios, is actually the probability that the scenario will actually occur and lead to a power crisis. For example, in the case of a cold front scenario, the probability is not limited to the probability that the cold wave will occur, but the probability that this cold wave will occur and lead to a power crisis is considered. To estimate this probability, the sum of the probability of the actual event and the transmission system operator's (TSO) assessment of the probability that this event will lead to a crisis in the electricity supply is taken into account. To identify the final national electricity crisis scenarios, the following conditions were considered:

- The scenarios having a high impact on the EPS and a low to medium probability of realization;
- The scenarios that have a relatively high probability of occurrence, but with little or limited impact on the operation of the EPS.

In accordance with Article 7 of the Regulation (EU) 2019/941, after taking into account the above revealed methodology and analyses, the Bulgarian Competent Authority, namely the Minister of Energy, has identified 15 relevant national electricity crisis scenarios, corresponding to the regional electricity crisis scenarios identified in the ENTSO-E reports and methodology for this purpose, as follows:

Table 1. 2. NATIONAL ELECTRICITY CRISIS SCENARIOS

Group of risks	**Number No.**	**Scenario**
Cyberattack	C1	Cyberattack against critical ICT business infrastructure of sites directly connected to the electricity network such as TSO, power plant or industrial load
Physical attack	C2	Physical attack on critical assets

	C3	Physical attack on dispatching centres
	C4	Insider attack
Natural disaster and extreme weather conditions	C5	Storm
	C6	Cold spell
	C7	Flooding
	C8	Forest fire
	C9	Blizzard/Freezing storm
Human activity and behaviour	C10	Strike
	C11	Unintentional tripping of an element of system importance due to human error
Technical reasons	C12	Failure of ICT systems and public telecommunications
Fuel shortage	C13.1	Fossil fuels shortage (natural gas)
	C13.2	Fossil fuels shortage (coal)
	C14	Nuclear fuel shortage
Political reasons	C15	War/Civil war

The simulations of the defined national crisis scenarios (Table 1.2) were carried out with a simulation software product for market modelling and according to a methodology meeting the requirements of ENTSO-E for the European Resource Adequacy Assessment (ERAA) with the calculation of the adequacy indicators expected energy not supplied (EENS) (MWh) and expected number of hours of power outage (LOLE) (h) applied at the regional level. For those scenarios where the ERAA methodology is not applicable, recorded historical data on load, energy mix, availability of thermal generation, grid topology, power generation from RES, interconnection schedules and others are used to estimate as best as possible the possible impact of the given scenario on the work of the EEC.

Table 1.3 shows how the national electricity crisis scenarios relate to and are connected to the regional ones defined by ENTSO-E.

Table 1. 3. Correspondence of national and regional electricity crisis scenarios

National scenario	**Regional scenario (From tab. 1.1.)**
C1. Cyberattack against critical ICT business infrastructure of objects connected to the electricity grid	1. Cyberattack - elements connected with the electricity network
C2. Physical attack on critical assets	3. Sabotage - critical infrastructure
C3. Physical attack on dispatching centres	4. Sabotage - control centres

C4. Insider attack	6. Insider attack
C5. Storm	9. Storm
C6. Cold spell	10. Cold spell
C7. Flooding	11. Heavy rainfall and flooding
C8. Wildfire	31. Wildfire
C9. Blizzard/Freezing storm	12. Winter weather conditions 16.Multiple accidents caused by extreme weather conditions
C10. Strike	23. Strikes, unrest, industrial action
C11. Failure of ICT systems and public telecommunications	17. Failure of IT/COM systems for work in real time
C12. Unintentional tripping of an element of system importance due to human error	20. Human error
C13. Fossil fuels shortage	13. Fossil fuels shortage (including natural gas)
C14. Nuclear fuel shortage	14. Nuclear fuel shortage
C15. War/Civil war	–

Table 1.4 presents the reasons why the remaining regional electricity supply crisis scenarios are not considered relevant and significant in view of the interconnected operation of Bulgaria's EPS with the rest of the synchronous area Continental Europe.

Table 1. 4. Scenarios with insufficient national significance for the EPS of Bulgaria

Scenario	**Reason**
Cyberattack - elements that are not connected with the electricity network.	no direct impact, no cross boarder impact
Sunny storm	negligible impact on generation and infrastructure, no cross-boarder impact
Volcanic eruption	there are no active volcanoes on the Balkan Peninsula, extremely low probability of manifestation
Local technical failure	small probability of manifestation with local impact
Multiple simultaneous accidents	low probability of occurrence - timely maintenance and the annual infrastructure repair program reduce the risk to a very minimal

Failure of the active power control mechanism in the EPS	low probability of manifestation based on many years of experience; availability of a backup system
Unwanted energy flows	the good connectivity and sustainability of the Bulgarian EPS reduces this risk to a negligible impact
Equipment damage	local character and low impact
Industrial/nuclear accident	very low probability of occurrence; Kozloduy NPP is operated and managed in accordance with all modern nuclear safety standards and has not had a serious incident during its entire existence.
Manipulation of the electricity market	the presence of interconnected day-ahead and intraday markets significantly reduce risk; can result in massive financial damage and indebtedness, but does not threaten the physical integrity of the electrical infrastructure
Unusual and big errors in the estimation of energy production from RES	the presence of interconnected day-ahead and intraday markets significantly reduces the risk and duration of such an event; the necessary operational reserves are able to provide the required levels of security within a few hours to a day
A pandemic	based on the experience in 2020 and 2021, it was seen that this type of risk has a very limited impact
Hot wave	electricity consumption in Bulgaria reaches peak values in winter, and loads in summer are significantly lower
Dry period	HPPs in Bulgaria are used as peak balancing capacities and their annual hourly availability is within 1700-1800 h; based on experience over the years, such extreme and prolonged droughts as to

	render hydroelectric power plants practically unusable are very rare
Earthquake	local character with a very minimal impact mainly on the low voltage network

1. 1. Cyberattack against critical ICT business infrastructure of units connected to the electricity grid (C1)

Risk profile	Impact	Probability	Cross-border influence
High	Disastrous	Very likely	Big

1.1.1. Short description

Information-communication and technological (ICT) systems are subject to increased threats from incidents or malicious attacks that threaten the confidentiality, integrity and accessibility/availability of individual systems. Actions to intentionally stop or obstruct the functioning of an information system by improperly entering, transmitting, deleting, damaging, degrading, altering, hiding or providing restricted digital data in an information system are defined as cyberattacks. Critical infrastructure in the energy sector that threatens the supply of electricity after cyberattacks are the dispatching systems for managing the electricity transmission and distribution networks.

1.1.2. Classification

Cyberattacks against critical infrastructure can happen at any time and are not seasonal. They can affect base and peak local electricity consumption or production.
Cyberattacks with impact on the critical infrastructure are of frequent occurrence, i.e. **the probability classification** of this scenario is **very likely**.

Affecting the control dispatch systems of transmission system operators, distribution system operators would lead to severe power outages (EENS>=0.25%) for a period bigger than 48 hours. This classifies the impact of the scenario on the electricity supply in the country as **disastrous** - in terms of the energy not supplied and critical - for the duration, i.e. the risk profile of the scenario is high. This predetermines it with a rating of 2 in the regional evaluation. Although dispatch control systems of transmission system operators, distribution system operators are physically separated from the business infrastructure, and data exchange is carried out with encryption in a demilitarized zone with a firewall to all connected systems, a cyberattack against dispatch control systems can have a large cross-border impact (rating 2):

- There may be a need for redispatching, counter-trading, or cross-border exchange of balancing services;
- There may be some impact on reactive energy (system stability support) or active energy (redispatching or counter-trading).

The scenario would affect three member states, which predetermines it with a regional rating of 60.

1. 2. Physical attack on critical assets (C2)

Risk profile	**Impact**	**Probability**	**Cross-border influence**
Critical	Limited	Likely	Small

1.2.1. Short description

The scenario involving a physical attack on critical assets includes a violent attack on power lines, transformers, substations and power plants. Violent attacks can be implemented in a variety of ways, from drone attacks, hostage-taking, use of explosives or other explosive devices, to attempted sabotage of physical infrastructure.

1.2.2. Classification

No seasonal character.

Physical attacks on critical assets can affect baseline and peak local electricity consumption or generation. Such attacks affecting the electrical infrastructure occur once every 5 to 10 years, i.e. **probabilistic classification** of this scenario is **likely.**

Affecting local power generation capacities does not lead to problems with the adequacy of energy resources in the country (EENS=0; LOLE=0) and the region, as the adequacy assessment (BGRAA 2022) includes Monte Carlo probabilistic modelling of the accident rate of the production facilities for 35 climate years. Additionally, coordinated NTCs of interconnections take into account the N-1 criterion.

The local impact on the network infrastructure is removed within three days (passing of the storm, clearing and taking measures to restore the infrastructure - LOLE≈72 hours) with an average energy not supplied of about 1 500 MWh (EENS≈0.005%) on a 15-year basis observations. This classifies the impact of the scenario on the electricity supply in the country as **small** - in terms of the energy not supplied and **critical** - for the duration, i.e.

the risk profile of the scenario is **critical.** This predetermines it with a rating of 5 in the regional evaluation. Despite its local nature and consideration of the N-1 criterion for interconnections, a physical attack against critical assets may even have **a small** cross-border impact (rating 1.2):

-There may be a need for redispatching, counter-trading, or cross-border exchange of balancing services;

- There may be some impact on reactive energy (system stability support) or active energy (redispatching or counter-trading).

The scenario would affect two member states which predetermines it with a regional rating of 4.8.

1.3. Physical attack on dispatching centers (C3)

Risk profile	**Impact**	**Probability**	**Cross-border influence**
High	Disastrous	Unlikely	Big

1.3.1. Short description

The scenario related to a physical attack on dispatching centres includes a violent attack targeting the central control sites of transmission system operators, distribution system operators or large power plants, as well as their back-up facilities. The violent attack can be implemented in various ways - from a drone attack, hostage-taking, the use of explosive devices or an attempt to sabotage the centres' operation.

1.3.2. Classification

The risk of attack on the dispatching centres is minimized, given the measures taken by ESO EAD and EDCs to protect them. They are included in the list of strategic sites and activity which are important for the national security of the Republic of Bulgaria. In this way, they fall under the special supervision of the State Agency for National Security (SANS). The necessary technical and organizational measures have been implemented in accordance with the requirements to strategic sites and the prescriptions of the Ministry of Interior and SANS. They interact with energy sector companies and warn of risks to a particular area or sites.

Physical attacks on dispatch centres can affect baseline and peak local electricity consumption or generation. Such attacks affecting the electrical infrastructure occur once every 10 years, i.e. **probabilistic classification** of this scenario is **unlikely.**

Affecting the control dispatch centres of transmission system operators, distribution system operators would lead to severe power outages (EENS>=0.25%) for a period bigger than 48 hours. This classifies the impact of the scenario on the electricity supply in the country as disastrous/catastrophic - in terms of the energy not supplied and critical - for the duration, i.e. the risk profile of the scenario is high. This predetermines it with a rating of 2 in the regional evaluation. Despite that Bulgaria has a back-up transmission system control centre with the necessary crisis procedures in place, a physical attack on dispatch control centres could have a major cross-border impact (Rating 2):

- There may be a need for redispatching, counter-trading, or cross-border exchange of balancing services;
- There may be some impact on reactive energy (system stability support) or active energy (redispatching or counter-trading).

The scenario would affect three member states which predetermines it with a regional rating of 6.

1.4. Insider attack (C4)

Risk profile	**Impact**	**Probability**	**Cross-border influence**
High	Disastrous	Unlikely	Big

1.4.1. Short description

An insider attack scenario involves deliberate sabotage by an employee or subcontractor, possibly initiated by a third party entity, group, state or other individuals. The attacker can target the physical infrastructure, the virtual infrastructure, or both. In addition to attempting to sabotage, the attacker may try to blackmail key employees or take those employees hostage during the attack.

1.4.2. Classification

An insider attack can affect base and peak local electricity consumption or production.

A person with detailed knowledge of the operating modes of the power system is able to inflict devastating damage in a short time, including system splitting, power supply outages in large areas, incl. damage to basic equipment, which events require significant time to restore the power system back to normal operation. For example, if the attack disrupts the grid, cross-border energy exchanges, sharing reserves and providing assistance may become impossible for a long period of time. If the insider attack is targeted at taking hostages instead of attacking the physical or virtual infrastructure, the recovery of the system can begin as soon as the hostage crisis is over, without the need to repair the infrastructure.

EDCs have also taken the necessary organizational actions to minimize this type of impact. All administrative buildings have security guards, and specific centres are equipped with

panic buttons to quickly inform the security companies or structures of the Ministry of Interior.
Insider attack, sabotage affecting the electrical infrastructure occur once in more than 10 years, i.e. **probabilistic classification** of this scenario is **unlikely.**
Insider attack, sabotage would lead to severe power outages (EENS>=0.25%) for a period of more than 48 hours. This classifies the impact of the scenario on the electricity supply in the country as disastrous/catastrophic in terms of the energy not supplied and critical in terms of duration, i.e. this scenario has a **high**-risk profile. This predetermines it with a rating of 2 in the regional evaluation. Although Bulgaria has a back-up transmission system control centre with the necessary crisis procedures in place, a physical attack on dispatch control centres could have a major cross-border impact (Rating 2):
- There may be a need for re-dispatching, counter-trading or cross-border exchange of balancing services;
- There may be some impact on reactive energy (system stability support) or active energy (re-dispatching or counter-trading).
The scenario would affect three member states which predetermines it with a regional rating of 6.

1.5 Storm (C5)

Risk profile	**Impact**	**Probability**	**Cross-border influence**
Critical	Limited	Very likely	Small

1.5.1. Short description

The initial conditions of this scenario include a storm with an expected wind speed of over 100 km/h, combined with wind gusts of over 150 km/h. The consequences of such extremely strong gusts of wind can seriously affect the components of the electrical infrastructure. In addition, the flow on some interconnections may be disrupted or even interrupted if specific network components are damaged due to the effects of the storm.
During the last 70 years, the high voltage network in Bulgaria (110 -400 kV) has been built in accordance with the applicable rules in the year of their construction. The applicable rules have been amended in recent years, which means that not all components are built with the same level of resilience. The most likely consequence and impact of a storm with such extreme wind speed will be the local disruption of the network integrity which will affect end-users on a local level.

1.5.2. Classification

Storms are typical mainly in winter and spring.

They can affect base and peak local electricity consumption or generation.

Storms affecting the electrical infrastructure occur more than once every 2 years, i.e. **probabilistic classification** of this scenario is **very likely.**

Affecting local power generation capacities does not lead to problems with the adequacy of energy resources in the country (EENS=0; LOLE=0) and the region, as the adequacy assessment (BGRAA 2022) includes Monte Carlo probabilistic modelling of the accident rate of the production facilities for 35 climate years. Additionally, coordinated NTCs of interconnections take into account the N-1 criterion.

The local impact on the network infrastructure is removed within three days (passing of the storm, clearing and taking measures to restore the infrastructure - LOLE≈72 hours) withestimated energy not supplied of about 1 500 MWh (EENS≈0.005%) on a 15-year basis observations. This classifies the impact of the scenario on the electricity supply in the country as **small** - in terms of the energy not supplied and **critical** - for the duration, i.e. the risk profile of the scenario is **critical.** This predetermines it with a rating of 5 in the regional evaluation. Despite its local nature and consideration of the N-1 criterion for interconnections, the storm may have even **a small** cross-border impact (rating 1.2):

- There may be a need for re-dispatching, counter-trading, or cross-border exchange of balancing services;
- There may be some impact on reactive energy (system stability support) or active energy (re-dispatching or counter-trading).

The scenario would affect two member states, which predetermines its regional rating of 12.

1.6 Cold spell/front (C6)

Risk profile	**Impact**	**Probability**	**Cross-border influence**
Insignificant	Insignificant	Likely	Big

1.6.1. Short description

The cold spell/front scenario includes a long period of low average daily temperatures of below 0 °C (reaching at certain times down to -20 °C and below) which lead to record levels of electricity consumption. The climate region in which Bulgaria falls, and the Balkan Peninsula as a whole, is characterized by abnormally low temperatures in winter from -25 to -30 °C.

1.6.2. Classification

The cold spell affect base and peak local electricity consumption in the winter season.

The cold spell occur once every 10 years, i.e. **probabilistic classification** of this scenario is **likely.**

The national impact of such scenario is **insignificant**, as it does not lead to problems with the adequacy of energy resources in the country (EENS=0; LOLE=0) and the neighbouring member states (EENS<=0,002%; LOLE<=3), as the adequacy assessment (BGRAA 2022[1]) includes Monte Carlo probabilistic modelling of the accident rate of the production facilities for 35 climate years. For this reason the scenario has a regional rating 0 - **insignificant impact**, although the interconnection of electricity in the region predisposes this scenario to have a **large** cross-border impact (rating 2), which is, however, rather market-based (high electricity prices). The regional rating is 0.

Flooding (C7)

Risk profile	Impact	Probability	Cross-border influence
High	Limited	Likely	None

1.7.1. Short description

Floods are common local natural phenomena on the territory of the Republic of Bulgaria causing enormous damage, as they affect urbanized and arable land and can destroy elements of the electricity transmission and distribution networks, as well as some local production facilities. The main causes of floods are again climate change leading to heavy rains and snow accompanied by unexpectedly strong increases in river inflows, bottlenecks, extensive spills, winds in estuaries, destruction of dikes, dam walls and tailing pond walls. The heavy rainfall and floods scenario includes prolonged heavy rainfall in combination with a spring wave on the tributaries locally. On the one hand, floods in certain areas can lead to inaccessibility to electricity generation, transmission and distribution infrastructure. On the other hand, floods can disable electrical infrastructure facilities, leading to unavailability for power generation and/or energy transmission/distribution.

1.7.2. Classification

Floods are typical mainly in the spring season and very rarely in the summer or winter season.

They can affect base and peak local electricity consumption or generation.

Floods affecting the electrical infrastructure occur once every 2 to 5 years, i.e. **probabilistic classification** of this scenario is **likely.**

[1] Bulgarian Resource Adequacy Assessment - 2022

Affecting local power generation capacities does not lead to problems with the adequacy of energy resources in the country (EENS=0; LOLE=0) and the region, as the adequacy assessment (BGRAA 2022) includes Monte Carlo probabilistic modelling of the accident rate of the production facilities for 35 climate years.

The local impact on the network infrastructure is removed within three days (passing of the tributary, clearing and taking measures for drainage, to restore the infrastructure - LOLE≈72 hours) with estimated energy not supplied of about 1 500 MWh (EENS≈0.005%) on a 15-year basis observations. This classifies the impact of the scenario on the electricity supply in the country as **small** - in terms of the energy not supplied and **critical** - for the duration, i.e. this scenario has a **high-risk** profile**,** respectively rating 2 is used for regional evaluation .

The scenario has a limited regional impact, because due to its local nature (catchment of a specific river), floods **do not have** cross-border impact (rating 1):

Potentially affected local power generation capacities do not have a dominant position in the market, therefore there is no need for re-dispatching, counter-trading, or cross-border exchange of balancing services;

The local flood nature predetermines physical and electrical distance from interconnections and substations to have an impact on reactive energy (system stability support) or active energy (re-dispatching or counter-trading).

1.8. Wildfire (C8)

Risk profile	**Impact**	**Probability**	**Cross-border influence**
High	Limited	Very likely	Small

1.8.1. Short description

On the territory of the Republic of Bulgaria and on the Balkan Peninsula, every year there are forest fires of different intensity, causing loss of human and material resources, and endangering mostly outdoor infrastructure (overhead power lines and substations) of the power system outside the urban environment. The analysis of possible events shows that their occurrence will lead to serious difficulties in the normal operation of the infrastructure in disaster areas. The changes in the country's climate in recent years are increasingly complicating the fire situation, especially in periods of high outdoor temperatures and prolonged summer droughts in large fields, semi-mountainous and some mountainous areas, which significantly increases external risks to the transmission and distribution system.

1.8.2. Classification

Fires are typical mainly in summer.

They can affect base and peak local electricity consumption or generation.

Such fires affecting the electrical infrastructure occur once per year, i.e. the **probabilistic classification** of this scenario is **very likely.**

Affecting local power generation capacities does not lead to problems with the adequacy of energy resources in the country (EENS=0; LOLE=0) and the region, as the adequacy assessment (BGRAA 2022) includes Monte Carlo probabilistic modelling of the accident rate of the production facilities for 35 climate years. Additionally, coordinated NTCs of interconnections take into account the N-1 criterion.

The local impact on the network infrastructure is removed within a week (extinguishing the fire and taking measures to restore the infrastructure - LOLE<168 hours) with an estimated energy not supplied of about 2 000 MWh (EENS≈0.005%) on a 15-year basis observations. This classifies the impact of the scenario on the electricity supply in the country as **small** - in terms of the energy not supplied and **critical** - for the duration, i.e. this scenario has a **high**-risk profile, respectively rating 2 is used for regional evaluation .

Despite its local nature and consideration of the N-1 criterion for interconnections, the wildfire may have even **a small** cross-border impact (rating 1.2):

There may be a need for re-dispatching, counter-trading, or cross-border exchange of balancing services;

There may be some impact on reactive energy (system stability support) or active energy (re-dispatching or counter-trading).

The scenario would affect two member states, which predetermines it with a regional rating of 4.8.

1.9. Blizzard (C9)

Risk profile	Impact	Probability	Cross-border influence
High	Limited	Likely	Small

1.9.1. Short description

Blizzard/Freezing storms are local natural phenomena in the northeast areas of the Republic of Bulgaria which cause enormous damage, as they affect urbanized and arable land and can destroy elements of the electricity transmission and distribution network, as well as some local production facilities. The main reasons for the occurrence of freezing storms are climate changes, leading to heavy precipitation of wet snow followed by a sharp cold. On the one hand, in certain areas they can lead to inaccessibility to electricity generation, transmission and distribution infrastructure. On the other hand, the freezing storms can disable electrical infrastructure facilities, leading to unavailability for power generation and/or energy transmission/distribution.

1.9.2. Classification

Blizzards are typical in winter.

They can affect base and peak local electricity consumption or generation.

Such storms affecting the electrical infrastructure occur once every 5 to 10 years, i.e. **probabilistic classification** of this scenario is **likely.** Additionally, coordinated NTCs of interconnections take into account the N-1 criterion.

Affecting local power generation capacities does not lead to problems with the adequacy of energy resources in the country (EENS=0; LOLE=0) and the region, as the adequacy assessment (BGRAA 2022) includes Monte Carlo probabilistic modelling of the accident rate of the production facilities for 35 climate years.

The local impact on the network infrastructure is removed within a week (passing of the storm, taking measures for clearing and restoring the infrastructure - LOLE<168 hours) with estimated energy not supplied of about 3 000 MWh (EENS≈0.01%) on a 15-year basis observations. This classifies the impact of the scenario on the electricity supply in the country as **small** - in terms of the energy not supplied and **critical** - for the duration, i.e. this scenario has a **high**-risk profile**,** respectively rating 2 is used for regional evaluation .

Despite its local nature and consideration of the N-1 criterion for interconnections, the storm may have even **a small** cross-border impact (rating 1.2):

There may be a need for re-dispatching, counter-trading, or cross-border exchange of balancing services;

There may be some impact on reactive energy (system stability support) or active energy (re-dispatching or counter-trading).

The scenario would affect two member states, which predetermines it with a regional rating of 4.8.

1.10. Strike (C10)

Risk profile	**Impact**	**Probability**	**Cross-border influence**
High	Big	Likely	Big

1.10.1. Short description

The strikes in the energy sector lead to the temporary suspension of the technical infrastructure operation for the extraction of primary energy resources, for the generation, transmission and distribution of electrical energy. An eloquent example is the coal mining strike at the end of January 2012. Despite the maintained stockpile of coal in power plants, their availability for generation was serially limited in terms of energy.

1.10.2. Classification

The strikes can affect base and peak local electricity consumption or generation.

The strikes affecting the electrical infrastructure occur once every 5 to 10 years, i.e. **probabilistic classification** of this scenario is **likely.**

Affecting local power generation capacities does not lead to problems with the adequacy of energy resources in the country (EENS=0; LOLE=0) and the region, as the adequacy assessment (BGRAA 2022 - scenario "A green ambition") includes Monte Carlo probabilistic modelling of the accident rate of the production facilities for 35 climate years with the withdrawal of the largest supplier of electricity in the country at the moment - coal plants (about 40% share).

This classifies the impact of the scenario on the electricity supply in the country as **insignificant** - in terms of the energy not supplied and **disastrous** - for the duration (over one week), i.e. this scenario has a **high**-risk profile**,** respectively rating 2 is used for regional evaluation.

Despite its local nature and consideration of the N-1 criterion for interconnections, the storm may have even **a big** cross-border impact (rating 2):

There may be a need for re-dispatching, counter-trading, or cross-border exchange of balancing services;

There may be some impact on reactive energy (system stability support) or active energy (re-dispatching or counter-trading).

The scenario would affect three member states, which predetermines it with a regional rating of 12.

1.11. Unintentional tripping of an element of system importance due to human errors (C11)

Risk profile	**Impact**	**Probability**	**Cross-border influence**
Low	Small	Very likely	Insignificant

1.11.1. Short description

Human errors in operation and operational management can lead to loss of human life, to an accident and subsequent unavailability of the technical infrastructure for the extraction of primary energy resources, for the generation, transmission and distribution of electrical energy. Although the operational and repair personnel in the electricity sites work according to regulations, rules and instructions, the possibility of human error cannot be excluded. It is possible that a mistake made by the operating and repair personnel will cause cascading tripping of equipment. In practice, human errors are possible where rules, regulations, instructions for safe operation are not followed.

1.11.2. Classification

Human errors can affect periods with base and peak local electricity consumption or generation.

Human errors affecting the electrical infrastructure occur more than once per year, i.e. **probabilistic classification** of this scenario is **very likely.**

Affecting local power generation capacities does not lead to problems with the adequacy of energy resources in the country (EENS=0; LOLE=0) and the region, as the adequacy assessment (BGRAA 2022) includes Monte Carlo probabilistic modelling of the accident rate of the production facilities for 35 climate years. In addition, the N-1 criterion is taken into account for interconnections, and all manipulations with the equipment require multiple approvals from both sides.

Local effects on the grid infrastructure are removed within hours with estimated energy not supplied of about 100 MWh (EENS<0.001%) and an average duration of 1 h (LOLE<8) based on 15 years of observations. This classifies the impact of the scenario on the electricity supply in the country as **insignificant** - in terms of the energy not supplied and **insignificant** - for the duration, i.e. the risk profile of the scenario is **small,** respectively for regional evaluation rating 1 is used.

The local nature and consideration of the N-1 criterion for interconnections predetermine **an insignificant** cross-border impact (rating 1):

The probability of occurring need for re-dispatching, counter-trading, or cross-border exchange of balancing services is insignificant;

The probability of having some impact on reactive energy (system stability support) or active energy (re-dispatching or counter-trading) is insignificant.

The scenario would affect two member states, which predetermines it with a regional rating of 2.

1. 12. Failure of ICT systems and telecommunications (C12)

Risk profile	**Impact**	**Probability**	**Cross-border influence**
Low	Small	Very likely	None

1.12.1. Short description

This scenario involves the unavailability of a large part of the telecommunication infrastructure used to manage the electricity system in real time. It may also include the inaccessibility of ICT systems, which are crucial for the short-term planning of the power system. The failure of the above-mentioned systems is most often caused by technical failures.

1.12.2. Classification

The loss of ICT systems and telecommunications can affect periods of base and peak local electricity consumption or generation.

The loss of ICT systems and telecommunications is of frequent occurrence, i.e. **the probability classification** of this scenario is **very likely**.

Failure of ICT systems and telecommunications would lead to minor power outages (EENS>=0.002%) for a period shorter than 12 hours. This classifies the impact of the scenario on the electricity supply in the country as small - in terms of the energy not supplied and small - for the duration, i.e. the risk profile of the scenario is small. This predetermines it with a rating of 2 in the regional evaluation. ICT systems and public telecommunications are redundant, so their outage may have a negligible cross-border impact (rating 0) as no re-dispatching, counter-trading, or cross-border exchange of balancing services is required and there is no impact on reactive energy (system stability support) or active energy (re-dispatching or counter trading).

The scenario is with regional rating of 0.

1.13. Fossil fuels shortage (C13)

The possible fossil fuel shortage scenario is divided into two sub-scenarios based on the type of fuel, namely coal and gas.

1.13.1. Fossil fuels shortage (natural gas) (C13.1)

Risk profile	**Impact**	**Probability**	**Cross-border influence**
Minimal	Insignificant	Likely	Big

1.13.1.1. Short description

The natural gas shortage scenario combines a period of high domestic electricity consumption combined with low stocks and fuel supply. Low stocks and yields can have several causes, in many cases related to the above scenarios, such as an accident or physical attack on infrastructure or even political reasons. Bulgaria's dependence on one gas supplier (Russia) was high before the war in Ukraine, but after the construction of the interconnector with Greece, this dependence has already been significantly reduced.

1.13.1.2. Classification

Suspension of gas supplies by Russia was registered in the winter of 2009 and since the spring of 2022. There was similar threat also in the winter 2014/2015.

The natural gas shortage can affect base and peak local electricity consumption or production by co-generation.

The natural gas shortage of political reasons occur once every 7 to 13 years, i.e. **probabilistic classification** of this scenario is **likely.**

The national impact of such scenario is **insignificant**, as it does not lead to problems with the adequacy of energy resources in the country (EENS=0; LOLE=0) and the neighbouring member states (EENS<=0,002%; LOLE<=3), according to the similar scenario ("gas crisis 2023") of BGRAA 2022. For this reason, the scenario is classified with a regional rating of 0 - **minor impact**, although the interconnection gas connectivity in the region predetermines gas supplies to have a **big** cross-border impact (rating 2), which is, however, rather market-based (high electricity and gas prices).

1.13.2. Fossil fuels shortage (coal) (C13.2)

Risk profile	**Impact**	**Probability**	**Cross-border influence**
Minimal	Insignificant	Unlikely	Big

1.13.2.1 Short description

Over the years, been coal-fired thermal power plants have traditionally been the largest producer of electricity in Bulgaria (about 40% of the total electricity production in the country). The Maritsa East mining complex provides the necessary amount of coal to the power plants located in the basin, exporting coal to neighbouring countries as well. The huge exploitation potential of the open mines in the complex would provide power plants in the region for decades to come. In this context, there is no shortage of coal due to lack of supply or exhausted stocks. The risk profile of coal shortage is determined as **minimal**. A coal mining crisis could occur due to prolonged miners' strikes (more than a month) or due to environmental and political reasons related to commitments to reduce carbon emissions.

The occurrence rate of the scenario is estimated to be once in more than 10 years, making it **unlikely**.

The simulations performed with Antares show **an insignificant** impact on the adequacy indicators in the EPS of Bulgaria and neighbouring member states (LOLE<3 and EENS<0.002%). For this reason, the scenario is classified with a regional rating of 0 - **minor impact**, as it practically does not cause problems for the member states in the region. If more attention is paid to the interconnection flows of electricity, it should be noted that Bulgaria is changing from a net exporter to a net importer of electricity and this would affect electricity prices in the region (therefore it can be assessed with a rating of 2 for cross-border influence).

1.14. Nuclear fuel shortage (C14)

Risk profile	Impact	Probability	Cross-border influence
Minimal	Insignificant	Very unlikely	Big

1.14.1. Short description

The nuclear fuel shortage scenario involves a delay in the supply of fresh nuclear fuel combined with high domestic electricity demand. In this case, the supply of fresh nuclear fuel may be delayed or interrupted for various reasons, including political. The Bulgarian nuclear power plant operates with nuclear fuel from one supplier, making it highly dependent. The available reserves allow operation of one reactor for the next two years, and the second - for four. This gives enough time to diversify nuclear fuel supplies.

1.14.2. Classification

Although the share of nuclear energy in total electricity production is about 35% and Bulgaria is highly dependent on it, the overall risk profile is assessed as minimal, mainly due to the statistically low probability of such an event and the possibility for diversification. This scenario is **very unlikely** according to the probability classification.

Based on the simulations made with the Antares simulator in the event of a nuclear power plant failure, the national impact of this scenario is **insignificant**, as it does not lead to problems with the adequacy of energy resources in the country (EENS<=0; LOLE<=0) and the neighbouring member states (EENS<=0,002%; LOLE<=3). For this reason the scenario has a regional rating 0 - **minor impact**, although the interconnection of electricity in the region predetermines this scenario to have a **big** cross-border impact (rating 2), which is, however, rather market-based (high electricity prices).

1.15. War / civil war (C15)

Risk profile	Impact	Probability	Cross-border influence
Disastrous	Disastrous	Very unlikely	Disastrous

In the current conditions in the Euro-Atlantic area, there is an atmosphere of peace and the risk of the threat of a conventional attack on the territory of the EU and NATO countries is low. However, the Strategic Defence and Security Concept of NATO member-states states that the conventional threat cannot be completely ignored, as many countries and regions around the world are gaining significant modern military capabilities which could have unpredictable consequences for international stability and Euro-Atlantic security.

In the event of military aggression, the main elements of the EPS become the main strategic goals, which are destructed. In practice, this would have a major impact on cross-border exchanges in electricity, as disabling interconnections would isolate the country from possible energy assistance from neighbouring countries. The impact on the energy not supplied and the duration define the scenario, such as **a disaster**.

1.16. Summary. Crisis scenario rating

Based on the above, each of the scenarios with the corresponding identification number is classified according to the impact and probability:

Crisis scenario rating						
Impact		**Probability**				
Estimated energy not supplied, MWh	**ENHPO*, h**	**Very likely**	**Likely**	**Probable**	**Unlikely**	**Very unlikely**
Disastrous	Disastrous					**C15**
Disastrous	Critical	**C1**			**C3 C4**	
Critical	Disastrous					
Disastrous	Big					
Big	Disastrous					
Disastrous	Small					
Small	Disastrous					
Disastrous	Insignificant					
Insignificant	Disastrous			**C10**		
Critical	Critical					
Critical	Big					
Big	Critical					
Critical	Small					
Small	Critical	**C5 C8**	**C7**	**C2 C9**		
Critical	Insignificant					
Insignificant	Critical					
Big	Big					
Big	Small					
Small	Big					
Big	Insignificant					
Insignificant	Big					
Small	Small	**C12**				
Small	Insignificant					
Insignificant	Small					
Insignificant	Insignificant	**C11**		**C6 C13.1**	**C13.2**	**C14**

Note ENHPO* - expected number of hours of power outage.

The cross-border dependence, national and regional rating of the scenarios are respectively:

Risk group	No.	Scenario	National rating	Cross-border dependence	Affected EU member states	Regional rating
Cyber attack	C1	Cyber attack on critical ICT business infrastructure of units connected directly to the electricity grid such as TSO, power plant or industrial load	10	2	3	60
Physical attack	C2	Physical attack on critical assets	2	1.2	2	4.8
	C3	Physical attack on dispatch control centers	1	2	3	6
Insider threat	C4	Insider attack	1	2	3	6
Natural disaster and extreme weather conditions	C5	Storm	5	1.2	2	12
	C6	Cold spell	0	2	3	0
	C7	Flooding	2	1	2	4
	C8	Forest fire	2	1.2	2	4.8
	C9	Blizzard	2	1.2	2	4.8
Human activity and conduct	C10	Strike	2	2	3	12
	C11	Unintentional tripping of an element of system importance due to human errors	1	1	2	2
Technical failure	C12	Failure of ICT systems and public telecommunications	2	0	1	0
Fuel shortage	C13.1	Fossil fuels shortage (natural gas)	0	2	3	0
	C13.2	Fossil fuels shortage (coal)	0	2	3	0
	14	Nuclear fuel shortage	0	2	3	0
Political	15	War / Civil war	1	2	3	6

2. ROLES AND RESPONSIBILITIES

The Minister of Energy has been designated as the competent authority for the Republic of Bulgaria in accordance with Article 3 of the RPR, in order to facilitate the application of the Regulation together with other directly related bodies and legal entities. The role of the Minister of Energy according to the requirements of Regulation 2019/941 is:

- Article 7: to identify the most appropriate national electricity crisis scenarios and to consult the relevant stakeholders
- Articles 10, 11, 12: to establish a risk-preparedness plan in the electricity sector (the Plan), after consultation, and to publish it on the website of the Ministry of Energy.
- Article 14: To issue an early warning to the EC and other Member States that there is a possible crisis in the electricity system, its causes, planned or taken measures to prevent the crisis and the possible need of assistance; after consulting the transmission system operator, to declare an electricity crisis and to inform the other Member States and the EC, together with the reasons, planned or taken measures to mitigate its consequences and the need of assistance from other Member States.
- Article 17: To submit a report to the Electricity Coordination Group (ECG) and the EC within three months after the end of the electricity crisis.

ESO EAD is the certified independent transmission system operator (TSO) in the Republic of Bulgaria, which is responsible for maintaining the security of electricity supply. As a TSO, ESO EAD is also responsible for the protection, management of emergencies and restoration of the power system.
The role of ESO EAD within the Plan is to contribute to the development of regional and national electricity crisis scenarios as part of ENTSO-E according to Article 6 and to provide expertise to the relevant sections in preparing the Plan according to Article 10 of Regulation 2019/941.
To date, four licensed electricity distribution system operators (DSOs) operate on the territory of Bulgaria: Elektrorazpredelitelni mrezhi Zapad AD, Elektrorazpredelenie Yug EAD, Elektrorazpredelenie Sever AD and Elektrorazpredelenie Zlatni Pyasatsi AD, the first three being the main ones. These companies are electricity distribution network operators and owners of the assets in the respective regions of the country. They manage the operation of the electricity distribution network in Bulgaria and work in close cooperation with ESO EAD on the aspects of the current operation, exchange of information and system defence plan. Within the framework of the System Restoration Plan of EPS, DSOs work with the National Dispatching Centre (NDC) to restore the normal configuration of the power system. Additional information on these plans is presented in section 3. 1.
The role of DSOs in the framework of the Regulation (EU) 2019/941 is to contribute expertise to the relevant sections in the preparation of the Plan in accordance with Article 10.

3. PROCEDURES AND MEASURES IN ELECTRICITY CRISIS

3.1 National procedures and measures

This section presents high-level measures and procedures applicable in the event of an electricity crisis and outlines the actions that need to be taken to maintain security of supply in the event of such a crisis. There are number of plans, protocols, processes and procedures that define the actions of the transmission system operator and the distribution system operators in the event of a crisis. Regulation (EU) 2017/2196 establishing a network code on electricity emergency and restoration identifies the procedures and systems that guide the actions to be taken in response to an emergency. ESO EAD has an internal set of business processes that ensure that the necessary steps are taken to restore the normal operational condition of the system as soon as possible. The Rules on Power Grid Control regulate the use of the Bulgarian transmission system by all users and contain a set of actions to be taken in emergency situations.

3.1.1. System Defence Plan of Bulgaria

The System Defence Plan has been developed by the National Dispatching Centre at the Electricity System Operator of Bulgaria, in accordance with the requirements of:

- Commission Regulation (EU) 2017/2196 establishing a network code on electricity emergency and restoration;
- Regulation (EU) 2017/1485 establishing a guideline on electricity transmission system operation;
- Rules on Power Grid Control;
- Policy on Emergency and Restoration, SAFA of ENTSO-E.

In developing the Defence Plan, the transmission system operator ESO EAD took into account the following elements:

- the operational security limits determined by the system operator for each transmission network element, including at least voltage limits, short-circuit current limits and permissible thermal current limits, including transitory admissible overloads;

- the behaviour and technical capabilities of consumers and producers of electricity within the synchronous zone;

- the specific needs of significant users of the transmission system of high priority and the terms and conditions for their disconnection, including the prevention of the possibility of disconnection based on voltage and frequency ranges in normal and alert state;

- the characteristics of the electricity transmission network and the adjacent electricity distribution networks.

The System Defence Plan contains the following provisions: the conditions under which the system defence plan is activated; the system defence plan instructions to be issued by the TSO; the measures subject to real-time consultation or coordination with the identified parties.

The system defence plan includes the following technical and organizational measures: automatic system protection schemes: under-frequency control scheme; over-frequency control scheme; actions in decrease in voltage (voltage collapse); actions in increase in voltage; system defence plan procedures: for frequency deviation control; for voltage deviation control; for power flow management; assistance for the active power procedure; manual demand disconnection procedure.

The measures contained in the Defence Plan are compliant with the following principles: their impact on system users shall be minimal; be cost-effective; only those measures that are necessary shall be activated; they shall not lead the power system or the interconnected transmission system into emergency state or blackout state.

3.1.1.1. Classification of the state of the power system

Regardless of the risk profile category in the electricity crisis scenarios listed in section 1.2, the actions taken by the TSO are determined by the seriousness of the situation. The level of system crisis is determined by the system alarm level. These system states range from normal to alert, emergency state, blackout state, and restoration state, with a set of defining criteria for each. In the table below, a brief description is given, characterizing each state according to the power system states classification.

State	**Criteria for establishing the state**
Normal	Normal state means a situation in which the system is within the operational security limits and all of the following conditions are met: ☐ voltage and power flows are within the operational security limits and the configuration of the electricity transmission network meets the security criteria; ☐ the steady state system frequency deviation is within the range of 50Hz ± 0.05 Hz or the absolute value of the steady state system frequency deviation is not larger than ± 0.2 Hz and the system frequency limits established for the alert state are not fulfilled; ☐ active and reactive power reserves are sufficient to withstand contingencies from the contingency list without violating operational security limits; ☐ operation of the concerned TSO's control area is and will remain within operational security limits after the activation of remedial actions following the occurrence of a contingency from the contingency list.
Alert	Alert state (pre-emergency) means the system state in which the system is within operational security limits, but a contingency from the contingency list has been detected and in case of its occurrence the available remedial actions are not sufficient to keep the normal. The system is in alert state when: ☐ voltage and power flows are within the operational security limits; ☐ the TSO's reserve capacity is reduced by more than 20 % for longer than 30 minutes and there are no means to compensate for that reduction in real-time system operation; ☐ the absolute value of the steady state system frequency deviation is not larger than the maximum steady state frequency deviation and the absolute value of the steady state system

	frequency deviation has continuously exceeded 50 % of the maximum steady state frequency deviation for a time period longer than the alert state trigger time or the standard frequency range for a time period longer than time to restore frequency; ☐ at least one contingency from the contingency list leads to a violation of the TSO's operational security limits, even after the activation of remedial actions.
Emergency	Emergency state means the system state in which one or more operational security limits are violated. The system is in emergency state when at least one of the following conditions is fulfilled: ☐ there is at least one violation of the operational security limits; ☐ frequency does not meet the criteria for the normal state and for the alert state; ☐ at least one measure of the System Defence Plan is activated; ☐ there is a failure in the functioning of tools, means and facilities, resulting in the unavailability of those tools, means and facilities for longer than 30 minutes. The emergency state includes the splitting of the coupling into areas - operating asynchronously, significant in volume cascade accidents and loss of resilience. It is characterized by a high degree of threat to the individual control blocks (areas) and violated security criteria. This is a situation in which the control systems and the emergency automation must prevent system splitting and limit the spread of disturbances and accidents to the neighbouring parallel operating energy systems.
Blackout	Blackout state means the system state in which the operation of part or all of the transmission system is terminated. Blackout state is when at least one of the following conditions is fulfilled: ☐ loss of more than 50 % of demand in the TSO's control area; ☐ total absence of voltage for at least three minutes, leading to the triggering of the Restoration plan.
Restoration	Restoration state means the system state in which the objective of all activities in the transmission system is to re-establish the system operation and maintain operational security after the blackout state or emergency state. In this state, the system

	operator has activated measures from the System Restoration Plan.

In classifying the EP system state, four types of threats are distinguished:

• Threat to the network: considers the adequacy of the baseline state or post-disturbance state against the operating criteria (transmission capacity and voltage);

• Threat to the balance between generation and consumption: considers the adequacy of the baseline state or post-disturbance state against balance maintenance;

• Threat to the communication and management infrastructure (means for ADCS), leading to deviation of the observed system parameters, outside the limits of normal system operation;

• Threat from an event that puts the parameters of the power system beyond the permissible ranges: considers the occurrence of an event that puts the parameters of the power system beyond the permissible ranges, such as exceptional weather conditions, terrorist attack, natural disaster, etc.

The power system operation depends on the interaction of the transmission system operator and DSOs. The priorities are determined by the operators (dispatchers at TDCs and NDC) of ESO. DSOs need to agree on clear rules for interaction, as well as to agree on response time in different situations.

When working with operational staff in a substation, according to the regulations, staff is subordinated primarily to ESO EAD, and then to the DSOs (dispatchers at the Specialised Dispatching Units (SDU). In the substations with remote control, the switching is performed from the Support point, but manipulations such as grounding, safety, etc. must be carried out by operational staff on site.

In a provision, rule or bilateral instruction, the response time of the operational staff must be agreed. The activities of the DSOs are highly dependent on this time. Based on this regulation, the operator can use a certain resource in a critical situation properly, rather than waiting indefinitely for manipulations in substations, which will increase the time of loss of supply to consumers. This is also necessary in severely worsened weather conditions.

3.1.1.2. Automatic and manual system protection schemes in crisis situations

3.1.1.2.1. Island operation (IO) with certain consumers

Island operation (IO) with certain consumer units before tripping to house load is a type of emergency control of certain thermal units of system importance, in case of a significant deviation of the frequency in the electrical network. IO is part of the under-frequency and over-frequency system protection schemes, enabling the thermal units of systemic relevance to maintain their operation and house load, in order to speed up the restoration of the power system after the accident. IO is an extremely rare event and is associated with the occurrence of a cascade accident, where there is a split of the synchronous area to asynchronously operating areas or disconnection of an area from the interconnected system. Note that this type of automated control is being gradually phased out and the system operator is adopting the ENTSO-E operation model of tripping to house load.

3.1.1.2.2 Automation and actions at reduced frequency

The sequence of actions for automatic adjustment at reduced frequency includes automatic load shedding, frequency control mode at the generating modules (primary regulation) and disconnection of the power storage modules, which are in user mode.

The sequence of actions includes disconnection of demand at different frequencies, from a starting mandatory level 49Hz to a final mandatory level 48Hz, within an implementation range whilst respecting a minimum number of six the step and maximum size of steps of 10% of the total load in the power system.

TSO and DSOs shall install relays necessary for low frequency demand disconnection taking into account load behaviour and dispersed generation.

3.1.1.2.3. Under-frequency Load-Shedding (ALS)

UFLS causes disconnection of electric loads from the electrical network (emergency shedding), in the absence of spinning reserve and system-wide deficit of active power, in order to stop further decrease of frequency and restore the established system operating mode at an acceptable level above 49Hz. UFLS is carried out by voltage devices with frequency patterns and logic, installed in the transformer substations 110/MV, which react to disconnection of MV terminals. UFLA should block Automatic Load Transfer (ALT) and auto-reclosures. The total volume of electrical demand that can be disconnected by UFLS should not be less than 45% of the total system load at any given time. Each UFLA device must be able to perform the functions UFLS-I, UFLS-II, accelerated UFLS and be able to disconnect consecutively four groups of consumers in a given MV section, always starting from the first to the fourth group.

3.1.1.2.4 The sequence of actions at reduced frequency

49.8 Hz	Frequency sensitive mode - allocation of the reserve for primary regulation
49.8 – 49.2 Hz	Automatic or operative disconnection of pumps in PSHPP; Automatic or operational mobilization of the available spinning reserve in TPPs and HPPs; Automatic or operative commissioning of hydro units in HPPs
49.0 Hz	Transition of HPP turbine regulators to frequency control mode (JFC)

49.0 – 48.0 Hz	Application of UFLS
48.8Hz, 0.2s	Transition of NPP turbine regulators to frequency control mode
48.7 Hz, 0.5s	Operation of frequency interconnection automation between Bulgaria and Serbia, Macedonia, Greece and Turkey
48.0 Hz, 0.2s	Disconnection of CCGTs (combined-cycle gas-turbine power plants) from the transmission network
47.9 Hz, 0.3s	Operation of frequency cross-border automation between Bulgaria and Romania
47.5 Hz	IO of system TPPs and region operation I-st degree, 0.5s - large region II-nd degree, 1.0s - medium region III-rd degree, 1.5s - small region IV-th degree, 2.0s - disconnection of TPPs from the electricity transmission network and supply of own needs
47.5 Hz, 0.2s	Separation of park modules and asynchronous modules from the transmission network
47.5 Hz, 2s	Separation of synchronous modules from the transmission network
46.5 Hz, 6s	Disconnection of HPPs

The groups of terminals, which are allocated for disconnection when activating UFLS are determined by the DSO's operators and agreed with the operators of ESO. It is carried out in order to preserve the power supply to consumers for whom the interruption of the power supply would lead to critical impacts on human health and life.

3.1.1.2.5. Automation and over-frequency actions

The sequence of actions for automatic regulation at over frequency shall lead to automatic decrease of the total active power injected in each LFC area.

The transmission operator determines the parameters and the schemes for automatic over-frequency control, including the frequency thresholds for its activation and the degree of reduction of active power injection, taking into account the frequency sensitive mode of generating modules (primary control).

If the limited frequency sensitive mode — over-frequency is not sufficient, the system operator shall set up a step-wise linear disconnection of the electricity generation in its LFC area.

3.1.1.2.6. Over-frequency control scheme sequence

50,3 Hz	Disconnection of renewable energy from the transmission network after 0.2 s
50,3 Hz	Automatic fast load-shedding of HPPs to the minimum allowable power for continuous operation
50,3 Hz	Disconnection of CHP units from the transmission network after 2.0 s
50,4 Hz	Automatic fast load-shedding of TPPs to the technological minimum
50,5 Hz	Transition of NPP turbine regulators to frequency control mode (after 0.2 s)
51,0 Hz	Transition of HPP turbine regulators to frequency control mode (aggregates joint frequency control)
52,0 Hz	Automatic frequency disconnection of TPPs from the electricity transmission network and supply of own needs, after 2.0 s
52,5 Hz	Disconnection of HPPs from frequency protection after 20… 35 s (the time setting is determined during the emergency shutdown test).

3.1.1.2.7. Under-voltage automation and actions

The automatic scheme against voltage collapse (voltage avalanche) includes the following actions:

- operation of the automatic voltage regulators of the generating modules;
- automatic connection of capacitor batteries to the transmission network;
- actions for disconnection of shunt reactors to the transmission network;
- under-voltage automatic load-shedding;
- blocking of the on-load switches of the transformers at decreased voltage.

3.1.1.2.8. Under-voltage automatic load-shedding

Based on its research, NDC identifies the areas of the electricity network where there is a risk of accidental voltage drop, loss of stability and risk of voltage collapse. In these areas, load-shedding automation is introduced when the voltage of the busbars of 110/MV substations is decreased, which acts towards disconnection of the terminals included in the UFLS.

3.1.1.2.9. Automatic voltage regulators in synchronous generating modules

Automatic voltage regulators (AVR)

AVRs are directly related to the automatic voltage regulation in the electric network and the stability of synchronous generators. The mass commissioning of static excitation systems with high-speed digital excitation regulators has significantly increased the possibilities for maintaining the resistance of synchronous generators to disturbances and oscillations in the electric power system.

3.1.1.2.10. Power System Stabilizers (PSS)

The main function of the power system stabilizer is to balance the rotor oscillations of the generators in the power plants, caused by a sudden change in the operating mode or power swing of the active power in the power system. This expands the operational stability range in the system (increases the possibility of power transfer). PSS is switched on automatically after the respective generator enters in parallel operation with the power system. Unauthorized removal by the plant's staff of PSS is considered non-compliance with an operational order of the system operator.

3.1.1.2.11. Overvoltage protection with reactive power control

The overvoltage automation includes the following actions:

• operation of the automatic voltage regulators of the generating modules;

• actions for disconnection of capacitors to the transmission network;

• automatic connection of shunt reactors to the transmission network;

• automatic disconnection of 400kV power lines in idle state.

Overvoltage special protection scheme (Overvoltage SPS) - 400kV

In order to protect the electrical equipment in the electricity transmission network from unacceptably high voltages, the 400 kV power lines are equipped with automatic equipment for protection against overvoltage. The settings of the automatic equipment against overvoltage must ensure the normal operation of the most voltage change sensitive element in the node. Usually, the insulation parameters of power transformers determine the lowest limiting conditions in overvoltage cases.

3.1.1.2.12. Frequency deviation control procedure

The procedure for the control of frequency deviations contains a set of measures to manage a frequency deviation outside the frequency limits defined for the alert state. The frequency deviation management procedure must meet at least the following requirements:

• the decrease of generation shall be smaller than the decrease of load during under-frequency events;

• the decrease of generation shall be greater than the decrease of load during over-frequency events.

Prior to the activation of the automatic low frequency demand disconnection scheme and provided that the rate of change of frequency allows it, the system operator, directly or indirectly through the distribution networks, activates demand response from the relevant service providers and:

• switches energy storage units acting as load to generation mode at an active power set-point;

• when the energy storage unit is not capable of switching fast enough to stabilise frequency, manually disconnects the energy storage unit.

3.1.1.2.13. Voltage deviation control procedure

When controlling voltage deviation, the system operator uses the following (manual) remedial actions:

• switches the deviations of the windings (tap changers) of system transformers and autotransformers;

• switches capacitor and shunt reactors;

• switches power-electronics-based devices used for voltage and reactive power control;

• blocks the automatic voltage regulation of the transformers;

• changes the voltage or reactive power settings of the synchronous power generating modules connected to the transmission network;

• changes the voltage or reactive power settings of the converters of the asynchronous (park) power generating modules connected to the transmission network.

3.1.1.2.14. Active power flow deviation control procedure

Active power flows in the power system are controlled by the transmission system operator in order to ensure that the system is operated within the thermal limits of the transmission facilities. When controlling power flows, the system operator uses the following (manual) remedial actions:

• modifies the duration of a planned outage or return to service of transmission network elements to achieve operational availability;

• angle shifting of autotransformers;

• changes the topology of the transmission network;

• recalculates the day ahead and intraday cross-zonal capacities, etc.

3.1.1.2.15. Assistance for active power procedure

In case of absence of control area adequacy in the day-ahead or intraday timeframe, and prior to any potential suspension of market activities, the system operator is entitled to request assistance for active power from:

• any balancing service provider which, upon the operator's request, shall change its availability status to make available all its active power, provided it was not already activated through the balancing market, and conforming to its technical constraints;

• any SGU connected in its LFC area, which does not already provide a balancing service to the system operator, and which, upon request, shall make available all its active power, conforming to its technical constraints;

• other TSOs that are in the normal or alert state.

3.1.1.2.16. Manual load disconnection procedure

The system operator may establish an amount of the netted load to be manually disconnected, directly or indirectly through the distribution networks, when necessary to prevent the propagation or worsening of an emergency state. Where demand is to be directly disconnected, the system operator informs the relevant distribution system operators without delay.

The system operator activates the manual disconnection (dispatching order) of the net load in order to:

- resolve overloads or under voltage situations;
- resolve situations in which assistance for active power has been requested but is not sufficient to maintain adequacy in day-ahead and intraday timeframes, leading to a risk of frequency deterioration in the synchronous area.

The system operator notifies DSOs of the amount of netted demand to be disconnected on their distribution networks. Each DSO disconnects the notified amount of netted demand, without undue delay.

Within 30 days of the incident, the system operator shall prepare a report containing a detailed explanation of the rationale, implementation and impact of this action and submit it to EWRC in accordance with Article 37 of Directive 2009/72/EC.

According to Chapter II, Section 3 of Ordinance No. 3 on the design of electrical installations and power lines, in terms of security of electricity supply, electricity consumers in Bulgaria are divided into four categories - null, first, second and third.

Null category includes consumers for which the interruption of electricity supply can endanger the people's life and health, cause a threat to state security, significant material damage, disruption of complex technological processes, disruption of particularly important economic facilities, communication systems and television. Null category users includes:

1. special installations and life support systems in hospitals;
2. signalling and security systems;
3. systems for informing the population in case of disasters;
4. places with use of emergency and evacuation lighting, etc.

The first category includes consumers for which the interruption of electricity supply causes disruption of important infrastructure of settlements, disruption of complex technological processes, mass scrapping of production with significant losses.

The second category includes consumers for which the interruption of electricity supply causes the cessation of mass production, downtime of workers, equipment and industrial transport, as well as disruption of the normal living conditions of a large number of people. The second category of consumers also includes residential buildings with high construction, administrative and public buildings, etc.

The third category includes all other users who do not fall into the categories - null, first and second.
Null-category consumers are supplied two independent mutually redundant power sources and from a third autonomous independent source. The permissible interruption of the power supply of a null category user is only for the time necessary for its automatic recovery from the backup source. In the case of life support systems and special cases that prevent power outages and for the time of automatic recovery, the continuity of power supply is ensured by the autonomous independent source.
The first category consumers are supplied with electricity from two independent mutually redundant sources. The permissible interruption of the power supply to a first category user is only for the time of the automatic switching from one source to another.
Second category consumers are supplied by two independent mutually redundant sources. The permissible interruption of the power supply to a second category user is for the time of the manual switching from one source to the other, performed by operative or operative-repair personnel.
Third category consumers are supplied with electricity from a single power source, provided that the interruption of the power supply necessary for the repair or replacement of a damaged element of the power supply system does not exceed 24 hours.
At the request of the clients, EDCs can assist in the construction of facilities for another category, where the responsibility for compliance with the redundancy lies with the client.
In the presence of shortage or overproduction of electricity according to the Rules on Power Grid Control (Issued by the Chairman of the State Energy and Water Regulation Commission (now EWRC), promulgated, SG, iss. 6 of 21.01.2014, amended, issue 100 of 15.12.2017, in force since 15.12.2017) and Ordinance No. 10 of 9.06.2004 on the procedure for introducing a restrictive regime, temporary interruption or curtailment of electricity production or supply, thermal energy and natural gas (Issued by the Minister of Energy and Energy Resources, promulgated, SG, iss. 63 of 20.07.2004, effective 20.07.2004, amended, iss. 42 of 9.06.2015, in force since 9.06.2015) ("Ordinance 10") measures are taken to limit consumption or production according to pre-prepared programs agreed with ESO EAD. The implementation and the manner in which they will be carried out are determined operatively by the dispatching units of ESO EAD.
EDCs strictly follow the instructions of ESO EAD and report in case of discrepancies or non-compliance by energy companies or producers.
Dedicated aggregates and systems for uninterruptible power supply, batteries, etc. can be used in addition to the power plants as a third independent source for electricity supply to consumers of null category and as a second independent source for consumers of first category.

3.1.2. System Restoration Plan of Bulgaria after severe accidents

The power system Blackout is a procedure used in case of partial or complete blackout of the power system. As a result of the serious nature of this event, all users of the electricity transmission network of system relevance are obliged to maintain a high level of awareness and training on the issues of system restoration. The ultimate goal is to ensure that customers are reconnected safely and as quickly as possible. The Restoration Plan defines:
- the general principles for the power system restoration after blackout;
- the distribution of the functions and actions of the operational staff of the transmission system operator, power plants of system relevance and the distribution network operators;
- the main restoration scenarios (description of corridors) that can be combined and applied to specific emergencies;
- the priorities and the sequence in the power system restoration;
- the main starting power sources in the power system restoration;
- actions of operational personnel in the absence of telecommunications.

The restoration of the power system after its complete or partial blackout goes through the following possibilities and stages:

- **Restoration through assistance from neighbouring power systems** - establishing an energy corridor from a neighbouring power system ("top-down" principle) is a priority way to restore the power system of Bulgaria. Where assistance from neighbouring power systems can be chosen, it starts with the system, which is currently better connected to the Continental European network. The plan envisions energy corridors from Romania, Serbia, Macedonia, Greece and Turkey.
- **Restoration by using local startup sources (HPPs with "black start" capability) -** Establishing an energy corridor from the start-up HPPs ("bottom-up" principle) is applied when no neighbouring power system is able to provide electricity assistance to Bulgaria.
- **Establishing energy corridors to TPPs and NPP - an energy corridor** is a set of facilities (substations and power lines) that provide power to the own needs of priority thermal power plants from start-up sources. Establishing an energy corridor from the start-up HPP to Kozloduy NPP is applied only if there is a malfunction in the supply of safety systems from the diesel generators of Unit 5 or Unit 6. Then, the establishment of an energy corridor to a priority TPP is postponed until later, when the power supply activities at Kozloduy NPP are secured.
- **Expansion of the corridors and ensuring power balance -** in the process of expanding the energy corridor, new power plants are successively launched, and loads are introduced in the substations, continuously ensuring power balance.

Corridors and islands are widened until certain substations equipped with synchronization equipment are reached.

- **Connection of self-operating areas and energy corridors in a common power system -** the synchronization between two regions/corridors is performed in substations that are equipped with synchronizing equipment. If it is possible to synchronize two self-operating islands or an island with part of the power system on several power lines in one site, first is the power line with the highest transmission capacity (strongest connection). After synchronization and merging of two self-operating islands, only one power plant should remain in "frequency control" mode. The other power plant must be switched to "active power control" mode.
- **Restoration of the operation of the Bulgarian power system in parallel with the neighbouring power systems and the planned cross-border exchanges** - the interconnection of the entire electricity transmission network is restored, after which transition is made to parallel operation of the Bulgarian power system with the neighbouring electricity systems that are in normal state. After the power system of Bulgaria starts parallel operation with the Continental Europe power system, the planned cross-border exchanges are restored.
- **Restoration of power supply to all customers**

3.1.3. Mechanisms for informing the public in electricity crisis

Different types of communication are used to inform stakeholders, including producers, distribution system operators, internal staff, the energy regulator and the market operator, that the power system is in an unusual state. Each user of the system is responsible for their internal procedures upon receipt of such a warning. The Minister of Energy is responsible for communication with the EC and other Member States regarding early warnings and alerts in accordance with the requirements of Regulation 2019/941. Market participants are informed through market messages/couplings.

The table below summarizes the communication methods used to communicate with key stakeholders.

At all times, during operation and in the operational planning phase, each system operator shall communicate to the other system operators the state of its own power system, based on a security assessment, taking into account internal or regionally agreed remedial actions. This information must be analysed in case of any change in the power system state.

In case of change in power system state from Normal to Alert, Emergency or Blackout, messages are sent in accordance with the procedures approved by RG CE (Regional Group Continental Europe) and described in the Crisis Communication Tool and ENTSO-E Awareness System. Subsequently it is specified: the type of threat and the nature of the criterion violated. Other system operators need to assess the impact on their own control blocks/areas. Under certain conditions (ex. frequency deviation), pre-prepared messages can be sent automatically.

Stakeholder	**Communication methods used by ESO EAD**
Producers	E-mail Telephone Fax SCADA signal Message on the market platform
EDC	E-mail SMS SCADA signal Telephone Fax
Regulator and government bodies	E-mail Telephone Fax
Exchange operator	E-mail Telephone Fax Market message
Other TSOs	Telephone Fax ENTSO-E Awareness System
Market participants	Communication on the market platforms of TSO and the power exchange operator E-mail
Public and media	Through a message on the website of ESO and the press centre Message on social networks

3.1.4. Procedures and information flows in electricity crisis

The diagram below shows the information flows in the event of a crisis in the electricity supply.

Some abbreviations:

SLR - Supplier of last resort

EAS – European Awareness System

EDC - Electricity Distribution Company

RSC - Regional Security Coordinator

DH - Departmental Headquarters

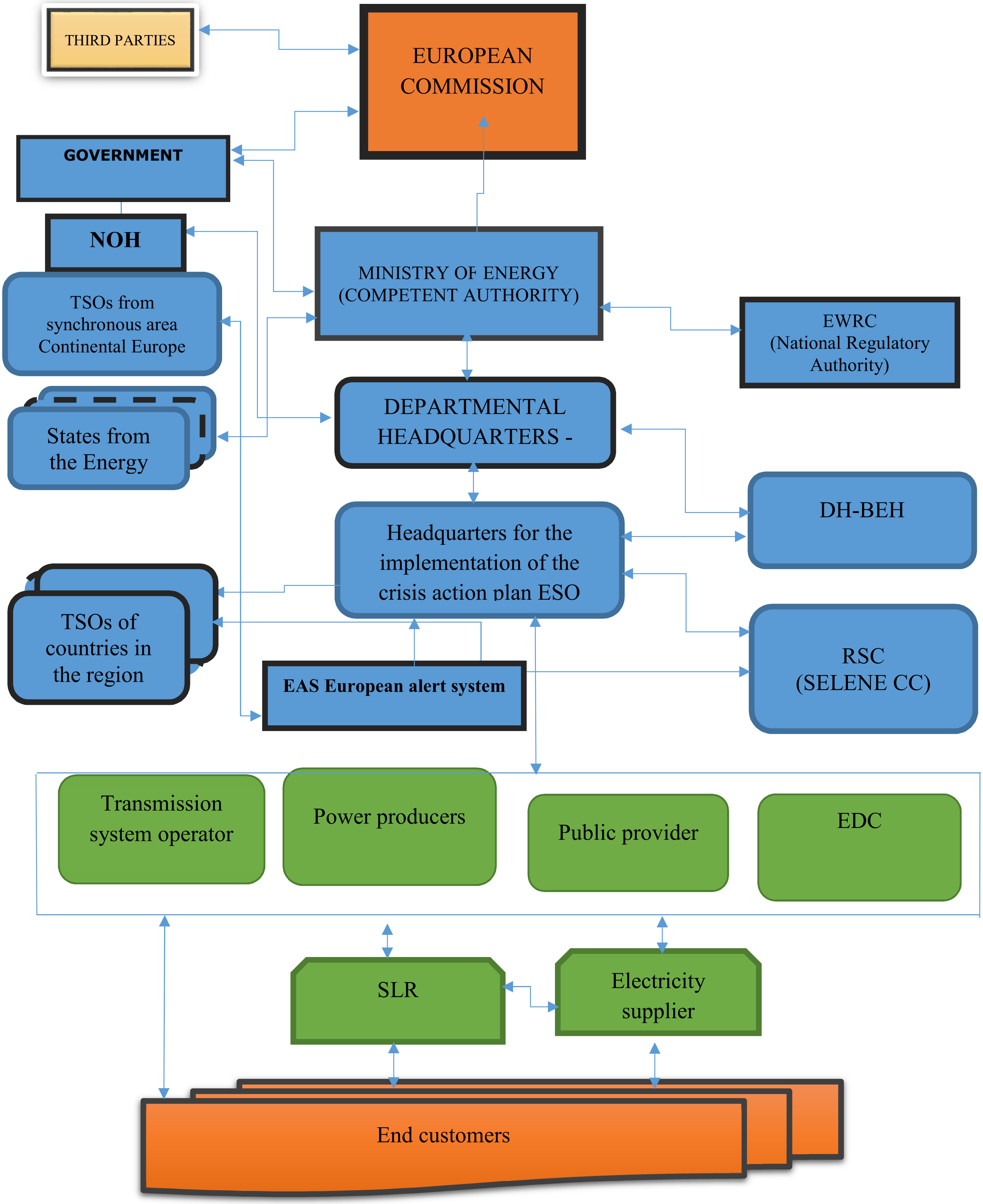
NOH - National Operational Headquarters

BEH - Bulgarian Energy Holding

EWRC - Energy and Water Regulation Commission

TSO - Transmission system operator

ELECTRICITY CRISIS NOTIFICATION SCHEME



3.1.5. Preventive and preparatory measures

General measures have been introduced to protect and prepare the power system for future changes. These measures are triggered by both European and national legislation. Every year, ESO EAD prepares a Network Development Plan, which sets out the intentions for the development of the electricity transmission network of Bulgaria and interconnections for a period of ten years. It presents the projects that ESO EAD considers necessary to strengthen the electricity transmission infrastructure and which will help achieving the strategic goals set by national and EU policies, including projects of common interest (PCI). This plan is prepared after intensive correspondence with current and future investors, taking into account the preliminary contracts for the construction of new generating capacity. In addition, the Plan contains projected energy balances and power balances for expected extreme loads, which serves as a simplified and deterministic assessment of long-term adequacy. This helps to identify potential adequacy gaps that could jeopardize security of supply and allows future transmission system users to gain a better idea of the possibilities for connecting new sites.

EDCs implement measures related to preventive activities to increase the reliability of the elements of the electricity distribution network, as well as modernization of the network itself. Periodic inspections of the facilities are carried out. Their readiness for operation is assessed. Measures are taken to improve their characteristics, and where necessary, they are replaced with new ones. After analysis of the network, activities related to the replacement of the network or elements of it are carried out, as well as the application of new innovative technologies and facilities.

Cybersecurity

Tackling cybersecurity threats is a growing concern in the energy sector, as analysis shows that the number of reported attacks on utility providers worldwide has increased in recent years. Regulators and legislators are trying to address the threat by tightening instructions to operators and introducing legislation that requires a minimum set of cybersecurity control measures. Within the EU, the Network and Information Systems Regulation (NIS-D), which was successfully implemented in Bulgaria in 2018, seeks to address this issue by identifying essential service operators (ESPs) and recommends a minimum standard for cybersecurity control, as well as mandatory requirements for cyber incident reporting. The State Electronic Government Agency has been appointed as a competent body in the Republic of Bulgaria. NIS-D obliges all ESPs to achieve and maintain a minimum level of cybersecurity maturity in order to reduce cyber risks and threats in the performance of their critical activities. According to NIS-D, the relevant competent authority measures the compliance of ESPs with the requirements of the regulation by assessing the level of compliance with security controls.

As a transmission system operator, ESO EAD is defined as an ESP within the meaning of Regulation (EU) 2016/1148 and is subject to more formal management and reporting measures on cybersecurity controls for critical systems and processes. The measures focus on logical access control for the systems and applications used by operators in the control room. Logical access control is a key component in protecting computer environments and can be complemented by physical access control and residual risk management monitoring. Standards for logical access control in a control room environment must be designed in such a way that they do not introduce undue complexity that may impede or delay operators' access to critical emergency systems, and should be complemented by a stable physical access control.

Regulation (EU) 2019/943 on the internal market in electricity provides for the development of a new EU Cybersecurity Network Code. It will provide a common set of rules and minimum requirements for cybersecurity throughout the electricity sector, including across borders. The Code is currently being developed, main drivers being ACER (the Agency for Cooperation of the Energy Regulators), ENTSO-E and the Organization of European Electricity Distribution System Operators (E.DSO).

Physical attack

Access to all power system control rooms and the adjacent critical infrastructure is strictly controlled by means of sophisticated access control systems. The security of the buildings and the monitoring of the sites is done by security guards and security system, in order to guarantee only legitimate entry into them.

Insider threat

As a result of the correct social policy and selection of the staff in the energy companies with public functions, a conscientious attitude towards the official duties and striving for protection of the entrusted property is formed. In addition, applicants for employment in NDC of ESO are subject to increased scrutiny by the State Agency for National Security prior to their appointment, as NDC is on the list of sites of strategic relevance for the electricity sector. The state of the most critical elements for preventing accidents and incidents is monitored. For this reason, it should be noted that the risks of sabotage, vandalism and theft committed by company employees are minimized.

It should be noted that currently ESO EAD lacks data and documents describing forms of malicious act by an employee or subcontractor.

Trainings for work on processes and instructions are conducted in EDCs. Quality control systems have been introduced, and in case of non-compliance with any of the processes, an analysis is made and measures are taken to limit the identified negative phenomena. Thus, the possibility of escalation of the problems with an internal cause is not allowed as a preventive measure.

Careful selection of the partnering companies is made. Continuous supervision of the work is performed, as well as inspection of the performed activities.
Risks of accidental error are limited through the "4 eyes" principle.

Natural disaster and extreme weather conditions

Extreme weather conditions, storms

Transmission and distribution networks are designed for service continuity and safety within economic constraints. The design and construction are in accordance with **Ordinance No. 3** on the design of electrical installations and power lines, including requirements related to meteorological conditions, such as wind and static ice load. The distribution network is generally exposed to less wind loads than the transmission network, as it is closer to the ground (usually less than 10 m).

Every year, NDC prepares a report on the operational mode of the Bulgarian power system during the forthcoming autumn-winter period. The report focuses on the analysis of the flow distribution by examining the normal and boundary modes of operation of the transmission electricity network of Bulgaria during the winter period, in order to determine:

- the loading of the elements of the electrical network;
- expected voltage levels;
- the implementation of the security criterion N-1 for the transmission electric network;
- the conditions for optimal operation of the electricity network with minimal losses of electricity from transmission and transformation;
- the possibilities for voltage regulation within the admissible limits and the necessary technical means;
- the transmission capacity of the electricity network in the exchange of electricity with neighbouring power systems.

The developed calculation models are summarized perspective calculation models of the power system of the countries of Southeast Europe for the absolute winter maximum mode, average working day mode and minimum mode for weekend. The absolute maximum mode is the starting point for determining the expected maximum load of the electrical network in normal and repair schemes. The average working day mode is necessary to determine the economic operation of the power system during the planned period, in terms of power losses in the grid, and the minimum regime is boundary to calculate the maximum voltage in the grid for the planned period and check the adequacy of voltage control. After taking into account all the characteristics of the regions and analysing the results of the flow distribution task, the report gives conclusions and recommendations on the general state of the electricity system, expected critical elements of the network, the need for additional voltage regulation and preventive switching, in

order to ensure the normal mode of operation of the power system during the upcoming winter period.
The same tools are used in the preparation of EDCs for autumn-winter operation of the facilities. For the Black Sea region, this is done in the spring before the active summer season.

Wildfire
The risks of forest fires are reduced by maintaining vegetation and cutting down wood near the overhead lines of the transmission network, the so-called clearing. This ensures minimal distances between vegetation and electrical infrastructure. The minimum insulation distances for open distribution systems and overhead lines are subject to regulation and are defined in **Ordinance No. 3** on the design of electrical installations and power lines.

A pandemic
In the event of a pandemic, energy companies take action to limit staff contact by using remote forms of communication and mandatory use of personal protective equipment. Conducting events to inform staff about the dangers. Taking preventive measures to limit the damage to the personnel of the EDCs.
All employees are provided with personal protective equipment, securing healthy conditions for the work process. Disinfection of workplaces is carried out. The measures are periodically updated, depending on the external information received from the anti-epidemiological headquarters.
Periodic conducting tests to establish the real health state of the staff. Identifying persons with increased risk of infection and determining measures to protect their health. In cases of signs of illness, non-admission of employees to work places - quarantine. The distribution by work areas, without the possibility of direct contact, both with external persons and within the company.
As an employer, contribution to the successful course of the vaccination process.
In particularly severe situations, the work process is carried out in isolated premises (for the operational staff where on 24 mode), without leaving the workplace, until the termination of anti-epidemic measures.

Flooding
System substations and ESO dispatching centres are located in low-risk areas and are not at risk of flooding. In certain places in the country, there may be a forced interruption of the power supply with a limited range or rotational preventive outages in order to prevent a major accident until damage is repaired or water is drained.
EDCs carefully monitor the ME forecasts for floods and high waters. If necessary, preventive disconnection of the voltage in the endangered sites is performed. In

particularly difficult situations, where possible, preventive relocation of equipment to a safe place is envisaged.

Technical failure

Failure of critical information and communication (ICT) systems

The growing dependence on the use of information and communication technology poses a moderate risk in the event of failure of one or more elements of it.

ESO EAD implements an investment policy aimed at permanent reconstruction and rehabilitation, including of hardware, software, communication channels and control and management systems.

The means of communication between the individual dispatching centres and between the dispatching centres and the major sites of the transmission network are backed up. SCADA/EMS system is backed up with a completely independent system in terms of interconnections and border substations. In case of physical damage in NDC, ESO EAD may transfer the management to a separate back-up operational centre in case of emergency.

Regardless of the measures taken to provide the necessary telecommunications, it is possible that some sites will be temporarily unable to communicate with the relevant dispatcher. This requires, in such a situation, to carry out the appropriate manipulations, which will facilitate and speed up the actions of operational staff after the restoration of telecommunications.

Given the diversity of local conditions, here and in the OPERATIONAL ORGANIZATION LIST are the basic guidelines for the actions of local staff in the absence of telecommunications. The local instructions shall specify the specific actions that the operational staff shall carry out independently in the event of loss of telecommunications, as well as the operations, which may be carried out independently.

The criteria for occurrence of a system accident in the absence of telecommunications between the site and the dispatcher from RDC/NDC are:

- voltage loss on all busbar systems and simultaneous triggering of at least one stage of UFLS or IO with certain consumer units;
- 20 minutes after voltage loss on all busbar systems.

Voltage loss of all busbar systems without UFLS or IO is not usually a criterion for a system failure. Such an effect also results from local damage such as: short circuit of busbars, short circuit of terminal with breaker failure, etc.

In case of complete loss of voltage on all busbar systems and lack of telecommunications with the dispatchers of the respective RDC, detailed descriptions of the actions to be taken by the operational staff of the respective energy sites are given.

Human error

The energy companies engaged in the production and transmission of electricity employ highly qualified personnel who are subject to periodic instruction and control of knowledge. Apart from that, the companies take constant care of the staff training, conduct periodic and extraordinary briefings related to the safe operation of the facilities. An appropriate social policy is implemented, which motivates employees to strictly follow the rules and requirements of labour discipline. This is crucial for minimizing the risk of human error in the system.

Fuel shortage

In Article 8 and Article 9 of Ordinance No. 11 of 10.06.2004 for fuel reserves in case of complete interruption of the supply of fuels for TPPS on solid, liquid and gaseous fuels are determined, the required quantities of reserves of primary and secondary fuel, corresponding to the forecast and/or agreed mode of operation of the power plant for a different number of days - ranging from 5 to 30 days.

In Art. 10 it is stated that an electricity producer operating a nuclear power plant shall collect and maintain reserves of fresh nuclear fuel not less than the fresh nuclear fuel required to refuel one power unit of each type of installed capacity on one site.

Actual fuel stocks at power plant sites are checked annually before the coming of the winter season by a committee of the Ministry of Energy. Also, the Kozloduy NPP is in the process of diversifying the supply of fresh nuclear fuel, which will ensure the independence of the future operational exploitation of the power plant from Russian nuclear fuel.

Political

Providing countries with sufficient quantities and quality, as well as affordable, energy resources is a major task in world politics and the policy of all EU member states. Bulgaria pursues a policy of active participation in the implementation of EU strategic initiatives. It participates in the development of an integrated and competitive energy market, as well as in building the necessary infrastructure and diversifying energy supplies in order to reduce its energy dependence.

War/Civil war

As the share of global energy consumption increases, energy supplies are increasingly at risk of disruption in order to exert political pressure or cause economic losses to affected countries. For this reason, NATO has identified ensuring the community's energy security as a key task in military planning. Taking into account the current events in Ukraine (since February 2022), the possibility of a military conflict shall not be excluded although Bulgaria is a NATO member state.

The impact of a possible military invasion on the physical integrity and modes of operation of the power system is almost always detrimental, which would lead to forced interruption of electricity supply to end users in the long run.
When a military crisis is declared, a Crisis Staff is convened. Actions are taken to assess the state, assess the available resources and redistribute them if necessary.
In case of emergency escalation, the crisis staff takes over the management of the affected territories. Priority is given to measures related to limiting the harmful impact and restoring the normal operation of the facilities in the electricity transmission and distribution networks and restoring customer power supply in the fastest way possible.
Setting priorities when restoring the power supply to the facilities:

- Provision of emergency power supply for house load needs of NPP and TPP Substations and HV Node Stations and HV network.
- MV terminals
- of transformer station groups with a large number of clients
- all other facilities including LV network
- in case of impossibility to supply the customers with a generator, as well as ensuring its current operation during operation.

3.1.6. Regional and bilateral procedures and measures

Bilateral operational agreements

Based on the specific requirements and recommendations described in the ENTSO-E Synchronous Area Framework Agreement (SAFA) concerning Continental Europe Regional Group (RG CE), ESO EAD has concluded bilateral agreements for transmission network operation (Operational Agreements) with the TSOs of all neighbouring countries of Bulgaria: TRANSELECTRICA (Romania), ADMIE/IPTO (Greece), EMS (Serbia), MEPSO (North Macedonia) and TEIAS (Turkey). The bilateral operational agreement regulates the technical issues and details at parallel operation of the two systems to the Continental Europe synchronous area and covers the following topics:

- Management of the frequency and load of the power system and the related reserves - the boundaries of the two control areas are determined;
- Preparation of electricity exchange schedules, settlement and allocation of cross-border transmission capacity;
- Operational security - includes information and general principles on the list of external network elements of common interest in emergencies, list of external observable network elements, operational constraints and parameters, single-line schemes of border substations, criterion N-1 in network calculations, settings of synchronization equipment and relay protections of interconnection power lines,

voltage and reactive power regulation, short-circuit currents, calculations on static and dynamic stability and transmission network development plans;

- Coordinated operational planning - includes information and general principles on the list of mutually influencing network elements in switching, coordination of planned downtime, manipulations and permits for work and calculation and coordination of interconnection capacity;
- Power system operation in emergencies and restoration - includes information and general principles for determining the operational state of the power system according to the ENTSO-E Awareness System classification, decreased frequency action plan, power system restoration, high disturbance frequency management and resynchronization;
- Communications - includes information and general principles on communication infrastructure, real-time data exchange, official language and time zone, means of oral and written correspondence, authorized staff;
- Operational training - general information about the forums and programs for mutual training of the operational staff of both countries;
- Commercial metering devices and reporting - general information and principles

Regional security coordinator

SEleNe CC is one of the six European Regional Security Coordinators (RSCs) in accordance with European Commission Regulations 1222/2015 (CACM) and 2017/1485 (SOGL), the Third Energy Package and the Clean Energy Package. SEleNe CC was established on 22 May 2020 by the transmission system operators of Bulgaria (ESO EAD), Greece (IPTO), Italy (Terna SpA) and Romania (Transelectrica), shareholders of the company with equal shares (25% each). The company is headquartered in Thessaloniki, Greece and covers two capacity calculation regions, i.e. GR-IT CCR and Southeast Europe (GR-BG-RO) CCR.

One of SEleNe CC's primary responsibilities is to ensure the safety and short-term adequacy of the EEC in the South-Eastern European region by offering best practices at a level that transcends the national boundaries of each Transmission System Operator (TSO) in order to reduce the costs of preventive or corrective actions and to minimize the possibility of events occurring in large geographical areas. SEleNe CC, acting as RSC, performs and provides the following tasks and services to its clients:

- Integration of individual grid model / common grid model;
- Coordinated calculation of interconnection capacity;
- Coordinated security analysis (including analysis related to corrective actions;)
- Short-term adequacy;
- Outage planning coordination.

Other regional and bilateral measures

In general, the following can be considered regional processes and bilateral security measures of the EU:

- A crisis management system at the level of communication between operators in a crisis. Within ENTSO-E, a dedicated list of officials from each TSO has been established and maintained so that information can be safely transmitted between operators and internally in case of crisis;
- Annual forecast reports (winter forecast and summer review, summer forecast and winter review) where the adequacy of the current state of the European EPSs to different conditions (meteorological, availability of generation, etc.) as well as to extraordinary cases is examined, as it was in the winter forecast (Winter Outlook) for 2022-2023 with the gas crisis created throughout Europe due to the suspension of Russian natural gas supplies;
- Bilateral operating agreements with IPTO and Transelectrica related with the actions of the operators during a blackout and severe disturbance of the EPS. Therein, the parties agree on the supply of 200 MW of emergency power to be supplied through the 400 kV interconnectors according to the recovery plans of the two EPSs, according to the scheme and conditions agreed between the shift dispatchers. At the discretion of the dispatchers, an emergency supply of more than 200 MW can be negotiated without, however, violating the security criteria according to the current operating conditions. The operation of an emergency scheme with the delivery of emergency assistance can continue until the planned operational reserves of the affected system are restored;
- Monitoring and operation of the European platform EAS (European Awareness System), through which the operator is informed in real time about the operational status of other systems and notifies other operators about the status of their system (Article 152 of Regulation (EC) 2017 /1485).

Emergency energy supply contracts

As of the end of January 2023, ESO EAD is in the process of updating the effective bilateral contracts with IPTO and Transelectrica for mutual emergency supply of energy to secure system services between the electricity systems of Greece and Bulgaria, and Bulgaria and Romania.

The purpose of these agreements is to establish the conditions and rules under which the parties will provide mutual energy assistance in emergencies, using the available reserves in real time, without jeopardizing the security of the power system entrusted to them.

The subject of the contract is the emergency supply of energy from the electricity system of the Provider to the electricity system of the Recipient through a high voltage interconnection in order to cover the needs of the Recipient. This emergency supply of energy is reciprocal between IPTO and ESO EAD, and Transelectrica and ESO EAD, and both parties can be Suppliers or Recipients of emergency energy. Emergency energy is supplied by each of the Providers in case of damage to major generating or transmission devices, which adversely affects the security of the electricity system of the Recipient. Emergency power supply in parallel operation is considered to be an appropriate and timely change of the CAS/SAS (Control Area Schedule/Scheduling Area Schedule) files of both parties. The supply of energy in emergency situations depends on the technical capabilities, available reserves and the remaining available cross-border capacity and must not affect the cross-border capacity offered on the market or the capacity already nominated.

The updated contracts comply with the requirements of Art. 15, paragraphs 3, 4, 5 and 6 of Regulation (EU) 2019/941 regarding the maximum quantity of the provided emergency electricity, the delivery facilities, the method of requesting and terminating the emergency assistance, as well as the fair financial compensation between the member states. The contracts are expected to be finalized and take effect in the second quarter of 2024.

In the event that a crisis occurs in the electricity sector before these contracts become effective, in rendering emergency assistance the parties involved will negotiate on a case-by-case basis, following the provisions of Art. 15, paragraph 8 of the Regulation.

4. CRISIS COORDINATOR

The Minister of Energy, as the competent body, is responsible for ensuring the security of the electricity system. He monitors and analyses the situation regarding the security of generation, transmission and distribution of electricity, coordinates activities in case of crisis, announces the separate crisis levels in case of emergency within the meaning of Regulation 2019/941, introduces curtailments on the consumption of electricity for certain periods of time on the territory of the Republic of Bulgaria or part of it in case of emergency within the meaning of Regulation 2019/941, he is responsible for communication with the European Commission and provides information on the application of both market and non-market measures to verify the correctness of the declared state of emergency, through its representative participates in the sessions of the Coordination Group at the Directorate General for Energy of the European Commission and ensures the exchange of information between the European Commission and the Ministry of Energy.

In order to deal with crisis situations, the plan defines the responsibilities and obligations of crisis management bodies and their members, to ensure their effective and timely response in case of emergencies that could disrupt the smooth supply.

In the Ministry of Energy a Departmental Headquarters has been set up for crisis management. It is a non-staff body established by order of the Minister of Energy, pursuant to Art. 63, para. 2 of the Disaster Protection Act. The Departmental Headquarters acts as a crisis management group. The Departmental assists the heads of the Ministry of Energy in carrying out disaster protection activities, management of crisis and emergency of non-military nature caused by natural disasters, fires, catastrophes, accidents, criminal activity, terrorism and other circumstances of social, economic and political nature in which the normal functioning of the energy system is disrupted, instability in the political and social environment is caused, life, health, property of citizens, cultural and material values, environment and in general the national security of the country are endangered. The Minister of Energy, who is also a competent body, exercises control over the activities of the Departmental Headquarters.

The structure of the Departmental Headquarters is determined by the order of the Minister of Energy, appointing heads from the Ministry of Energy who have the necessary expertise and experience in crisis management and are familiar with the regulations governing protection in disasters and crises of various kinds.

The Departmental Headquarters executes the following main tasks:

- establishes constant communication with the National Disaster Protection Staff (NDPS) and the crisis staff of the energy companies from the energy sector, located in the disaster zone or affected by the crisis/emergency situation;
- through the duty officers in the Ministry of Energy, receives up-to-date information on the situation in the affected areas. Works to achieve maximum efficiency in the implementation of measures to protect the population and infrastructure and prevent interruptions in electricity supply;
- analyses the information received from the companies and the NDPS, assesses the degree of destruction and the harmful consequences of a disaster or crisis/emergency situation in the energy system and determines measures for immediate implementation;
- assesses the situation, composition and state of the response forces in case of disaster and crisis/emergency situations in the energy companies of the energy sector;
- takes decisions for undertaking specific actions for controlling the disaster or the crisis/emergency situation and proposes them to the Minister of Energy and, when necessary, to the NDPS.
- organizes the interaction of the Ministry of Energy with the structures of the Single Rescue System of the country (DG Fire Safety and Protection of the Population - Ministry of Interior, regional directorates of the Ministry of Interior, Bulgarian Red Cross, ministries and departments, municipal staff for disaster protection, emergency medical care establishments in the area of the disaster, etc.) in carrying out the measures for protection in case of disasters and the implementation of the tasks and measures for disaster management;

- organizes, coordinates and controls the actions carried out by the formations of the Energy Sector, an integral part of the power system, for the implementation of the tasks and measures for disaster protection;
- it is responsible for the implementation of the assigned obligations arising from the implementation of the National Preventive Disaster Protection Plan and the Action Plan of the ME, in constant cooperation with the National Staff, the Regional Cooperation Centre, the EC structures;
- proposes to the Minister of Energy solutions for managing crisis/emergency situations and eliminating the consequences of the disrupted electricity supply;
- makes proposals to the Minister for providing additional financial resources, fuel reserves and other resources for the activities for disaster protection and crisis/emergency management and for liquidation of the consequences;
- proposes estimates for the allocation of reserves of energy and other resources in a crisis/emergency situation and the introduction of a restrictive regime for the supply of electricity, thermal energy or natural gas in cases where it is necessary to limit or interrupt the supply for a period of time longer than 48 hours throughout the country;
- proposes measures to support the supply of electricity to neighbouring countries (Member States of the European Union) or cooperation with the Member States of the European Union;
- prepares summary inquiries and reports to the Minister of Energy and/or the NDPS on the changes in the situation and the course of implementation of the restoration/rescue activities.

The work of the Departmental Headquarters is supported by the operational duty officers in the Ministry of Defence and the experts from the Directorates Security of Energy Supply and Crisis Management. In carrying out its activities, the Departmental Headquarters, depending on the situation, may operate in normal and crisis mode according to the rules approved by the Minister of Energy.

In case of absence of any of the members, his deputy is appointed by the respective administrative unit, who participates in the work of the Departmental Staff. If necessary, by decision of the Chairman of the Departmental Staff, other employees may be included in the Staff.

If necessary, the transmission system operator appoints a permanent Staff for the Implementation of the Action Plan (SIAP), which is responsible for the implementation of the Plan on its part. The scheme of notification in case of occurrence or anticipated occurrence of a certain level of crisis, is determined by the order of the Executive Director of the operator.

5. STAKEHOLDER CONSULTATIONS

Based on the scenarios of regional power supply crises and national power supply crises, the Risk Preparedness Plan has been drawn up after consultations have been carried out by the competent authority with the distribution network operators, the transmission network operator, electricity companies, natural gas utilities, electricity customers and the regulatory authority.

Representatives of the Ministry of Energy, Elektroenergien sistemen operator EAD, Elektrorazpredelitelni mrezhi Zapad AD, Elektrorazpredelenie Yug EAD, Elektrorazpredelenie Sever AD participated in the working group that drafted the Plan. The latter has been aligned with the competent authorities of the Republic of Greece and Romania, according to the requirement of Regulation 2019/941.

6. EMERGENCY TESTS

Due to the fact that not all neighbouring countries of Bulgaria are members of the EU (Turkey, Serbia, North Macedonia) and they have not made commitments to meet the requirements of Regulation 2019/941, so far no regional emergency tests have been conducted concerning power supply crises. In case agreements are reached for such regional tests, their essence and results will be reflected in the next update of the Plan.

However, in accordance with the requirements of Regulation (EU) 2017/1485 establishing a guideline on electricity transmission system operation (SOGL), ESO EAD conducts annual trainings and tests of RDC and NDC dispatchers in order to refresh and improve knowledge and skills needed to respond adequately to a wide range of emergencies. For this purpose, some of the tests are conducted on the so-called dispatcher-training simulator (DTS). DTS is part of the information and management system of the NDC. With the conduct of the trainings, the dispatchers are trained for actions in normal and emergency operational situations, provided for in the Defence Plan and the Severe Accident Restoration Plan. Some of the main options are as follows:

- Training and coaching of new dispatchers for operational management, work with software applications and AGC (Automatic Generation Control) functions of the model of the power system which simulates the real power system;
- Training and coaching of dispatchers preventively for the management of the energy system in emergency situations and recovery actions;
- Facilitates the development and testing of new applications and modification of the energy system;
- Introducing dispatchers to new applications and modification of the energy system;
- Provides training and analysis of dispatcher’s responses to various events and restrictions;

- Provides training and analysis of dispatching skills for working with procedures for emergency restoration of the power system in case of complete or partial separation.

Regarding the requirement of the Regulation to conduct regional tests for responding to crises in the electricity supply, the Bulgarian competent authorities plan to carry out such tests every two years, with the first event of this type expected to take place in the third quarter of 2024. The institutions planned to join the exercise are the Ministry of Energy, TSO, electricity distribution companies, national regulator, independent market operator, and invitations will also be sent to the Romanian and Greek identical response authorities. Planned tests will be selected, allowing to assess the level of:

- Preparedness of staff (expert and operational);
- Maturity of procedures and general cooperation and communication;
- Sustainability of infrastructure;

7. LIST OF MATERIALS USED

1. Regulation (EU) 2019/941 of the European Parliament and of the Council of 5 June 2019 on preparedness to deal with risks in the electricity sector and repealing Directive 2005/89/EC.
2. Commission Regulation (EU) 2017/2196 establishing a Network Code on emergencies and restoration of electricity supply.
3. Commission Regulation (EU) 2017/1485 establishing guidelines for the operation of the electricity transmission system.
4. Power system management rules.
5. Policy on Emergency and Restoration, SAFA of ENTSO-E.
6. Policy 5: „Emergency Operations” of ENTSO-e.
7. Protection plan of the electricity system of the Republic of Bulgaria, developed by Electricity System Operator EAD.
8. Plan for restoring the electricity system of the Republic of Bulgaria after severe accidents, developed by the Electricity System Operator EAD.