REPUBLIC OF BULGARIA

TENTH NATIONAL REPORT UNDER THE CONVENTION ON NUCLEAR SAFETY

Sofia, 2025

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A. INTRODUCTION

The Republic of Bulgaria joined the Convention on Nuclear Safety in 1995. The Convention was ratified by an Act of the National Assembly, and entered into force on 24 October 1996. With its accession to the Convention, Bulgaria confirmed its national policy to maintain a high level of nuclear safety, ensuring the necessary transparency and implementing the highest safety standards.

Nuclear energy in the Republic of Bulgaria is a major factor in the country's energy balance under conditions of high technological effectiveness and production efficiency and upholding a high level of nuclear safety and radiation protection. Ensuring the safety of nuclear facilities is a national policy in the development of nuclear energy in the Republic of Bulgaria. In this context, a paramount duty of the government is the development and implementation of adequate legislation in this area. The adopted Act on the Safe Use of Nuclear Energy (ASUNE) with the regulations thereto consider and implement in the national legislation the relevant international conventions and treaties to which Bulgaria is a party, as well as the EU legislation, and IAEA safety standards and guidelines.

The National Energy Policy stipulates the preservation of the nuclear energy share in the electricity generation and takes in long-term operation of Kozloduy NPP Units 5 and 6. Potential options for the construction of a new nuclear power unit is also considered. A new energy Strategy for Sustainable Energy Development to 2030, with a Horizon to 2050 is being adopted.

The Bulgarian nuclear energy programme was launched in 1974 with the commissioning of Unit 1 of the Kozloduy NPP. The nuclear facilities of the country are concentrated at the Kozloduy NPP site where six power units and two spent fuel storage (SNF) facilities have been built.

Units 1-4 of Kozloduy NPP with WWER-440 type reactors were shut down in 2002 and 2006. With a Decision of the Council of Ministers the units were declared a radioactive waste management facility and were transferred to the State Enterprise Radioactive Waste (SE RAW).

Units 5 and 6 of Kozloduy NPP with WWER-1000 reactors were commissioned in 1987 and 1991, respectively. In connection with the amendments to the ASUNE, introduced in 2024, the licenses for operation of Units 5 and 6, as well as for the two SNF storage facilities located on the plant site, have been amended into licences which are not limited in time. The requirement to conduct periodic safety reviews (PSRs) of the facilities at least once every 10 years is retained.

With the purpose of diversification the nuclear fuel supplies for Unit 5, a phased transition of the unit to operation with RWFA-type nuclear fuel was initiated in 2024, with 43 fuel assemblies loaded in the core. Another 42 RWFA fuel assemblies are loaded in the same unit in 2025, with the transition planned to be made over four fuel cycles.

On 25 October 2023, the Council of Ministers of the Republic of Bulgaria adopted a decision granting consent in principle under Art. 45 para 1 of the ASUNE for the construction of Unit 8 of the Kozloduy NPP. In this regard, an application for a permit for the siting of a nuclear facility (site selection) for Unit 8 was submitted to the Nuclear Regulatory Agency (NRA) in the beginning of 2025.

Institutional Framework

The Republic of Bulgaria has established an institutional framework for developing and implementing the national policy on the safe use of nuclear energy and for carrying out state regulation and control. The responsibilities and functions are clearly defined and divided between the separate institutions as follows:

- The Nuclear Regulatory Agency (NRA) performs state regulation of the safe use of nuclear energy and ionising radiation, and the safe management of radioactive waste and spent nuclear fuel. The NRA establishes regulatory requirements on nuclear safety and

radiation protection, issues licences and permits, carries out regulatory control and imposes enforcement measures to ensure compliance with the regulatory requirements;

- The Ministry of Energy (MoE) carries out the state policy on energy development and implementation of the national energy policy. The Ministry proposes and implements the national strategy for energy development and the national strategy for spent nuclear fuel management and radioactive waste management;
- The Ministry of Health (MoH) develops and implements the state policy aimed at protecting the health of the public by establishing mandatory health standards, requirements and rules for radiation protection and by ensuring a healthy living environment. The Ministry of Health carries out specialised functions in the field of health protection in the use of nuclear energy and ionizing radiation through its bodies - the National Centre for Radiobiology and Radiation Protection and the Regional Health Inspectorates with Radiation Control departments;
- The Ministry of Environment and Water (MoEW) manages, coordinates and supervises the development and implementation of the state policy on environmental protection, conservation and use of water and the earth's subsurface. The Ministry is in charge of the National System for Environmental Monitoring and is the competent decision-making authority in respect of any environmental impact assessment performed;
- The Ministry of Interior (MoI) ensures the security of nuclear facilities and related sites, identified as particularly important in terms of their physical protection. The Ministry, through the Fire Safety and Civil Protection General Directorate, coordinates the activities on the protection of the public and the national economy in cases of disasters and emergencies, including conducting risk assessment, preventive measures, rescue and urgent remedial works and providing international assistance.

The Minister of Transport and Communications and the Minister of Defence also perform specialised functions in the area of using nuclear energy and ionizing radiation.

Content and Structure of the Report

This tenth National Report was developed with the participation of all the responsible institutions in the area of safe use of nuclear energy as well as the nuclear facilities' licence-holders. This report reflects the country's developments following the ninth report. It provides information on the progress of the activities related to enhancing the safety of the nuclear facilities. The report discusses the safety assessments and analyses performed during the reporting period, the methodologies used, the results obtained and the major conclusions. The operational safety of the nuclear facilities is also reviewed, as well as the regulatory practices for updating of the statutory framework, licensing, safety assessments and analyses, surveillance and inspection activity.

The following appendices are attached to the Report:

Appendix 1: List of operating events reported over the period 2022 -2024.

Appendix 2: List of the peer reviews conducted in Bulgaria.

B. EXECUTIVE SUMMARY

This tenth National report has been developed as a stand-alone document that does not require reading the previous reports and at the same time clearly depicts the development of the country over the period following the ninth report.

Based on the Energy Act a draft Strategy for Sustainable Energy Development to 2030 of the Republic of Bulgaria, with a Horizon to 2050 has been developed. The draft document was prepared taking into account the current framework of the EU energy policy, aimed at achieving the ambitious community goals for the transition to a low-carbon economy. The main strategic decisions have been defined, aimed at achieving the national goals, taking into account the peculiarities of the energy mix. The strategy reflects the trends, measures and policies in the field of energy security, energy efficiency, the liberalisation of the electricity and gas market, as well as their integration into the Common European Market, the development and application of new energy technologies. The draft Strategy follows the common European policies and goals for the development of energy and for limiting climate change, reflecting national specificities in the field of energy resources, production, transmission and distribution of energy. The policies are laid down also in the Integrated Energy and Climate Plan of the Republic of Bulgaria 2021-2030, which was prepared in pursuance of Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Actions.

In the Republic of Bulgaria, there are no changes in the institutional and legislative framework for the formation and implementation of the national policy in the field of the safe use of nuclear energy and for carrying out state regulation and control.

Review of the secondary legislation

During the period under review, the normative requirements were updated, taking into account the development of the international standards and European legislation. Amendments and supplements were made to two regulations and four regulatory guidelines:

- Regulation on the Procedure for Issuing Licences and Permits for the Safe Use of Nuclear Energy;
- Regulation on Ensuring the Safety of Nuclear Power Plants;
- Guidelines on Deterministic Safety Analyses of Nuclear Power Plants with PWRs;
- Guidelines on Probabilistic Safety Analyses (PSA) of Nuclear Power Plants;
- Guide on Applying Probabilistic Safety Analysis in the Management of Safety in Nuclear Power Plants;
- Guide on Protection against Internal Fires in Nuclear Power Plants.

Further information on the essence of the amendments and supplements made to the specified regulations and regulatory guidelines is contained in the text of the separate report articles.

Issues important to safety

Over the past three-year period the implementation of the Integrated programmes for continuous improving of the safety of Units 5 and 6 and the two SNF storage facilities continued, and this resulted in addressing a number of safety significant issues, the most important among which are:

- replacement of the equipment whose operational lifetime expires within the extended operation period;
- additional seismic reinforcement of emergency boron injection system piping, Emergency Core Cooling System (ECCS) (active part) piping, steam generators emergency feedwater

piping, pressurizer system piping and Unit 5 ECCS (passive part) piping (to be implemented at Unit 6);

- upgrade of the neutron flux monitoring system of Units 5 and 6;
- upgrading the emergency and preventive protection and automatic power control systems of Units 5 and 6;
- migration of the Computer Information and Control System (CICS) of Units 5 and 6 to a new generation platform, including the integration of a Safety Parameters Display System (SPDS) and symptom-based emergency operating procedures (SBEP);
- update of Level 1 PSA, Level 2 PSA is also in the process of being updated;
- upgrade of the stack release monitoring systems of Units 5 and 6 and Auxiliary Building-3.

A final report was prepared in October 2023, reporting on the implementation of all 78 measures of the Updated National Action Plan after the Fukushima NPP accident.

Long-term operation of Units 5 and 6

As a result of the implementation of the project for long-term operation, a number of activities (measures) have been identified and planned for implementation to ensure the reliable performance of the safety-related design functions of the structures, systems and components (SSCs). The existing Management Plan for the activities under measures implemented during the long-term operation period of Units 5 and 6 was updated and reissued in 2024 as the Management Programme for activities under measures implemented during the long-term operation of Units 5 and 6 of Kozloduy NPP. The measures related to safety are included in the scope of the Integrated Safety Improvement Programmes of the units.

Safety significant issues addressed in the previous CNS review

The tenth review under the CNS reports on the progress made in implementing the measures planned in the ninth National Report to increase the nuclear facilities safety and the challenges faced by the Republic of Bulgaria. The current report reviews the performance of these measures, and their status is described in detail as appropriate in the texts of individual articles, namely:

- replacement of equipment whose operational lifetime expires within the extended operation period is carried out in accordance with the approved plans and programmes;
- the off-site emergency response centre (ERC) has been commissioned and the necessary amendments have been made to the NPP Emergency plan;
- a system has been installed to monitor and evaluate the water vapour and oxygen concentration in the containments of the units;
- the studies of the possibilities for reactor core melt confinement in case of a severe accident and those for direct water supply to the reactor core from an external source have been completed;
- the activities to ensure the possibility of direct water supply to the spent fuel pools from an independent external source have been completed;
- the possibility for a direct water supply to the SGs from an external source has been provided;
- the Level 1 PSA has been updated.

International reviews and outcomes

The Republic of Bulgaria implements a consistent policy for continuous safety enhancement of nuclear facilities based on comparison with international standards, exchange of knowledge, experience and good practices in the industry in an atmosphere of openness and maximum transparency. Periodic self-assessment and the accompanying peer reviews are forms of international cooperation in support of this goal. Bulgaria has been a traditional host of similar forms of cooperation both regarding operating and regulatory practices. For the last five years, 12 peer reviews and missions have been conducted by representatives of the International Atomic Energy Agency (IAEA), European Union (EU), and the World Association of Nuclear Operators (WANO). Information on the missions and reviews conducted is provided in Article 6 of the Report. For all the reviews, the results have been summarised, and both areas for improvement and good practices have been identified. Necessary actions have been taken to address the identified recommendations and suggestions.

In the end of 2024, an IRRS mission organised by the IAEA was conducted with 16 experts from 15 member states, two observers and three IAEA representatives. The mission was in line with the recommendation of the EU Nuclear Safety Directive, which encourages periodic reviews of national frameworks and self-assessments of competent supervisory authorities to improve nuclear safety every ten years.

Implementation of the principles of the Vienna Declaration on Nuclear Safety, adopted of 9 February 2015

The national policy, legislative and regulatory framework in the field of use of nuclear energy is in line with the European Union legislation, the IAEA safety standards and safety guidelines and the best international practices. Since 2007, the national legislation has been harmonised with the European one and Bulgaria has been applying the recognised European practices. The requirements of Council Directive 2009/71/Euratom establishing a Community framework for nuclear safety of nuclear installations, amended with Council Directive 2014/87/Euratom of 8 July 2014, have been introduced.

In this context a paramount duty of the government is the development and implementation of adequate legislation in this area. The adopted Act on the Safe Use of Nuclear Energy (ASUNE) with the regulations thereto consider and implement the international conventions and treaties to which Bulgaria is a party, the EU legislation, as well as the IAEA safety standards and guidelines.

Conducting a periodic safety review (PSR) at least once every ten years is a basic requirement regarding the licences for operation of the nuclear facilities. As a result of the periodic safety assessments carried out on Units 5 and 6, the Wet Spent Fuel Storage Facility (WSFSF) and Dry Spent Fuel Storage Facility (DSFSF), as well as additional stress tests, a number of significant modifications to the existing design of the units have been implemented and a number of new systems have been put in place to prevent severe accidents and mitigate their consequences.

In the main report, under Articles 6, 14, 17, and 19, the relevant requirements, technical criteria and standards, as well and performed design improvements are described in details; they reflect the implementation of the three principles of the Vienna Declaration on Nuclear Safety of 9 February 2015, within the national legislative framework and the by-laws on the application of the ASUNE.

In its regulatory practice and policy in the field of safe use of nuclear energy Bulgaria adheres to the objectives of the Convention on Nuclear Safety and the principles of the Vienna Declaration on Nuclear Safety.

Future challenges

In the short-term, the Republic of Bulgaria faces the following more significant challenges:

- sustainable development of the national infrastructure providing the nuclear sector with a sufficient number of qualified personnel;
- improving regulatory capacity to license innovative technologies, including small modular reactors;
- securing supply chains for goods and services.

C. REVIEW OF CNS ARTICLES 6 THROUGH 19

Article 6 Existing nuclear installations

Each Contracting Party shall take the appropriate steps to ensure that the safety of nuclear installations existing at the time the Convention enters into force for that Contracting Party is reviewed as soon as possible. When necessary in the context of this Convention, the Contracting Party shall ensure that all reasonably practicable improvements are made as a matter of urgency to upgrade the safety of the nuclear installation. If such upgrading cannot be achieved, plans should be implemented to shut down the nuclear installation as soon as practically possible. The timing of the shut-down may take into account the whole energy context and possible alternatives as well as the social, environmental and economic impact.

Brief information about the nuclear facilities in Bulgaria

The Bulgarian nuclear energy programme was launched in 1974. The nuclear facilities of the country are concentrated at the Kozloduy NPP site where six power units and two spent fuel storage facilities were built. The table below provides information on the current status of the nuclear facilities.

List of the nuclear facilities in Bulgaria

No.	Unit/facility	Commissioning date	Permanent shutdown	Status
1	Unit 1	1974	2002	Decommissioning
2	Unit 2	1975	2002	Decommissioning
3	Unit 3	1980	2006	Decommissioning
4	Unit 4	1982	2006	Decommissioning
5	Unit 5	1987		In operation
6	Unit 6	1991		In operation
7	WSFSF	1990		In operation
8	DSFSF	2016		In operation

Units 1-4 of Kozloduy NPP with WWER-440 type reactors were shut down in 2002 and 2006 and are in the process of decommissioning.

Units 5 and 6 of Kozloduy NPP with WWER-1000 reactors were commissioned in 1987 and 1991, respectively. Following the implementation of project for the lifetime extension (PLEX) in the period 2012-2018, the licenses of Units 5 and 6 were renewed in 2017 and 2019 respectively. In accordance with the changes made in 2024 to the ASUNE, the licences for the operation of the two units have been amended to licences which are not limited in time.

At the site of Kozloduy NPP there are two spent nuclear fuel storage facilities in operation: an interim pool type storage facility for storing SNF from the WWER-440 and WWER-1000 reactors (WSFSF) and a storage facility for dry storage of SNF from the WWER-440 reactors (DSFSF). The licences for operation of the two SFSF are also included in the scope of the changes made in 2024 to the ASUNE as a result of which they were changed into licences which are not limited in time.

The requirement to conduct periodic safety reviews (PSRs) at least once every 10 years is retained. The results of the periodic safety reviews conducted are submitted to the NRA in the form

of a report and an integrated programme for the implementation of safety enhancement measures and are approved by an order of the Chairperson of the NRA in accordance with the changes made in 2024 to the ASUNE.

Review of the issues important to safety

List of events reported to the NRA in the period 2022 – 2024

Over the past three-year period no operating events important to safety have been registered as per the IAEA International Nuclear Events Reporting Scale (INES). The total number of events reported for units 5 and 6 is 13, and they have been rated 0 level as per INES. The use of the results from operating events assessment and analysis, as well as the corrective actions as elements of the operating experience feedback system are described in article 19(7) of this report. Appendix 1 contains a list of the events reported.

Programmes and measures planned for the continuous safety enhancement

The following programs are under implementation to ensure the safe and long-term operation of Kozloduy NPP Units 5 and 6:

- Integrated Programme for Implementation of Safety Enhancements Measures at Unit 5 in the 2017-2027 Period (89% of the measures were implemented by the end of 2024);
- Integrated Programme for Implementation of Safety Enhancements Measures at Unit 6 in the 2019-2029 Period (69% of the measures were implemented by the end of 2024).

The integrated programmes combine measures resulting from the periodic safety reviews conducted and the projects for long-term operation, the most important among which relate to:

- replacement of the equipment whose operational lifetime expires within the long-term operation period;
- additional seismic reinforcement of emergency boron injection system piping, Emergency Core Cooling System (ECCS) (active part) piping, steam generators emergency feedwater piping, pressurizer system piping and Unit 5 ECCS (passive part) piping;
- upgrade of the neutron flux monitoring system;
- upgrade of the emergency and preventive protection and automatic power control systems;
- migration of the Computer Information and Control System to a platform of the latest generation, including the integration of a Safety Parameters Display System (SPDS) and symptom-based emergency operating procedures (SBEP);
- update of Level 1 PSA, Level 2 PSA is also in the process of being updated;
- upgrade of the stack release monitoring system ensuring representativeness of samples.

All measures are implemented in accordance with schedules subject to regulatory oversight.

Programme for diversification of fresh nuclear fuel supplies for Units 5 and 6

In line with the European Energy Security Strategy and following the developed in 2019 in Kozloduy NPP EAD programme for diversification of fresh nuclear fuel supplies for Units 5 and 6, a phased transition of unit 5 to operation with a new type of nuclear fuel (RWFA) was initiated in 2024. 43 and 42 RWFA fuel assemblies were loaded into the Unit 5 reactor during the Outages in 2024 and 2025, respectively.

A contract was signed with Framatome GmbH on 24 March 2023 for fresh nuclear fuel supplies for Unit 6 until the end of 2034. The contract was also approved and signed by the Euratom Supply Agency (ESA) in August 2023 whereby the treaty formally entered into force. Under the

conditions of the contract and its annexes, the first delivery of SNF is scheduled to take place towards the end of 2026.

Long-term operation of Units 5 and 6

The Project "Lifetime Extension of Units 5 and 6 at Kozloduy NPP" was implemented in two main stages:

- First Stage: Complex Assessment of the actual Condition and Rest Lifetime of the Equipment and Facilities;
- Second Stage: Implementation of the Programme for Preparation of the Units for Plant Life Extension.

The measures foreseen for implementation in the long term operation period aim at ensuring that the safety related structures, systems and components adequately perform their functions. The existing Management Plan for the activities under measures implemented during the long-term operation period of Units 5 and 6 was updated and put into action in 2024 as the Management Programme for activities under measures implemented during the long-term operation of Units 5 and 6. The measures in the programme which are related to safety are included in the scope of the Integrated Programmes of the units.

National action plan of the Republic of Bulgaria after the Fukushima NPP accident

A final report was prepared in October 2023, reporting on the implementation of all 78 measures of the Updated National Action Plan. All revisions of the National Action Plan of the Republic of Bulgaria after the Fukushima NPP accident and the final report on the plan implementation are published on the website of the NRA.

International Review Missions (IAEA, EC, WANO)

Kozloduy NPP is continuously striving to enhance the operational safety of the plant and use the experience of other NPPs in relation to the best international practices in nuclear energy field. In this respect within the period 2022-2024, Kozloduy NPP hosted the following international missions and peer reviews:

Technical Safety Review mission of the International Atomic Energy Agency (IAEA), conducted in the period 20 - 31 March 2023 at Kozloduy NPP

In March 2023, a Technical Safety Review (TSR): Probabilistic Safety Assessment (PSA) for the Updated Level 1 PSA study for units 5 and 6 of Kozloduy NPP was carried out as an important analytical tool for risk assessment and safety enhancement in nuclear power plant operation. The analysis covered the following areas: internal events, internal fires, internal floods and other internal hazards, seismic and all external hazards relevant for Kozloduy NPP site, other internal events and the multi-unit considerations in various plant operating states - full power, low power and shutdown reactor.

As a result of the overall review it was found that the scope, data used, models and approaches applied, as well as the results, in the PSA are in compliance with the IAEA safety standards and internationally recognised good practices. Recommendations were also made which are now reflected in the PSA.

ENSREG Topical Peer Review in the area of fire protection

In November 2020, ENSREG decided that the topic for the second TPR is fire protection. In this regard, the licensee carried out a national assessment in accordance with WENRA technical specifications during the period July 2022 - October 2023. In October 2023, NRA prepared a report based on the results of the assessment, which was submitted for peer review in the period November

2023 - mid 2024.

The results of the peer reviews were presented at an ENSREG workshop held in Luxembourg, which was attended by nearly 130 experts from nuclear operators, regulators, technical associations, international organisations and the European Commission. Bulgaria met the expected high level of performance, with good practices established in some areas and room for improvement in others.

In 2025, national action plans and an ENSREG common plan are to be developed. Follow-up inspections will then be carried out to monitor the implementation of the measures foreseen to enhance fire safety as a significant factor in the high level of safety of the European nuclear facilities.

Corporate Peer Review of WANO, conducted in the period 16 – 26 October 2023

The purpose of the Corporate Peer Review was to assess the interactions between the Bulgarian Energy Holding EAD and Kozloduy NPP EAD through analysing the underlying concepts, the objectives and tasks formulated, as well as the ways to carry out the related activities and the provision of resources (including staff, financing, technical support, etc.). The review also focused on other aspects of the activities performed at the corporate level related to ensuring nuclear safety. Four Areas for Improvement were identified as a result of the Peer Review.

Follow-up Peer Review of WANO, conducted in the period 13 – 17 November 2023

After an analysis of the results of the 2021 WANO Peer Review, a corrective action programme was developed based on areas for improvement identified during the peer review. The control over the implementation was carried out by a Coordination Council specially set up for that end, and it held 13 meetings in 2023. The report on the implementation of the corrective actions was included in the advance information package for the Follow-up Peer Review.

In the framework of the conducted WANO Follow-up Peer Review, a team of 4 experts from Slovakia, Russia and Ukraine traced the progress in the eight the areas for improvement identified during the Peer Review in 2021. Information was collected from observation of the implementation of activities, walkdowns of sites and facilities, interviews with specialists from various organisational units, as well as reviews of the documentation of the Kozloduy NPP.

The main findings of the Follow-up Peer Review are that three of the eight areas for improvement have been resolved (Level A) and that satisfactory progress has been achieved in the remaining five areas (Level B).

OSART Mission of the International Atomic Energy Agency (IAEA), conducted in the period 18 November – 05 December 2024 at Kozloduy NPP

The IAEA Operational Safety Review Team (OSART) for Kozloduy NPP reviewed ten areas: Leadership and Management for Safety; Training and Qualification; Operations; Maintenance; Technical Support; Operating Experience Feedback; Radiation Protection; Chemistry; Emergency Preparedness & Response, and Accident Management. The review team was composed of experts from Canada, Czech Republic, Finland, France, Germany, Netherlands, Spain, Sweden, UK, USA, and two IAEA staff members.

As a result of the mission, the team identified two recommendations, seven suggestions and four good practices.

A list of all international missions and reviews conducted at Kozloduy NPP in the last 5 years is presented in Appendix 2.

Construction of new nuclear facilities

Construction of new nuclear units at the Kozloduy NPP site

Unit 7 of Kozloduy NPP

The licensing procedure for the construction of Unit 7 of Kozloduy NPP was launched after the NRA granted a permit to Kozloduy NPP - New Build in 2013 for determining the location of a nuclear facility (site selection). In the period 2013 – 2015, the necessary surveys of potential sites were carried out, as a result of which Site 2 was identified as the most suitable for the construction of a new nuclear power plant. In February 2020, the selected site was approved by an order of the Chairperson of the NRA, which obliged the licensee to periodically reassess the characteristics of the selected site at least once every ten years, applying up-to-date methodologies and data to determine the parameters of external impacts of natural and technogenic origin and their effects on safety. On the basis of this requirement, Kozloduy NPP - New Build is expected to submit the results of a re-evaluation of the site characteristics to the NRA in order to confirm that the current safety requirements are met.

In order to proceed with the licensing procedure for the construction of Unit 7, it is necessary to submit an application to the NRAfor the issuance of a design permit, accompanied by the required documents to demonstrate the scope of the design activities and to specify the safety standards to be applied in the design of the nuclear facility.

Unit 8 of Kozloduy NPP

In October 2023, the Council of Ministers adopted a decision granting consent in principle under Art. 45 para 1 of the ASUNE for the construction of Unit 8 of the Kozloduy NPP. As a result of this decision, in February 2025 an application was submitted to the NRA together with the necessary documents for the issuance of a permit for the siting of a nuclear facility (site selection) for Unit 8. These documents are currently under review and evaluation by the NRA.

Belene NPP Project

No actions related to the implementation of the Belene NPP project were taken in the period 2022 – 2024.

Nuclear facilities shut down for decommissioning

Within this category of nuclear facilities fall Units 1 to 4 of Kozloduy NPP with WWER-440/B-230 reactors.

Statement regarding the status of the nuclear facilities

The results of the safety assessment of Units 5 and 6 of Kozloduy NPP and the implementation of the planned measures of the Integrated Programmes with the aim of continuously increasing safety give grounds for stating that the actions taken and planned by the Republic of Bulgaria are in accordance with the requirements of Article 6 of the Convention.

Article 7 Legislative and Regulatory Framework

1. Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of nuclear installations.

2. The legislative and regulatory framework shall provide for:

i) the establishment of applicable national nuclear safety requirements and regulations;

ii) a system of licensing with regard to nuclear installations and the prohibition of the operation of a nuclear installation without a licence;

iii) a system of regulatory inspection and assessment of nuclear installations to ascertain compliance with applicable regulations and the terms of licences;

iv) the enforcement of applicable regulations and of the terms of licences, including suspension, modification or revocation.

Article 7 (1) Establishing and maintaining a legislative and regulatory framework

Act on the Safe Use of Nuclear Energy

The fundamental Act in the field of safety of nuclear installations is the Act on the Safe Use of Nuclear Energy (ASUNE). The ASUNE regulates the public relations related to the state regulation of the safe use of nuclear energy and ionising radiation and the safe management of radioactive waste and spent nuclear fuel. The state regulation is effected by the NRA Chairperson who is an independent specialised authority of the executive power and has the competence as specified in the Act. The ASUNE was adopted in 2002 and has been brought into line with the international standards, including EU legislation. The ASUNE was amended and supplemented, taking into account the experience gained in law enforcement, the adoption of new EU directives on nuclear safety and radiation protection and the amendments in the Convention on Physical Protection of Nuclear Material. Afterwards the ASUNE was amended and supplemented in order to align it to Council Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom (Directive 2013/59/Euratom).

In 2024, significant amendments were adopted to the ASUNE (State Gazette, No. 27 of 29 March 2024), introducing:

Licence for operation not limited by time: A new regime according to which licences for the operation of nuclear facilities in which nuclear material is used, manipulated or stored shall not be limited by time. At the same the obligation to carry out a periodic safety review at least every ten years is retained within the scope of the current licence. This obligation is in compliance with the Nuclear Safety Directive (Directive 2014/87/Euratom), the international conventions on the safe use of nuclear energy and the IAEA standards.

The new provisions also regulate the possibility of revoking a licence in the event of non-compliance with the requirements of the law relating to periodic safety reviews. This provides a mechanism for continuous control and maintenance of a high level of safety at the nuclear facilities.

Related national legislation

According to the ASUNE, in addition to the Chairperson of the NRA, other bodies also exercise specialised oversight over facilities and activities related to the use of nuclear energy and ionizing radiation. In this regard, the Act explicitly identifies as competent authorities the Ministers of Health, Environment and Water, Interior, Defense, Agriculture, Transport and Communications,

Education and Science, and the Chairperson of the State Agency for National Security, who exercise oversight in accordance with their powers. Such powers have been granted by the following acts:

- Environmental Protection Act;
- Energy Act;
- Spatial Development Act;
- Health Act;
- Disaster Protection Act;
- Ministry of Interior Act.

International conventions and treaties

The Republic of Bulgaria is a Party to the Convention on Nuclear Safety, the Convention on Early Notification of a Nuclear Accident, the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, the Convention on the Physical Protection of Nuclear Material, the Vienna Convention on Civil Liability for Nuclear Damage, and the Additional Protocol to the Treaty on the Non-Proliferation of Nuclear Weapons.

The Agreement between Euratom and non-member states of the European Union on the participation of the latter in the Community arrangements for the early exchange of information in the event of radiological emergency (ECURIE) was signed by the Republic of Bulgaria in 2003 and ratified by law in 2005. In pursuance of the Agreement, the NRA Chairperson is designated as the central authority and contact point under the Agreement.

The national legislation of the Republic of Bulgaria has been harmonised with the European one and Bulgaria has been applying the recognised European good practices. The requirements of Council Directive 2009/71/Euratom establishing a Community framework for nuclear safety of nuclear installations, amended with Council Directive 2014/87/Euratom of 8 July 2014, have been introduced.

Article 7 (2) (i) National safety requirements and regulations

Secondary legislation

Article 5, para 17 of the ASUNE provides that the NRA shall develop and submit to the Council of Ministers (CM) for approval any secondary regulatory legislation associated with the law enforcement. The drafts of regulations and the annexes thereto are published on the NRA website and the portal for public consultations of the CM.

In conformity with the national legal requirements, the NRA policy statement confirms that the NRA updates the normative requirements in accordance with the development of international standards and the EU legislation, and develops regulatory guides and guidelines in areas where this is necessary. In pursuance of this policy, the NRA maintains a programme for review and update of the secondary legislation documents.

Two main secondary normative documents were amended and supplemented in the period 2022-2025:

- The Regulation on the Procedure for Issuing Licences and Permits for the Safe Use of Nuclear Energy has been brought into line with the new regime of licences not limited by time and periodic safety review requirements. Individual provisions have also been updated based on practical observations from the application of the regulation, with a view to increasing legal clarity, consistency with other regulations, and the effectiveness of the regulatory process;

- The Regulation on Ensuring the Safety of Nuclear Power Plants has been amended and supplemented to bring it into line with both legislative changes and the international standards of the IAEA and the updated reference levels of WENRA.

Guides issued by the regulatory body

The basic requirements on nuclear safety, radiation protection and physical protection of nuclear facilities are set out in the ASUNE and the regulations on its application that specify more detailed requirements. The regulations provide for the issuance, where necessary, of regulatory guidelines with instructions on their application.

The following regulatory guidelines were updated in the period 2022–2025:

- Guidelines on Deterministic Safety Analyses of Nuclear Power Plants with PWRs;
- Guidelines on Probabilistic Safety Analyses (PSA) of Nuclear Power Plants;
- Guide on Applying Probabilistic Safety Analysis in the Management of Safety in Nuclear Power Plants;
- Guide on Protection against Internal Fires in Nuclear Power Plants.

Activities for harmonisation of nuclear safety requirements

Being a member of the West European Nuclear Regulators Association (WENRA), the NRA participates with its representatives in activities in two working groups – the Reactor Harmonisation Working Group, and the Working Group on Waste and Decommissioning.

The NRA is an organization that actively participates in international peer reviews, various knowledge networks, supported by the IAEA, as well as those at the European level, and, since 2021, it has also been participating in the initiatives of the Nuclear Energy Agency (NEA) of the Organization for Economic Cooperation and Development (OECD).

Article 7 (2) (ii) System of Licensing

The ASUNE sets out a licensing regime to ensure the safety of facilities and activities taking into account the principles of transparency and equal treatment.

The ASUNE defines the scope of activities, facilities and materials subject to licensing. A license is issued for operation of a nuclear facility (a power unit of a nuclear power plant, facility for spent fuel management, facility for radioactive waste management, research reactor), as well as for decommissioning. The latest amendments to the ASUNE introduced the possibility of issuing licences not limited by time for the operation of nuclear facilities, subject to periodic safety reviews at least once every ten years. The new mechanism aims to maintain and improve the safety of nuclear facilities, while meeting the requirements of EU directives, international standards, and gained regulatory and operating experience. The Act sets out clear requirements for the operator regarding the conditions and criteria that must be met in order to obtain a licence, while avoiding subjectivity in decision-making by the regulatory body to the greatest extent possible.

For certain one-off activities, the Act provides for the issuance of permits in the following cases:

- selecting a location for a nuclear facility (siting);
- design of a nuclear facility;
- construction of a nuclear facility;
- commissioning of a nuclear facility;
- activities leading to modification of:

- structures, systems and equipment related to nuclear safety and radiation protection;
- limits and conditions for operation of a nuclear facility on the grounds of which the license for operation or decommissioning has been issued;
- internal rules for the implementation of the activity, including procedures, programmes, technical specifications and other documents, attached to the operating licence for a nuclear facility or to the licence for decommissioning.

- transport of nuclear material;
- transactions in nuclear installations and nuclear materials;
- import and export of nuclear material;
- transit of nuclear material.

The licence or permit, its amendment, or the refusal of the NRA Chairperson to issue the respective document are subject to appeal before the respective administrative court in accordance with the Code of Administrative Procedure.

The terms and procedure for issuance of licences and permits are defined in the Regulation on the Procedure for Issuance of Licences and Permits for the Safe Use of Nuclear Energy. According to this Regulation, the applicant has to submit documents confirming compliance with the requirements of nuclear safety and radiation protection, defined mainly in the regulations on the application of the ASUNE.

The Statutory Instruments Act gives the opportunity to members of the public for public consultation, including comments, proposals for amendments in the statutory acts published. The Access to Public Information Act gives the opportunity to stakeholders to receive information of public interest. In addition, the Environmental Protection Act requires public consultation on the results of the environmental impact assessment report for a nuclear facility.

Article 7 (2) (iii) System of regulatory inspection and assessment

Regulatory inspections

The ASUNE assigns to the Chairperson of the NRA the responsibility to exercise regulatory control over nuclear safety and radiation protection during use of nuclear energy and ionizing radiation and in radioactive waste management and spent fuel management. The controls shall include the:

- preventive control by issuing licences and permits for activities and individual licenses;
- on-going control over the compliance with the terms of licences and permits for activities, and individual licences;
- follow-up monitoring on the implementation of recommendations and prescriptions given by the control bodies.

In fulfilment of their control powers, the NRA Chairperson shall:

- perform periodic and extraordinary inspections through authorised officials;
- inform other specialised control authorities to take action within their competence range;
- alert the prosecuting authorities upon evidence of any crime performed;
- amend or revoke issued licences or permits, or individual licences;
- impose coercive administrative measures and administrative sanctions provided for by this Act.

The NRA Chairperson is entitled to request from individuals information about their activities; the necessary documents in respect to the regulatory oversight, and, if necessary, request the assistance of specialised control bodies.

The overall objective of the regulatory inspections and application of coercive measures is to ensure implementation by the operator of all activities in a safe manner and in accordance with the requirements, rules and regulations on nuclear safety and radiation protection. In pursuance of this objective the NRA annual inspections plan includes the areas of regulatory control identified by the ASUNE and the conditions of the currently effective licences and permits. The inspection activities are planned by taking into account the operational states of the nuclear facilities, the results from previous inspections, and planned modifications, i.e. coordination with the activities planned by the operators is ensured. Financing of the inspection activities is secured within the NRA budget framework.

The NRA strives to apply in its activities a non-prescriptive approach, therefore, of particular importance are the systematic contacts with licence holders and permit holders (in the case of Kozloduy NPP – daily contacts), in which issues are discussed in an open dialogue. The aim is to assist licence holders and permit holders in implementing the requirements of the law and secondary regulatory documents. Coercive administrative measures and sanctions provided by the Act are imposed only if all other possibilities have been exhausted. Discussions take place on a routine basis both at the Kozloduy NPP site, and the NRA headquarters, at the initiative of either of the two parties.

The NRA Chairperson authorises certain officials of the Agency administration (inspectors) to carry out control under the ASUNE, in accordance with their powers of authority. These inspectors have the right to:

- freely access the controlled persons and sites at any time, to check the status of nuclear safety, radiation protection and the technical condition of the nuclear facilities and the sources of ionizing radiation;
- require from the respective officials the necessary data, information, explanations, including other operational information, including on measurements and tests in order to clarify the technical conditions and the operational conditions of the facility, including staff qualification, and any other information related to ensuring the nuclear safety and radiation protection;
- issue acts for administrative violations in terms of this Act;
- make proposals to the NRA Chairperson for modification, suspension, termination or revocation of the permits, licences or individual licences issued;
- issue mandatory improvement notices for ensuring the nuclear safety and radiation protection.

The inspection results are recorded in an inspection report (report of findings), to which the evidences collected, explanations and results of observations, measuring and/or testing are attached. The improvement notices given by the inspectors implementing their authorities as per ASUNE are obligatory. The results of inspection and control activities of the NRA and the specialised control authorities are published in the NRA annual report, which is submitted to the Council of Ministers, state authorities, non-governmental organisations and the public.

Review and assessment of safety

The Agency carries out safety review and assessment both in the process of issuing licences or permits, and periodically, during the implementation of the activity. The process of review and assessment of documents supporting applications for issuance of licences/permits can be summarised in the following principal steps:

- determining a programme and a team of experts to review and evaluate the documentation and, in some cases, specifying of methodological instructions to perform the task;
- review and assessment of the applications and respective attachments for compliance with the requirements in force, and, where appropriate, with the relevant documents of the IAEA or other regulatory authorities. If necessary, the applicant is required to submit additional information for the assessment;
- summarizing and documenting the results of the review and assessment conducted and preparing a proposal for issuing the permit or for a reasoned refusal;
- final decision on the issuance of a permit or a motivated refusal.

In cases where the documents contain information, the assessment of which requires special knowledge, the NRA Chairperson may award contracts for additional review and assessment of these documents to be done by external consultants.

When, in the process of assessment, a non-compliance with the safety requirements is identified in the information submitted, detailed comments are sent to the applicant for their elimination. In such cases, it is a well established practice to organise meetings with representatives of the applicant in order to discuss and clarify questions and comments.

The ongoing inspection and assessment of the adherence to the requirements for nuclear safety and radiation protection, and the conditions of the licences for operation issued, is carried out through review of the licence holder's reports, and through in-situ inspections for compliance with the requirements for safe operation.

Analysis and evaluation of operational events

The requirements for providing information by the licence holder or permit holder, including the requirements for mandatory notification of the Agency in case of an event (deviation, incident or accident) are defined by the Regulation on the Conditions and Procedure for Notification of the Nuclear Regulatory Agency of Events in Nuclear Facilities, at Sites and in Activities involving Sources of Ionising Radiation, and during Transport of Radioactive Material. The Regulation specifies the cases when the regulatory body should be notified if the nuclear safety and radiation protection requirements have been violated. The regulation also defines the procedure and time limits for notifying the regulatory body, the methods for events evaluation and analysis, and the reports' structure and contents.

A written report is submitted for each event within 30 days of its occurrence. All operational event reports are reviewed and evaluated by the NRA inspectors. A working group has been established with the aim to evaluate the effectiveness of proposed and implemented corrective actions, as well as to define the final INES rating of each event. When necessary, additional information is requested or additional analyses and expert reviews are conducted in order to clarify the root causes of the specific event. If events important to safety have occurred, NRA inspectors take part in the commissions of the licence/permit holder for analysis and assessment.

Article 7 (2) (iv) Enforcement of applicable regulations

To prevent and discontinue administrative violations and to prevent and remedy the consequences thereof, the NRA Chairperson imposes sanctions (property sanctions and fines) and coercive administrative measures. The ASUNE specifies different amounts of the sanctions depending on the type of violation. The establishment of the violations, the issuance, the appeal and the execution of the writs of penalty shall be carried out in accordance with the procedure established by the Administrative Violations and Sanctions Act.

Coercive administrative measures shall also be imposed in case of breaches of requirements for nuclear safety and radiation protection, physical protection and emergency preparedness which

pose or create an imminent threat of causing an accident. Coercive administrative measures that may be imposed in these cases are:

- discontinuation or restriction of the activity for which a permit or licence has been issued;
- suspension of individual licences;
- an order to perform expert reviews, inspection or testing of an installation, facility, product, parts, systems or components thereof; modification of the established operating limits and conditions;
- an order for modifications to designs and structures relevant to nuclear safety;
- an order for supplementing or modifying curricula and courses and conducting additional training, including testing of staff knowledge and skills.

Coercive administrative measures are imposed by an order of the NRA Chairperson, based on a record of findings of the NRA inspectors. The order imposing coercive measures determines appropriate time limit for their implementation. The order for imposing coercive administrative measures may be appealed before the respective Administrative Court under provisions of the Code of Administrative Procedure. An appeal does not suspend execution, unless the court has ruled otherwise.

Any violation of the conditions of the permit or licence is considered an administrative violation whereof a fine or property sanction in an amount determined by the ASUNE is imposed to the person who committed the violation. Any breach or violation of permit or license conditions as per the ASUNE may give sufficient grounds for revocation of the licence or permit. Revocation of a permit or licence shall be made by a decision of the NRA Chairperson, which determines the terms and conditions under which the person may apply for a new permit or licence for the same activity.

The Agency resorts to coercive administrative measures and issue of writ of penalty orders solely when all other possibilities have been exhausted. The effectiveness of the regulator’s policy is confirmed by the small number of writs of penalty issued or coercive administrative measures imposed.

Article 8 Regulatory body

1. Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 7, and provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities.

2. Each Contracting Party shall take the appropriate steps to ensure an effective separation between the functions of the regulatory body and those of any other body or organization concerned with the promotion or utilization of nuclear energy.

Article 8 (1) Establishment of the regulatory body

Foundation

In 1957 Bulgaria ratified the Statute of the IAEA and became one of the co-founders of the international organisation. The year saw the setting up of a Committee for the Peaceful Use of Atomic Energy (CPUAE) with the mandate to monitor and direct the reasearch and development activities in the use of nuclear energy. After the commissioning of the first two units of Kozloduy NPP in 1975, the Committee was also assigned control functions. In 1980 a Decree on State Control of Nuclear Safety was published and assigned to the CPUAE. In 1985 the first Act on the Use of Nuclear Energy for Peaceful Purposes was adopted. The Act created a Committee on the Use of Atomic Energy for Peaceful Purposes (CUAEPP) and determined in detail its functions and tasks, setting up an Inspectorate on the Safe Use of Atomic Energy.

In 2002, a new Act on the Safe Use of Nuclear Energy was adopted, in line with current requirements in the field of nuclear legislation. The Act takes into account the practices of European Union countries in this area, as well as the recommendations of the IAEA experts who evaluated the draft. As per this Act, the CUAEPP was transformed into an independent regulatory body – the Nuclear Regulatory Agency.

Legal basis and status of the regulatory body

The status and responsibilities of the NRA are set by the ASUNE. The state regulation of the safe usage of nuclear energy and ionizing radiation and the safe management of radioactive waste and spent Nuclear fuel is effected by the NRA Chairperson. The Agency is an independent specialised body within the executive power.

The NRA Chairperson is approved by the Council of Ministers and appointed by the Prime Minister for a 5-year mandate and may be appointed for one more term of office. In exercising their powers, the Chairperson is assisted by two deputy-Chairpersons, who are approved by the Council of Ministers and appointed by the Prime Minister, upon a proposal of the NRA Chairperson.

Mission and objectives

The regulatory functions performed by the NRA in the public interest determine the organisation's mission, namely: "Protection of the individuals, public, future generations and environment from the harmful effects of ionising radiation". To achieve its mission the NRA is guided by the internationally accepted principles of nuclear safety and radiation protection and constantly strives to improve its effectiveness through implementation of internationally recognised regulatory best practices.

In accordance with the goals, plans, priorities and expected tasks, the NRA develops a three-year strategic plan for its activity. It is the basis for the preparation of the annual plans, which define the scope and the objectives of NRA activities for the respective year. The strategic plan is periodically updated as a result of a change in priorities and goals of the organisation or as a result of the risk analysis.

The organisation's priorities and expectations to the staff are set in the Policy Statement of the Management.

Authorities and responsibilities

Under the ASUNE, the NRA Chairperson has the following authorities and responsibilities:

- manage and represent the Agency;
- issue, amend, supplement, renew, suspend and revoke licences and permits for the safe conduct of activities under the ASUNE;
- supervise compliance with the requirements and standards for safe use of nuclear energy and ionizing radiation, radioactive waste management and spent nuclear fuel management and the conditions of the licences and permits issued;
- issue, terminate and withdraw individual licences for carrying out activities in accordance with the ASUNE;
- impose mandatory administrative measures and administrative penalties as provided by the ASUNE;
- contract expert reviews, studies and research, related to nuclear safety and radiation protection, in respect of the use of nuclear energy and ionising radiation, and management of radioactive waste and spent nuclear fuel;
- interact with the executive authorities, which have been granted regulatory and supervisory functions in respect of the use of nuclear energy and ionizing radiation, and propose to the Council of Ministers measures to coordinate these activities;
- carry out the international cooperation of the Republic of Bulgaria in the area of the safe use of nuclear energy and ionising radiation, and the management of radioactive waste and spent nuclear fuel;
- provide the citizens, legal entities or state authorities with objective information on the state of nuclear safety and radiation protection;
- submit annual reports to the Council of Ministers on the state of nuclear safety and radiation protection concerning the use of nuclear energy and ionising radiation, and in the management of radioactive waste and spent nuclear fuel as, as well as the activity of the NRA;
- organise and coordinate the preparation of and submit to the Council of Ministers, the reports under the Convention on Nuclear Safety and the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management;
- organise and coordinate the implementation of the Bulgarian obligations under the Agreement between the Republic of Bulgaria and the International Atomic Energy Agency for the application of the safeguards, in connection with the Non-proliferation treaty of nuclear weapons and the additional protocol;
- perform the functions of a central authority and contact point for emergency notification and assistance under the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency;
- act as the competent authority, point of contact, and coordinator under the Convention on the Physical Protection of Nuclear Material;
- develop and propose for adoption by the Council of Ministers the regulations on the implementation of the ASUNE;

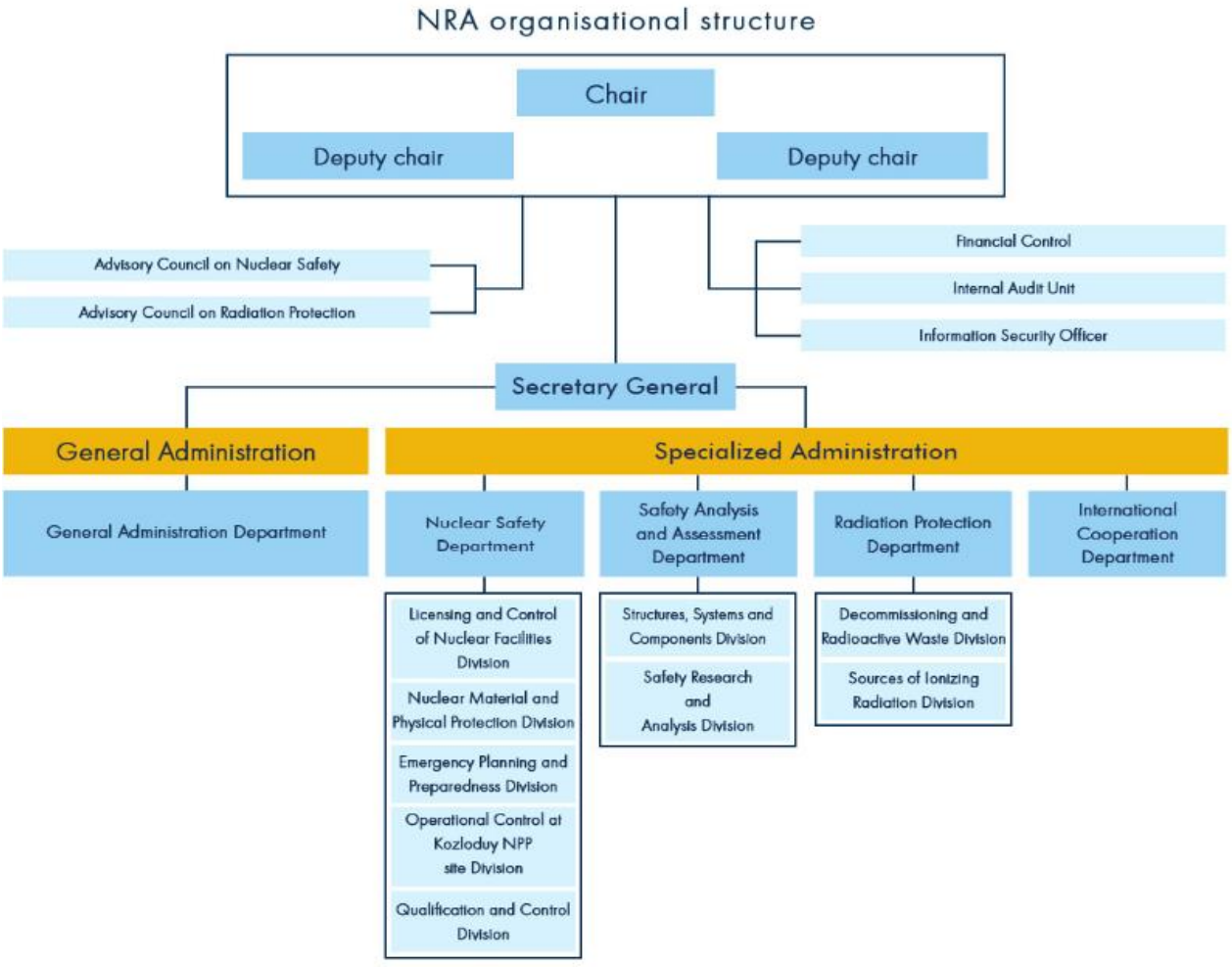
- within the limits of its powers, provides to competent institutions the information intended by the Treaty establishing the European Atomic Energy Community (EURATOM).

The ASUNE identifies as essential functions of the NRA the licensing activities, implementation of regulatory control, safety reviews and analyses, development of regulatory requirements, maintaining emergency preparedness, issuing of individual licences, and international cooperation of Bulgaria in the area of its competence. In addition, the Act states that the NRA Chairperson may have other specific authorities when conferred upon him/her by normative acts.

Organisational structure

The structure, operation and organisation of work of the Agency and its human resources are determined in the NRA Rules of Procedure, adopted by the Council of Ministers upon proposal of the NRA Chairperson.

The NRA's structure is consistent with the Administration Act, which sets out uniform requirements for the structure of the state authorities administrations and takes account of all the fields of activity of the regulatory body, in conformity with the powers vested to the Chairperson by the national legislation. The NRA Administration is headed by Secretary General. The NRA employees are divided into general and specialised administration. The General Administration provides technical support to the activities of the Specialised Administration and carries out administrative services to citizens and legal entities. The Specialised Administration is organised into four Directorates and assists the Agency Chairperson in carrying out his/her regulatory and supervisory functions related to nuclear facilities, sources of ionising radiation, nuclear material, radioactive waste, emergency preparedness and international cooperation and includes a regional office at the Kozloduy NPP site. The NRA organisational structure is shown on the figure herein.



Development and maintenance of human resources

The responsibilities of the NRA staff members to the public determine the higher demands on their qualifications and experience, which are accurately and clearly defined for each particular position. Most of the Agency's employees have many years of professional experience in the field of regulation, design, construction and operation of nuclear facilities and facilities with sources of ionising radiation.

According to the Rules of Procedure, the NRA has 114 statutory positions, with 101 positions actually occupied in the end of 2024. Ninety-two percent of all employees of the NRA are university graduates, as the average professional experience of the specialised administration officers exceeds 20 years.

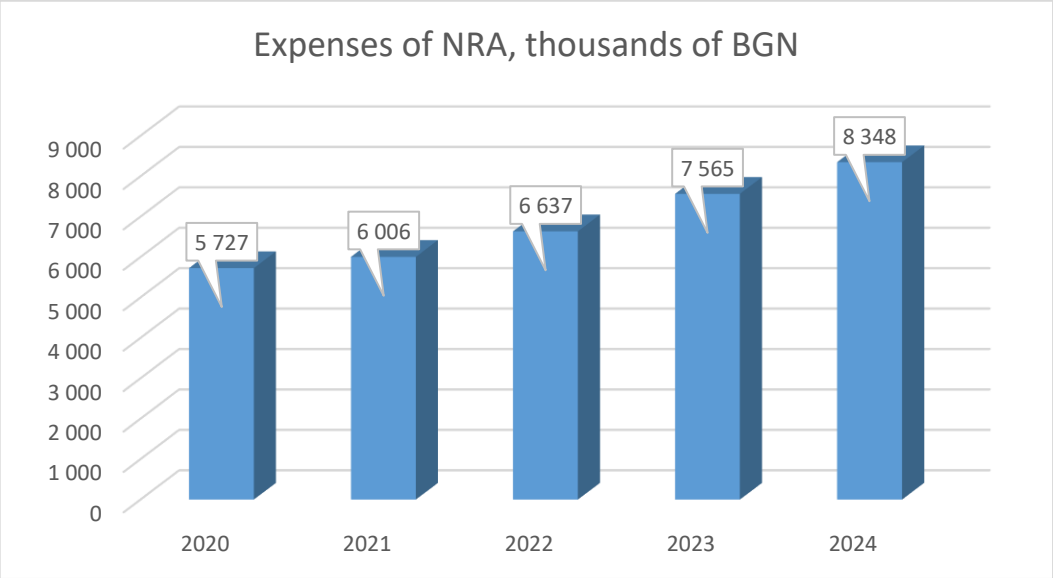
In compliance with the staff training and qualification system applied at the NRA, specialised training is held to maintain and improve the qualifications of the employees, including the acquisition of additional professional knowledge and skills. A specialised training plan is approved annually for the NRA employees.

Each new employee undergoes initial training, with an individual training plan developed based on the job description. The training includes theoretical training, practical training, and mentoring.

The Agency has a policy of attracting university students by offering internship programmes.

Financial resources

The Safe Use of Nuclear Energy Act creates preconditions for the financial independence of the regulatory body. The activities of the NRA are financed by the state budget and from the proceeds from fees collected under the ASUNE. The NRA Chairperson is a first-level budget spending unit and draws up its own budget in accordance with the Public Finance Act. As a result, the financing of the regulatory body in recent years has been steady.



Quality Management System

The NRA implements an Integrated Management System (IMS) that brings together all the interconnected elements of the organisation – structure, resources, processes (working practices) and organisational culture, which interact to help carry out the policy and achieve the goals of the NRA in an efficient and effective way. The processes required to implement the policy and achieve the NRA goals are defined and documented. The hierarchy, consistency and interaction of processes

and activities within the organization are defined to ensure comprehensive control and consistency of the decision-making process.

The IMS of the NRA provides conditions for maintaining and developing an organisational culture that is demonstrated in the personal attitude and commitment of each individual to safety issues as a priority for achieving the organisation's goals.

The IMS processes are structured in three groups:

- ***management processes*** – these are aimed at leading and managing the organisation, controlling the main and supporting processes, and the effectiveness and efficiency of the management system, e.g. Policy, strategy and planning; Risk management; Evaluation and improvement of the IMS;
- ***main processes*** – they are of strategic importance, they accomplish the NRA mission and are critical for the achievement of the set goals, e.g. nuclear safety control; control of safety at work with sources of ionising radiation; development of regulatory requirements; control of specialised training and issuance of certificates of competence; development of regulations and guidelines; coercive measures; emergency preparedness, etc.;
- ***support processes*** – they create the conditions for carrying out the main processes and provide technical administrative support activities, e.g. professional capacity management; financial management and control; infrastructure management; controlled document management; management of products and services from external suppliers and international cooperation.

The management system is described in documents structured in three levels.

Level 1 documents are strategic and formulate the mission, policy and goals, present the organisational structure, powers and responsibilities of the managers, the functions of the administrative units, contain an overview of the management system and include: policy statement; management system manual; strategic plans; orders defining the functions and numbers for administrative units.

Level 2 documents (procedures, instructions, guides, plans, programmes, etc.) are aimed at achieving the goals of the strategic documents. They regulate the implementation of processes, define responsibilities and lines of communication, providing administrative guidance to managers at different levels.

Level 3 documents are records that register the results of process execution.

The effectiveness of the IMS is monitored and measured to assess the degree of adequacy of the defined processes of the objectives set and to identify opportunities for improvement. For this purpose, internal audit, self-assessment, management review are used, non-conformances are identified and managed, and corrective actions are taken.

At the beginning of 2019, the Agency was successfully certified under ISO 27001:2013 - Information Security Management System, with the certificate being reissued in 2022. The NRA maintains and continuously improves the information security management system.

Openness and transparency

The public is sensitive to the topics related to the use of nuclear energy and radioactive waste management. In pursuit of its main priority – ensuring nuclear safety and radiation protection, the Agency adheres to fundamental principles such as transparency, impartiality in its work, and open dialogue with all stakeholders. The Nuclear Regulatory Agency's public communication is aimed at strengthening trust and establishing its image as an independent regulatory body with effective mechanisms for reporting on its activities to the public.

The Agency provides information to stakeholders in accordance with the Access to Public Information Act.

On its website, the NRA provides transparent, timely, and accurate information on nuclear safety and radiation protection, operational events at nuclear facilities, and its overall activities. Public registers are maintained of licences and permits issued for nuclear facilities and activities with sources of ionizing radiation (SIR), licences to conduct specialised training, and individual licences to implement activities with SIR or work in nuclear facilities. The annual reports of the NRA are also published, as well as national reports in fulfilment of the obligations arising from the conventions to which the Republic of Bulgaria is a party.

The Agency regularly publishes on its social media profiles useful information and news and reports on important events related to nuclear safety and radiation protection.

External technical support

In order to strengthen internal expertise in specific technical areas, the NRA commissions external technical support organisations to perform independent analyses, reviews, and safety assessments. In such cases, regulatory decisions are taken by the Chairperson of the NRA.

The Agency provides the human and financial resources necessary for the effective operation of the technical support system through:

- full-time experts within the regulatory body who are competent and capable of performing regulatory reviews and assessments;
- full-time experts who are trained and capable of evaluating reports on assigned analyses, reviews, and safety assessments;
- sufficient financial resources to use technical assistance from other organisations;
- access to new developments in science and technology for the NRA staff;
- continuous improvement of staff competence, through training and education programmes, as well as participation in international research and exchange programmes, etc.

During this period, the most significant support from an external organisation was received in connection with the licensing of a new type of nuclear fuel for Unit 5 of Kozloduy NPP.

Advisory Councils

Two advisory councils have been established to the Chairperson of the NRA under the provisions of Article 9, para. 1 of the ASUNE:

- Advisory Council on Nuclear Safety;
- Advisory Council on Radiation Protection.

The advisory councils support the NRA Chairperson by giving opinions on the scientific aspects of nuclear safety and radiation protection. These opinions are advisory in nature, while the full responsibility for the regulatory decisions rests with the NRA.

The Advisory Councils include prominent Bulgarian scientists and experts in the field of nuclear energy and ionising radiation, management of radioactive waste and spent nuclear fuel; however there are no representatives of licence holders. The members of the Advisory Councils have extensive academic, research and operational experience in various aspects of nuclear safety and radiation protection, nationally and internationally.

Article 8 (2) Status quo of the regulatory body

The regulatory body within the governmental structure

In terms of Article 4 of the ASUNE and Article 19, para. 4 of the Administration Act, the Chairperson of the Nuclear Regulatory Agency is considered an executive authority. As such, the Chairperson annually submits to the Council of Ministers a report on the status of nuclear safety and radiation protection in the use of nuclear energy and ionising radiation, and radioactive waste and spent fuel management, as well as on the activities of the Agency. As an independent regulatory body within the system of the executive power, the NRA Chairperson reports directly to the Prime Minister of the Republic of Bulgaria.

Article 9 Responsibility of the licence holder

Each Contracting Party shall ensure that prime responsibility for the safety of a nuclear installation rests with the holder of the relevant licence and shall take the appropriate steps to ensure that each such licence holder meets its responsibility.

Formulation in legislation of the licence holder's prime responsibility for safety

The full responsibility of the licence holder to ensure the safety of the nuclear installations is regulated by the Act on the Safe Use of Nuclear Energy (ASUNE), the Regulation on Ensuring the Safety of Nuclear Power Plants and the Regulation on the Procedure for Issuing Licences and Permits for Safe Use of Nuclear Energy. The other regulations on the implementation of ASUNE define the responsibilities in specific areas: management of radioactive waste, management of spent nuclear fuel, emergency planning and preparedness, physical protection, NRA notification for events in nuclear installations or with sources of ionising radiation.

The underlying principle in the ASUNE states that "nuclear energy and ionising radiation shall be used in accordance with the requirements and principles of nuclear safety and radiation protection, to ensure the protection of human life, health and living conditions of present and future generations, environment and valuables from the harmful effects of ionising radiation". The principle that when using nuclear energy "the responsibility for ensuring nuclear safety and radiation protection, rests in full with the persons responsible for the facilities and the activities, and may not be delegated to other persons" was introduced.

According to the Regulation on Ensuring the Safety of Nuclear Power Plants "The operating organisation bears the full responsibility of ensuring safety, including when other entities implement activities or provide services to the nuclear power plant, as well as in relation to the activities of the specialised regulatory authorities in the field of nuclear energy and ionising radiation." The same Regulation requires the operating organisations to establish organisational structure for the safe and reliable operation, with clearly defined responsibilities, powers and lines of interaction of the staff involved in ensuring and control of safety. The changes in the organisational structure that are important to safety shall be justified in advance, systematically planned, and evaluated after their implementation.

The Regulation on the Procedure for Issuing Licences and Permits for Safe Use of Nuclear Energy describes the general conditions for the implementation of the main activity of the licence holder. Each licence issued for nuclear facility operation determines the type and scope of activity, the main requirements for its implementation, the obligations to maintain adequate financial, human and other resources and specific requirements that must be provided in respect of:

- nuclear safety, radiation protection, physical security, quality assurance, emergency preparedness, management of radioactive waste and of nuclear material, notification of regulatory body in deviations and accidents;
- providing information to the regulator about: the operations, including fulfilment of licence conditions; the procedure for notification in case of a change in the circumstances under which the licence was issued;
- the obligations of the licence holder in connection with the regulatory control, carried out by the NRA, the applicable legislation, interfaces with other permits or licences, etc.

For issuing a permit or a licence, the applicant has to demonstrate that it has adequate organisational structure to maintain high level of safety, has developed a system for high level of safety culture, and has ensured compliance of facilities and declared activities with the requirements, rules and regulations on nuclear safety and radiation protection. Any amendment to the Rules of Organisation and Operation of the licence holder is subject to authorisation by the NRA.

Description of the principal means whereby the licence holder bears the prime responsibility for safety

The management system defines the responsibilities, powers and lines of interaction of the staff, who carry out activities related to ensuring and monitoring of safety.

In order to achieve full compliance with the set legal requirements, the licence holder's responsibilities were distributed through the management and organisational structure and internal organisational documents of Kozloduy NPP. The Rules for the Organisation and Operation of Kozloduy NPP specify the principles for the overall company organisational structure, management bodies, levels of management and their functions, responsibilities and tasks of different organisational units and lines of interaction. The staff responsibilities are defined by job descriptions for each work place, and for the operating personnel – with job procedures. Safety management is integrated in the Management System (MS) of the Company. Kozloduy NPP EAD Management System Guide defines the responsibilities, powers and relations in the execution of processes and activities of the management system. The procedure for making organisational changes related to the administrative and organisational structure and the management system is set in the Quality Rules for the Management of Organisational Changes at Kozloduy NPP EAD. The rules define the criteria for assessing the impact of changes on safety, responsibilities for planning, execution and analysis of the consequences of the amendments made. The internal control and coordination to ensure safety in the company as a top priority, compliance with regulatory requirements and licence conditions is ensured by the Safety and Quality Directorate, whose functions, tasks and responsibilities are described in Article 10, Safety Management section. The responsibilities and financial obligations of the licence holder to manage radioactive waste and spent nuclear fuel, the activities for decommissioning and the liability for nuclear damage are described in Article 11 (1).

Description of the mechanism whereby the regulatory body shall ensure that the licence holder bears the prime responsibility for safety

The ASUNE unequivocally determines that in the use of nuclear energy, sources of ionising radiation and in the management of radioactive waste and spent nuclear fuel, nuclear safety and radiation protection have priority over all other aspects of this activity. One of the main principles for achieving the priority of safety laid down in the Act is that the responsibility for ensuring nuclear safety is borne in full by the licence holder and cannot be transferred to other entities.

The mechanism for implementing the specified requirements is laid down in the regulatory control carried out, which includes:

- preventive control, consisting of the application of an authorisation regime related to the issuance of licences for the performance of a long-term activity (operations and decommissioning), and permits to perform one-time activities, such as site selection, nuclear facility design, commissioning, design modifications of structures, systems and components, changes in internal rules for the implementation of the activity (procedures, technical specifications), attached to the licence for operation, and others;
- current and subsequent oversight, consisting of checking the fulfilment of the conditions of the issued licences and permits, as well as the recommendations and prescriptions made from the inspections carried out.

Description of the mechanisms whereby the licence holder maintains transparent and open communication with the public

An important priority for Kozloduy NPP is the public dissemination of accurate and up-to-date information about the state and activities of the plant to the media, the general public and all other interested parties in compliance with the principles of openness and transparency. The aim is to increase trust and public acceptance of Kozloduy NPP and nuclear energy, as well as to promote

the role of the nuclear power plant as a safe, reliable and environmentally friendly electricity producer and a responsible corporate member of society. Information about events in the nuclear facilities is disseminated in a timely manner, including on the company's website.

A number of well-established mechanisms are used to maintain open and transparent communication with the public which include:

- maintaining up-to-date information on the website regarding safety and the state of the facilities;
- maintaining an official social media profile for the NPP;
- maintaining active media relations through press releases with up-to-date information, press conferences and briefings upon any occasion demanding provision of information;
- issuing annual reports presenting the overall activity of Kozloduy NPP;
- conducting Doors Open Days and organising group or individual visits for Bulgarian and foreign citizens, pupils and students;
- working meetings, workshops, round tables, public discussions with partners from the country and abroad, with representatives of NGOs, the media and the public;
- preparation and dissemination of print and information publications, including ones targeted at children;
- holding public opinion polls on the level of public acceptance of the plant's activities.

Description of the mechanism whereby the licence holder is provided with the necessary resources and authority for the effective management of accidents on site and mitigation of the consequences thereof

The organisational structure of Kozloduy NPP EAD has established a separate department – Emergency Preparedness (EP), which is responsible for keeping the Kozloduy NPP on-site Emergency Plan and the pertaining procedures and instructions up-to-date; ensuring and maintaining emergency and technical equipment, automated information systems, systems and means of communication in the On-site Emergency Response Centre (ERC) and the Off-site Emergency Response Centre in the town of Kozloduy; emergency kits; developing and conducting emergency drills and exercises.

The assessment of the adequacy of the existing organisational measures, technical means, and human resources at the Kozloduy NPP site for emergency response and accident management is carried out through periodic self-assessment of the Emergency Preparedness and Severe Accident Management area in accordance with specific criteria of the IAEA and WANO, as well as through the conduct of drills, emergency exercises, general national and fullscale emergency exercises. Conducting emergency exercises and drills is a basis to make a comprehensive assessment of the adequacy of the stipulated requirements for the established emergency organisation of the actions included in the emergency plan, adequacy of managerial and technical staff, and adequacy of the technical means on site. The adequacy of emergency stocks, such as mobile equipment, emergency kits, radiation instruments, batteries, cables, oils and diesel fuel, is also assessed. Funds to maintain emergency preparedness and measures for improvement after conducted exercises are included in the Investment Programme which is part of the Company's Business Plan, and Kozloduy NPP management team applies a uniform resource management policy to all processes and activities with key priority in terms of safety.

The ASUNE defines an obligation to maintain property insurance that covers nuclear damage liability limited to BGN 96 million. Kozloduy NPP EAD maintains a permanent financial guarantee covering the nuclear damage liability, annually concluding a contract for General Civil Liability insurance with a national nuclear insurance pool.

The Disaster Protection Act (DPA) provides for the financing of post-accident recovery activities. The support and recovery in case of accident includes providing urgent and recovering support to the victims and carrying out urgent recovery works. The urgent support is organised, ensured and provided by the mayors of the municipalities (for more information, see Article 11).

Article 10 Priority to safety

Each Contracting Party shall take the appropriate steps to ensure that all organizations engaged in activities directly related to nuclear installations shall establish policies that give due priority to nuclear safety.

Review of regulatory requirements regarding the licence holder's policies and programmes to prioritise safety in the design, construction and operation of nuclear installations

The Act on the Safe Use of Nuclear Energy (ASUNE) specifies the basic principle that nuclear energy and ionising radiation are used in accordance with the requirements and principles of nuclear safety and radiation protection in order to ensure the protection of human life, health and living conditions of current and future generations, the environment and material values from the harmful effects of ionising radiation. Nuclear safety and radiation protection take priority over all other aspects оф the use of nuclear energy and ionising radiation.

The Regulation on Ensuring the Safety of Nuclear Power Plants requires the operating organisation to ensure safety in the site selection, design, construction, commissioning, and operation of the nuclear power plant in accordance with the requirements of the ASUNE and the regulations for its implementation, as well as in accordance with the conditions of the permits and licences for operation issued by the Chairperson of the NRA. The operating organisation is required to adopt a document, Safety Policy, based on which it puts the highest priority to safety in all activities, demonstrates a clear commitment to continuously improve safety, stimulates personnel for a critical attitude to the work they perform, supports and encourages mindsets and behaviours which facilitate a high level safety culture.

The Safety Policy provides for the issue of procedures on its implementation and monitoring of activities that have an impact on safety. The Safety Policy sets clearly phrased safety goals and intentions that can be easily controlled and tracked by the management of the operating organisation. The Safety Policy shall require continuous enhancement of nuclear safety by means of:

- a continuous process of reassessment of the safety of the nuclear power plant taking into account operating experience, safety studies and analyses, and research and development achievements;
- timely implementation of feasible improvements;
- timely application of important new information related to the nuclear power plant safety.

In accordance with the safety policy, the operating organisation shall adopt interrelated long-term objectives and strategies, as well as short-term objectives and plans, and quantitative indicators applied at different levels within the operating organisation shall be used to assess their implementation. This requires the development and implementation of a system for continuous monitoring of safety and performance of activities, which includes systematic self-assessment at all levels within the operating organization. Monitoring and self-assessment should determine the level of safety achieved in the performance of activities and identify any signs of a decline at that level. The monitoring scope shall cover personnel behaviour and attitude towards safety, violations of the operational limits and conditions, operational instructions, regulations and provisions of the operating licences. Relevant safety indicators shall be developed and implemented enabling managers to detect and correct any weaknesses and deviations in the safety management. Based on the monitoring and review of the safety indicators, corrective actions shall be identified and implemented, and their implementation shall be subject to control and assessment.

Actions taken by the licence holder to meet regulatory requirements for priority of safety

Kozloduy NPP

Licence holder's policies prioritising safety in the performance of activities

The intentions for the Kozloduy NPP long-term management are expressed in the Kozloduy NPP EAD Management Policy Statement and in the Company's Management Policy. Management priorities are developed and substantiated, with specific goals and principles, in separate policies of Kozloduy NPP EAD:

- safety management policy;
- environmental management policy;
- occupational health and safety management policy;
- security management policy;
- quality management policy;
- business and financial management policy;
- personnel training and qualification policy;
- fire safety management policy;
- human resources management policy.

Safety policy

The top priority for Kozloduy NPP EAD is nuclear safety and radiation protection in the context of long-term operation of nuclear facilities, and this priority is enshrined in the Safety Management Policy.

The Safety Management Policy is aimed at achieving the objectives related to ensuring nuclear safety, effective protection of personnel, the public, and the environment from the harmful effects of ionising radiation, safe management of fresh and spent nuclear fuel, safe management of radioactive waste, and continuous safety culture enhancement.

Managers at all levels of management at the nuclear power plant are committed to ensuring and improving safety by demonstrating leadership and a high level of safety culture, developing, encouraging, and supporting personnel thinking and behaviour which results in a high level of safety culture in the performance of activities, and contribute to the effectiveness of the company's management system.

Safety culture development programmes, (discussion of safety culture enhancement measures)

Maintaining and enhancing the level of safety culture is subject to a continuous, systematic approach applied at Kozloduy NPP EAD. This approach involves periodic assessment of the safety culture status, annual planning of activities to enhance it, active involvement of all staff members in those activities and fostering a responsible attitude. A high level of safety culture is achieved by establishing safety as a core value and a personal need for its continuous improvement, personal example set by the managers and contribution of each member of the staff.

In order to systematise and support the work, the Company has established the following documents:

- "Safety Rules. Development and maintenance of values that promote a positive safety culture at Kozloduy NPP EAD";

- “Safety Rules. Continuous safety culture enhancement at Kozloduy NPP”;
- “Methodology. Safety culture self-assessment at Kozloduy NPP EAD”, and
- “Handbook of the leader at Kozloduy NPP EAD”.

The organisation and implementation of the activities is carried out by the Safety Culture Committee which is headed by the Safety and Quality Director. The company has a Safety Culture Group, which is part of the Operating Experience Department.

Annually, a plan for the work of the Safety Culture Committee is prepared and approved, where goals are set with a deadline for implementation within the calendar year. Safety culture enhancement programmes set medium-term goals immediately after conducting a safety culture self-assessment.

The Safety Culture Committee holds regular meetings to present the status of measures to maintain and enhance safety and to monitor their implementation. In addition to the implementation of plans and programmes to improve safety culture, these meetings also review current information and issues related to safety culture, information from operating experience in the field (internal and external), as well as information and good practices resulting from benchmarking.

The activities carried out in the field of safety culture are described in an annual report, which is included in the company’s annual report on the status of nuclear safety and radiation protection and the management review of the management system. This report is also submitted to the Nuclear Regulatory Agency.

Safety management

Methodical guidance, coordination and control for ensuring and maintaining safety at Kozloduy NPP are facilitated by the Safety and Quality Directorate which is directly subordinate to the Kozloduy NPP Chief Executive Officer. The above Directorate, represented by two departments – “Safety” and “Quality”, exercises control and monitoring in the following areas:

- nuclear safety;
- safety in the management of SNF and RAW;
- radiation protection;
- fire safety;
- technical surveillance;
- emergency planning and preparedness;
- providing health and safety at work;
- radiological monitoring of the industrial site and environment;
- authorisation regime regarding the use of nuclear energy and nuclear material.

The Directorate performs the following basic functions:

- drafts the safety management policy and keeps it up to date;
- organises and participates in the drafting and review of internal governing and working documents, training programmes and materials in the areas being controlled;
- conducts intra-departmental control in the areas of safety and issues binding prescriptions;
- analyses and evaluates the general state of safety by periodically preparing reports, develops measures to maintain and enhance safety and safety culture;

- organises the entire process for obtaining the required permits and licences in accordance with the ASUNE, controls the compliance with the provisions set therein and reports them to the NRA;
- administers the activities of the Safety and Quality Committee and Safety Culture Committee.

Kozloduy NPP applies a graded approach to ensure that requirements for a product (equipment, structure, system, component, service) or process activity are commensurate with their relative importance, complexity, and potential impact on safety, quality, environment, occupational health and safety, productivity, costs, and stakeholder expectations.

An assessment is made of the impact of activities outsourced to external organisations on safety, independent control of the implementation of the conditions of the permits issued for the implementation of plant modifications, monitoring of activities affecting nuclear safety, nuclear security, and safety culture, and an assessment of any organisational change regarding its impact on safety.

Control is exercised over the implementation of:

- Integrated programme for the implementation of measures to improve safety of Unit 5 for the period 2017-2027;
- Integrated programme for the implementation of measures to improve safety of Unit 6 for the period 2019-2029;
- Integrated programme for the implementation of measures to improve safety of the WSFSF for the period 2024-2034;
- Emergency Plan of Kozloduy NPP;
- Radiological Monitoring Programme;
- Site monitoring programme, etc.

In compliance with the conditions of the licences for the operation of nuclear facilities issued, monthly reports on the safety status at Kozloduy NPP, biannual and annual reports on the implementation of safety measures are submitted to the NRA.

Independent safety assessments

An independent assessment at Kozloduy NPP EAD is conducted periodically on behalf of senior management and is used:

- to ensure objective assessment of the compliance of the processes and activities performed with the applicable regulatory requirements and internal requirements of the management system;
- to assess the effectiveness of processes in terms of achieving the set goals and implementing the resulting strategies and plans;
- to determine the adequacy of the work performed and its management;
- to assess leadership practices and the safety culture of the personnel;
- to control the quality of the activities performed and the results of these activities;
- to identify opportunities for improvement.

The independent assessment is internal and external. Internal independent assessment is conducted by separate organisational structural units with control functions with a certain degree of independence which perform control for adherence to the requirements of the international and national regulatory documents and standards in nuclear safety, radiation protection, quality

assurance, environment, fire safety, industrial safety, technical surveillance and metrology assurance areas. External independent assessment is conducted by the NRA and other supervisory bodies, as well as by international organisations at the invitation of Kozloduy NPP EAD. The results of the internal and external independent assessments are provided to the management for taking the necessary corrective actions and improvement measures.

Safety culture enhancement measures

One of the approaches to safety culture development is to conduct a review and assessment of its status. At Kozloduy NPP, a safety culture self-assessment is periodically carried out in several stages:

- preparation and planning of the self-assessment – resources, activities, deadlines, responsibilities;
- data collection using qualitative and quantitative methods – document review, observations, interviews, focus groups and surveys;
- summarising and analysis of collected data;
- identification of strengths and areas for further improvement;
- preparation of a corrective action programme to enhance safety culture.

A Safety Culture Self-Assessment Methodology has been developed at Kozloduy NPP in compliance with the IAEA Safety Culture Assessment Methodology. The document stipulates the performance of a complete self-assessment once every three years, and, if necessary, a partial one in a shorter period of time, using specific methods or for specific administrative units.

In fulfilment of the WANO requirements, self-assessment of the nuclear safety culture was also conducted periodically from 2017 to 2023 by means of a survey using a questionnaire prepared in accordance with “WANO PL 2013-01 Traits of a Nuclear Safety Culture”.

Since 2024, Kozloduy NPP has adopted a unified safety culture model that meets the requirements of the IAEA and WANO, according to which, in accordance with the approved methodology, the safety culture in the Company is to be assessed.

At the end of 2024, preparatory activities were launched for the fifth consecutive self-assessment of the safety culture at the plant, using the full range of data collection methods. As a first step in these activities, training was provided to the self-assessment team. Activities related to questionnaires and interviews, focus groups, and interviews with the personnel at their work places have begun.

The activities included in the programmes from the self-assessments conducted are not the only ones aimed at improving the safety culture. The functions of the Safety Culture Committee include the implementation of current projects and tasks as well as the discussion of emerging cases related to safety culture and human performance. Committee members and Safety Culture Group members are involved in the development and update of training and information materials, focus groups, conduct of training and interviews with the personnel at their work places. In accordance with a decision by the Safety Culture Committee, a human performance review bulletin is prepared and published monthly on the company’s internal network. This bulletin represents feedback from personnel performance, which emphasizes ensuring and maintaining the safety and reliability of the nuclear power plant and opportunities for improvement.

A practice has been established to exchange experience with the aim of increasing the quality of performance in a number of areas related to safety culture, operating experience, human factor and human performance, personnel motivation, risk assessment, etc.

Since the beginning of 2023, a series of training workshops, meetings, and support missions have been held by WANO and the IAEA, aimed at familiarising participants with the concepts of

leadership and human factors in the nuclear industry, based on the best practices and recommendations of the association's members:

- Leadership, Management and Culture for Safety;
- Safety Culture Continuous Improvement Process;
- Operational Decision Making;
- Human Errors Prevention Tools;
- Maintenance Fundamentals and Foreign Material Exclusion;
- Participation in a working group on human performance and organizational effectiveness;
- Evaluation of training effectiveness and indicators of return on investment in training.

Kozloduy NPP - New Build EAD

Kozloduy NPP - New Build EAD is a joint-stock company whose main purpose is the organisation and management of the entire process of feasibility study, design, construction and commissioning of nuclear power facilities. The Kozloduy NPP - New Build Management Policy Statement defines the strategic goal of the company: efficient management of this process in compliance with nuclear safety, quality, and public and environmental protection standards in accordance with applicable national and international legislation and the terms of the permits and licences issued, taking into account the stakeholders.

In order to achieve this, Kozloduy NPP - New Build EAD applies a management system which ensures the implementation of the declared activity with a focus on high levels of safety, efficiency, and cost-effectiveness in achieving maximum results through a qualified, competent, and motivated team and sound financial and economic stability.

Currently, Kozloduy NPP - New Build EAD has an order approving the selected site for Unit 7 and has submitted an application to the NRA for a permit for the selection of a location for a nuclear facility (siting) for Unit 8.

Regulatory processes for monitoring and surveillance of the licence holder' measures for priority of safety

Safety management is one of the areas in the scope of topical inspections of the NRA (Management System area). In this regard, the annual inspection plans also include inspections covering the following topics:

- safety policy, including priority of safety, commitment of senior management to maintaining a high level of safety, providing resources;
- assessments of the impact of structural and organisational changes on safety;
- results of indicator based self-assessment;
- available experience and knowledge of the senior management, focus on safety issues, graded risk assessment approach, motivating of staff, self-criticism;
- safety related activities – planning, risk assessment, optimal test and maintenance intervals, questioning attitude towards work;
- monitoring of performance of activities and internal evaluations.

In all the areas subject to inspection, safety culture is being monitored. A proactive approach is used to identify weaknesses and negative trends in the organisation and in the behaviour of the staff, which, if no action is taken, may lead to non-compliance of the established practice of the licence holder with the regulations and provisions of the granted licences and permits.

Measures used by the regulatory body to give priority to safety in its own activities

In accordance with the provisions of ASUNE, when using nuclear energy, nuclear safety and radiation protection take priority over all other aspects of this activity. The same basic principle is stated in the NRA Management Policy Statement. Ensuring nuclear safety and radiation protection is directly related to compliance with the principles and requirements set out in the ASUNE, European legislation, and IAEA standards.

The established licensing regime ensures compliance with the requirement for the priority of safety in all regulatory activities and decision-making. The management system of the NRA, which regulates the working practices, strictly follows the requirements set out in the ASUNE and the regulations for its implementation.

The regulatory body independence is a fundamental prerequisite for ensuring that safety is a top priority. The main elements related to ensuring independence are laid down in the ASUNE and include:

- independent decision-making;
- provision of budget and resources;
- availability of sufficient number of qualified employees;
- international cooperation in the field of nuclear safety and radiation protection;
- independent analyses and expert reviews related to nuclear safety and radiation protection;
- application of corrective actions and coercive administrative measures.

Article 11 Financial and human resources

1. Each Contracting Party shall take appropriate measures to ensure that sufficient financial resources are allocated to support safety of any nuclear installation throughout its life cycle.

2. Each Contracting Party shall take appropriate measures to ensure the availability of a sufficient number of qualified personnel with the appropriate education degree, training and retraining for all safety related activities carried out on or in connection with any nuclear installation throughout its life cycle.

Article 11 (1) Financial resources

Mechanism providing the licence holder with financial resources to ensure the safety of the nuclear installation throughout its life cycle

The requirements for the operator to have sufficient financial, technical, material resources and administrative structure to maintain a high level of safety for the entire period of operation of the nuclear installation and in the management of radioactive waste and spent fuel, as well as for its decommissioning, are defined in the Act on the Safe Use of Nuclear Energy (ASUNE), the Energy Act and in the special regulations to these acts. These requirements are incorporated in the operating licenses of the nuclear facilities as per the ASUNE and in the license for electricity generation as per the Energy Act.

Principles for financing of activities to improve safety at Kozloduy NPP throughout its life

The governing document used by Kozloduy NPP EAD to declare its strategic and business goals through specific activities and measures is the Company's Business Programme. The Business Programme is developed for a five-year period and integrates the implementation of all measures related to production activities, management of nuclear fuel, maintenance activities and safety enhancement of the nuclear facilities.

The main principles in the planning and financing of the activities aimed at improving the safety of the nuclear facilities are as follows:

- Paramount importance in providing financial resources for the safety management;
- Adequacy of the resources provided;
- Timeliness in providing the necessary resources;
- Adequacy of the administrative structure and financial and economic interactions guaranteeing the commitments to ensure safety will be met.

A system for planning, financing, preparation, approval, implementation and control of the activities for supporting and enhancing safety is in place, and it guarantees that the funds that are planned and spent on these activities are adequate and provided in a timely manner.

Principles for securing funding for decommissioning, spent fuel and radioactive waste management during the commercial operation of nuclear installations

The provision of funding for decommissioning, radioactive waste and spent nuclear fuel management during the commercial operation of the nuclear facilities is consistent with the relevant legislation and national policy set out in the Strategy for Spent Nuclear Fuel and Radioactive Waste Management. In accordance with the Strategy, the Kozloduy NPP costs for SNF management, including transport, storage and processing as well as the costs for RAW management are currently recognised as costs for the licensed activity forming the cost of electricity. In the event that transportation of spent nuclear fuel for storage and processing is not possible, costs for provisions for future obligation for SNF transportation are accrued for the respective year. These sums are deposited in a special deposit account and are spent solely for SNF management in the following

years. The collection and spending of the funds in the special deposit account is administered by the Ministry of Energy.

National policy for financing the safe management of RAW and decommissioning of the nuclear facilities

In accordance with the ASUNE, the State Enterprise Radioactive Waste (SE RAW) was established with a principal activity of radioactive waste management, construction and operation of facilities for radioactive waste management and decommissioning of nuclear facilities.

For the implementation of the national policy for safe management of RAW, including its disposal, operation and funding of SE RAW, as well as for the decommissioning of nuclear facilities, two funds have been created and functioning under the Minister of Energy:

- Radioactive Waste Fund (RAW Fund);
- Decommissioning of Nuclear Facilities Fund (DNF Fund).

The funds are assigned funds, established in accordance with ASUNE and governed by managing boards. The procedure for assessment, collection, spending and control of funds as well as the amount of due contributions to the two funds are stipulated in the regulations adopted by the Council of Ministers. The proceeds to the RAW Fund are collected from the contributions from the entities which, as a result of their activities, generate radioactive waste subject to transferring as well as from state budget funds, whereas the accrued funds are spent expressly on the operation and funding of SE RAW. The proceeds to the DNF Fund are collected from contributions from the entities operating nuclear facilities, from the state budget, etc. The accrued funds are expended solely to finance decommissioning projects and activities.

The underlying principles that are followed to ensure funding to the two funds during the commercial operation of the nuclear facilities are:

- predictability and consistency in the provision of funds;
- sufficiency of funds and adequate availability in case of justified necessity in order to prevent transferring an excessive burden to the future generations;
- transparency in the financial management of the funds, while ensuring that these funds will not be diverted unduly for other purposes;
- meaningful and efficient spending of funds.

Financial support

In order to satisfy the statutory requirements related to the performance of the licensed activity, Kozloduy NPP EAD applies a unified Business and Finance Management Policy to all processes and activities, with the main priority of ensuring safety.

Funding of the measures under the Plan on Nuclear Facilities Safety Maintenance and Enhancement is ensured with priority, the costs being integrated into the Annual Plan and medium term Business Programme. Costs are covered by revenues from electricity sales and the positive financial results achieved from the activity.

The planned investment activities are aimed at ensuring and improving the nuclear safety and security at Kozloduy NPP, radiation protection , and environmental protection during the operation of the power units and the auxiliary facilities, in compliance with the requirements of the applicable regulations.

The priority tasks and activities are systematized in strategic investment projects for the Company:

- activities ensuring the long-term operation of Kozloduy NPP Units 5 and 6 and providing for the safe and reliable operation of the reactor installations of Units 5 and 6;
- activities assessed as contributing to maintaining and improving the safety of the plant, not covered by existing programmes related to nuclear safety, radiation protection, fire safety, emergency preparedness, physical protection and the environment, or regulatory requirements. They result from operating experience, reviews performed or regulatory requirements;
- investment activities for regular maintenance of the units and auxiliary facilities and infrastructure to ensure the normal operation of the balance-of-plant supporting the production activity.

In the period 2022-2024, investment activities to the total amount of BGN 388 million (EUR 199 million) were carried out . For the period 2025-2029, an investment programme totalling BGN 1,216 million (EUR 622 million) is planned, assuming the projects will be entirely self-funded.

Kozloduy NPP EAD achieved good financial results and all the necessary measures related to safety maintenance and enhancement are implemented in their full scope.

RAW and DNF funds

According to ASUNE and the Regulation on The Procedure for Determination, Collection, Spending And Control of The Resources and on the Amount of Due Payments to the Radioactive Waste Fund and The Decommissioning of Nuclear Facilities Fund, the monthly instalments to each Fund are determined by a methodology for the assessment of the waste management costs, including the waste disposal, and also a methodology based on the assessment costs for the decommissioning of nuclear facilities relative to the overall lifetime of the facility.

At present, the instalments of Kozloduy NPP payable to the two funds, as the holder of licences for the operation of nuclear facilities, amount to 10.5% of the revenues from electricity sales, thus ensuring that sufficient amount of financial resources will be accrued to provide for the future decommissioning of the nuclear facilities, and for RAW and SNF management.

The proceeds and costs of the two funds in the period 2022-2024 are presented in the table:

Year	DNF Fund		RAW Fund	
	Proceeds, BGN	Costs, BGN	Proceeds, BGN	Costs, BGN
2022	459,624,256	24,780,500	183,926,423	25,657,720
2023	197,039,047	28,025,122	78,967,089	25,671,297
2024	154,254,605	27,755,841	61,939,033	25,450,519

The amounts available in the national funds as at 31 December 2024 are as follows:

- DNF Fund – BGN 2,588,760,295.46
- RAW Fund – BGN 448,387,875.77

The activities related to decommissioning of nuclear facilities are funded also by resources from the Kozloduy International Decommissioning Support Fund (KIDSF) (for the shut down units 1-4) through the European Bank for Reconstruction and Development (EBRD).

Financial provisions assessment

Periodically, at least once every five years, the estimated costs of both RAW and DNF funds are re-estimated, including the costs of managing the spent nuclear fuel that remains on the site after

the final shutdown of the units. If necessary, the contributions of the nuclear facility operator may change in a way to guarantee that after shutting down the last nuclear reactor there will be sufficient financial resources accumulated for the implementation of the planned activities.

According to the current regulations, when the implementation of a decommissioning project exceeds the financial resources approved by the fund, the necessary costs are borne by the person who last operated the nuclear facility.

Taking into account thee current financing schemes, the forecasts of Kozloduy NPP show that by 2051 the accumulated financial resources in the funds will amount to BGN 10,801 million, including: DNF Fund – BGN 8,037 million, and RAW Fund – BGN 2,764 million.

Work has begun on developing a preliminary plan and selecting a concept for decommissioning of Units 5 and 6. An indicative estimate of the estimated costs for decommissioning of the units has been prepared, amounting to approximately EUR 1,600 million (without escalation and discounting of costs). The calculations were made on the basis of an alternative estimate for the costs of decommissioning for 1 MW(e), which is based on comparative analyses of the IAEA and the Organisation for Economic Co-operation and Development and existing global practices in this area. The amount of total costs for decommissioning will be significantly influenced by the final decision on selecting an option for the long-term management of SNF and high-level waste (HLW).

Taking into account the balance of financing raised in the two funds as of 31.12.2021, BGN 2,058 million (BGN 1,858 million in the DNF Fund and BGN 200 million in the RAW Fund), with long-term operation of Units 5 and 6 for another 30 years and with an increased base output to 104%, the funds will accumulate about BGN 6.5 billion nominal value until 2051.

Currently, a preliminary concept has been developed for the decommissioning of the Kozloduy NPP Units 5 and 6, with continuous dismantling and a stage of safe storage of the equipment in the controlled area. The estimated costs for the decommissioning of the units amount to about EUR 1,800 million in nominal value and have been estimated on the basis of an alternative estimate for the costs of decommissioning for 1 MW(e), which is based on comparative analyses of the IAEA and the Organization for Economic Co-operation and Development and existing global practices in this area. The amount of total costs for decommissioning will be significantly influenced by the final decision on selecting an option for the long-term management of SNF and high-level waste (HLW).

In fulfilment of its strategic goals in the period 2022-2024, Kozloduy NPP has financially ensured the costs of safe management of SNF, including costs for carrying out the transportation of SNF from WWER-1000 and WWER-440 for processing and storage in the Russian Federation. The commitments to transport SNF come from signed, including by ESA, framework annexes to the contract with PA MAYAK for the shipment of 414 WWER-1000-type fuel assemblies by the end of 2023 and for the shipment of 1,268 WWER-440-type spent nuclear fuel assemblies in the period 2023-2028.

The SNF shipments planned for the period 2022 – 2024 were not carried out. In this regard, and in implementation of the SNF and RAW Management Strategy, in accordance with the Company's Accounting Policies and International Accounting Standard 37, provisions have been accrued in the current expenses of Kozloduy NPP EAD for the obligation to transport SNF, for 2022 - BGN 24 million, for 2023 - BGN 32 million and for 2024 - BGN 32 million, respectively. The funds are set aside in the Company’s special deposit account for the fulfilment of future commitments for SNF management.

The current objectives, priorities and activities for the coming year are reviewed on an annual basis, and the five-year business programme is updated with the same periodicity, in order to minimise the risks of liquidity problems of the company and to identify the future needs of financial resources, to ensure the operational and the investment activities.

Description of measures to ensure the necessary financial resources in case of a radiological emergency event

As a party to the Vienna Convention on Civil Liability for Nuclear Damage, the Republic of Bulgaria has designated the entities which, within the meaning of the Convention, are operators of a nuclear facility as well as the type and provisions of the financial guarantee covering nuclear damage liability of the operator.

Kozloduy NPP EAD has a statutory obligation to sign and maintain a property insurance for the sites/facilities whereby it performs the licensed activity, and a General Civil Liability insurance covering the nuclear damage responsibility, as defined by the ASUNE, the Energy Act and the Regulation on Licensing of the Activities in Energy. The liability of the operator for damage caused by any nuclear accident is defined by ASUNE, and is limited to BGN 96 million.

As an operator of nuclear facilities Kozloduy NPP EAD has the obligation to maintain a permanent financial guarantee, covering the nuclear damage responsibility, and in pursuance of this requirement the company has concluded a contract for General Civil Liability insurance with the Bulgarian National Nuclear Insurance Pool.

The Disaster Protection Act provides funding options for disaster/accident recovery activities. The Act has established an Interdepartmental Commission for Recovery and Assistance, headed by the Minister of Interior. The assistance and recovery in case of disaster/accident covers provision of urgent and recovering assistance to injured persons and carrying out urgent recovering actions. The urgent aid is organised, ensured and provided by the mayors of the municipalities. The Act provides for a procedure for provision of funds for contingency and/or urgent expenses in the part for prevention, control and overcoming the consequences of disasters/accidents. The funds are provided to finance the rescue and emergency works, urgent restoration works, preventive and other activities.

Article 11 (2) Human resources

Procedure and regulatory requirements for staffing, qualification, training and retraining of personnel in nuclear installations

The ASUNE requires that each licence holder has a sufficient number of qualified and licensed personnel with the appropriate level of education and training for the implementation of all activities under the licence, being obliged to provide training for the staff, as well as oversight and qualification enhancement. The activities in the nuclear facilities and with sources of ionizing radiation which have an impact on safety may be performed only by professionally qualified personnel holding individual licences.

The specific job positions with such functions are defined in the operating licences of the nuclear facilities. The individual licences are issued by the Chairperson of the NRA for individuals performing activities related to ensuring and/or control of nuclear safety and radiation protection in nuclear facilities, and full-scope simulator instructors. For the rest of the staff professionally engaged in the nuclear facilities, specialised initial and continuing training is conducted at an organisation that holds a licence to deliver specialised training as per the ASUNE.

The Regulation on Ensuring the Safety of Nuclear Power Plants stipulates that the operating organisation shall identify and allocate the required resources (staff, infrastructure, working conditions, information and knowledge, suppliers, material and financial resources) within its management system, to perform all the activities; to define the requirements on the staff qualification at all levels and ensure training to achieve the required level of qualification; to determine, provide, maintain and periodically reassess the infrastructure and working conditions, required for the performance of the activities in a safe way in compliance with the requirements. The adequacy of the staff and their qualifications have to be analysed and validated in a systematic manner, and any changes in the staff numbers, which could be significant for safety, have to be justified in advance, to be planned, and evaluated after the performance. The operating organisation

has to define the requirements regarding the qualification of the staff at all levels and to provide the required training. It also has to analyse and identify the training needs and the objectives of the training programmes, to ensure oversight of the training sessions and an evaluation of the training programmes.

The Regulation on the Terms and Procedure for Obtaining Vocational Qualification and on the Procedure for Issuing Licences for Specialised Training and Individual Licences for Work Activities involving Nuclear Power stipulates the general requirements to the personnel recruitment and qualification system, the terms and procedure for acquiring vocational qualifications, for provision of specialised initial and continuing training, for knowledge test and acquiring individual licences to perform activities on nuclear facilities. The Regulation stipulates the procedure for issuance of a licence to perform specialised training, the obligations and responsibilities of the licence holders.

Kozloduy NPP holds a Licence for Conducting Specialised Training on Activities in Nuclear Facilities and with Sources of Ionising Radiation. This activity is carried out through the Personnel and Training Centre Division. The existing Training Centre is equipped with a full-scope simulator.

The staff who perform activities on nuclear facilities and with ionising radiation sources are obliged to maintain and enhance their own knowledge and to improve their skills. The training process starts when the employment contract between the employee and the Kozloduy NPP is signed, and continues until the end of employment. Before admission to unassisted work performance, newly recruited workers and professionals need to complete an initial training to acquire knowledge and skills related to the operation and maintenance of specific SSCs, instructions, technologies and operating procedures, specific requirements regarding nuclear safety and radiation protection, and also to establish relationships, ensuring high safety culture. Knowledge and skills, obtained after the initial training are maintained, further developed and built upon through continuing training – periodic and extraordinary, to carry out specific or rarely recurring tasks.

Methods used for the competence requirements and training needs analysis for all safety related activities

The Kozloduy NPP staff is divided into 4 groups depending on their functions and the relation of those functions with nuclear safety and radiation protection. The corresponding qualification requirements are defined for each group. The highest qualification requirements apply to two of the groups in which personnel with functions affecting nuclear safety and radiation protection fall.

The input data to plan training and develop the training programmes are the results of the performed specialised training needs analysis. The training needs analysis is performed on the basis of:

- the requirements for taking a certain job position, the key functions and duties, rights and responsibilities as described in the job descriptions;
- the requirements defined in the applicable international and national regulatory documents;
- data and requirements regarding the manner of implementing the activities described in the internal regulations, procedures and instructions, including the results of the individual work performance assessment;
- rules and requirements in terms of nuclear safety, radiation protection, and industrial safety;
- internal and international operating experience;
- implemented and planned modifications in the nuclear facility or related to sources of ionizing radiation.

A process for individual work performance assessment and personnel development is in place at Kozloduy NPP. The implemented process is based on pre-defined criteria.

Arrangements for initial and continuing training of shift staff, including simulator training

The initial specialised training of MCR operators and personnel performing functions that have an impact on nuclear safety and radiation protection is carried out by applying a systematic approach. The scope and duration of the training is specified in training programmes for initial specialised training developed for each specific position. For the MCR operators, training at the full-scope simulator (FSS) is mandatory and covers initial and yearly continuing training.

The continuing training of shift staff whose functions are to oversee, ensure, or influence nuclear safety and radiation protection is conducted on the basis of individual training programmes. The subject-matter includes topics that are dealt with in the initial training programme courses, topics on modifications to SSCs, regulatory and internal documents, topics resulting from the operating experience feedback, etc. The training is conducted as off-the-job training.

Capabilities of the Kozloduy NPP simulator to accurately reflect processes, systems and components as well as the scope of the simulated processes

The requirements for establishing and maintaining the compliance of the full-scope simulator with the reference unit are provided in the Regulation on the Terms and Procedures for Obtaining Vocational Qualification. The particular technical requirements to the simulator, as an engineering tool, are based on the US national standard for NPP simulators designed for training and evaluation of operators – ANSI/ANS-3.5-2018.

The scope and quality of the simulation models at the full-scope simulator for Units 5 and 6 (FSS-1000) ensure its full-featured functioning as a training aid for initial and continuing training and for evaluation of the operators' main functions. The human-machine interface is a replica of the main control room of Unit 6, while the simulation model supports capabilities to operate in all modes – normal operation, transients, and design basis accidents.

The technical features of the FSS-1000 allow for the facility to be also used as an engineering tool for validation of symptom-based emergency operating procedures, testing of design modifications, testing of operations instructions and procedures, and analysis of operating events.

At the end of each year, an annual plan is prepared for the activities to be implemented during the next calendar period in order to maintain the FSS-1000 in conformity with the reference unit. The plan includes an analysis of the planned changes and modifications on the unit associated with the FSS-1000 configuration, description of the necessary activities and the conditions, deadlines and responsible persons for their implementation.

Arrangements for training of maintenance and technical support staff

The arrangements for training of the maintenance and technical support staff are similar to the activities, described in the section Arrangements and Regulatory Requirements concerning staffing, qualification, training and retraining of staff in nuclear facilities.

The specialised training is conducted as off-the-job and on-the-job training, and depending on the type of the activity and specifics of the workplace it is carried out as:

- theoretical training - classroom training, workshops and interactive computer based training;
- on the job training;
- practical training in workshops, laboratories, on mock-ups, computers, and radiometric, dosimetric and spectrometric equipment and other technical aids.

The forms of training are applied in a mixed manner to ensure proper learning and the acquisition of relevant skills and habits. Kozloduy NPP has training facilities for maintenance

personnel equipped with appropriate mock-ups and technical aids. Before the implementation of complex maintenance operations or operations with increased dose rates, trial activities are carried out on mock-ups in order to familiarise the maintenance personnel with the performance of the maintenance work. Prior to the implementation of significant modifications and in case of necessity, extraordinary pre-job briefings are conducted to familiarise the personnel with the task, and after the modification implementation, the personnel is debriefed on the analysis of the maintenance activity performed.

The contracts with suppliers also cover training on the maintenance and repair of the supplied equipment.

Improvements to the training programmes as a result of the safety analyses, operating experience, development of training methodologies and practices, etc.

An analysis of the specialised training efficiency is conducted each year, and it is the basis for planning, taking corrective actions and improving all activities, associated with the training process. The training efficiency assessment is a joint activity of the Training Centre and plant administrative units. The training efficiency is evaluated on the grounds of data analysis from various sources:

- feedback or inquiry forms filled in by trainees, lecturers, managers;
- results of the training;
- data from internal inspections and audits;
- reflecting the modifications to SSCs, operations procedures, operating experience, etc., in the training.

The results of the training effectiveness analysis serve as a basis for assessment of the needs of: personnel training; training programmes development, improvement and updating; organising and conduct of initial, continuing or extraordinary training; development, improvement and keeping up-to-date of training materials and aids.

Methods used for the assessment of the sufficiency of the staff of Kozloduy NPP EAD

Based on the Company's future staffing needs, a "Forecast Plan for Human Resource Needs for the Long-Term Operation of Units 5 and 6 of Kozloduy NPP EAD" has been developed. The plan includes forecast information on the future staffing needs in the Comapny for a 30-year period. The model used for the planning includes: Demographic information on the current state of the workforce; staffing needs by year; staff reductions by year; forecasting future staffing needs; "supply" of graduates from secondary vocational and higher education programmes. "Kozloduy NPP EAD Staffing Needs Plan" has been developed in order to provide the necessary information for the company's future staffing needs for a 10-year period and to ensure the timely selection and training of personnel to fill the respective positions.

The total number of the required staff, as per positions and plant administrative units, is specified in the Kozloduy NPP payroll. The required number of employees engaged in the conduct of operations is determined as per the technical specifications for operation and taking into consideration the uninterrupted production cycle.

Annual reviews are performed on the current payroll, any deviations are analysed and the necessity for its optimisation is assessed. The analysis is performed in order to accommodate the plant administrative structure with the functional distribution of responsibilities among the administrative units.

The composition of the operational shift is defined and structured in a manner to manage and control the whole process. The shift staff work schedule is drawn up for a period of one calendar year. The work schedule is organised in five shifts in a way that the 24-hour duration of the working day is covered by 3 shifts of 8 hours each.

Methods for the assessment of the sufficiency of the staff of Kozloduy NPP - New Build

The provision of the needed qualified personnel and competent team is based on an analysis of the processes, scope and specifics of the activities being implemented and the compliance with the company's established organisational structure.

The need for staff having the necessary qualifications is defined by:

- identifying the need for competencies and their respective carriers;
- initially determining the level of competence of the necessary employees;
- planning the necessary human resources based on preliminary analysis and assessment;
- defining clear and precise competence requirements for the team;
- defining criteria for the selection, appointment/reappointment of a team in the Company;
- planning and providing training to achieve the necessary knowledge, skills, and competencies, which ensures awareness of the significance and importance of each activity for safety, environmental protection, and the achievement of the Company's objectives;
- evaluation of the effectiveness of the conducted training.

Policy and principles governing the use of contracted personnel to support or supplement the licence holder's own staff

Pursuant to the licence conditions for the operation of the nuclear facilities, Kozloduy NPP has implemented and maintains a system for assigning, management and oversight of activities and services of contractors, while bearing the responsibility for their performance. Some of the activities that have a significant impact on and affect directly nuclear safety may not be assigned to contractors' personnel in accordance with the regulatory requirements.

The requirements to the contractors' activity and their staff qualification are specified in the terms of reference (ToR) for awarding contracts, and in the terms and conditions of the signed contracts. The contractors' personnel that perform works in the field shall have the appropriate qualification, as per the relevant regulations, specifics of the activity, and rules adopted at Kozloduy NPP. In case of performing specific activities, there are additional requirements for specific qualification and competence of the contractor's personnel.

Kozloduy NPP oversees the implementation of the activities by the contractors through inspections in the field, reporting of the inspection results, control over the remedy of detected non-conformances, and audits of contractors' management systems.

The operating organisation specifies the responsibilities and the requirements regarding the necessary specific qualification and competence of the contractors' personnel as early as the contractor selection stage. The contractors are required to demonstrate that their personnel are of adequate number and qualification to perform the activity. A system for assessment of the attached evidence of contractor's qualifications and competence at the tender stage and at the stage of contract agreement has been set up.

One of the requirements is an existing/certified Management System of the contractor, and, in certain cases, a Quality Assurance Programme and/or a Quality Control Plan submitted by the contractor. The Programme and/or Plan are subject for approval by the Kozloduy NPP before providing the contractor with access to the site. Before being admitted to work, it is mandatory for the contractors' staff to take a training course on Introduction to Kozloduy NPP, either by attending the training in person, or electronically, and the workers performing activities in the controlled area pass an additional training course on Radiation Protection - contractors. Both trainings end with a knowledge test and evaluation.

Description of the national provision of and demand for experts in nuclear science and technology

In 2022 the Council of Ministers adopted the National Strategy for Human Resource Development in the Nuclear Field 2022-2032. The main objective of the Strategy is to build a sustainable system for the training, improvement, and development of the specialists needed for the effective operation of the nuclear sector and to overcome the mismatch between needs and availability of personnel. The Strategy analyses the status of human resources in the nuclear field in the country. It outlines the challenges that need to be addressed. Strategic objectives and activities for their achievement, as well as the role of state institutions and economic entities are formulated. The monitoring and financing processes are outlined.

In 2023, a three-year plan for the implementation of the Strategy was prepared and adopted by the Council of Ministers. Regular meetings are held to monitor the activities for the implementation of the plan.

The system of nuclear staff training and qualification in the Republic of Bulgaria follows a multistage approach and includes:

- secondary vocational education;
- higher education for obtaining the relevant educational-qualification degree (BA or MA) in natural sciences and engineering, and the educational and research doctor's degree;
- initial and continuing specialised training to obtain an individual licence to work at a nuclear power plant, taking a specific position (further vocational qualification in licensed specialised training centres).

The higher education degrees in nuclear technology and nuclear science are obtained in the professional fields of physics, chemistry, power engineering and chemical technologies in five accredited universities. The total number of students enrolled in higher education institutions in fields related to nuclear technology and nuclear sciences for the 2024–2025 academic year is 316.

Since 2018, Kozloduy NPP has been supporting a scholarship programme for students enrolled in full-time studies in nuclear specialities at the Technical University of Sofia and Sofia University “St. Kliment Ohridski”.

Methods used for the analysis of competences, availability and adequacy of additional personnel for severe accident management, including hired personnel or personnel from other nuclear installations

The assessment of the sufficiency of the available human resources and their competence for action and severe accident management at the site of Kozloduy NPP is accomplished in practice by periodically conducting exercises, emergency drills, general national and full-scale emergency exercises. After each exercise and drill, an analysis and report are prepared containing identified actions for improvement. An independent assessment of the general emergency exercises is given by an expert committee which includes experts from the NRA, Directorate General for Fire Safety and Civil Protection - MoI, Ministry of Energy, Bulgarian Energy Holding, etc.

An assessment was made of the sufficiency of the management and field personnel as well as response teams. The Procedure for Organisation and On-call Performance to Ensure the Emergency Planning of Kozloduy NPP was updated, and the total number of emergency personnel was increased to achieve exchangeability of the teams in case of a severe accident or fuel meltdown accident in various nuclear facilities on the plant site.

Kozloduy NPP is a member of the WANO Regional Crisis Centre in Moscow set up following the Fukushima NPP accident. The Centre envisages provision of additional, expert on-line support in case of a severe accident at Kozloduy NPP. The Crisis Centre has an approved work plan that includes joint exercises with the Member States.

Regulatory review and control activities

The Agency undertakes review and assessment of the documents submitted by the applicant to support the licence application for specialised training in compliance with the provisions of the ASUNE and the Regulation on the Terms and Procedures for Obtaining Vocational Qualification and on the Procedure for Issuing of Licences for Specialised Training and of Individual Licenses for Use of Nuclear Power.

Under the licence conditions, the NRA periodically receives information on the performed specialised training and maintains a public register of the individual licences issued for work on nuclear facilities and with sources of ionising radiation.

The NRA's Inspection Programme includes the Training and Qualification of the Personnel area, which provides framework for the NRA inspectors to perform reviews of the activity of the licence-holders and the individuals which are issued individual licences. During the inspections prior to a unit start-up following an annual outage, the NRA verifies the availability of the shift staff and their qualification.

Article 12 Human Factor

Every Contracting Party takes the appropriate steps to ensure that the capabilities and limitations of human performance are taken into account throughout the lifetime of a nuclear installation.

Overview of the arrangements and regulatory requirements to take into account human and organisational factors related to nuclear installations safety

The Regulation on Ensuring the Safety of Nuclear Power Plants sets out requirements to take into account human and organisational factors in the design and operation of the nuclear installation. The design has to be human-error-tolerant as much as practicable, providing for technologies to prevent human errors or to limit the consequences thereof. To that end, the control and monitoring devices, and presentation of the information should be such as to allow the shift staff to control and monitor the normal operation; to easily evaluate the general condition of the power plant during normal operation, anticipated operational events and emergency conditions; to control the reactor condition and the condition of all SSCs; to identify modifications important to safety; to verify the execution of the relevant automatic actions. The changes in the normal operation conditions which could affect safety should be accompanied by audible and visual alarms in the main control room (MCR). The safety systems should be designed so that they prevent operators' actions which could compromise their automatic actuation and efficiency in emergency conditions; provide the shift staff with information on the monitoring of the automatic actions effect; provide conditions automatic diagnostics of their operability.

The design should provide for sufficient and reliable communication between the main control room and the supplementary control room, the local control panels and both emergency response centres (on-site ERC and off-site ERC). The working areas and conditions should be designed to take into account the ergonomic principles and allow for reliable and efficient task performance.

The operating mode of the nuclear power plant and any changes to it should be monitored and controlled by licensed and qualified shift staff. When operating the nuclear power plant, there are at least two control room operators holding licences issued by the NRA Chairperson in the MCR. The personnel is provided with the necessary resources and conditions for implementation of the activities in a safe manner. The shift staff operates the NPP in accordance with written procedures and instructions that have to be clearly identifiable, discernible in terms of their function, and easily accessible. The operators' actions to diagnose the state in emergency conditions, for restoration or compensation of impaired safety functions, and for prevention or mitigation of core damage consequences, should be defined in Symptom-Based Emergency Operating Procedures (SBEOPs), and Severe Accident Management Guidelines (SAMGs).

When assessing safety, the human factors and human-machine interface should be taken into account, in all normal operation modes, anticipated operational occurrences and emergency conditions. The scope of PSA should also cover the human error analysis in all operating conditions and emergency conditions.

During the operation of the nuclear power plant, continuous monitoring should be applied, covering observation of the staff behaviour and their attitude towards safety and violations of operational limits and conditions, operations procedures, regulatory requirements and conditions of the operating licences. Systematic self-assessment at all levels of the operating organisation is a part of the monitoring. Appropriate safe performance indicators are developed and used for the purposes of the self-assessment, enabling managers to identify and respond to weaknesses and inconsistencies in safety management.

A programme for collection, analysis and documentation of internal and external operating experience, as well as operating events at the NPP, has been developed and is systematically implemented. Assessment of operating experience is used to detect hidden defects related to safety,

potential preconditions and possible trends for the deteriorated performance of the activities that have an impact on safety, or decrease of safety margins. The NPP staff are required to report deviations from normal operation and are encouraged to report near misses important to safety. The information ensuing from operating experience is disseminated to the relevant staff, shared with all interested national and international organisations, and is used in the training of staff performing activities that have an impact on safety.

The Regulation on the Conditions and Procedure for Notification of the Nuclear Regulatory Agency about Events in Nuclear Facilities, Sites and in Activities with Sources of Ionising Radiation and during Transport of Radioactive Material requires that the analysis of the human-induced events contains the causes and circumstances that had led to the human behaviour issues which contributed to the occurrence and evolution of the event. Based on the analysis, the areas of human error that may be related to procedures, training, communications, human-machine interaction, management or supervision are identified and corrective measures are planned.

Consideration of human factor in the design of nuclear installations and subsequent modifications (also refer to Article 18 (3) of the Report)

The requirement that the design of the Kozloduy NPP Units 5 and 6 should be human-error-tolerant is implemented through:

- automatic actuation of protections and interlocks, or safety systems in the event when operating actions or changes in equipment state result in changes to the operating parameters exceeding the operational limits, or levels of safety system actuation;
- absolute priority of protections over operator actions, automation, and interlocks, which is maintained as long as the signal for performing the protective function is present;
- the design of safety systems provides for non-interference of the operator in their operation;
- data on the parameters and means for their control, in normal operation and in emergency conditions, are localised and concentrated through appropriate location of the control and monitoring tools in the MCR;
- the MCR data about the parameters and positions of the actuators is sufficient to detect failures and to assess the effects of the operators' actions;
- when designing SSCs to be used in the management of emergency conditions and severe accidents, the preferred technical solutions are aimed at minimizing the errors of shift staff in the human–machine interaction;
- process visual and audio alarm on MCR and SCR panels, including urgent alarms to auxiliary control panels and local control panels.

The following diagnostic systems are in place for additional control of the technological equipment parameters, provision of information enabling early diagnostics, accurate trending of processes and supporting the decision-making process to assist operators:

- post-accident monitoring system (PAMS);
- safety parameter display system (SPDS);
- primary to secondary leak control system based on the 16N reference nuclide in the main steam pipelines;
- containment hydrogen, oxygen, carbon oxide and steam concentration measuring system;
- reactor coolant level monitoring system for emergency conditions;
- site seismic monitoring system;
- automated information system for off-site radiation monitoring;

- system for wide-range temperature monitoring of the RPV;
- automated information system for off-site radiation monitoring;
- loose Parts Monitoring System (LPMS) in primary process components;
- a primary circuit leakage detection system.

In order to improve the working environment of the operators of Units 5 and 6, in compliance with ergonomic principles, the following activities have been carried out in the last three years:

- Units 5 and 6 MCR control panels are replaced. The design meets the current requirements for ergonomics and workspace organisation, with priority given to ensuring safety through easy access for control and manipulation of the control components with an improved and optimised interface on the Ovation Computer Information and Control System (CICS) displays in order to reduce the likelihood of operator error;
- Migration of the Ovation Computer Information and Control System of Units 5 and 6 to a new generation of Ovation Platform with integrated safety parameters display and symptom-based emergency operating procedures. Cyber security has also been improved;
- Implementation of optimised process alarm on MCR panels to increase operator awareness and support decision-making.

Organisational measures have also been implemented to limit errors from the personnel:

- Placing protective caps on the control keys (CK) of the equipment located on MCR and SCR panels;
- The concept of "protected equipment" has been introduced in order to establish reliable protective boundaries, separating protective zones for equipment that is in operation or is a back-up one, thereby preventing uncontrolled impact on equipment ensuring the critical safety functions, as well as reducing the likelihood of events occurring and minimizing the consequences of any errors that do occur;
- Unit equipment and BoP are well differentiated, with clear and unique technological names of the individual equipment parts and marked complying with the common requirements;
- Colour coding has been introduced to mark rooms, assemblies, sections – the technological name is written on a green (for Unit 5), red (for Unit 6) or blue (for BoP) background colour. This colour coding is also applied to the permit-to-work system to prevent making errors by maintenance teams.

In terms of documentation, the same rules for unique and clear identification numbers are applied so that they are easily recognised by the operators. A colour coding of normal operating procedures, emergency operating procedures, alarm response procedures, symptom-based emergency operating procedures and SAMGs is applied in the Main Control Room.

The human factor is also taken into consideration in subsequent design modifications by taking actions to ensure training and familiarisation of the staff with the implemented modifications.

Methods and programmes of the licence holder for analysis, prevention, detection and correction of human errors in the operation and maintenance of nuclear installations

Methodologies for analysis of causes for human error (the ASSET and the HPES) are used in Kozloduy NPP. During the analysis of events, all the aspects related to human and organisational factors are reviewed, deficiencies are identified that might be related for instance with ergonomics and human-machine interface, written instructions, training programmes, using tools to prevent errors, other organisational deficiencies, such as erroneously identified or missing expectations, responsibilities and duties. Relevant corrective actions are outlined.

The requirements for operational interactions between the shift personnel and managers, between the individual administrative units in Kozloduy NPP have been established. The rules for keeping the operating documentation are defined.

Self-assessment of managerial and organisational issues by the operating organisation

Within the self-assessment indicators system for effective management of Kozloduy NPP a number of performance indicators are monitored, aimed at identification of the human performance and organisational issues, such as:

- Fitness for duty of the operators;
- Adherence to the requirements of the established standards, policies, procedures and rules;
- Industrial safety accident rate;
- Human performance improvement (HPI);
- Safety culture improvement;
- Use of the operating experience feedback;
- Independent assessment process improvement;
- Effectiveness of fire safety programmes;
- Effectiveness of radiation protection programmes.

In order to maintaining a high level of personnel motivation, workers and employees are provided with the possibility to assess the working environment conditions established by the management. Once a year, a survey of motivation is conducted on a representative sample of at least 15% of the staff. The survey measures employees' attitude toward 24 factors of the working environment that are indicators of their motivation. The feedback from the personnel to the management is a self-assessment through the assessment of the employees on the policies, the managerial and leadership skills of the managers, on the organisation of work and the quality of the working environment. In order to provide a two-way feedback, the analyses of the motivation surveys carried out are published in the internal information system. Where necessary, corrective measures are taken to increase motivation.

Arrangements for operating experience feedback referring to human factors and organisational issues

One of the objectives of the use of operating experience is human performance improvement and eliminating organisational weaknesses. This is achieved through analysis of operating events, related to human and organisational factors, and determining corrective actions to remove them, aiming at:

- improving the training programmes for the personnel through updating the existing training materials, preparing new ones and updating the training periodicity;
- improving the methods and techniques for reducing the number of human errors - through additional training and briefings; strengthening the expectations for using written procedures and instructions; updating written procedures and instructions; introducing additional technical and administrative barriers to minimise the probability of making errors;
- improving the ergonomics and the human-machine interface through implementing design modifications;
- introducing the applicable operating experience in the simulator training sessions at the full-scope simulator;

- integrating operating experience in the annual continuing training of the personnel through selected internal and external events related to human and organisational factors, main conclusions and lessons learnt;
- motivating the personnel in terms of reporting and use of operating experience through meetings, Intranet communications, posters.

In order to improve the effectiveness of operating experience feedback related to human errors and organisational issues, Kozloduy NPP has introduced the WANO coding system in addition to the existing tools. WANO coding system was designed to clearly and consistently state the causes of the events, consequences thereof, damaged or affected systems and components, involved personnel, work they performed, general plant state at the beginning of the event. The data for the period 2022 - 2024 show that the indicators identified and coded after the WANO coding system related to human performance (human factor and management) represent 45,3% of the identified deficiencies, which falls in the working zone (40÷60%) and the figure is comparable with the worldwide good practices.

For analysis of human performance and organisational factors, the low level events and near misses (LLE and NM) system is also used, which provides for categories (codes) to report events related to human performance/behaviour and organisational factors. In addition, the 'Relative share of LLE and NM related to human and organisational factors' indicator is monitored to evaluate the level of reporting low level events and near misses related to human and organisational factors, The work (including expanding the scope of the organised trainings) with the staff regarding the need for reporting LLE and NM, clarification of the declared no-blame policy for inadvertent human errors continues.

With the aim of optimising the process of periodic review and assessment (classification, coding and reporting to the management), the non-conformances, including low level events and near misses, are recorded as Comments in the Information System for Organisation of Operational Activity (IS OOA). 4 levels of review and assessment of non-conformances are introduced.

- level one - daily review and assessment of newly recorded comments for initial assessment of their potential impact on safety and/or production during the morning operations briefing of Kozloduy NPP organisational units;
- level two - daily review, assessment and coding of newly recorded comments from the previous 24 hours; It is specified if the comment is related to human performance or not;
- level three - re-classification and re-coding of comments is performed every weak for LLE and NM coded as Low Level Events subject to non-committee analysis and Near Misses from the previous week with the aim of discussing their potential re-classification in category three event (LLE and NM requiring commission analysis under specific criteria (significant actual consequences for equipment/personnel and/or significant potential consequences for safety), in order to perform a more comprehensive analysis;
- level four - at the production meetings of the interested main organisational units (Units 5 and 6, Quality Division, Safety Division, Operations Division), the classified LLE-1 and LLE-2 (the report prepared at the third level of review and assessment) are discussed and the level of analysis is determined, if necessary (final classification).

Regulatory review and control activities

The human factor management is subject to regulatory review and control in the following areas:

- analysis of operating events related to human error, breached or non-fulfilled operating procedures, organisational issues;
- implementation of corrective measures from operating events related to human factor;

- management of organisational changes;
- interaction of different organisational units, effectiveness of management decisions;
- periodic analysis of the safety performance indicators related to human factor;
- performing assessments of the modifications in SSCs as regard to human-machine interface;
- planning and implementing activities related to maintenance and repair referring to work load and the established working conditions.

The regulatory control process includes assessment of the effectiveness of the interaction between the different organisational units, effectiveness of the management decisions and possible effects on safety due to organisational changes.

Article 13 Quality Assurance

Each Contracting Party shall take the appropriate steps to ensure that quality assurance programmes are established and implemented with a view to providing confidence that specified requirements for all activities important to nuclear safety are satisfied throughout the operational lifetime of the nuclear facility.

Provisions and regulatory requirements

The requirements stipulated in the Act on the Safe Use of Nuclear Energy (ASUNE) define the obligations of the organisation performing activities related to the use of nuclear energy, sources of ionising radiation and radioactive waste management to establish and maintain an effective management system (MS) of the activities, which gives priority to safety and ensures high level of safety culture.

The Regulation on Ensuring the Safety of Nuclear Power Plants requires that the operating organisation develops, applies, assesses and continually improves the management system whose main objectives are to ensure and improve the safety of the nuclear power plant as well as to promote and support a high level of safety culture of the personnel.

The regulatory requirements ensure the implementation of and compliance with the IAEA safety standards and the specified requirements for safety management and the management system for facilities and activities.

Pursuant to the requirements, the management system combines all elements of management in a way that the requirements to protect human health and the environment, and to ensure physical protection and quality as well as the financial aspects of the activities of the operating organisation are not regarded separately from the safety requirements in order to prevent potential negative impact on safety. The management system incorporates the required control over processes and activities performed by contractors considering the full responsibility of the operating organisation to ensure safety.

The implementation of the management system applies to all stages of the lifetime of the nuclear power plant, as well as for the overall duration of the activities under normal operation, transients and emergency modes.

Status with regard to the development and implementation of an integrated management system

In order to achieve safe, efficient and environmentally friendly generation of energy, under long-term operation conditions and guaranteed quality and security of supplies, in compliance with the relevant national and international standards, Kozloduy NPP's management applies a management system, integrating all requirements imposed for the nuclear power plant activities in line with the priorities set to ensure the highest level of safety, effective and competitive electricity generation, certified, competent and motivated staff as well as financial stability.

The management system integrates all management aspects and ensures concordance in the implementation of the requirements regarding safety, occupational health and safety, environment, security, quality and business activity of the company, in a way that safety is guaranteed as an overriding priority. The management system is in line with the requirements of the IAEA standard GSR Part 2 - Leadership and Management for Safety. Based on the applied systematic approach to integrated risk management, the management system processes define and implement appropriate measures and activities to manage risks that may jeopardize the achievement of the strategic, performance, and operational objectives set. The integrated risk management measures ensure their identification and assessment, the impact on their influence and control, contributing to informed

decision-making that is consistent with the safety priorities and risks to achieve the Company's objectives.

The management system effectiveness is assessed through internal audits, reviews by the regulatory body and during reviews conducted by international organisations.

Main elements of the management system

The Kozloduy NPP management long-term intentions are defined in the Management Policy Statement of Kozloduy NPP EAD as well as in the Company's Management Policy. The strategic goal of Kozloduy NPP EAD is long-term operation of the nuclear power units with guaranteed safe and reliable performance in compliance with the operating licences. Policies have been developed in compliance with the Kozloduy NPP management policy in pursue of the goal set. The management gives priority to safety and declares its commitment to its maintaining and continuous improvement in the Safety Management Policy.

The management system covers 29 processes (3 management, 5 core and 21 supporting), which comprise all the activities related to: business and operative planning; management of material, financial, human resources and knowledge; safety management (nuclear safety and radiation protection, industrial safety and emergency preparedness, environment and security); operating experience; conduct of operations; design support; maintenance; nuclear fuel cycle management; purchase and supply of products/services; RAW management; organisational change management; measurement, evaluation and improvement of the management system. The required resources, criteria and methods for functioning, management, monitoring and measurement are provided for all processes with functions being defined for a responsible person, coordinator and manager. A graded approach is applied to the activities and the results thereof (product, service) for each process, which allows to focus the resources and attention on the activities and equipment important to safety.

Requirements have been defined with regard to the external organisations ensuring that:

- the activities carried out comply with the Kozloduy NPP policy for maintaining a high level of safety, continuous enhancement of safety culture, as well as observing the requirements of the applicable regulations;
- there is an established organisation, clear allocation of responsibilities within the external organisation (EO), as well as between the EO and Kozloduy NPP;
- the external organisations have appropriate equipment in a good working condition, special tools and personal protective equipment necessary for work performance;
- the activities are performed by qualified and certified personnel having the experience required for the job;
- the requirements, standards and rules for nuclear safety, radiation protection, physical protection, industrial and fire safety, and environmental management, which are in place at Kozloduy NPP, are observed during the performance of the activities.

Continuous monitoring and evaluation of the performed activities, periodical reviews and independent assessments of all processes, as well as the self-assessment on behalf of the managers at all managerial levels are the main mechanisms for early detection of unfavourable trends, timely response in the event of non-conformances detected, as well as for identification of opportunities for safety enhancement and MS improvement.

Kozloduy NPP senior management reviews the management system once a year, whereby its functioning, adequacy, effectiveness and capability to achieve the goals set and identify measures for improvement are assessed.

Licence holder's audit programme

The internal audits of the management system are carried out in accordance with approved five-year and annual schedules, ensuring the evaluation of each process of the management system. When planning, the following is taken into account:

- the priorities of Kozloduy NPP management team for Company management;
- implementation of the five-year audit plan;
- significance of the audited process/activity;
- specific requirements of applicable regulations and standards related to the periodicity for conducting audits in certain areas;
- requirements related to conducting audits of management systems of the accredited/licensed organisational units acting within the management system;
- changes to regulations and standards applicable to Kozloduy NPP;
- changes to the requirements of the management system in place;
- changes in the organisational structure;
- conclusions and results of previous audits and inspections (recurring non-conformances);
- results of inspections by supervisory bodies, missions/peer reviews conducted;
- operating events;
- status of the performance indicators of Kozloduy NPP effective management self-assessment activities.

The management of the audit programme, planning, and conduct of internal quality audits in the company are performed by a separate Management System Audits Section within the Safety and Quality Directorate.

In the period 2022–2024, internal audits were conducted on two management, four core, and 13 supporting processes of the MS, in accordance with the five-year internal audit schedule in the Company. Annual audits of the management systems of the accredited organisational units within the company were conducted (a total of 15 for the reporting period).

At the initiative of the company's management, four quality inspections were conducted during the reporting period on the following topics:

- Results of specialised receiving inspection of metal products delivered in 2023;
- Application of the requirements of the non-compliance management process from Management Process.1.4 of the management system review and improvement process for the period 01 January to 31 July 2024;
- Document the continuous self-assessment of 3rd and 4th managers in the monthly reports of the organisational units of Kozloduy NPP EAD;
- Application of the internal self-assessment indicators of the Kozloduy NPP EAD organisational units.

Audits of suppliers and service providers (contractors)

The responsibilities and the order for performing purchasing activities related to request, selection of supplier, signing contracts, carrying out deliveries, receiving, testing, and storing the product, are clear and well defined.

The requirements for purchasing are defined based on the significance of the purchased product/service to safety, health, environment, physical protection, and business activity, with an overriding priority given to safety.

The oversight exercised over the suppliers is determined depending on the type of the product, its impact on safety and the requirements of the management system, and it may include:

- audit of the manufacturer's or supplier's management system on behalf of Kozloduy NPP;
- inspection of the materials intended for complex and important items;
- specialised receiving inspection.

In the period 2022 - 2024, annual quality inspections were carried out to check the readiness and quality of the activities performed by external organisations under contracts for maintenance and repair of facilities of the systems important to safety of Kozloduy NPP. 23 quality inspections of suppliers were reported.

Review and control by the regulatory body

NRA exercises preventive control on the process of issuing licences and permits including review of the documents describing the management system of the applicant.

Verification of the practical implementation of the management system is carried out during the routine inspections on the implementation of the issued licences and permits' conditions. The inspection plans of the NRA include focused areas of control covering the processes implemented within the plant management system.

In the period 2022 - 2024 inspections of the practical implementation of Kozloduy NPP management system and the processes therein were carried out in the following areas: emergency planning and preparedness; physical protection; chemical and radiochemical control; radiation monitoring; provision of specialised training; operations, maintenance and lifetime of systems important to safety; operating events and effectiveness of corrective measures; metrological assurance and control; management of design modifications; management of qualified equipment, etc.

Article 14 Safety assessment and review

Each Contracting Party shall take the appropriate steps to ensure that:

(i) comprehensive and systematic safety assessments are carried out before the construction and commissioning of a nuclear installation and throughout its life. Such assessments shall be well documented, subsequently updated in the light of operating experience and significant new safety information, and reviewed under the authority of the regulatory body;

(ii) verification by analysis, surveillance, testing and inspection is carried out to ensure that the physical state and the operation of a nuclear installation continue to be in accordance with its design, applicable national safety requirements, and operational limits and conditions.

Article 14 (1) Safety assessment

Overview of arrangements and regulatory requirements for comprehensive and consistent safety assessments

The Act on the Safe Use of Nuclear Energy (ASUNE) requires from the licensees to perform assessment of nuclear safety and radiation protection of the nuclear facilities and to undertake actions and measures for their enhancement, taking into account the internal and international operating experience, and the scientific achievements in this area. The scope of the assessment verifies the established measures to prevent accidents and mitigate their consequences, the protective physical barriers and administrative procedures, the disruption of which would result in significant damage to plant personnel and the population caused by the impact of ionising radiation.

Pursuant to the ASUNE, licences for siting, design, construction and commissioning of a nuclear facility, as well as modifications in structures, systems and components (SSCs), internal rules, operational limits and conditions of the facility shall be issued. A licence is issued for operation and decommissioning of nuclear facilities.

The safety requirements applicable to the review and assessment process of the documents accompanying the applications for issuing licences and permits are set out in the Regulation on Ensuring the Safety of Nuclear Power Plants including the stages of siting, design, construction, commissioning and operation of a nuclear facility. The Regulation sets out conceptually new safety requirements for modern NPPs based on the safety objectives published by WENRA of the design of new NPPs, and the updated IAEA safety standards and WENRA reference levels for safety harmonisation.

Regulatory guides of the NRA providing guidance on the application of regulatory requirements are also used in the course of the review and assessment process for issuing of licences and permits. Such guides are used, for example, in the review of: deterministic safety analysis; probabilistic safety analysis and its applications; qualification of structures, systems and components important to safety; ageing management; and periodic safety review.

The ASUNE, its implementing regulations and regulatory guides are published on the NRA website.

Safety assessments in the framework of the licensing process and safety analysis reports for the different stages in the operating lifetime of nuclear installations (e.g. siting, design, construction, operation)

Pursuant to the requirements of the Regulation on Ensuring the Safety of Nuclear Power Plants, the safety assessment is a systematic process that is carried out during siting, design, construction, commissioning, operation, design modifications and operation, as well as in the course of periodic safety review.

Studies and surveys of factors of natural and human-induced origin are carried out in order to evaluate the characteristics of potential sites for the location of the NPP and the selection of the

preferred site. These studies and surveys shall identify all external events of natural and human-induced origin related to the selected site and the region around it. The regulatory requirements for the scope, activities and documentation of the results from the studies and evaluation of the site for deployment of a new NPP are set out in the part of the report referred to in Article 17 (1).

Information on the studies and assessments of the Kozloduy NPP site carried out are included in parts of the report referred to in Articles 17(1) and 17(3).

The NPP safety assessment aims at confirming that the impacts and loads on the SSCs as a result of external events, internal events and realistic combinations of events are taken into account in the design basis and the implemented defence-in-depth, in accordance with the provisions of the Regulation on Ensuring the Safety of Nuclear Power Plants. The design limits shall include technical and radiological criteria for assessing the integrity of the barriers and the performance of the determined safety functions. The final list of events and accidents taken into account in the design covers the scenarios leading to limit loads of the SSCs with the least margin to meet the acceptability criteria set for the results of the deterministic event and accident analysis. The events and accidents considered in the design are categorised according to their frequency of occurrence and their consequences, demonstrating that the most frequently occurring events have minimal consequences.

The SSCs important to safety and their functional characteristics are designed with a reasonable margin for the specified limit loads resulting from design events and accidents. Information on the requirements for the reliability, classification, redundancy of SSCs and their independence at the levels of the defence-in-depth is provided in the part of the report referred to in Article 18.

The design basis, the safety assessment and the technical and organisational measures ensuring the application of the defence-in-depth concept are documented in a preliminary, interim and final safety analysis reports (SAR) related to the licensing regime under the ASUNE.

According to the Regulation on Ensuring the Safety of Nuclear Power Plants, the results of the deterministic safety analysis are documented in the SAR, which confirms the design basis of the NPP for the specific site and location. Analyses shall be performed for the reactor installation and the spent fuel pool (SFP) for each specific unit both for normal operation and emergency conditions.

The operating organisation (utility) maintains the safety analysis report updated in accordance with the modifications made to the SSCs important to safety, the new assessments and analyses carried out and the current safety requirements. The report is updated in a timely manner and when there is new information on the safety assessment, including information regarding the site and NPP siting area characteristics. The computer programmes and analytical methods used in the safety analysis are verified and validated and the uncertainties of the results are quantitatively identified.

For the purposes of licensing analyses in the SAR, the initiating events for analysis in operational and emergency modes are categorised according to the expected frequency of occurrence and consequences into the following categories:

- steady-states and transients during normal operation;
- anticipated operational occurrences;
- accidents without nuclear fuel melting;
- accidents with nuclear fuel melting.

Within the scope of the SAR, external event analyses are performed in order to verify the effectiveness and sufficiency of the design modifications and the means of site protection, to ensure the defence-in-depth concept, to perform safety functions by the SSC, to prevent the progress of fixed equipment accidents.

To fulfil the requirement to keep the SAR updated, Kozloduy NPP has introduced internal rules for conducting this activity and an organisational unit directly responsible for the periodic and

annual update of the SAR as well as coordination of the modifications and amendments implemented following their agreement with the NRA has been established.

In the period after the 9th National CNS Report, the SARs of Units 5 and 6 were updated in connection with the implemented modifications as follows:

- design modifications resulting from measures completed from the periodic safety review of Units 5 and 6;
- update of Chapter 15 "Accident analysis" of Unit 5 referring to the phased transition process to the new RWFA nuclear fuel type;
- analysis of the possibilities for early containment bypass and the duration of the stay in the MCR of the personnel and their transfer to the ECR to minimise the consequences of a severe accident;
- updated probabilistic safety analysis (PSA) of Units 5 and 6 considering all internal and external events and external events and hazards typical for the Kozloduy NPP site;
- upgrading the emergency and preventive protection and automatic power control systems of Units 5 and 6;
- modifications resulting from measures completed in the period of long-term operation of Kozloduy NPP Units 5 and 6.

Periodic safety assessments in the course of the operation of the nuclear facilities using deterministic and probabilistic methods of analysis, where applicable, and performed with the relevant standards and practices

The amendments to the ASUNE introduced at the end of March 2024 establish an unlimited term of validity for licences for the operation of nuclear facilities in which nuclear material is used, handled, or stored. Pursuant to these amendments, the operating licences of Kozloduy NPP Units 5 and 6, wet and dry SFSFs are not limited in time.

The licences impose additional conditions related to the periodic safety review (PSR) of each nuclear facility, at least once every ten years.

The results of the PSR should justify the safe operation of the nuclear facilities and are a prerequisite for the NRA Chairperson to issue an order approving the results of the review and determining the period for the next periodic safety review (Art. 37c, paragraph 2 of the ASUNE). Should any non-compliances with the requirements for PSR are identified, the NRA Chairperson shall refuse to issue the relevant order, which shall constitute grounds for revocation of the licence.

The conduct of PSR is an important element in the process of continuous safety enhancement at Kozloduy NPP. PSR is a comprehensive review of all important aspects of safety, which conducted at regular intervals. Detailed guidance on the process of conducting and scope of the periodic safety review is provided in the Regulation on Ensuring the Safety of Nuclear Power Plants and the Regulatory Guide for Periodic Safety Review of Nuclear Power Plants. In the process of reviewing the separate safety factors included in the periodic safety review, the guidance presented in other NRA regulatory guidelines is also applied.

The process of conducting a PSR includes the following three main stages:

- Stage one: define and agree with the NRA a common methodological basis and action plan; training of the personnel to be involved in the assessment;
- Stage two: carry out the PSR according to the defined methodology, submit to the NRA a report with the results of the review and a draft of an integrated programme for the implementation of the practicable safety improvement measures, taking into account the interfaces among the deviations identified;

- Stage three: complete the PSR and implement an integrated programme for the implementation of safety improvement measures, following agreement with the NRA on the scope and deadlines of the measures implementation.

The PSR assesses the consequences of the cumulative ageing effects, modifications and requalification of SSCs, operating experience, current safety standards and scientific and technological achievements, changes in the characteristics of the NPP site, and organisation and management of the nuclear facilities. On the basis of the results and conclusions of the safety review, the practically feasible measures to enhance safety are defined and implemented.

The PSRs completed for Units 5 and 6 in the period 2020-2023 resulted in update of the probabilistic safety analysis (PSA) considering all internal and external events and hazards typical for the Kozloduy NPP site. The analysis covers scenarios that, individually or in combination, could lead to nuclear fuel damage in the facilities where the nuclear fuel for units 5 and 6 is stored. The nuclear fuel in the reactor and the spent fuel pool (SFP) are considered as radioactive sources. The study covers all possible operating conditions – full power, low power, and shutdown unit – as well as the full range of initiating events and all possible internal and external hazards (natural and human-induced). The impact of one unit on the other is considered in the context of the possibility of fuel damage in more than one nuclear facility on the site. The results obtained for the total fuel damage frequency from the operation of each of the units meet the requirements of the Regulation on Ensuring the Safety of Nuclear Power Plants, demonstrating a significant reduction in risk compared to the levels assessed in the previous PSA. The implementation of a number of measures aimed at safety improvement during unit's operation has led to a reduction in the fuel damage frequency during unit operation at power levels.

An independent technical review of the updated Level 1 PSA was conducted by the IAEA in the period November 2022 – March 2023. The purpose of the review was to verify the compliance of the documentation and the PSA model with the applicable IAEA standards. The experts' comments and recommendations were reflected in a new version of the updated Level 1 PSA, which was verified during the follow-up mission in 2024.

The results of the comprehensive review confirmed that the scope, modelling, and data of the updated PSA comply with standards and internationally recognized best practices for conducting such analyses. The positive results of the review provide for possibilities to use the PSA more effectively in the process of risk-informed decision-making to ensure safety, as well as in connection with the application of an integrated approach to safety assessment of Kozloduy NPP Units 5 and 6.

Referring to Unit 5 PSR, in 2024, the review has started within the deadlines and scope set by the current requirements.

Overview of safety assessments performed and the main results for existing nuclear installations including summary of significant results (for each of the nuclear facilities, not just their type and generation)

Units 5 and 6 Lifetime Extension

Technical measures formulated from the recommendations resulting from the completed project on "Kozloduy NPP Units 5 and 6 Lifetime Extension" are planned and in process of implementation in the period of long-term operation. The implementation of the measures is envisaged for the entire period of long-term operation, till the end of 2047 for Unit 5, and till the end of 2051 for Unit 6 respectively.

The planned technical measures are included in the Action Management Programme on corrective actions to be carried out in the period of long-term operation of Units 5 and 6 and are mainly related to:

- Safety enhancement;

- Replacement of SSCs whose service life has ended;
- Preparation of additional analyses and justifications of the residual lifetime of the SSCs;
- Re-certification of equipment, devices, systems, and units when revalidation and verification of quantitative assessments of residual resources are required;
- Activities and changes into existing practices aiming at improving the efficiency of the ageing management process.

Introduction of a new type of nuclear fuel at Unit 5

The process of the introduction of alternative nuclear fuel type at Kozloduy NPP Unit 5 was initiated with the development of a feasibility study and safety analyses to demonstrate the viability of the joint operation of the two fuel types during the 4-year transition period. The safety assessment completed included neutron-physical, thermo-mechanical, thermo-hydraulic and radiological analyses. The Technical Safety Analysis Reports were reviewed by the Kozloduy NPP experts and were accepted on a Kozloduy NPP Expert Technical Council.

In July 2023, the NRA received an application to issue a permit for the phased transition of Kozloduy NPP Unit 5 to operations using RWFA type nuclear fuel. Following thorough review, in April 2024, the NRA Chairperson issued a permit for a phased transition of unit 5 to operation with RWFA type nuclear fuel. The transition shall take place over four consecutive fuel campaigns (four years) in compliance with the conditions of the permit issued, which result from the outcomes of the safety analysis review completed. The deadlines for fulfilling the conditions are set taking into account both the relative importance of meeting the specific condition in terms of safety and the time needed to collect data from fuel operation with the aim of performing additional analyses and/or supplementing those already submitted to the NRA.

A key milestone was the installation of BEACON core monitoring and control system in 2023, which provides real-time monitoring and predictive calculations capability for both mixed and homogeneous cores. Following verification and validation, the advanced version of the In-Core Monitoring System was commissioned in June 2024 to support the safe and efficient control of the Unit 5 thirty-first (31) fuel campaign.

The phased transition to RWFA type nuclear fuel practically started in May 2024 with the loading of the first 43 fuel assemblies in Unit 5 core and is expected to complete in 2027.

Regulatory review and control activities

The regulatory reviews and assessments of the submitted documents related to the application of the permit and licensing regime for Kozloduy NPP Units 5 and 6 refer mainly to the following activities carried out by the licensee:

- modifications of SSCs important to safety including change of the nuclear fuel type used;
- changes in the operational limits and conditions of the units on the basis of which the operating licence has been issued;
- changes resulting in amendments to the internal rules included in the operating licences of the nuclear facilities;
- organisational changes in Kozloduy NPP EAD;
- maintain the SAR of the nuclear facilities in accordance with the actual status of the SSCs important for safety, the current characteristics of the site, the results of analyses and assessments performed, and the implementation of corrective actions to improve safety.

The regulatory review of the documents submitted with the application for the introduction a new type of nuclear fuel at Unit 5 was carried out in the period 2023-2024 in accordance with the

Procedure for Review and Assessment of Information Related to the Safety of Nuclear Facilities under which a special Review Programme was developed and adopted. Both experts from the NRA and leading external consulting organisations from France, the Czech Republic, and Ukraine participated in the review of the documents. The regulatory review covered a wide range of issues, including:

- compliance of the design and safety analysis with the regulatory requirements, safety standards, and the recognised good practices in leading countries;
- safety assessment of the joint operation of the two types of nuclear fuel, resilience to external hazards, initiating events, and common cause failures;
- update of the safety analysis report;
- safety assessment during transport ans storage of RWFA type fresh and spent nuclear fuel in compliance with the safety requirements and standards.

Article 14 (2) Verification of safety

Overview of arrangements and regulatory requirements for safety review of the Contracting Party

In accordance with the requirements of the Regulation on Ensuring the Safety of Nuclear Power Plants, the operating organisation shall develop and implement programmes for maintenance, testing, supervision and inspection of SSCs important to safety, which ensure the fulfilment of the design requirements for the operability, reliability and functionality of the SSCs throughout the entire operating life of the NPP.

The maintenance programmes shall cover activities to control degradation processes, prevent failure, restore the operability and reliability of SSCs, as well as to take into account the results of the ageing management programme.

The operating organisation shall develop, implement, evaluate and improve an ageing management programme (AMP). The programme shall cover the SSCs important to safety as well as the activities necessary to maintain their operability and reliability. The measures and activities for the maintenance of SSCs should be determined on the basis of the established ageing mechanisms and the consequences of ageing for specific SSCs.

The Ageing Management Programme shall take into account all the factors of influence (radiation embrittlement, thermal ageing, fatigue, corrosion, etc.) on the specific SSCs and compare the level of degradation of the SSCs with that envisaged in the NPP design. The ageing management programme shall be evaluated and updated as a minimum at the time of conducting a periodic safety review.

The results of the implementation of the periodic inspection, surveillance and testing programmes shall certify the fulfilment of the requirements for the SSCs important to safety or identify the need for corrective measures or recovery activities. The scope and frequency of the maintenance, testing, surveillance, and inspections of SSCs shall be determined using a systematic approach based on:

- their importance to safety;
- their intrinsic reliability;
- their tendency for degradation;
- operating experience, the results of the SSCs monitoring and other applicable experience.

Maintenance, testing, surveillance and inspection activities shall be performed under validated and approved working procedures, and the results of these activities shall be logged, stored and

analysed in order to detect deterioration trends in a timely manner for the SSCs characteristics and to timely apply any corrective actions.

Maintenance programmes shall be periodically reviewed in the light of operating experience and proposals for changes in the programmes. Proposed changes to the maintenance programmes are evaluated for compliance with applicable requirements, impact on SSCs characteristics and NPP safety.

After each operating event that has compromised safety functions or the functional integrity of a component or system, relevant remedial actions and verification of the safety functions shall be performed.

Main elements of the continuous safety review programmes (in-service inspection, surveillance, performance tests of systems)

In-service inspection of equipment and pipelines is performed to assess the current condition of the base metal, overlayed surfaces and welded joints. The applicable non-destructive testing methods, volumes and frequency of testing are specified for each specific unit and element. In-service inspection of the metal of the primary and secondary equipment and pipelines is carried out according to specially developed programmes and is an integral part of the documents for outage preparation. In-service inspection is carried out by certified personnel according to the applicable testing methods.

Depending on the annual analyses of the internal operating experience results, the information received on the applicable external operating experience, as well as studies and calculations of the strength of components of operating equipment with identified non-compliances, the work programmes are supplemented with the necessary volumes and methods for non-destructive testing of the primary and secondary SSCs.

The surveillance activities on SSCs include monitoring of compliance with the operational limits and conditions and the analysis of trends within the established limits in order to identify emerging deviations in a timely manner and to take appropriate remedial actions.

The results of the equipment surveillance activities are used to analyse and assess the SSCs condition in the period of the long-term operation of Kozloduy NPP Units 5 and 6, to adjust the operating modes and conditions, and preventive maintenance and repair activities.

The applied activities and methods for supervision of the SSCs important to safety consider the requirements of the technological specifications of the units, the results of the safety analyses, the results of SSC surveys, data from the commissioning of Units 5 and 6, data and requirements of equipment manufacturers, requirements of supervisory bodies and regulatory and technical documents.

The periodic inspections and tests shall confirm that SSCs important to safety have sufficient margin to meet the requirements for further safe operation.

The stipulated activities for ensuring the reliability of the SSCs and for checking the compliance of the units are aimed at timely detection of deteriorated characteristics of the SSCs, which could lead to disruption of the equipment’s performance during the implementation of the safety functions or to a failure. The supervision of the SSCs covers the organisational and procedural aspects related to:

- control and diagnostics of the technical state of the nuclear fuel and the SSCs;
- control and analysis of the water chemistry of the systems;
- periodic performance tests of SSCs;
- metrological verification of the operability of the measuring instruments; calibration of sensors and instruments;

- tests to re-certify the systems important to safety;
- inspections and check-ups of the condition of the facilities subject to technical supervision;
- tests after maintenance or repair;
- post-modifications surveillance programmes for implementation of modifications important to safety;
- maintenance and repair activities;
- ageing management.

The activities related to the diagnostics of the condition of the SSCs are performed on the basis of approved monitoring methods, according to the developed and implemented procedures.

The organisation and procedure for performing metrological control of the measuring instruments and measuring systems at Kozloduy NPP are regulated by the "Procedure for metrological control of measuring instruments at Kozloduy NPP EAD". The scope and methods of calibration and metrological checks of the measuring instruments and measuring channels are described in the respective methodologies. The scope and sequence of verification of the technical condition of the measuring instruments and measuring systems related to the systems important to safety are established by procedures. The procedures determine the content, order and methodology for performing the necessary verification activities, the analysis of the condition of the equipment and the requirements for formulation of the results.

Inspections and checks of the conditions of the facilities shall be carried out by means of visual inspections, non-destructive testing of the metal, corrosion control (screening), pneumatic and hydraulic tests and, if necessary, mechanical and metallography testing of material samples. Guiding documents are the procedures for in-service inspection of SSC and technical certification procedures describing the scope and criteria for certifying the equipment or part of a process system in order to demonstrate compliance with the requirements of the applicable current regulations and standards.

After an outage, the preliminary planned complex performance tests of the equipment and systems are carried out, and the results are documented to confirm the fulfilment of the maintenance objectives set and the requirements for the component (system) before putting them back into operation.

After implementation of design changes, performance tests of the replaced equipment or system are carried out, if necessary. Specific performance test programmes are developed in this regard. The programmes have two objectives - to check the compliance of the implementation with the requirements of the design and to determine on the basis of the accumulated experience the optimal scope and period of supervision. Analyses of the performance results of the replaced equipment is carried out during operation to determine the most favourable operating modes of operation.

Maintenance and repair include a complex of operations to restore the operability and/or the lifetime of the equipment and are carried out:

- under an established schedule - long-term schedule for maintenance of SSCs, as well as specific (detailed) schedules;
- in case of deterioration of the technical condition;
- in case of negative trends and recommendations based on periodic analyses and as per information on applicable operating experience (internal and external);
- in cases of failures and violations.

Elements of the Ageing Management Programme

In order to ensure the safety, reliability and availability of the SSCs important to safety, an ageing management (AM) process is implemented at Kozloduy NPP based on the understanding of the degradation mechanisms and taking actions to prevent, detect, control, monitor and mitigate the consequences of the ageing effects on the SSCs. The process includes:

- implementation of an AMP for the systems and components important to safety and other ageing management relevant programmes - for maintenance and repair, operation, equipment qualification, water chemistry, surveillance, in-service inspection, monitoring etc.;
- establishing ageing management working groups, including experts from different organisational units of the plant;
- distribution of the functions and responsibilities of the plant officials, defining the terms and conditions for coordination and interaction between the respective structural units, ensuring the implementation of the specified activities;
- description of how documenting of the activities (archiving, recording) under the ageing management programme is performed in order to ensure traceability.

The ageing management process covers the activities of all Kozloduy NPP structural units related to equipment important to safety. In order to effectively coordinate the activities of the different departments relevant to the ageing management process, a component-based AMP and a Programme for proactive management of equipment ageing have been developed and implemented.

Assessment of the effectiveness of ageing management is carried out annually in accordance with established rules of the management system, and, for this purpose, performance and specific indicators have been developed and included in the performance indicators' system for the effective management in the company.

Arrangements for internal review by the licensee of safety related issues to be submitted to the regulatory body

Expert committees, including a wide range of specialists, review and resolve safety related issues at Kozloduy NPP. Depending on the scope of the issues under review, the following types of expert committees are established:

- Safety and Quality Committee - an advisory body of the Kozloduy Chief Executive Officer on issues related to safety and quality during operation, maintenance and reconstruction of the nuclear facilities, nuclear fuel cycle and radioactive waste management, and maintaining emergency preparedness;
- Safety Committee - a specialised advisory body of Units 5 and 6 Chief Engineer assisting him on issues related to ensuring the safety of the nuclear facilities and the necessary conditions for compliance with the requirements for nuclear, radiation, industrial and fire safety of Units 5 and 6, ensuring the efficiency of the installed power capacities, implementation of the quality assurance programme for units' safe operation, protection of the personnel, the environment and the public;
- Safety Culture Committee - advisory body on safety culture related issues (See the text referred to in Article 10);
- ALARA implementation committee (See text referred to in Article 10);
- Operating Experience Committee (See text referred to in Article 19);

- Expert Technical Committee - advisory body on issues related to the implementation of technical and/or process proposals and developments for design modifications of the equipment and systems;
- Independent Nuclear Safety Advisory Council from external experts.

Regulatory review and control activities

The regulatory control for the nuclear facilities in operation, including activities related to issuing of permits for modifications to the design of the facilities, is focused on the ageing management aspects. “Ageing Management” area has been included in the scope of the NRA’s long-term inspection programme and inspections in this area are foreseen while preparing the annual inspection plans. Monitoring and evaluation of the planned activities is also performed in the course of the inspections carried out to check the preparedness of the units for start-up after outage.

Regulatory review and control activities include the implementation of the conditions of the operating licences for units 5 and 6, in particular the conditions requiring the submission of periodic information on the status of nuclear safety and radiation protection and on the indicators for safe operation. The following documents are also revised and submitted prior to units’ planned shutdown:

- Maintenance schedule (programme);
- Report on the neutron-physical characteristics of the new reactor core and analysis of the compliance with the accepted criteria;
- Programme for in-service inspection of the base metal, overlayed surfaces and welded joints of the equipment and pipelines.

The compliance with the conditions for safe start-up and operation of the power units after outage are subject to verification including the following main areas: implementation of safety improvement measures; performance tests and document amendments; in-service inspection activities carried out on the metal of equipment and pipelines and the outcomes thereof; core loading; radiation protection, etc. The unit is commissioned after a positive conclusion of the inspection.

After units’ commissioning, the results of the activities carried out included in the Ageing Management Programme regarding the determination of the neutron fluence of the reactor vessel, as well as a summary report on the residual life of the reactor vessel (including an increase in the critical temperature – Tc) and the equipment of the unit, for which an assessment of the residual life is carried out are submitted to the NRA.

Continuous monitoring of the units’ operation is carried out by the on-site NRA inspectors, including monitoring of the operating parameters, periodic tests and the housekeeping and conditions of the facilities.

The scope of the exercised regulatory control includes various types of inspections as well as proactive communication with the licence holders, including work meetings to discuss specific cases.

Article 15 Radiation protection

Each Contracting Party shall take the appropriate steps to ensure that in all operational states the radiation exposure to the workers and the public caused by a nuclear installation shall be kept as low as reasonably achievable and that no individual shall be exposed to radiation doses which exceed prescribed national dose limits.

Regulatory requirements for radiation protection in nuclear installations

The regulatory requirements for radiation protection at nuclear facilities are set out in the Act on the Safe Use of Nuclear Energy (ASUNE), the Regulation on Radiation Protection (RRP) and the Regulation on Ensuring the Safety of Nuclear Power Plants.

In the use of nuclear energy and ionising radiation and in the management of radioactive waste and spent fuel, ionizing radiation exposure of personnel and the public shall be maintained at the lowest reasonably achievable level.

The Regulation on Radiation Protection adopted in 2018 has been developed in accordance with Euratom Directive 59/2013 and defines:

- the general principles, requirements and measures for radiation protection;
- basic and derived dose limits of external and internal radiation;
- limits for radiation control and protection planning purposes;
- rules and limits for release of materials from regulatory control.

The effective dose limit for each occupationally exposed person is 20 mSv for a period of one year. Equivalent dose limits for occupationally exposed persons are also established:

- the equivalent dose limit for the eye lens is 20 mSv for a period of one year, or 100 mSv total dose for any five consecutive years, provided that the maximum dose does not exceed 50 mSv for one single year;
- the equivalent dose limit for the skin is 500 mSv for a period of one year, averaged over every1 cm^2 of the skin surface, irrespective of the area of the exposed surface;
- the limit of equivalent dose for the limbs is 500 mSv for a period of one year.

For the activities related to the operation of nuclear power plants, research nuclear installations, facilities for radioactive waste and spent nuclear fuel management, as well as for the transport of radioactive substances, the specific safety requirements set out in the relevant regulations shall be applied.

According to the Regulation on Ensuring the Safety of Nuclear Power Plants in all operating states of the nuclear facilities on the NPP site, the annual individual effective dose resulting from external and internal exposure of the public caused by the impact of all nuclear facilities on the site, shall be maintained as low as possible and shall not exceed 0,15 mSv. To ensure radiation protection, the NPP design shall identify all real and potential sources of ionising radiation and shall provide measures for ensuring the necessary technical and administrative control over their use. Provisions shall be made in the design for an automated system for radiation monitoring at the workplace and at the NPP site, and a system for radiation monitoring in the precautionary action zone and the supervised area. These systems shall ensure the collection and processing of information on the radiation situation, on the effectiveness of the protective barriers, on the radionuclide activity, and information necessary to predict changes in the radiation conditions in all operational states and accident conditions.

The equipment of the automated system for radiation monitoring shall enable the implementation of:

- process radiation monitoring;
- radiation dosimetry control;
- radiation control of the NPP premises and site;
- radiation monitoring to prevent the spread of radioactive contamination.

The laboratory methods and technical means of the system for radiation monitoring shall ensure measurement of the human induced radionuclides content in soil, water, deposits, vegetation, water flora and fauna, and agricultural products.

The range and scope of radiation monitoring are coordinated with the competent state authorities - NRA, Ministry of Health (MoH), and Ministry of Environment and Water (MoEW). The control of radiation parameters of the environment and of agricultural production within the boundaries of the precautionary action zone and the supervised area, including the assessment of the radiation exposure of the public inhabiting these zones, is carried out by both the licensees and the state bodies for specialised control.

Regulatory requirements for licensee's processes for dose optimisation and implementation of the ALARA principle

In accordance with the ALARA principle, radiation dose limits (dose quotas) for personnel and the general public and security factors for the planning of external and internal radiation protection have been introduced. The dose quotas of the various nuclear facilities shall be justified in the course of the licensing process.

The values which are set in the Regulation on Radiation Protection shall include:

- secondary (derivative) exposure limits for external and internal exposure of personnel and the general public, including the equivalent dose rate limits and the limits of the annual intake of radionuclides into the body by inhalation and ingestion;
- limits for the purposes of radiation control and protection planning (control limits) in the case of external and internal exposure of members of the personnel and the public, which include: limits on the annual average volumetric activity of aerosols and radioactive noble gases in the air of personnel workplaces; limits on surface radioactive contamination; limits on the annual average flux density of ionising particles (electrons, photons, neutrons) in external exposures of personnel (body, eye lens and skin); limits on the annual average volumetric activity of radioactive noble gases and aerosols for ambient air; limits on the annual average volumetric activity of radionuclides for drinking water.

The Regulation on Radiation Protection specifies the requirements for radiation protection of occupationally exposed individuals:

- preliminary risk assessment and optimisation of protection;
- classification of workplaces and zoning;
- categorisation of occupationally exposed individuals;
- radiation monitoring of the working environment, including individual dosimetry monitoring;
- medical monitoring of personnel.

Organisation of the radiation protection at nuclear installations

Kozloduy NPP implements a programme for radiation protection of the personnel and the public, which includes:

- preliminary risk assessment and optimisation of protection;
- classification of workplaces and zoning;
- categorisation of occupationally exposed individuals;
- radiation monitoring of the working environment, including individual dosimetry monitoring;
- rules for conduct in the controlled area;
- rules for access to the controlled area;
- informing the personnel about radiation risks;
- personnel training and qualification maintaining;
- medical monitoring of personnel.

Applying the protection optimisation principle and based on the limit values specified in the Regulation on Radiation Protection, Kozloduy NPP have introduced:

- dose limits (annual and per activity) for occupationally exposed individuals;
- reference levels for operationally measurable radiation parameters, with the aim of timely identifying deviations and taking corrective actions.

Implementation of radiation protection programmes at Kozloduy NPP

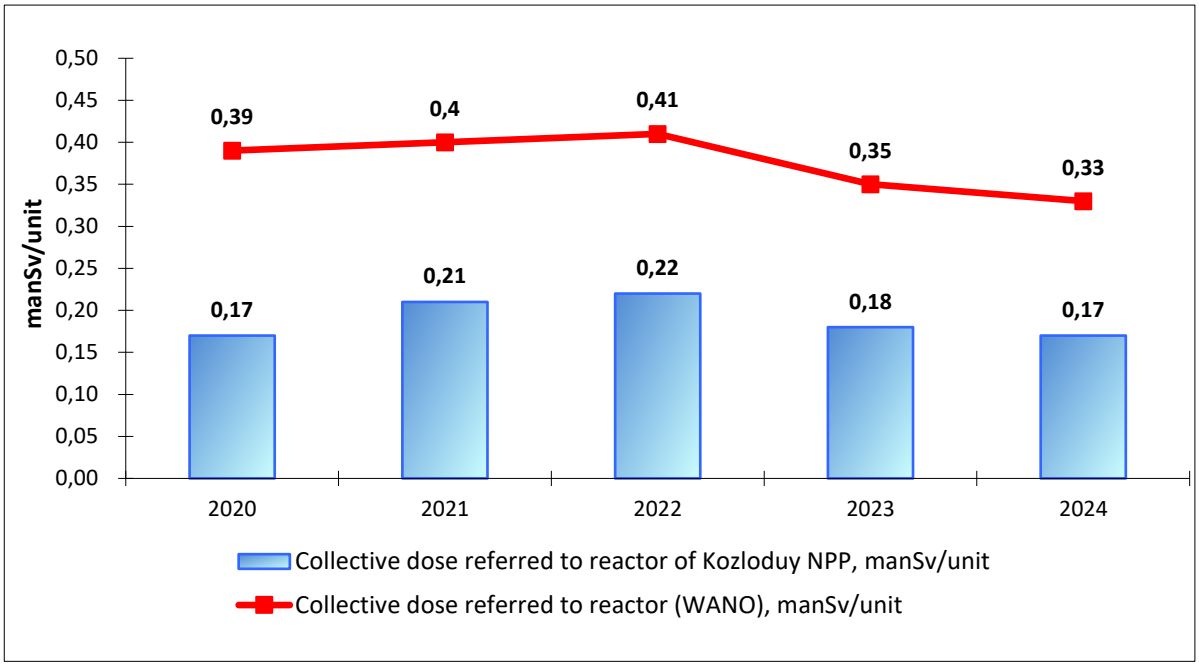
Dose exposure monitoring

Independent control of the occupational exposure is carried out by an Inspection Body Type C – Control Centre Personal Dosimetry, accredited by the Executive Agency Bulgarian Accreditation Service according to BDS EN ISO/IEC 17020.

The table below presents data on the occupational exposure at Kozloduy NPP (Units 5, 6 and WSFSF) over the last five years.

Indicator	2020	2021	2022	2023	2024
Collective effective dose, manSv	0.34	0.42	0.41	0.36	0.34
Maximum effective dose, mSv	5.28	9.14	7.43	5.80	8.19
Share of the internal exposure in the occupational exposure, %	0	0	0	0	0
Number of individuals, whose dose exposure values exceed the annual dose limit for occupational exposure	0	0	0	0	0

The collective effective dose in 2024 for the Kozloduy NPP normalised to the number of reactors in operation (WWER-1000) is 0.17 manSv/unit. For the last five years the collective dose has been commensurate with or below the average value of the WANO indicator for PWR type reactors (shown in the figure).



For the last five years the maximum individual effective dose ranges from 5 mSv to 9 mSv per year. There have been no cases of exceeding the annual administrative dose limit of 12 mSv established at the plant (60% of the regulatory limit for occupationally exposed individuals, category A).

Conditions for release of radioactive substances to the environment, operational control measures and main results

The basic principles, norms and rules to be followed in the release of radioactive substances to the environment resulting from licensed or authorised practices are set out in the ASUNE, the Regulation on Radiation Protection, and the Regulation on Ensuring the Safety of Nuclear Power Plants. The ASUNE does not provide for the issuance of a separate permit for the release of gaseous and liquid radioactive substances to the environment. Radioactive releases from nuclear facilities shall be evaluated when considering the technical design of the facility and shall be authorised with operating licences as an integral part of the operational limits and conditions of the nuclear facilities.

Liquid and gaseous radioactive discharges to the environment

Liquid Discharges

The dose limit of the individual effective dose from liquid discharges accepted for the plant site is 50 μSv/y. Based on this dose limit, the limit values and reference levels for the activity released to the environment by liquid discharges have been established. These limits are also included in the technical specifications of the Kozloduy NPP units, which contain the limits and conditions for safe operation.

When monitoring the liquid discharges to the environment, limits have been established on two parameters - total activity released for a certain period of time and volumetric activity registered at the time of wastewater drainage.

The table indicates the limits and reference levels for the total wastewater activity of the production process for all facilities on Kozloduy NPP site (including Units 1-4).

Indicator	Quarterly reference level	Quarterly limit	Annual reference level	Annual limit
Total activity (without tritium), GBq	37	185	148	740
Tritium, TBq	9,44	46,2	37,7	185

The reference levels are set at around 20% of the limit values. In order to prevent high activity releases for a short time, quarterly limit values have also been set for liquid discharges in addition to the annual limit values.

The following limits and reference levels, controlled operatively in the drainage process, have been set for the monitoring of the wastewater activity:

- volumetric activity limit (without tritium) of process water - 1850 Bq/l and corresponding reference level 370 Bq/l;
- volumetric activity limit of water from washrooms, toilets and baths located in the controlled area - 11 Bq/l.

Gaseous discharges

For the gaseous radioactive discharges, annual limit values are set for separate components so that, when they are reached, the limit of an individual effective dose of a member of the public is not exceeded - 50 μSv/y. The limit values thus obtained apply to all facilities at the plant site (including Units 1-4). In addition, a distribution was made between the separate ventilation stacks (VS) based on operating experience.

The annual limit values for the gaseous discharges from the Kozloduy NPP site are given in the table below:

Emission Components	VS-1 Units 1,2	VS-2 Units 3,4	5VS Unit 5	6VS Unit 6	0VS AB-3	WSFSF VS	NPP - Total
RNG, TBq	100	100	1400	1400	700		**5600**
^{131}I, GBq	3	3	13,5	13,5	5		**65**
Aerosols, GBq	3	3	12	12	5	3	**50**
^{3}H, TBq	10	10	60	60	60		**250**
^{14}C, GBq	1000	1000	9000	9000	9000		**38000**

Since the actual discharges are much lower than the limit values set, the main objective in controlling gaseous discharges is early identification of negative trends in the operation of the units and optimisation of the radiation protection of the public. In this regard, the 24-hour reference levels presented in the table below have been additionally introduced:

Emission Components	5VS Unit 5	6VS Unit 6	0VS AB-3	WSFSF VS	NPP - Total
RNG, TBq	3,8	3,8	2,0		15
^{131}I, MBq	38	38	14		178
Aerosols, MBq	33	33	14	7	137

The 24-hour reference levels are constantly monitored using automated control systems. A detailed assessment of the radionuclide composition and the activity contained in the discharges is periodically made on the basis of samples obtained by means of continuous sampling. This periodic radiation monitoring is intended to provide data on the most realistic assessment of the dose exposure of the public and to provide information to the public on the discharges from the plant to the environment.

Results from the periodic monitoring of liquid and gaseous discharges to the environment

Gaseous discharges

The table presents the results from the monitoring of the gaseous discharges through the ventilation stacks of Units 5 and 6 and the WSFSF for the period 2020-2024. The values indicated for radioactive noble gases (RNG) and aerosols represent sums of the values obtained for the individual radionuclides in the respective group. The list of controlled radionuclides complies with the European Commission Recommendation 2004/2/Euratom.

Component	RNG, TBq		^{131}I, MBq		Aerosols, MBq		*^{14}C, GBq		*^{3}H, GBq	
Year	WSF SF	Units 5,6	WSF SF	Units 5,6	WSF SF	Units 5,6	WSF SF	Units 5,6	WSF SF	Units 5,6
2020	0	0,657	0	0,74	0,02	1,04	0	594	0	614
2021	0	3,78	0	50,8	0,39	8,95	0	724	0	607
2022	0	0,83	0	4,95	0	4,52	0	621	0	430
2023	0	1,32	0	27,8	0	3,22	0	673	0	660
2024	0	0,71	0	19,1	0, 02	3.96	0	58	0	606

** The values apply to a total of ^{14}C and ^{3}H (organic and inorganic forms).*

Liquid Discharges

The activity released to the environment by liquid discharges during the operation of Units 5 and 6 is indicated in the table below. The wastewater from the wet spent fuel storage facility (average 15 m^3 per month) is treated in the auxiliary building of Units 3 and 4. There are no direct discharges from the WSFSF. The total activity is formed as the sum of the activities of the individual radionuclides. The list of controlled radionuclides complies with the European Commission Recommendation 2004/2/Euratom.

Year	Total activity, MBq (without H-3)	H-3, TBq
2020	13,8	23,3
2021	45,3	24,4
2022	66,1	22,6
2023	48,8	22,6
2024	50,6	24,3

During the period 2020-2024, the released radioactive substances with gaseous and liquid discharges from Kozloduy NPP are below 1% of the specified limits. Tritium activity in the liquid discharges is about 14% of the specified limits.

The total dose exposure of the public in the 30 km zone around Kozloduy NPP due to radioactive emissions to the environment is:

Year	Maximum individual effective dose, [Sv/y]				
	Airborne	Liquid*	Liquid**	Total*	Total**
2020	$7{,}15.10^{-7}$	$4{,}14.10^{-7}$	$3{,}47.10^{-6}$	$\mathbf{1{,}13.10^{-6}}$	$\mathbf{4{,}19.10^{-6}}$
2021	$8{,}33.10^{-7}$	$4{,}38.10^{-7}$	$3{,}66.10^{-6}$	$\mathbf{1{,}27.10^{-6}}$	$\mathbf{4{,}49.10^{-6}}$
2022	$9{,}71.10^{-7}$	$4{,}05.10^{-7}$	$3{,}41.10^{-6}$	$\mathbf{1{,}38.10^{-6}}$	$\mathbf{4{,}38.10^{-6}}$
2023	$8{,}53.10^{-7}$	$4{,}03.10^{-7}$	$3{,}38.10^{-6}$	$\mathbf{1{,}26.10^{-6}}$	$\mathbf{4{,}23.10^{-6}}$
2024	$5{,}88.10^{-7}$	$6{,}42.10^{-7}$	$4{,}53.10^{-6}$	$\mathbf{1{,}23.10^{-6}}$	$\mathbf{5{,}12.10^{-6}}$

** - for a representative member of the public.*
*** - for a person with extreme habits (conservative).*

For calculating the additional public dose exposure due to radioactive discharges from the plant to the environment, verified and validated modelling codes for evaluation, based on the CREAM methodology adopted by the European Union (EU) and adapted to the geographical and hydrological specifics of the Kozloduy NPP area are applied. The transfer models for the tritium from the MODARIA platform are taken into consideration.

Processes and steps taken to ensure that staff are exposed to radiation as low as reasonably achievable for all maintenance and repair activities

In recent years, Kozloduy NPP maintains levels of radiation exposure of personnel and public comparable to the best world practices and constantly makes efforts to optimize radiation protection.

The main directions in which efforts are being made to improve the level of radiation safety at the plant are:

- administrative management of dose exposure optimisation measures;
- integration of radiation protection measures into the generation process, along with other safety measures at work;
- improvement of radiation risk assessment by workplace and identification of appropriate protection measures;
- conduct of training and briefings to avoid unplanned exposure caused by human error;
- raise worker's awareness about radiation risks through briefings, use of colour coding, light signalling;
- detailed planning of protective measures when performing activities with an increased risk during outages;
- improvement of the dosimetric permit-to-work system and the dosimetric monitoring system;
- analysis of activities performed and operating experience feedback;
- evaluation of the effectiveness of the measures implemented.

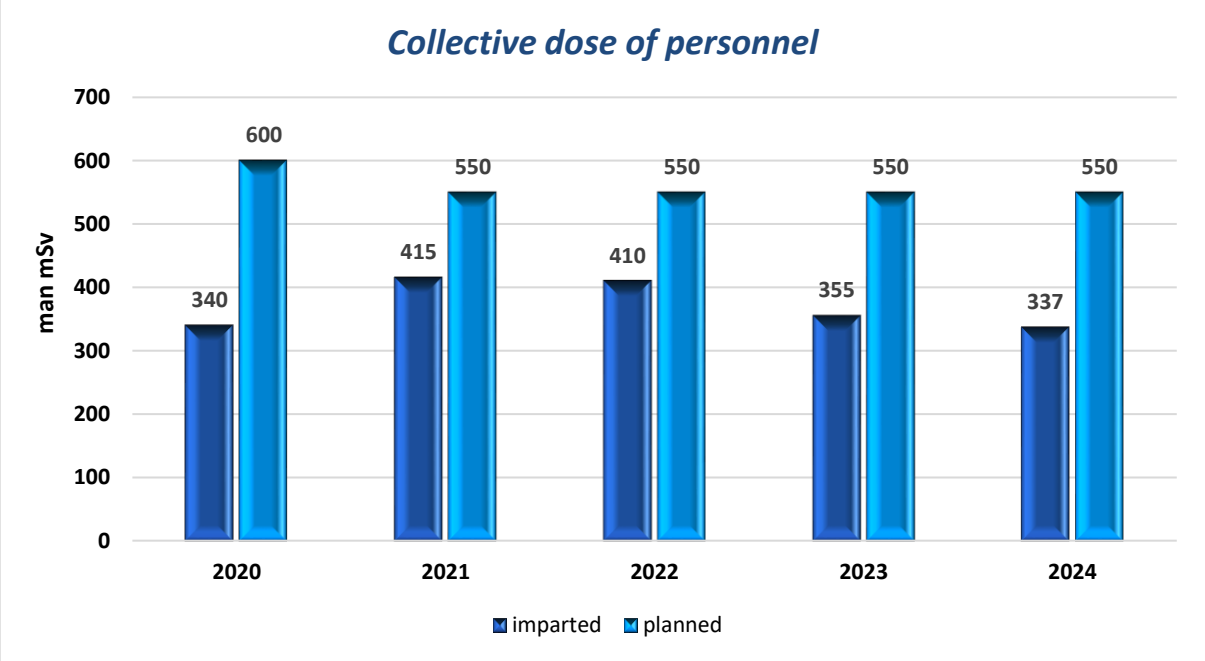
The administrative regulation and exposure planning are of primary importance in the optimisation of the radiation protection system at Kozloduy NPP. The main approaches applied are:

- setting dose limits for the annual individual dose exposure of the personnel;
- determining reference levels for the content of radioactive substances in the air in the premises of the radiologically controlled area, for surface contamination and the dose rate

in them so that the expected individual effective dose of personnel is maintained as low as reasonably achievable;

- holding ALARA committee meetings to discuss the radiation risk associated with certain maintenance operations, planning the collective dose and measures for optimisation the radiation protection when performing these operations;
- establishing reference levels for liquid and gaseous radioactive releases to the environment and carrying out radiation monitoring at the site and in the vicinity of the plant.

The results of the planned and received collective dose of plant personnel in recent years are presented in the figure below. The results show that the actual received collective dose of personnel is lower than planned.



Environmental monitoring and key results

The radioecological monitoring of Kozloduy NPP complies with the national and European regulatory requirements in the field and corresponds to the experience and good practice of the countries with developed nuclear power industry. The range and scope of the performed monitoring complies with the requirements of Art. 35 of the Euratom Treaty and Recommendation 2000/473/Euratom. The results of the monitoring are verified by independent studies of the control by the supervisory authorities in the country - NCRRP/MoH and EEA/MoEW. The departmental radioecological monitoring is accredited under ISO/IEC 17025 since 2012.

Automated and laboratory control of radiation parameters in the Bulgarian section of the 30 km Urgent Protective Action Planning Zone and comparative measurements in benchmark points up to 100 km are performed. An automated system for radiation monitoring of settlements within the 30 km Urgent Protective Action Planning Zone is in operation with 13 local measuring stations, information from which is transmitted to the national radiological monitoring network in accordance with the Environmental Protection Act. At public places in these settlements there are stationary instruments for visualization of the radiation gamma background.

There are 36 monitoring points around Kozloduy NPP where measurements and sampling for the content of rechnogenic radionuclides in major environmental specimen are carried out. The airborne radioactivity, atmospheric deposits, vegetation, soil and radiation gamma background are monitored on a regular basis. Outside these points, samples of water, bottom sediments, milk, fish and agricultural products produced in the area are analysed. Attention is paid to drinking water

sources and the Danube River, along which there are several sampling points. standardised and validated methods are used, such as gamma spectrometry, alpha spectrometry, total alpha and beta activity low-background radiometry, liquid scintillation spectrometry for the determination of tritium, carbon-14 and strontium, etc. A specialised mobile laboratory equipped with sampling and rapid measurements equipment is used for radiation surveillance and field measurements. More than 2,200 samples from different environmental specimen are tested annually: air, water, soil, vegetation, milk, fish, crops, etc., with the total number of laboratory tests exceeding 4,000. Besides, more than 1,200 measurements of radiation gamma background are performed at the monitored posts and monitoring routes with portable dosimetry devices and stationary located thermoluminescent dosimeters.

The quality assurance of the analyses is ensured through analyses of blank, duplicate and labelled samples, control tests of the equipment and regular participation in elite international laboratory comparisons and proficiency tests organised by IAEA, Federal Office for Radiation Protection BfS of Germany (PTB), National Physical Laboratory of Great Britain (NPL), etc. In 2025 the Kozloduy NPP Radioecological Monitoring Laboratory (Radioecological Monitoring Department) became a member of the ALMERA (Analytical Laboratories for the Measurement of Environmental Radioactivity) network established by the IAEA, which provides broad prospects for developing and upgrading the analytical capacity in compliance with the leading global standards and good practices. The technical means used are duly calibrated and metrologically assured.

The results of the radioecological monitoring carried out are reported periodically to the competent authorities in the country - NRA, MoEW and NCRRP/MoH. Monthly newsletters with radiation status data are sent to the mayors of the neighbouring municipalities - Kozloduy, Mizia and Oryahovo. Real-time public access to the data from the automated radiation monitoring system in settlements of 30 km zone is provided. The general public is familiarised with the main conclusions on the radioecological status in the area through presentations and practical demonstrations during organised visits.

Regulatory control

Nuclear Regulatory Agency

The licences issued for operation of nuclear facilities at Kozloduy NPP site include specific requirements regarding the provision of radiation protection, radiation monitoring and the periodicity and type of reporting of results. Under the terms of the licences, periodic information shall be submitted on the condition of the installations, gaseous and liquid releases, the results of dose monitoring for the personnel and environmental radiation monitoring, including an assessment of the radiation exposure of the public from the releases.

Regulatory oversight of the radiation protection status includes analysis and assessment of information submitted to the NRA for compliance with regulatory and licensing requirements on radiation protection. The results are published in the NRA’s annual reports on the state of nuclear safety and radiation protection.

NRA carries out independent regulatory oversight of radioactive releases from Kozloduy NPP. Internal procedure stipulates the monitoring by assigning the analysis of the samples to an independent laboratory. The procedure describes the scope and organisation of the monitoring, the programme and timetable for sampling and analysis, the responsibilities of individual participants, the requirements for reporting the results. The sampling programme includes at least 5% of the number of samples taken at Kozloduy NPP depending on their type. The NRA also has its own aerosol sampler situated at the Kozloduy NPP site, the samples from which are also analysed by the independent laboratory.

In the period 2020-2024, approximately 80 samples of radioactive releases from Kozloduy NPP were analysed annually for gamma radionuclides, transuranic elements, ^{90}Sr, ^{3}H and ^{14}C. The data from the sample analysis protocols submitted to the NRA show good compliance with the results of Kozloduy NPP.

Ministry of Environment and Water

The MoEW, through the Executive Environment Agency and its regional structures, monitors the environment radiation status in the 30 km area of Kozloduy NPP.

The radiological environmental monitoring is performed in two ways:

- through an automated monitoring systems;
- through a network of points for monitoring of the radiation parameters of the main environmental components.

Continuous and periodic monitoring is performed on the following radiological parameters:

- radiation gamma background;
- atmospheric radioactivity;
- the content of technogenic radionuclides in uncultivated areas from points in the monitored area;
- radiological indicators in surface waters from the 30 km zone and discharge waters from the plant;
- content of technogenic radionuclides in sediments from the Danube River.

The real-time radiometric measurements, sample taking and laboratory-analytical activity in the area of Kozloduy NPP are carried out by the Regional Radiation Measurement Laboratories in Vratsa and Montana at the Environment Executive Agency (EEA). Periodic monitoring is performed of atmospheric aerosols, uncultivated soils, discharge waters from the plant, surface waters and sediments from the Danube River and other water bodies in the area.

The data obtained from the measurements show no influence of the operation of the nuclear power plant on the environmental components.

The EEA administers the National Automated System for Continuous Monitoring of Radiation Gamma Background. The system consists of 26 local monitoring stations located throughout the country, with a larger concentration of stations in the 100 km area around Kozloduy NPP. The users of the operational information from the automated system are the Ministry of Interior - General Directorate Fire Safety and Civil Protection and the Nuclear Regulatory Agency - Emergency Centre. Eight automatic stations from the off-site dosimetry control of Kozloduy NPP located within a radius of 1.8 km from the plant are integrated into the system. The system is integrated into the European Radiological Data Exchange Platform (EURDEP). Data is sent to the EURDEP every hour for all modes of the automated system.

The EEA also administers the Automated Radiation Monitoring System for water of the Danube River in the area of Kozloduy NPP. The system consists of two local monitoring stations, installed at the Kozloduy port, before the plant and the port of Oryahovo, after the cooling water discharge canal of the plant. The stations carry out continuous river water sampling and automatic analysis for gamma-emitting radionuclides. The system did not detect elevated levels of technogenic radionuclides such as caesium-137 and iodine-131.

The results of the radiological monitoring carried out are published on the EEA's website – daily and quarterly bulletins and the National Environmental Status and Protection Report.

Ministry of Health - National Centre for Radiobiology and Radiation Protection

The Ministry of Health, through the National Centre for Radiobiology and Radiation Protection (NCRRP), carries out independent state health and radiation control of factors of the work and living environment that can lead to exposure of persons (personnel and public) to sources of ionising radiation, assessment of the exposure and radiation risk of the public as a whole or of a representative person. The state health and radiation control at Kozloduy NPP includes:

- preliminary control by coordinating, where necessary of the general and detailed development plans; drawing up a health report, evaluating and issuing statements on the compliance with the health and radiation protection requirements for the personnel and the public in: designing, construction, reconstruction, expansion, commissioning of sites for public use and activities with sources of ionizing radiation;
- systematic control without prior notification of Kozloduy NPP is carried out through ongoing control of compliance with the health requirements established by a regulatory act for the site as well as for the activities carried out therein. The current control at the plant is carried out by the State Health and Radiation Control Department at the NCRRP, through the NPP Control Group on site according to a preliminary approved plan. On-going monitoring includes sampling, measurements of the radiation factors of the working environment, laboratory analyses, data processing and preparation of protocols/reports, as well as, in case of violations, issuance of mandatory prescriptions, verification of the implementation of the prescriptions;
- targeted control in case of received signals from citizens, state and municipal authorities and organisations or in case of data on occurrence of incidents with risk to health of personnel and public.

In order to evaluate the annual effective dose and the exposure over the natural background of the public from the Kozloduy NPP activity, the NCRRP performs radiation monitoring of sites from the terrestrial and aquatic ecosystems in the area (3-90 km zone) of the plant. The content of technogenic radionuclides, in particular strontium-90 and caesium-137 in atmospheric deposition, water, sediment sludge, vegetation, soils and food of local origin is determined by performing radiochemical and gamma-spectrometric analyses. Monitoring data during the reporting period are comparable to those reported by Kozloduy NPP.

The annual personal effective dose of the exposure over the natural background of individuals from the public living in the area around the Kozloduy NPP is below 0.010 mSv (0.004-0.007 mSv) as estimated on the basis of the radiation monitoring results obtained and it is below the dose limit of 0.15 mSv in accordance with the Regulation on ensuring the safety of nuclear power plants.

The results of the assessments and analyses are published in annual reports, the National annual report on the state of health of citizens and the National environmental status and protection report, issued by the Ministry of Health and the Ministry of Environment and Water, respectively.

Article 16 Emergency preparedness

1. Each Contracting Party shall take the appropriate steps to ensure that there are on-site and off-site emergency plans that are routinely tested for nuclear installations and cover the activities to be carried out in the event of an emergency. For any new nuclear installation, such plans shall be prepared and tested before it commences operation above a low power level agreed by the regulatory body.

2. Each Contracting Party shall take the appropriate steps to ensure that, insofar as they are likely to be affected by a radiological emergency, its own population and the competent authorities of the States in the vicinity of the nuclear installation are provided with appropriate information for emergency planning and response.

3. Contracting Parties which do not have a nuclear installation on their territory, insofar as they are likely to be affected in the event of a radiological emergency at a nuclear installation in the vicinity, shall take the appropriate steps for the preparation and testing of emergency plans for their territory that cover the activities to be carried out in the event of such an emergency.

Article 16 (1) Emergency plans and programmes

Overview of the arrangements and regulatory requirements for on-site and off-site emergency preparedness

The emergency preparedness and response in case of nuclear or radiological event is a part of the general national arrangements for protection in case of disaster. The main legislative and regulatory requirements for the structure and organisation of the emergency preparedness are stipulated in the Disaster Protection Act (DPA), the Act on the Safe Use of Nuclear Energy (ASUNE), the Regulation on Emergency Planning and Emergency Preparedness in case of Nuclear and Radiological Emergencies, the Regulation on Radiation Protection, and the Regulation on the Conditions and Procedures for the Functioning of the National System for Early Warning and Notification of the Bodies of the Executive Power and the Population in the event of Disasters and for the Disclosure of Air Hazards.

The DPA establishes a unified approach and organisation for planning, maintaining emergency preparedness and response at the national, regional, municipal and object level in case of a disaster or an emergency. The DPA and ASUNE establish basic requirements for the development of emergency plans, including their contents, human resources required, material and technical support, etc. The ASUNE determines additional specific requirements for emergency preparedness and response to nuclear or radiological emergency.

According to the DPA, the Council of Ministers establishes and implements the state policy to protect the public in case of disaster, approves the National Disaster Risk Reduction Strategy, the National Disaster Risk Reduction Programme and the National Disaster Protection Plan. Disaster Risk Reduction Council and an Interdepartmental Commission for Recovery and Assistance have been established under the Council of Ministers. The Disaster Risk Reduction Council is a permanent advisory body which ensures the coordination and cooperation during implementation of the state policy in case of disaster. Its main functions are related to development of the National Disaster Risk Reduction Strategy, the National Disaster Risk Reduction Programme, and the National Disaster Protection Plan, as well as support in development and application of Acts and sublegislative acts related to reducing the risk of disaster.

The National Disaster Protection Plan contains an analysis of the hazards that may occur on the national territory. Specific measures have been developed for each hazard to protect the public, eliminate the consequences and restore the affected area. To respond to a nuclear or radiological emergency, an External Emergency Plan, which represents an integral part of the NDPP, has been developed at Kozloduy NPP.

Disaster protection is planned at municipal, regional and national levels, resulting in plans for each of these levels.

Disaster protection plans at all levels shall be prepared taking into account the identified hazards specific to the area concerned, with consideration of a nuclear or radiological emergency being mandatory. The plans shall identify:

- disaster hazards and risks;
- measures to prevent or reduce disaster risks;
- measures to protect the population;
- the allocation of responsibilities and the authorities and persons responsible for implementing the response measures;
- the means and resources needed to implement the actions referred to in items 2, 3 and 4;
- how the components of the integrated rescue system will interact;
- the arrangements for early warning and notification of the executive authorities, the components of the integrated rescue system and the public in the event of a hazard or disaster;
- recovery measures.

According to the ASUNE, state authorities and persons involved in commissioning, operation and decommissioning of nuclear facilities shall take measures to prevent incidents and accidents and limit their consequences. Emergency planning and emergency preparedness measures are established with the emergency plans as follows:

- off-site emergency plan that defines the functions and actions of the executive authorities to protect the public, property and the environment in the emergency planning zones in the event of an emergency;
- on-site emergency plan that defines the functions and actions of the licensee for accident mitigation and elimination of consequences within the site boundaries.

In case of an accident, the licensee shall:

- immediately inform the population, the mayors of the municipalities within the emergency planning zone, and the competent authorities;
- take actions to mitigate and eliminate the consequences of the accident;
- control the exposure of emergency workers involved in the mitigation and elimination of the accident;
- ensure continuous monitoring of radioactive releases into the environment.

Regulation on Emergency Planning and Emergency Preparedness in case of Nuclear and Radiological Emergencies (Emergency Regulation) defines:

- terms and conditions for development of emergency plans;
- persons who implement emergency plans and their obligations;
- actions and measures to mitigate and eliminate the consequences of a nuclear or radiological emergency;
- ways of informing the public;
- process to maintain and check the emergency preparedness;
- risk categories of sites, facilities and activities, as well as emergency classes.

In accordance with the requirements of the Emergency Regulation, emergency planning zones have been defined for Kozloduy NPP, as follows:

- emergency planning zone;
- precautionary action zone (PAZ) with a radius of 2 km;
- urgent protective action planning zone (UPZ) with a radius of 30 km.

The Kozloduy NPP on-site emergency plan covers the site. The plan also defines the Kozloduy NPP obligations related to the notification of the personnel on site, in PAZ, and the public in UPZ, as well as the performance of radiation monitoring in the three zones in the event of an emergency.

The Regulation on Radiation Protection defines the following:

- basic elements of management in situations with emergency exposure;
- reference levels for exposure of members of the public;
- reference levels for emergency workers in emergency occupational exposure;
- requirements to the contents of the off-site emergency plan;
- requirements to the scope and contents of the information provided to the public in case of an emergency.

In addition to the above regulations, requirements for emergency preparedness are applied in:

- Regulation No. 28 on the terms and conditions for medical assurance and health standards to protect the individuals in the event of a radiological emergency;
- Regulation on the construction, maintenance and use of collective protection equipment;
- Regulation on the conditions and procedures for the functioning of the National System for Early Warning and Notification of the bodies of the executive power and the public in the event of disasters and for the disclosure of air hazards;
- Regulation on the procedure for creating, storing, updating, maintaining, supply and reporting of stocks of personal protective equipment;
- Regulation No.11 on setting requirements to the limits of radioactive contamination of foods in case of a radiological emergency;
- Regulation on the conditions and procedures for notification of the Nuclear Regulatory Agency about events in nuclear facilities and sites, activities with sources of ionising radiation, and transport of radioactive substances.

Key elements of the National Disaster Protection Plan, including management hierarchy, roles and responsibilities of the licensee, the regulatory body and other competent authorities

The National Disaster Protection Plan (NDPP) includes: analysis of possible disasters and prediction of their consequences; measures to prevent or mitigate the consequences; measures to protect the public and the environment; procedure for requesting or rendering international assistance; obligations of the executive authorities and the persons responsible for the implementation of protective actions; funds and resources allocated to mitigate the consequences; ways of interaction between the executive authorities, and the procedure for early warning and notification of executive authorities, the components of the integrated rescue system and the public.

Activities to protect the public in case of disasters are performed by the Integrated Rescue System (IRS), which includes structures of ministries and departments, municipalities, trade companies and sole traders, medical and health care institutions; non-profit legal entities, voluntary formations and armed forces. The main structures of the IRS are Directorate General Fire Safety

and Civil Protection at the Ministry of Interior (DGFSCP-MoI), District Directorates of the Ministry of Interior, Bulgarian Red Cross and Emergency Care Centres.

The main structures of the IRS are established throughout the country in compliance with the administrative division and are available 24/7 to receive signals in the event of disasters and subsequent response. Additional IRS structures provide assistance upon request in compliance with the relevant disaster protection plan, and the armed forces – only with the permission of the Minister of Defence. The coordination of the IRS structures is carried out through operational centres of the DGFSCP-MoI.

When the NDPP is activated, National Headquarters are established by an order of the Prime Minister, who: performs analysis and evaluation of the situation; makes decisions on the implementation of actions to protect the public and the environment; organises and coordinates the actions of ministries, departments, regional governors and mayors of the municipalities who are assigned functions in the event of a disaster; informs the public through the media on the progression of the disaster, the protective actions taken and other actions to mitigate and address the consequences. The organisation and control of the activities in the disaster area shall be carried out by a head of operations assigned by an order of the the Prime Minister.

According to the Disaster Protection Act, the NRA is part of the Integrated Rescue System. In case of a nuclear or radiological emergency, the NRA Chairperson is a member of the National Headquarters.

The NRA Chairperson performs the functions of a central authority and a point of contact for notification in case of an emergency and providing assistance under the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency.

The NRA maintains an emergency response team and carries out training for its members. In case of a nuclear or radiological emergency, the main activity of the emergency team consists of incoming data processing, prediction of the accident progression, evaluation of consequences for the public and preparation of reasoned proposals to the National Headquarters in order to apply protective actions. Real-time data from the Safety Parameter Display System (SPDS) and the Critical Parameter Monitoring System (PAMS) of Kozloduy NPP Units 5 and 6 are received at the NRA Emergency Response Centre. Technical means are available for video-conferencing and communication between the NRA, Kozloduy NPP and the Ministry of Interior, as well as for communication with the IAEA and the EU for early notification in emergency situations.

In accordance with the requirements of the ASUNE, Kozloduy NPP has developed an on-site emergency plan. When it is activated, the Ministry of Interior, the Chairperson of the NRA, the Ministry of Energy, corresponding regional centres (Regional Directorate Fire Safety and Civil Protection - Vratsa and RD FSCP - Montana) are notified, including the public in the municipalities within the Urgent Protective Action Planning Zone. The responsibilities of the licensee, pursuant to the on-site Emergency Plan, are as follows: classification, declaration and notification of the emergency, management of activities related to accident management, handling and mitigation, and organisation and implementation of actions aimed at protection of the personnel at plant site and in the Precautionary Action Zone.

Implementation of emergency preparedness arrangements by the licensee

Classification of emergency conditions

The emergencies are classified according to the texts included in the Regulation on Emergency Planning and Emergency Preparedness in Case of Nuclear and Radiological Emergencies and the IAEA definitions stipulated in GSR Part7 in terms of the possible consequences and the associated actions to be taken:

- general emergency;

- site area emergency;
- facility emergency;
- alert;
- other emergency situations – emergency organization and actions are subject to separate emergency plans.

Key elements of the on-site emergency plan of nuclear facilities, including sufficient resources and authorities to effectively manage and mitigate the consequences of an accident

Emergency preparedness arrangements at Kozloduy NPP are defined in the on-site Emergency Plan, which specifies the action in case of an emergency at the plant. The on-site Emergency Plan is part of the package of documents required for a licence issuing. It is mandatory for implementation by all the plant personnel and personnel of organisations located on the site and in the Precautionary Action Zone. The Emergency Plan is developed based on the project documentation, the additional analyses and safety assessments, requirements of the national regulations and international recommendations, established common standards and practices in emergency planning and preparedness, nuclear safety and radiation protection.

The Emergency Plan reviews and classifies the nuclear and radiological emergencies and events without direct radiological consequences (non-radiological, conventional accidents) creating real or potential prerequisites for significant reduction in the level of safety of plant facilities.

Upon the occurrence of an emergency event, the emergency condition is determined by procedures on initial assessment of the initiating event and procedures on periodic assessment of the facilities, based on:

- state of the reactor systems;
- state of the nuclear fuel in the reactor and spent fuel pools (SFP);
- radiation situation at the plant and in the precautionary action zone;
- state of the spent fuel storage facilities (WSFSF and DSFSF);
- state of plant safety (different events, natural disasters, human activity, etc.);

The Plant Shift Supervisor (PSS) is the senior operations shift manager. He is responsible for the organisation and implementation of immediate actions in case of an emergency and rendering first aid to the injured. The official responsible for the overall management of activities under EP is the Emergency Response Manager (ERM). Until the emergency teams are assembled, the responsibilities and obligations of ERM are performed by the Plant Shift Supervisor. The operating time required for deployment and taking the workplaces in the on-site and off-site Emergency Response Centres by the members of the emergency team is 30 minutes.

The structure of the emergency response authorities includes the following additional units:

- Regional Fire Safety and Civil Protection Service (RFSCPS-Kozloduy);
- Regional Police Station - Kozloduy NPP;
- Occupational Health Service and Surveillance Department;
- Motor Transport Department.

These units have developed their own emergency plans describing the actions jointly implemented and coordinated with the Kozloduy NPP on-site Emergency Plan.

The EP annexes describe the technical means available at Kozloduy NPP required for control and mitigation of an accident. Additionally, the Procedure for Actions of the Emergency Teams in case of simultaneous occurrences at various nuclear facilities on Kozloduy NPP site describes the

available mobile equipment located on the site and in the precautionary action zone, the logistics – accumulator batteries, cables, oils and diesel fuel in case of an emergency related to simultaneous events combined with fuel meltdown at various site facilities.

In the event of on-site Emergency Plan activation and announcement of site/general emergency at Kozloduy NPP, the Prime Minister of the Republic of Bulgaria activates with an order the Kozloduy NPP off-site Emergency Plan. Following the activation of the on-site Emergency Plan, the plans of ministries and institutions are activated, as well as regional and municipal disaster protection plans in the part concerning nuclear and radiological emergencies.

Upon deactivation of the Emergency Plan at the NPP and in case recovery activities are needed, the Post-Emergency Recovery Framework Plan in activated. The Post-Emergency Recovery Framework Plan specifies the responsibilities, functions, rights and obligations of the Recovery Team. It also stipulates the plant restoration process and long-term maintenance of failed facilities in a safe state.

Article 9 of the Report provides information on the availability of sufficient resources and mechanisms for effective management of emergencies on site and mitigation of their consequences.

Facilities of the licensee to ensure emergency preparedness

Kozloduy NPP on-site Emergency Response Centre (ERC) was seismically qualified for beyond-design-basis earthquake conditions. The ERC was constructed at plant site and equipped with means of communication with the regional and national bodies and with workplaces in the plant buildings and facilities. The ERC has a back-up power supply and independent power supply from two diesel-generators. The ERC is equipped with autonomous filter-ventilation system operating in three modes (clean ventilation, filter-ventilation and full isolation mode) and with air monitoring equipment, autonomous water supply and sewerage, and food stock. There is a sanitary check-point in the ERC equipped with surface contamination monitors for the responders where decontamination can also be performed.

The off-site Emergency Response Centre (off-site ERC) is located on the territory of Kozloduy. The off-site ERC is seismically qualified to withstand and to remain operational during and after an earthquake exceeding the design basis earthquake for the plant site. The external power supply is backed up, but nevertheless the off-site ERC has independent power supply from one diesel-generator, and part of the equipment can be supplied from an UPS. The off-site ERC is equipped with autonomous filter-ventilation system operating in two modes (clean ventilation and filter-ventilation), autonomous water supply and sewerage, and a stock of food and bottled water. There is a sanitary check-point in the off-site ERC equipped with two types of monitors for the responders - gamma radiation and surface contamination monitors. The facility provides for decontamination of responders entering the building and rendering first aid and psychological support for the injured personnel.

The two Emergency Response Centres are equipped with process, radiological and meteorological monitoring equipment, software and hardware for assessment, prediction and visualisation of the results. The radiation monitoring in the premises is carried out automatically and with portable devices, including for aerosol content in the air. Personal radiological monitoring of the responders is performed by thermoluminescent dosimeters and electronic dosimeters.

The personnel and the public are notified through the Local Early Warning and Notification System and the National Early Warning and Notification System that have workstations in the both Emergency Response Centres. For the communication between the emergency response teams and for the notification purposes, TETRA terminals are used that remain operable in the emergency planning zones. Additionally, satellite telephones are installed in the main control rooms, on-site and off-site Emergency Response Centres. Technical means are available for video conferencing between the Emergency Response Centres, NRA and the National Headquarters.

The on-site and off-site ERCs receive information from the following systems:

- automated system for on-call duties under the Emergency Plan;
- Units 5 and 6 Safety Parameters Display Systems (SPDS) and Post-Accident Monitoring Systems (PAMS);
- automated information system for off-site radiation monitoring;
- automated information system for on-site radiation monitoring;
- automated aerological probing system;
- automated gamma radiation monitoring in the settlements of the Urgent Protective Action Zone;
- automated system for monitoring the hydraulic mode of the service water dual supply canal of Kozloduy NPP and monitoring of the Danube river water level;
- automated meteorological monitoring system;
- six water stations for specific volumetric activity measurement of liquid discharge and sewage waters.

The data from radiation monitoring system, the meteorological monitoring system (MMS) and the source of release are used as input data to software for determining protective measures for the personnel and the public. Data from the environmental monitoring mobile laboratory are received during an accident. The data is transferred to the ERC in online mode via TETPA radio channel and GPRS. Additionally, the on-site radiological monitoring data is sent to the ERC of the NRA. Kozloduy NPP daily receives information from the National Operations Centre (NOC) of the Ministry of Interior about forthcoming extreme weather conditions two days prior to the event.

Annexes to the on-site Emergency Plan contain inventories of emergency facilities and equipment available at the plant site:

- inventory of tactical and technical characteristics of fire equipment and armament in the RFSCPS of Kozloduy NPP;
- list of personnel and equipment for evacuation and recovery operations;
- inventory of mobile equipment required for the safe reactor cooling, including the available quantity of fuel.

Training and exercises, activities related to their assessment and main results of performed exercises, including lessons learned

Systematic approach is applied during training on emergency preparedness and response. Training is divided into initial and continuing training that take into consideration the specific functions of the responders depending on their position. Training programmes comply with the specific responsibilities of the responders and include both theoretical and practical modules. The training of Kozloduy NPP response teams is conducted at the plant Training Centre and in on-site and off-site ERCs. The executive authorities, local authorities and legal entities conduct periodic emergency drills and exercises to maintain the emergency preparedness and to improve emergency response actions. Pursuant to the current requirements, a National Exercise is conducted at least once every 5 years to verify the elements of Kozloduy NPP Off-site Emergency Plan.

The national exercises involve the executive authorities, the operating organisation, legal entities having obligations related to Off-site Emergency Plan implementation and the local authorities. The assessment of the national exercises is prepared by an expert committee that comprises of representatives of the NRA, MoI, MoE, BEH, licensee, etc.

In the period 2022-2024, the following exercises were conducted:

- PROTECTION 2024 national full-scale exercise on “Terrorist attack on Kozloduy NPP” resulting in severe radiological accident
- joint exercises between the NRA and Kozloduy NPP with following periodicity:
  - twice a year on scenarios that include severe accident;
  - four drills a year on scenarios that include design basis accidents;
  - once a year a general emergency exercise on a scenario with a severe accident with participation of all emergency teams’ members.
- international exercises between Kozloduy NPP and WANO Centres to test the emergency notification forms – 10 exercises per year.

18 ministries and institutions, four regional headquarters and two municipal headquarters participated in the PROTECTION 2024 national full-scale exercise conducted in June 2024. The emergency team of WANO-MC Regional Crisis Centre also participated in the exercise. The exercise scenario covered an accident related to terrorist attack on Kozloduy NPP site, transport operations with spent nuclear fuel (SNF), loss of off-site power supply and ultimate heat sink resulting in severe multiunit accident and further release of radioactive substances into the environment.

The following was checked and evaluated during the exercise:

- the existing arrangements, the sufficiency of the emergency teams and the technical means at the Kozloduy NPP site to deal with a terrorist attack under stress with simultaneous events involving fuel melting at various nuclear facilities on the site;
- sufficiency of the regulatory requirements for the organisation of actions in the emergency plan and procedures;
- sufficiency of managerial and executive personnel;
- sufficiency of technical means on site to deal with simultaneous events involving fuel melting at various nuclear facilities on the site;
- timely and proper implementation of protective actions for the public in the Urgent Protective Action Planning Zone;
- sufficiency of diesel fuel and lubricants.

The overall assessment of the conducted full-scope exercise is that the existing arrangements and technical means of action, as envisaged in the on-site emergency plan, in the event of simultaneous events involving core meltdown at various nuclear facilities on site, are sufficient and effective. In order to improve the interaction between the plant emergency teams and the external emergency teams, the need for more frequent training and briefings on the Kozloduy NPP communication plan has been identified.

In the period 2022-2024, the NRA participated in international and national exercises (full-scale, computer-simulated) for response actions in the event of various emergencies (nuclear or radiological emergency and terrorist act). The NRA also participated in all exercises of the IAEA ConvEx series for international information exchange in the event of a nuclear or radiological emergency and in the international ECUREX exercises organised by the EU.

In November 2023, Kozloduy NPP and NRA conducted a joint exercise to verify the revision of the Kozloduy NPP On-site Emergency Plan. During the exercise, the existing arrangements, the completeness and sufficiency of emergency teams, the rotation of the emergency teams and the operability of both Emergency Response Centres in case of a severe accident were assessed. The sufficiency and operability of the mobile equipment located at plant site and in the Precautionary Action Zone were also assessed.

In the above mentioned period, apart from the pre-planned exercises eight additional joint exercises were conducted by the NRA and Kozloduy NPP to verify the time for notification and time for arrival of emergency teams members at their workplaces in the plant ERC and at the NRA Emergency centre.

The main recommendations from the drills and exercises conducted in 2022-2024 relate to the need for periodic participation in drills and exercises of the whole emergency personnel included in the plant emergency organisation to maintain the level of competence required for handling various emergencies.

Regulatory review and control activities

According to the ASUNE, the NRA jointly with the specialised state authority for fire safety and civil protection develop the regulatory requirements for emergency preparedness and response in the event of a nuclear and radiological emergency. According to these requirements, the organisation that operates the nuclear facility shall develop an on-site emergency plan and shall submit it to the NRA Chairperson, to the specialised state authority for fire safety of the public and to the Minister of Environment and Water not later than six months prior to the commissioning. The emergency plan is tested in practice prior to commissioning of the facility and during its operation.

The NRA controls the emergency preparedness of the licensees through annual inspections in accordance with an approved 3-year Inspection Programme. During these inspections (topical inspections), the following is checked:

- emergency plan, emergency instructions and procedures, interaction with local authorities, exchange of information with the regulatory body;
- initial assessment of the emergency, an estimate of discharges to the environment, levels of intervention and implementation of protective measures;
- personnel training on the emergency plan, conduct of exercises and drills, preparation of exercises, documentation and feedback;
- informing the public, preliminary information, notification and periodic testing of the early notification system.

Article 16 (2) Informing the public and neighbouring countries

Informing of the public in the nuclear facility area about emergency planning and emergency situations issues

Pursuant to the ASUNE, the NRA provides the public with objective information about the condition of nuclear safety and radiation protection in normal operation as well as in emergency situations in the country. According to the Regulation on Emergency Planning and Emergency Preparedness, the executive bodies within their competency framework are obliged to notify the public in the event of a nuclear or radiological emergency. The Regulation on Radiation Protection defines the requirements for the provision of information to the members of the public who are or may be affected in the event of an emergency. General information for the public regarding emergency planning, informing in the event of an emergency and protective actions implemented is available on the NRA website.

The Plans for Disaster Protection at all levels define the requirements and the procedure for immediate notification and periodical information of the public for the whole period from the emergency occurrence until the final elimination of the consequences.

In the event of an emergency, the public shall be immediately notified through the Kozloduy NPP early notification system (within 12 km of the urgent protective action planning zone) and through the National Early Warning and Notification System. The public shall be periodically provided with information on the evolution of the emergency, the necessary protective measures

and recommendations for adhering to the instructions of the competent authorities. Upon activation of the National Disaster Protection Plan, the official information is provided to the media and the general public by the National Headquarters.

The public electronic mass media - Bulgarian National Radio (BNR) and Bulgarian National Television (BNT) and the operators broadcasting radio and television programmes with national coverage shall provide an opportunity to ensure airtime at at all times of the day and night for live streaming or broadcasting of preliminary prepared emissions containing information on the emergency. BNR, BNT and the Bulgarian Telegraph Agency shall disseminate official information immediately, without alteration of content or meaning. Messages shall also be broadcast in English.

Upon activation of the On-site Emergency Plan, the information policy of Kozloduy NPP aims at providing the public with information and transparency regarding the evolution of the emergency, the actions and measures undertaken to protect the personnel located on the site and to mitigate the consequences of the emergency. Timely and accurate information about the emergency and about the forecasts for its future evolution is planned to be provided through the media and the internet site of the plant.

Meetings are carried out annually between the representatives of Kozloduy NPP, responsible for emergency planning, and Kozloduy Municipality management. During these meetings issues are discussed related to the activity and status of the nuclear power plant and are of public interest, as well as issues related to the preparation for response to emergency situations. Special attention is paid to public awareness of emergency planning issues through preparation of information materials and meetings with local authorities and the public.

International agreements, including ones with neighbouring countries

The Republic of Bulgaria ratified the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency. In compliance with the ASUNE, the NRA performs the functions of a central authority and a point of contact under the both IAEA conventions (USIE-IAEA). The NRA is also a point of contact in compliance with the EU requirements (ECURIE-EU). The Republic of Bulgaria has been a member of the Response and Assistance Network (RANET) for providing assistance in the event of a nuclear or radiological emergency, established by the IAEA.

The NRA has signed agreements on notification and exchange of information in the event of a nuclear or radiological emergency with the regulatory bodies of Greece, North Macedonia, Romania, Russia, Ukraine and Cyprus.

The Republic of Bulgaria has signed intergovernmental agreements on cooperation in the field of nuclear safety and exchange of information in the event of an emergency with Greece, Romania, Turkey, Ukraine and the Republic of Serbia. The agreement signed between the governments of the Republic of Bulgaria and Romania on cooperation in the field of emergencies includes also cooperation in the following areas:

- exchange of information on sources of risk that may cause disasters, especially those with transboundary consequences, affecting the national territory of other Contracting Party;
- exchange of information on measures to reduce the vulnerability of the critical infrastructures in order to increase the effectiveness of their protection.

Article 17 Siting

Each Contracting Party shall take the appropriate steps to ensure that appropriate procedures are established and implemented:

i) for evaluating all relevant site-related factors likely to affect the safety of a nuclear installation for its projected lifetime;

ii) for evaluating the likely safety impact of a proposed nuclear installation on individuals, society and the environment;

iii) for re-evaluating as necessary all relevant factors referred to in sub-paragraphs (i) and (ii), so as to ensure the continued safety acceptability of the nuclear installation;

iv) for consulting Contracting Parties in the vicinity of a proposed nuclear installation, insofar as they are likely to be affected by that installation and, upon request providing the necessary information to such Contracting Parties, in order to enable them to evaluate and make their own assessment of the likely safety impact on their own territory of the nuclear installation.

Article 17 (1) Evaluation of factors related to the siting

Arrangements and regulatory requirements related to selection and evaluation of sites for nuclear installations

The authorisation regime for determining the location of a nuclear installation (siting) is established by the Act on the Safe Use of Nuclear Energy (ASUNE). In its nature, the authorisation regime is a two-stage regulatory activity: issuance of authorization for site selection activities and approval of the selected site by the NRA Chairperson by issuing the respective administrative act - Order for the approval of the selected site.

The performance of the environmental impact assessment (IEA), including the transboundary aspects of this assessment, is required by the Environmental Protection Act. The latter act establishes the conduct of public hearing on EIA report with the participation of representatives of the municipal administration, state authorities, public organisations, the competent environmental authority, the public, and the natural persons and legal entities concerned. Within the framework of the procedure on environmental impact assessment, the Contracting Authority makes proposals for future sites where the investment proposal could be implemented. Subsequently, the most suitable site in terms of both region characteristics and minimisation of the impact on the components and factors of the environment and human health is selected.

The Regulation on the Procedure for Issuing Licenses and Permits for Safe Use of Nuclear Energy establishes the procedure for granting a site selection permit for a nuclear installation and issuance of Order for the approval of the selected site. In order to grant a site selection permit, along with the conceptual description of the nuclear installation and the acceptance criteria for the sites, the applicant submits Terms of Reference for pre-feasibility studies of the site, which includes a description of the actions to implement the studies, methods for their implementation and result evaluation.

For the approval of the selected site, the applicant submits a Preliminary Safety Analysis Report (PSAR), which should include, in addition to other information, a comparative analysis of proposed sites in terms of nuclear safety and radiation protection, as well as a selection of an option based on:

- impact of man-induced and natural origin factors on the safety of the installation;
- radiation impact of the nuclear installation on the public and the environment;
- site-specific characteristics of importance for migration and accumulation of radioactive substances;

- capacities for implementation of public protection actions in the event of emergencies;
- size of the emergency planning zones.

The preliminary report shall include the results of the study of the selected site characteristics, including:

- geographic, topographic and demographic conditions;
- man-induced factors;
- hydrometeorological conditions;
- geological, hydrogeological, seismic and engineering and geological conditions;
- site-specific and region-specific characteristics for the needs of emergency planning, accident management, and physical protection.

The site approval documents shall also include:

- site monitoring programmes, including: seismic monitoring, underground and surface water regime and monitoring of other natural phenomena;
- a programme for additional studies of the selected site, when the submitted SAR has identified the need for such studies.

When it is planned to locate the nuclear installation at the site of already constructed and commissioned nuclear installation, the potential safety impact of the new installation and the other nuclear facilities located on the same site will be considered in the preliminary safety analysis report.

For the approval of the selected site, it shall be demonstrated that all factors that may have impact on safety are identified and assessed, and the requirements and criteria for site selection specified in the Regulation on Ensuring the Safety of Nuclear Power Plants are implemented. The Regulation specifies the engineering studies and investigation of processes, phenomena and factors of natural and man-induced origin which may affect the safety of the NPP and which should be performed during the site characterisation process to identify the following:

- characteristics of tectonic activity;
- characteristics of seismic movement of an earthquake with frequencies of events of 10^{-2}/year and 10^{-4}/year at the level of the natural terrain of the site;
- hazards of landslide displacement of the slopes, possibility of karst, sufosis, and karst-sufosis processes development;
- presence of specific ground layers (biogenic, sinking, swelling, saline, alluvial, man-induced);
- the areas of water-saturated unconnected layers susceptible to liquefaction during seismic impacts, and the boundary values of ground acceleration with potential liquefaction;
- impact on the safety of the NPP due to an uplift of groundwater level;
- rare phenomena characteristics such as tornadoes;
- maximum water level and duration of possible flooding due to precipitation, intensive snow melting, high water level in water bodies, ice blocking of the river, avalanche, and slides;
- the probability of occurrence and the maximum height of tsunami or seiche waves, extreme precipitation, icing, thunderstorms, etc.

For the site selection, the impact of a nuclear power plant on the public and the environment by studying the aerologic, hydrometeorological, hydrogeological, and geochemical conditions of radionuclide dispersion, migration and accumulation, and also the natural radiation background shall be determined. The atmospheric dispersion is assessed and the characteristics of the migration

of radionuclides in the surface and groundwater are defined, as well as the accumulation of radionuclides at the bottom of water bodies.

The Regulation requires investigating the area for the location of a nuclear power plant and the site of a nuclear power plant to identify the sources of potential man-induced hazards. The parameters of their impact and, as appropriate, the likelihood of their achievement should be determined.

According to the Regulation, the assessment of external events shall include the following:

- identification of all sources of hazard specific to the NPP site area and the area of the NPP siting;
- preliminary screening based on the established criteria;
- assessment of the impact parameters of the selected external events;
- analysis of external events using deterministic and probabilistic methods.

The design of a nuclear power plant should consider single events of natural origin and combination of casual or unrelated phenomena and processes (design-basis events) as well as extreme events which are identified, assessed and analysed in order to define the margins to the occurrence of threshold effects and determination of reasonably practicable measures.

For the evaluation of the defence-in-depth levels, it is required to consider the fact that the event may cause multiple failures in the safety systems and/or their supporting systems and may simultaneously threaten multiple power units at the same site, site infrastructure, regional infrastructure and external supplies.

Review of assessments carried out and criteria used for assessment of all the site-specific factors which may affect the safety of the nuclear installation, including multiple unit emergency conditions and a loss of infrastructure and access to the site resulting from an event

For the consistent application of the defence-in-depth concept to the design of nuclear installations, the values of impact parameters are defined for the relevant periods of recurrence of external events that could affect safety.

Potential consequences of external events, considered in the design basis of nuclear installations are analysed using deterministic methods to verify the selected concept of protection. For protection against rare phenomena and events including extreme external events and natural phenomena that could affect simultaneously the whole site, reasonably practicable measures are planned.

One of the essential commitments of the operating organisation is identification of work procedures that specify features for the prevention, protection and mitigation of site-specific hazards by applying strategies for coping with the impact of hazards to ensure that the fundamental safety functions are maintained for all plant operational states.

The Kozloduy NPP site and the region have been subject to investigation since 1967 when the site was selected for the construction of the nuclear power plant in Republic Bulgaria. In the following period a number of additional analyses and investigations were performed to identify the potential natural phenomena and hazards, as well as sources of potential man-induced hazard. The methods of performed assessments and their results are documented in the plant safety analysis reports and are subject to reassessment within the periodic safety review.

According to the engineering and geological pre-feasibility studies of the site, the following adverse phenomena were identified:

- earthquakes;
- loess collapse;
- subsidence due to large loads of some facilities;
- subsidence of levees;
- filtration of service water and transfer of contaminants to the aquifer;
- soil liquefaction;
- erosion and flooding of Marichin Valog tributary valley.

Actions were taken to limit these processes and prevent their impact through applying various methods to improve the bedrock.

In 1992, a re-evaluation of seismic loads was carried out at Kozloduy NPP site. For the qualified equipment, Review Level Earthquake (RLE) was established for the recurrence period of 10,000 years. Based on this re-evaluation, the following impact parameters were determined:

- peak ground acceleration for design basis earthquake SL-2 (recurrence period of 10,000 years) of 0.2 g;
- peak ground acceleration for design basis earthquake SL-1 (recurrence period of 100 years) of 0.1 g;
- design response spectra for free field surface and relevant three-component accelerograms with a duration of 61 s.

The methods of probabilistic analysis of seismic hazards are based on the Cornel standardised mathematical model and the McGuire 1976 and Toro&McGuire 1988 software products.

The seismic levels, enveloping design response spectra for free surface and relevant three-component accelerograms were reviewed and verified by the IAEA expert missions in 1995 and 2000, correspondingly. Following the IAEA recommendation, the response spectra for free surface and the relevant three-component accelerograms with a duration of 20 s were determined.

In addition to the geological, engineering geological and seismotectonic study of Kozloduy NPP site and siting area, the meteorological and hydrological conditions were also studied to determine the design basis of the power plant in relation to external hazards, including flooding, temperature and wind loading, etc. The evaluation of flooding hazard considers an accident with the water control structures along the Danube river with the accumulation of maximum water quantity with the occurrence frequency of once in 10,000 years. For all phenomena causing floods and flooding, the water amount in the Danube river is defined, as well as the maximum flooding level which is compared to the existing level at the Kozloduy NPP site and the crown of the water control structures providing for the service water supply to the nuclear power plant. A conclusion was made that the Kozloduy NPP site is not jeopardised by flooding from the Danube river. The river water levels in case of high waters are lower than the level of the crown of facilities and the plant site.

The frequency of occurrence of rare and extreme external events, such as a hurricane, extreme precipitations, air and water temperatures, icing, thunderstorms, dust and sand storms, erosion of the river banks and water bodies, and tornadoes, was also evaluated.

With regard to the sources of man-induced hazards in the plant area, the analyses and investigations for their identification using the distance screening and probability level methods were performed. Applying these two methods, the man-induced sources within a 30-km area

surrounding the Kozloduy NPP site were identified. The potential sources of the man-induced hazard were evaluated, as follows:

- explosion at Kozloduy NPP site and in the stationary and portable explosion sources located in the vicinity of the plant;
- emergency release of chemically active substances, including those from industrial sites where toxic and corrosive substances are processed, used, stored and transported;
- external fires, including river and road transport vehicles, etc.

During the stress tests of the European nuclear power plants carried out in 2011 following the Fukushima NPP accident, the response of the plant in general and the effectiveness of the protective actions in case of extreme external events affecting all the site facilities resulting from earthquakes, floods, and extreme meteorological conditions were evaluated. The current margins of facilities and equipment before the occurrence of boundary conditions were also evaluated, and the results were summarized in the Report Section referred to in Article 17(3). In the frames of the National Action Plan of the Republic of Bulgaria resulting from the stress tests, the IAEA Action Plan on Nuclear Safety, and the conclusions of the Second Extraordinary Meeting of the Contracting Parties to the Convention on Nuclear Safety held in 2012, additional assessments and safety improvements in case of extreme external events resulting in failure of all on-site facilities, degraded infrastructure condition, and a loss of access to the site were planned and implemented. Some of the implemented actions are related to:

- analysis of extreme weather conditions using the probabilistic methods;
- re-evaluation of the engineered features and administrative controls in case of a simultaneous accident with fuel melt in the nuclear facilities at the plant site;
- development of an emergency procedure for actions in case of destruction of the Zhelezni Vrata 1 and 2 hydroelectric facilities;
- update of the on-site and off-site emergency plans in a context of a simultaneous accident, degraded infrastructure condition and difficult access to the on-site facilities.

The Level 1 PSA updated in 2023 considers all external events and hazards specific to Kozloduy NPP site which - individually or in combination - can lead to nuclear fuel damage in the reactor core and in the Spent Fuel Pool. The study covers all operational states and the full spectrum of initiating events - internal initiating events, internal and external hazards (natural and human induced). The results obtained for the total fuel damage frequency from the operation of each of the units meet the requirements of the Regulation on Ensuring the Safety of Nuclear Power Plants, demonstrating a significant reduction in risk compared to the levels assessed in the previous PSA.

Review of the design solutions against man-induced external events and natural external events such as fire, explosion, aircraft crash, external flood, extreme weather conditions, and earthquake, as well as the impact of the subsequent natural events (tsunami due to earthquakes, mudslides/sediments due to torrential rains)

The layout of reactor buildings of Kozloduy NPP Units 5 and 6 meets all the basic requirements for ensuring the protection of personnel, the public and the environment from radiation exposure and is under the principles that have become generally accepted in international practice in the design of the nuclear installation, and reflected in the IAEA documents.

In the period 2004 to 2006, investigations and analyses of the seismic stability of the buildings at re-evaluated seismic levels (0.2 g for SL-2 and 0.1 g for SL-1) and analyses of the behaviour of safety system equipment in case of earthquakes were also performed. As a result, actions were identified and implemented to perform seismic re-qualification and to ensure the seismic stability of safety system equipment and civil structures taking into consideration the increased seismic impact.

From 2006 to 2007, the analyses of prestressed and deformed condition of the containment were carried out applying the finite element method and using data from the automated monitoring system and laboratory tests and assessments of the components. The assessment of the containment strength properties was expanded and clarified in 2012 when updating the Level 2 PSA. An assessment of the structural reliability was carried out for all design internal and external events taking into account the actual condition of the structure and the prestressing system. The containment behaviour under severe accident conditions was also analysed determining the ultimate bearing capacity for each of the units. The ageing processes were analysed, critical elements were identified, and a remaining lifetime management programme was developed. The analysis and the evaluation results demonstrate that the containments of Units 5 and 6 are capable of fulfilling their intended functions for all design basis external and internal events.

The analysis of design modification for SSCs performed during the stress-tests in the European NPPs confirmed the availability of sufficient margins of the equipment and facilities before the occurrence of boundary effects. As a result, no need was identified to apply additional design modifications for man-induced external natural and man-induced events, such as fire, explosion, aircraft crashes, external floods, extreme weather conditions, and consequent natural disasters (tsunami and mudslides due to torrential rains).

During the implementation of the Programme for preparation of Units 5 and 6 for lifetime extension, the stability and functional capacities of the main buildings at the site for another 30 years in terms of characteristics listed below were evaluated and re-evaluated. As a result of the re-evaluation of the containment structures of the two units, the following conclusions were made:

- technical condition - no significant defects of concrete were identified;
- integrity - reinforcement, pre-stressed tendons and concrete of the containment structures withstand the load combination of a postulated accident and RLE with a sufficient margin;
- leak tightness - maximum tensile strain in the liners due to a combination of a postulated accident and RLE reaches up to 64% of the allowable values. The shear stress in the welds between the liner sheets and in the concrete profiles reaches 77% of the estimated bearing capacity. The welds between the sheet steel and in the concrete profiles have a margin of estimated bearing capacity of up to 23%.

The design modifications for external events were reviewed in the scope of the Periodic Safety Review of Units 5 and 6. The characteristics determined in the course of the review do not demonstrate any safety deficiencies or factors that can potentially affect the safety in the planned period of operation of the units. The current status of the reviewed actions related to the assessment of site characteristics provides for the long-term operation of the units in compliance with the safety requirements and standards.

The updated Level 1 PSA (2020-2023) provides the complete list of external hazards specific to Kozloduy NPP site and Units 5 and 6 considered in the Level 1 PSA model. The analysis was performed through:

- requirements review for analysis of external hazards affecting the safety of the NPP;
- compilation of a complete list of external hazards affecting the safety of the NPP;
- definition of criteria for external hazards grouping and quality screening;
- determination of the full list of external hazards specific to Kozloduy NPP site and Units 5 and 6.

The results for the fuel damage due to external impacts comply with the requirements for modern NPPs, and the protection of Units 5 and 6 against external hazards is considered to be adequate.

The procedure for a new nuclear unit construction at the Kozloduy NPP area was launched by a Decree of the Council of Ministers dated 11 April 2012. Within the Survey and selection of a site for the construction of Unit 7 Project, in the period 2013-2015 engineering geological investigations were performed along with other surveys of potential sites described in the National Report under Article 17(3) of the Convention on Nuclear Safety. Following the performance of all the necessary studies, Kozloduy NPP - New Build EAD has submitted an application, and in February 2020 received an order approving the selected site for Unit 7.

In January 2023 the Council of Ministers adopted a decision with which it instructs the government, through the Minister of Energy, to undertake all necessary actions to build Unit 7 and commence the licensing procedure and EIA procedure for the building of Unit 8 at Kozloduy NPP.

Regulatory review and control activities

The activities related to review of documents accompanying the application of Kozloduy NPP - New Build EAD for approval of the selected site for Unit 7 construction were initiated in the NRA in 2016. Within the regulatory review an independent assessment of the PSAR was conducted reviewing and assessing the completeness of the provided data on site characteristics both in separate PSAR parts and in the topical reports provided. Expert assessment of the accuracy and currentness of the information related to the geological, seismic, hydrological, and meteorological characteristics of the site and the area around the site was performed to confirm the absence of excluding factors. For consideration of the issues from the regulatory review of the safety report, including the external assessment, a new revision of the PSAR was prepared and submitted to the NRA.

The requirements of the order for the selected site approval provide for the implementation of monitoring programmes for Kozloduy NPP site that include meteorological , hydrological, seismic, geodetic, non-radiological and radiological types of monitoring described in the National Report under Article 17 (3).

In October 2023, the Council of Ministers issued a Decision granting an approval in principle for the building of Kozloduy NPP Unit 8 which includes searching for effective solutions for launching the licensing procedure for the new nuclear unit.

Article 17 (2) Impact of the installation on individuals, society, and the environment

According to the ASUNE, the proposal for construction of a new nuclear power plant is submitted by the Minister of Energy together with the assessment of nuclear safety, radiation protection and environmental impact. The Minister makes arrangements for public consultations of the proposal, which are attended by state and local authorities, representatives of public organizations and interested natural and legal persons. When the operation of a nuclear power plant might have an impact on the public and the environment of another country, the Minister of Foreign Affairs shall notify the competent authorities of the relevant country and provide upon request the information necessary to analyse and assess the potential impact of the nuclear power plant on their country in terms of safety of the public and the environmental protection.

The Regulation on Ensuring the Safety of Nuclear Power Plants requires assessment of the radiological consequences in all operational states and emergency conditions in a nuclear power plant and, if required, provision of technical and administrative arrangements for ensuring the safety of the population. The Regulation specifies the limit of the individual effective dose due to internal and external exposure of the public as a result of the effect of liquid and gaseous discharges to the environment in all operational states of all nuclear facilities at the plant site.

According to the Regulation on the Procedure for Issuing Licences and Permits for Safe Use of Nuclear Energy, for approval of a selected site for construction of a new nuclear unit, among the

other documents, site monitoring programmes, such as seismic monitoring, underground water and surface water monitoring, and monitoring of the other natural phenomena are required. To issue a permit for the commissioning of a nuclear installation, this Regulation requires submitting a programme for monitoring the radiation parameters at the nuclear facility site and an environmental radiation monitoring programme during its operation.

The following monitoring programmes are in place at Kozloduy NPP site:

- monitoring of current ground motions - geodetic monitoring of deformation processes;
- seismic monitoring - measurement through diversified systems, such as local seismological network; system for seismic monitoring of components and structures, seismic monitoring system and alarm system for the control room operators;
- monitoring of the underground waters regime and monitoring of the surface waters regime (hydrology);
- geotechnical monitoring of the soil foundation - monitoring of the density and humidity of the embankments of the water intake and discharge structures to the Danube river, content of long-lived sources of ionizing radiation, rate and direction of filtration;
- meteorological monitoring - on-line measurements of the current meteorological parameters in the region through 3 weather stations.

The intention for the construction of new nuclear units at Kozloduy NPP site is within the scope of the Environmental Protection Act, which requires the performance of the EIA. The EIA Report for the construction of a new nuclear facility - Unit 7, in the vicinity of Kozloduy NPP, specifies the impacts and evaluates their effects on the environment and the public. The unavoidable and lasting effects resulting from the construction, operation, and decommissioning of the new nuclear unit were analysed and compensatory actions were identified. The analysis covers the territories of the Republic of Bulgaria and Republic of Romania as affected countries, as well as the recommendations and requirements of the Republic of Austria as a country that requested and took part in the EIA procedure.

The main conclusion of the EIA Report is that the implementation of the investment proposal for the construction of a new nuclear plant in Kozloduy NPP area will not have a lasting negative impact on the factors and components of the environment and human health, as well as on the biological diversity.

In connection with the requirements for publicity and public participation, during the preparation process for the development of the EIA Report for Unit 7, consultations with a significant number of national and international institutions, non-governmental organisations, and natural and legal persons were held. Five public consultations were held in the Republic of Bulgaria and three in the Republic of Romania. The requirements of the Republic of Austria were also considered.

Article 17 (3) Re-evaluation of site-related factors

Activities for re-evaluation of site-related factors mentioned in Article 17(1), which ensure continuous acceptability of the safety level at the nuclear installation, and which were performed in accordance with the relevant standards and practices

Re-evaluation of the factors resulting from the stress-tests

In the frames of the stress-tests performed at Kozloduy NPP following the Fukushima NPP accident, a comprehensive re-evaluation was performed of the safety margins and effectiveness of preventive actions in case of extreme events caused by earthquakes, external floods, and extreme weather conditions.

The performed seismic re-evaluation confirmed the adequacy of the current design basis: peak ground acceleration for SL-2 design basis earthquake of 0.2 g and peak ground acceleration for SL-1 design basis earthquake of 0.1 g. In the course of the re-evaluation, it was identified that the analysis of seismic resistance of the equipment fulfilling safety functions in these scenarios was performed, and the parameters characterising its fragility curves were determined. The limit values of the seismic accelerations were determined that any nuclear facility on the Kozloduy NPP site is capable to withstand without severe fuel damage and radioactive releases to the environment. The summarised evaluation shows that the margin for Units 5 and 6 is 0.13g or 65% of the Review Level Earthquake RLE (PGA=0.2g), i.e the units may survive without any fuel damage an earthquake 1.65 times higher than the re-evaluated. The main results of the performed analysis of the dynamic non-linear behaviour and seismic capacity of the containment structures of Units 5 and 6 are as follows:

- limited damages and cracks in the concrete without loss of integrity - for interactions with PGA = 0.75g;
- loss of integrity due to plastic deformations in the steel liners - for interactions with PGA=1.7 g;
- damage to the structure due to rupture of the pre-stressed tendons and shear of the reinforced concrete cross-section - for interactions with PGA= 1.9 g.

The analysis of the beyond design seismic impact demonstrates that the seismic capability of Kozloduy NPP SSCs is sufficient to ensure plant safety for maximum credible seismic effects at the site.

Based on the re-evaluation of the flooding occurrence frequency and effects at the site, a new maximum water level was determined and its duration was re-considered. The potential for ice blocking of the river was investigated, and the potential for the combination of a maximum water level and other adverse phenomena was evaluated. The new maximum water level for the Kozloduy NPP site (32.93 m) was determined based on the maximum water level of the Danube river with the frequency of occurrence of once in 10,000 years, accident at the Zhelezni Vrata hydroelectric facility and maximum values for rain precipitation and wind. An assessment with a probabilistic analysis was performed for the combination of two events - natural extreme water levels of low probabilities (from 10^{-5} to 10^{-7}) and rupture of hydroelectric facilities Zhelezni Vrata 1 and 2. The estimated water levels are as follows:

- 32.98 m for extreme levels with the probability of $p=10^{-5}$ (once in 100,000 years) and rupture of hydraulic engineering facilities;
- 33.26 m for extreme levels with the probability of $p=10^{-6}$ (once in 1,000,000 years) and rupture of the hydraulic engineering facilities;
- 33.42 m for extreme levels with the probability of $p=10^{-7}$ (once in 10,000,000 years) and rupture of the hydraulic engineering facilities.

These results confirm that the potential risk of flooding the Kozloduy NPP site, which is located at elevation of 35.00 m, is almost excluded.

The analysis of the resistance to extreme meteorological events typical for the site (extreme wind, tornadoes, snowfall and icing, extreme temperatures, and extreme precipitation) considers the condition of the structures and the availability of protective actions and arrangements ensuring power supply of the consumers at the site and nuclear fuel cooling. The results demonstrate that the Kozloduy NPP has the required resistance to extreme meteorological conditions, and the existing procedures and instructions are adequate for the staff actions in extreme situations.

Results of recent activities for site re-evaluation

Within the PSR of Units 5 and 6, in the period 2016-2019 thorough analytical assessments were performed using up-to-date methods and data for site characteristics for any particular facility. The assessments and analyses are licence-bound and cover the complete identification of the external hazards and specific factors related to the characteristics of the impact and interaction with the site, as well as:

- change of geographic, topographic and man-induced factors;
- analyses of data on seismic and geological condition of an area and geotechnical aspects related to Units 5 and 6 site;
- analyses of all geological, hydro-geological, seismo-tectonic, hydrological and engineering-geological conditions of the site;
- analyses to identify and provide a conclusion on the potential fault in the area;
- analyses to determine extreme values of meteorological parameters, including rare events and climatological characteristics of the area;
- analyses of the likelihood of floods due to one or several causes both of natural origin and resulting from levee breach and water control facilities with a high risk potential;
- analysis of the likelihood of instability occurrence in the site bank area due to erosion, sedimentation, etc.;
- assessment of the likelihood for the site to be affected by waves caused by earthquakes and other geological phenomena;
- analyses related to floods caused by rupture of hydraulic facilities that pose a potential hazard for the site.

Within the scope of the analyses performed in the PSR, multiple good practices for ensuring surveillance and monitoring of the impact of the typical site phenomena were identified. Based on the submitted in-depth analysis, the activities related to the monitoring and identification of the trends in the development of specific impacts meet the requirements and provide for the engineering and technical facilities required for the application of safety assurance concept.

In the frames of the project for investigation of the Kozloduy site to define the location for the construction of a new nuclear unit, the following evaluations and investigations were carried out from 2010 to 2015:

- engineering-geological studies of the potential sites;
- modelling of the migration of radionuclides to the subsoil of the potential sites;
- update of the seismic hazard on site;
- definition of the seismic design basis;
- analysis of geophysical fields and contemporary ground motions;

- climatology and local meteorology, dispersion characteristics of the atmosphere;
- hydrology of the Danube river;
- demography and anthropogenic effects;
- additional engineering-geological and geophysical studies of the selected site;
- additional evaluation of the protection of the Kozloduy site against meteorological, hydrological, and geological hazards.

In the frames of the re-evaluation of the Kozloduy NPP site, the regional climate was studied and the loads resulting from climatic effects were determined for different frequencies of occurrence ranging from 5 to 10,000 years. Analysis of the Kozloduy NPP civil structures based on a combination of extreme weather conditions was performed using the determined loads. The behaviour of the structures was analysed, an engineering evaluation was made, and their margins for resistance to loads due to climatic effects were determined. For the civil structures, which do not have the required capacity, the interaction of the relevant structural element with other SSCs was analysed and, based on that, administrative arrangements and engineering measures for reinforcement and mitigation of consequences of climatic effects were identified.

To consider the extreme external events with a frequency of occurrence higher than 10,000 years which may lead to a loss of basic safety functions, the specific extreme events and a combination of extreme events, related due to their origin, for example, extreme rainfall and hurricanes; extreme low temperatures; high winds, and icing were addressed.

The level of groundwaters at Kozloduy NPP site is monitored monthly (over 100 boreholes). The data is submitted for processing, analysis, and storage to the relevant water control structures experts.

Within the Survey and selection of a site for the construction of Unit 7 Project, in the period 2013-2015 additional surveys related to the engineering and geological studies of potential sites, modelling the migration of the radionuclides to the subsoil, definition of the seismic design basis, analysis of geophysical fields and contemporary ground motions, climatology and hydrology were performed. The results of the additional surveys performed were subject to independent verification.

The data on the site evaluation were included in the preliminary safety analysis report of the Unit 7 and were used during the re-evaluation while performing periodic safety reviews of Kozloduy NPP Units 5 and 6.

To ensure a continuous monitoring on site, a monitoring network has been developed and implemented which includes ten control monitoring points that provide the required data allowing:

- identification and collection of sufficient number of representative samples of certain environmental components to determine the spread of potential radioactive contamination;
- deriving realistic estimates of the dose exposure of the population living near the site;
- accumulation of sufficient and reliable data on the current on-site radiological condition;
- establishment of the compliance of the actual radiological status in the site area with the applicable legislation;
- collection, systematisation and analysis of information about the seismic condition (or seismic processes) on the site;
- collection, systematisation and analysis of data on the meteorological situation in the site area;
- tracking, systematisation and analysis of information about changes in the level and chemical composition of groundwater in the site area.

Taking into consideration the close proximity of the approved Unit 7 site to the Kozloduy NPP Units 5 and 6 site, the monitoring network was developed in a manner that allows its integration into the radiation and non-radiation monitoring network of the existing nuclear power plant.

The information obtained from the monitoring network is accumulated in a specialized database created for this purpose. Kozloduy NPP - New Build EAD maintains the database in a form that ensures compatibility of the accumulated information with the one collected within the framework of the environmental monitoring carried out during the operation of the existing nuclear power plant.

Referring to the decision for the construction of two new nuclear units (Units 7 and 8) and in compliance with the requirement for the re-evaluation of the site characteristics every 10 years, Kozloduy NPP - New Build EAD undertook actions for conducting the required engineering studies and analyses for characteristics re-evaluation by applying up-to-date methods and data. The reassessment will focus on updating the parameters of processes, phenomena and factors of natural and human-induced origin, factors affecting the impact of the nuclear facility on the public and the environment, as well as the impact of the existing nuclear facilities on the site. The updated parameters of the impact of the hazards characteristic of the approved site will be considered and set as requirements in the next stage of the licensing procedure – the design of the nuclear facility.

Regulatory review and control activities

The regulatory review activities for re-evaluation of the site-related factors for the nuclear facilities at the Kozloduy NPP site are carried out in the process of review and assessment of the periodic safety review (PSR) reports. Pursuant to the Regulation on Ensuring the Safety of Nuclear Power Plants, the PSR shall be included at least once every 10 years and shall include the site characteristics considered in the design, and, if necessary, their re-evaluation by applying up-to-date methods and data.

For the past 3 years the regulatory activities related to the re-evaluation of the Kozloduy NPP site were carried out within the SFSF periodic safety review. As a result of the review, measures are planned update the SFSF safety analysis report to consider the data from the external hazard assessments carried out in connection with the site selection for units 7 and 8 in the immediate vicinity of the Kozloduy NPP site. No need for additional studies of the site characteristics in connection with the operation of the SFSF for the period 2024-2034 has been identified.

The control over the implementation of the measures under the PSR, included in integrated programmes for each unit separately, is carried out by the NRA based on the reporting documentation submitted for each measure. Furthermore, the implementation of the measures is supervised by the NRA inspectors while performing different types of inspections and periodic reviews of the condition of SSCs.

The regulatory activities related to the review of the data submitted in connection with the issuance of an order approving the selected site for the construction of Unit 7 are described in the text of the National Report under Article 17 (1).

Article 17 (4) Consultations with other Contracting Parties likely to be affected by the facility

International agreements

Consultations with other Contracting Parties likely to be affected by the facility are conducted pursunat to the Environmental Protection Act, Regulation on the Environmental Impact Assessment (EIA), and in compliance with the Convention on Environmental Impact Assessment in a Transboundary Context, to which the Republic of Bulgaria is a party.

Referring to the above-mentioned, the Ministry of Environment and Water (MoEW) notified the Republic of Romania as an affected party by the implementation of the investment proposal for the construction of a new nuclear unit at the Kozloduy NPP site. There were three public consultations held within the Republic of Romania. In the course of the procedure, written consultations were also performed with the Republic of Austria, which found them satisfactory. The results, recommendations and requirements of the affected parties were considered when performing the analyses and assessment of the impact of the investment proposal on the construction of a new nuclear unit at the Kozloduy NPP site on the environment and human health, and preventive actions to limit the impact in a transboundary context were also planned.

Bilateral agreements with neighbouring countries

There are bilateral agreements signed between the government of the Republic of Bulgaria and the governments of Greece, Romania, Serbia, Turkey and Ukraine on early notification in the event of a nuclear accident and exchange of information about nuclear facilities. The Agreements with Romania and Ukraine state that the parties shall notify each other if a construction of new nuclear installations is planned and shall also provide the required technical information about those facilities.

Article 18 Design and construction

Every Contracting Party shall take the appropriate steps to ensure that:

i) the design and construction of a nuclear facility provide for several reliable levels and methods of protection (defence-in-depth) against the release of radioactive materials, with a view to preventing the occurrence of accidents and mitigating their radiological consequences should they occur;

ii) the technologies incorporated in the design and used in the construction of the nuclear facilities shall be proven by experience or qualified by testing or analysis;

iii) the design of a nuclear facility allows for reliable, stable and easily manageable operation, with specific consideration of human factors and the man-machine interface.

Article 18 (1) Application of the defence-in-depth concept

Defence-in-depth concept application status for all nuclear installations; ensuring multiple-level protection of the fuel, reactor coolant pressure boundary and containment while taking into account internal and external events and the impact of related subsequent environmental phenomena

The main principle incorporated in the design basis of the Kozloduy NPP Units 5 and 6 is ensuring the protection of the personnel and the public against external and internal radiation exposure as well as the protection of the environment against radioactive contamination. The design is based on conservative approach providing for inherent protection of the reactor installation. The design provides for technical measures and features focused on ensuring safety in the event of a single potential failure of a normal operation component which may be combined with a long-lasting hidden failure of another component. Simultaneously with the failure of a normal operation component, the failure of an independent active protection component and independent active localization component is considered. The protection and localization equipment perform their safety functions in all design accident conditions considered, including the so called “maximum credible design basis accident”, having the potential to perform their intended functions and being triple redundant – even in terms of power supply. The primary coolant circuit is located entirely in the containment structure. All penetrations in the containment walls are equipped with localization functionality providing for separate testing of the penetrations whose seals are capable of withstanding design pressure.

The existing Symptom-Based Emergency Operating Procedures (SBEOP) for Units 5 and 6 and Severe Accident Management Guidelines (SAMG) define the personnel actions for diagnostics of the unit condition, recovery or compensation for the violated safety functions and prevention or mitigation of the core damage consequences.

The applied basic design principles and safety criteria, including the application of independence, redundancy and diversity, in general, fulfil the concept of defence-in-depth, as defined in the IAEA document INSAG-10 - Defence in Depth in Nuclear Safety. The results of the safety analysis performed, including accident analyses performed with advanced computer programs, show that reliable levels of protection are ensured, including maintaining normal operation, preventing the development of postulated accidents with specific initiating events, and mitigating their consequences. The analyses confirm that safety is also ensured during multiple failure accidents, including anticipated transients without scram. Specific components and systems have been installed to mitigate the consequences of core melt accidents in order to protect the personnel and the public.

Concerning capability against external hazards of natural origin, it has been demonstrated that the seismic margin of the Units 5 and 6 SSCs accounts for 0.13 g or 65% of the RLE (review level earthquake) (PGA = 0.2 g). The equipment important to safety and included in the emergency

scenarios has been analysed in terms of seismic capability identifying the functional parameters which determine its fragility curves. The limit values of the peak ground accelerations that a nuclear installation at the site may withstand without a severe fuel damage and radioactive release to the environment have been determined. The analysis and evaluations of the margins during the stress tests showed that in terms of seismic hazards, the safety-important SSCs can withstand a combination of seismic loads of up to 0.26 g without losing their intended functions and the cliff edge effects and loss of capabilities and residual life are anticipated for seismic loads in the range of 0.26 g to 0.33 g.

Therefore, the analysis of the beyond design basis earthquake is conservative enough and ensures that the seismic capability of the Kozloduy NPP SSCs is sufficient to ensure plant safety for maximum credible seismic effects at the site.

Apart from that, for stress test purposes, the maximum water level (MWL) of the Danube River and duration of high waters have been determined, the potential for ice packs on the Danube River has been analysed, and the potential for a combination of MWL and other adverse effects has been evaluated. The results demonstrate that flooding of the Kozloduy NPP site is practically impossible.

As indicated in the master plan of Kozloduy NPP, the Units 5 and 6 infrastructure and buildings have been constructed on solid loess soil, insusceptible to collapse in the region where no mining works have been performed in the past. During the construction phase, unstable soils were removed and a waterproofing membrane was laid on the loess base, which protects the facilities from groundwater and also serves as a barrier against the spread of radioactive products to groundwater.

Extent of use of design principles, such as passive safety or the fail safe function, automation, physical and functional separation, redundancy and diversity, for different types and generations of nuclear installations

The design of the safety-important SSCs at Units 5 and 6 of Kozloduy NPP incorporates solutions based on the principles of passive safety, fail safe function, and intrinsic safety (automatic control, thermal inertia and other natural processes). Intrinsic safety and passive safety functions provide for substantial safety margins, thus ensuring safe shutdown and long-term reactor cooling.

The specific technical solutions applied to the design of the safety system are based on the relevant regulatory documents – multi-channel architecture (redundancy), physical separation and diversification. Automatic equipment is actuated by signals generated through a comparison of several measurements in order to prevent spurious actuation of the safety system in the event of occasional measurement deviation. Once the safety system is actuated, its operation cannot be interrupted before completion of its intended functions. The physical separation of trains is achieved by locating each train in separate rooms and with separate cable routes. Diversification of the safety system physical functioning design principles is achieved by using both active and passive technologies. The combination of redundancy, diversification and physical separation ensures effectiveness of the safety system in the event of common cause failures. Units 5 and 6 of Kozloduy NPP and spent fuel storage facilities are physically and functionally separated.

Implementation of design measures or modifications to prevent beyond design basis accidents and mitigate radiological consequences in the event of a severe accident (for the entire nuclear installation including SFP)

As a result of the Units 5 and 6 periodic safety reviews, the implementation of the LTO programme and plan, and the stress tests, a number of significant changes to the existing plant design have been made. Several new systems have been implemented to prevent and mitigate the consequences of severe accidents, as the most significant are:

- Containment filtered venting system designed to prevent containment overpressure and maintain the localisation safety function;
- Containment hydrogen recombination system;
- A system for monitoring and evaluation of the containment water vapour and oxygen concentration in the event of a severe accident;
- High-temperature resistant plugs designed to prevent early containment bypass in the event of a severe accident;
- Emergency SG feedwater system energised by 6 kV or 0.4 kV mobile diesel generators (MDGs);
- PAMS (Post-Accident Monitoring System) providing the operators with highly reliable data during accident and post-accident conditions;
- Reactor pressure vessel wide-range temperature monitoring system for measurement and recording of the temperature of the cylindrical surface of reactor pressure vessel where the failure is expected in the case of a severe accident with massive core melt;
- Reactor vessel gas and steam generation monitoring system (coolant level) in all modes and during severe accidents;
- Post-accident containment radioactive gas, aerosol and iodine concentration control and monitoring system; Wide-range (10^{9} – 10^{15} Bq/m^{3}; 10^{-2} – 10^{6} Gy/h) temperature monitoring sensors for radiation measurement in the containment have been installed.
- Post-Accident Monitoring System (PAMS);
- Safety Parameter Display System (SPDS);
- Direct water supply to the steam generators from an off-site source;
- Additional pipeline to the spent fuel pool cooling system as an external source backup;
- Energising reliable power supply buses by a mobile diesel generator - 6kV buses are energized in the event of simultaneous failure of the stationary DGs;
- Safety system battery charging from 0.4 kV mobile diesel generator;
- Replacement of the batteries of all three trains of the safety systems with new batteries with sufficient capacity to supply the relevant loads with power for a period of 11 hours;
- Power supply from a battery of the primary gas removal valves and main steam relief valves between the primary circuit and hydroaccumulators for severe accident management;
- Independent system for control of the localisation pressure-operated vales in the spent fuel pool cooling system for beyond design accidents.

Implementation of specific measures, where applicable, to protect the containment physical integrity in order to prevent long-term external contamination, especially activities undertaken or planned to deal with extreme natural hazards that are not considered in the design basis

As a result of the implementation of the filtered containment venting system, high-temperature resistant plugs for prevention of early containment bypass, containment passive hydrogen recombiners, monitoring systems qualified for the conditions of severe accidents, and system for monitoring the concentration of hydrogen, oxygen, carbon dioxide and steam, etc., as well as the severe accident management guidelines (SAMGs), the containment capability to retain radioactive substances during core melting accidents has been significantly improved.

The study of the options for core melt localisation during severe accidents has shown that it is necessary to feed coolant at a high flow rate at the appropriate time to the space where the corium is located in order to localise it in its place of formation. This is combined with all other actions for severe accident management, such as core pressure reduction, management of containment conditions, secondary side pressure reduction, and water supply to the steam generators depending on the specific situation. These actions are included in the Severe Accident Management Guidelines of the Kozloduy NPP.

Improvements of the design of nuclear power plants as a result of the deterministic and probabilistic safety assessments; review of the major improvements made following the commissioning of the nuclear installation

As a result of the periodic safety review (PSR) conducted at Units 5 and 6 the following major measures were implemented:

- Replacement of safety-important equipment;
- Improvement of SSCs' seismic resistance and monitoring of their structure support systems;
- Update of emergency operating procedures as a result of the implemented accident management measures;
- Upgrade of the Reactor Control Surveillance and Limitation system;
- Update of Units 5 and 6 Level 1 Probabilistic Safety Assessment (PSA) for full power, low power, and shutdown reactor, and expansion of its scope to cover specific for Kozloduy NPP internal and external hazards, including interdependencies of the units;
- Fire hazard evaluation and modernization of the fire suppression and fire detection and alarm systems;
- Comparative analysis of the results of the impact of "load combinations" of external hazards with the results of the tolerable "load impacts" determined by the studies, analyses, and assessments under the project for 'Units 5 and 6 Plant Life Extension'.

Regulatory review and control activities

Modifications of safety-important SSCs are carried out based on permits granted under the ASUNE and the Regulation on the Procedure for Issuing Licences and Permits for Safe Use of Nuclear Energy. The Regulation defines the documents the applicant shall submit for review and assessment. The review of the information submitted includes an assessment of compliance with regulatory safety requirements and the guidelines of the regulatory authorities. IAEA safety standards are also applied. If specialised knowledge is required to perform the review, an expert opinion is sought from external technical support organisations. The results of the assessments are documented in opinions based on which a decision is made to issue a permit for the implementation of a modification.

Subsequent control of the completed modification is carried out through inspections.

Article 18 (2) Use of proven technologies

Measures and regulatory requirements for the use of technologies proven by experience or qualified by tests or analyses

According to the Regulation on Ensuring the Safety of Nuclear Power Plants, the design shall provide for the use of proven or experimentally tested and qualified components in order to ensure the appropriate reliability, efficiency and independence of the safety-important SSCs. The design solutions used in NPP evolution designs shall be approved in previous applications at existing NPPs.

Where this is not possible, safety shall be justified by use of results from ancillary research programmes or by the operating experience gained in other relevant applications. Based on the results and conclusions of the operating experience, safety analysis and researches conducted, the necessity and benefit of improvement of the design beyond the established practice shall be reassessed. When introducing innovative or unapproved design solutions, compliance with safety requirements shall be demonstrated through a suitable ancillary programme for preliminary experimental testing and confirmation of the relevant features.

All safety-important SSCs shall be assigned safety classes based on their function and safety importance. The classification of SSCs is carried out using a structured approach based on a combination of deterministic and probabilistic methods and supplemented by engineering evaluation, if appropriate. The SSCs are designed, manufactured, installed, tested, operated and maintained to provide quality and reliability for the relevant class.

Measures taken by the licensees to use proven technologies

There is a configuration management system in place at Kozloduy NPP. Every design modification shall be implemented based on the relevant decision for design modification which specifies the requirement to the SSCs taking into consideration their classification and qualification status.

The existing Information System for Organisation of Operating Activity ensures that all the phases of planning and implementation of design modifications are performed upon a review by the process owners. Every design modification is subject to safety impact assessment.

Consideration of the international experience, engineering research and receiving inspection performed by the authorised plant structures provide that the procured and delivered equipment complies with the quality and reliability requirements in the design documentation and has been manufactured in compliance with the applicable standards and technologies.

Analysis, testing and experimental methods to qualify new technologies

In order to ensure the appropriate reliability, efficiency and independence of the safety-important SSCs, the design shall provide for the use of proven or experimentally tested and qualified components.

Working conditions of important to safety components and structures are simulated by verification nature tests and full-scope simulator tests, or alternative methods of proven equivalent effect shall be used in the cases these tests are practically impossible. According to the Regulatory Guide for qualification of safety-important SSCs, the following internationally recognised methods are applied:

- testing of equipment samples;
- analyses, including comparison with already qualified components;
- application of the relevant operating experience with a similar application of the equipment.

As part of the measures planned in the Integrated Safety Improvement Programmes, a review and analysis have been conducted to ensure that the existing qualification programs for safety-important equipment comply with the relevant safety requirements.

For all new digital control systems, instrumentation and automation systems installed on Units 5 and 6 during the review period, the relevant analyses were performed to demonstrate their applicability and impact on safety. The following have been replaced: Excore NIS (Nuclear Instrumentation System) plus associated cables; I&C cabinets of primary and secondary normal operation systems; RCSL (Reactor Control, Surveillance, and Limitation) system; Automatic Rod

Control System; Unit 6 RPCS (Reactor Power Cutback System) plus associated cables; Reactor Coolant Pumps' diagnostic systems.

During the review period, the Computer Information and Control systems of the two units were migrated to a new generation Ovation platform, including integration of a Safety Parameter Display System (SPDS) and symptom-based emergency operating procedures. The upper layer of the Unit 5 ICIS (In-Core Instrumentation System) has been replaced. A cybersecurity system has been installed.

All modifications related to new equipment have been validated by tests for compliance with design characteristics, including harsh work environment (LOCA, HELB and fire resistance). The results are documented in certificates, protocols, and reports.

Regulatory review and control activities

The reports from analyses, inspections and tests are submitted to the NRA by the licensee as part of the documentation required for the issue of the relevant permits for modification.

The regulatory review and control of activities are described under Article 18 (1) in accordance with the existing regulations and cover the above aspects.

Article 18 (3) Design for reliable, stable and manageable operation

Review of measures and regulatory requirements relating to reliable, stable, and easily manageable operation, with specific consideration of the human factor and human-machine interaction

The Regulation on Ensuring the Safety of Nuclear Power Plants defines the requirements for plant process control. For control and monitoring of the plant's normal operation systems and safety systems in a nuclear power plant, the Main Control Room (MCR), Supplementary Control Room (SCR), normal operation control systems, control safety systems and independent data acquisition and storage equipment should be provided. There should be a potential to keep the unit in a safe state or to restore this state, if required, under all operating conditions and design basis accidents from the MCR. It is required that control safety systems are designed to automatically actuate the relevant systems, including reactor shutdown systems, to ensure compliance with the design limits for anticipated operational occurrences.

The design of a nuclear power plant should consider human errors as potential initiating events and credible combinations of internal and external events based on credible assumptions. The probabilistic safety analyses should include an analysis of human errors with consideration of the factors that may influence the behaviour of the operational staff for all operational states and accident conditions.

To take into account human factors, the Unit 5 and 6 design provides for:

- Automatic or passive engineered features for actuation and control of safety systems to the extent that no operator's actions are required within 30 minutes of the occurrence of an initiating event;
- Engineered features to prevent human errors and limit their consequences, including maintenance of the SSCs important to safety.

The safety assessment confirms that the design has considered human factors and a man-machine interface:

- The design of Units 5 and 6 tolerates human errors as much as practically achievable;
- The actions assigned to operational personnel to ensure safety have been defined and analyses of the tasks involved in operational decision-making have been carried out;

- The information and control features are sufficient to enable the operating staff to control and monitor normal operation; easily evaluate the general condition of the nuclear power plant under normal operation, anticipated operational occurrences and accident conditions;
- Working areas and working conditions have been ergonomically designed and provide for reliable and efficient task performance;
- All actions to be performed in a timely manner are automatic;
- Sufficient and reliable communication between the Main Control Room and Supplementary Control Room, local control panels and Emergency Response Centre is provided.

The layout of the control and monitoring equipment and the visualization of the information in the MCR should enable the operating staff to clearly and quickly determine the state and the behaviour of the power unit, adhere to operational limits and conditions, identify and control the automated actuation and operation of safety systems, as well as the operation of accident management systems.

The specific consideration of the human factor and man-machine interface is discussed in Article 12 of the National Report.

Upgrades undertaken by the licensee

The MCR provides for the control and monitoring of all engineered safety systems and safety-important systems, as well as for taking measures to maintain and restore the unit safe condition during any abnormal situation.

In situations when the MCR is inaccessible, there is an option for full control not only of the safety systems but also of the normal operation systems from the SCR via the newly installed workstation for monitoring and control of the normal operation systems. The backup equipment of the SCR is physically, electrically, and functionally separated from the MCR equipment.

In order to extend the operating life of the Units 5 and 6 safety system and enhance its reliability, the Reactor Control, Surveillance, and Limitation System as well as the Automatic Rod Control System have been upgraded. The new systems retain the basic design functions and existing principles of automatic reactor power control and limitation. The user-oriented properties have been improved through implementation of modern electronic components, industrial personal computers, and built-in diagnostic functions.

In order to support the loading of RWFA fuel assemblies at Unit 5, an additional Incore Nuclear Instrumentation System under the BEACON platform has been implemented. The system operates in parallel with the existing neutron monitoring system (SVRK-M). In order to optimise the human-machine interface and implement a redundant monitoring of the reactor core physics and thermal-hydraulic parameters, additional software displays have been developed and implemented in the computer information and control system, which replicate as closely as possible the appearance and functionality of the existing neutron monitoring system screen displays.

The upgrade of the Excore Nuclear Instrumentation System on both units has improved the neutron monitoring accuracy, speed, and reliability, thus ensuring the safe and reliable operation of the reactor installations.

Design modifications have also been made to implement additional urgent alarms for equipment condition monitoring.

Regulatory review and oversight activities

The regulatory review and oversight activities are generally described in Article 18 (1) and are carried out as per the current regulations and internal procedures. Specifically, with regard to

measures for reliable, stable and easily manageable operation, examples include the reviews and assessments of the following new systems' designs and their integration with existing systems:

- Assessment of the reliability and availability of the Unit 6 upgraded Excore Nuclear Instrumentation System, including verification of the system operability, efficiency and sustainability, which plays a key role in ensuring safety – not only the technical reliability of the system was assessed, but also its ability to function in real conditions, considering all modes of operation;
- Assessment of the BEACON system compatibility and capability to operate in parallel with the existing system for monitoring of the thermal-hydraulic and reactor core physics parameters of Unit 5 – based on the analyses performed, it has been verified how the new BEACON system will interact with the existing system for monitoring and control of the thermal-hydraulic and reactor core physics parameters. This includes assessing the compatibility of the two systems, as well as their capability to operate in parallel under normal and emergency operating conditions.

Article 19 Operation

Each Contracting Party shall take the appropriate steps to ensure that:

i) the initial authorization to operate a nuclear installation is based upon an appropriate safety analysis and a commissioning programme demonstrating that the installation, as constructed, is consistent with design and safety requirements;

ii) operational limits and conditions derived from the safety analysis, tests and operational experience are defined and revised as necessary for identifying safe boundaries for operation;

iii) operation, maintenance, inspection and testing of a nuclear installation are conducted in accordance with approved procedures;

iv) procedures are established for responding to anticipated operational occurrences and to accidents;

v) necessary engineering and technical support in all safety-related fields is available throughout the lifetime of a nuclear installation;

vi) incidents significant to safety are reported in a timely manner by the holder of the relevant licence to the regulatory body;

vii) programmes to collect and analyse operating experience are established, the results obtained and the conclusions drawn are acted upon and that existing mechanisms are used to share important experience with international bodies and with other operating organizations and regulatory bodies;

viii) the generation of radioactive waste resulting from the operation of a nuclear installation is kept to the minimum practicable for the process concerned, both in activity and in volume, and any necessary treatment and storage of spent fuel and waste directly related to the operation and on the same site as that of the nuclear installation take into consideration conditioning and disposal.

Article 19 (1) Initial authorization

Review of regulations and regulatory requirements for commissioning of nuclear installations demonstrating that the installations, as constructed, are consistent with design and safety requirements

The Regulation on Ensuring the Safety of Nuclear Power Plants requires the operating organisation to develop a commissioning programme covering all operational states of the nuclear power plant, the activities to be implemented at each stage and the planned duration of each stage. The results of the programme implementation shall confirm compliance of the characteristics of SSCs important to safety and the NPP process parameters with the design requirements and the provisions of the commissioning permit issued by the Chairperson of the NRA. The programme shall ensure that all the necessary tests to confirm the compliance of the constructed nuclear power plant with the design requirements are completed.

The NPP commissioning shall be performed at sequential stages, for which separate programmes shall be developed. The implementation of each stage shall be preceded by an evaluation of the results from the previous stage and a confirmation that objectives set and design requirements have been met. The Regulation on the Procedure for Issuing Licences and Permits for Safe Use of Nuclear Energy specifies the main stages and the required document to be submitted to the Bulgarian NRA to receive a commissioning permit at each separate stage.

Conduct of appropriate safety analyses

The safety analyses are subject to the interim safety analysis report, which requires an Order by the NRA Chairperson to approve the technical design (licensing stage prior to commissioning). The commissioning programme shall envisage all necessary tests to verify the design characteristics of the nuclear power plant as specified in the interim safety analysis report. The activities conducted under the commissioning programme shall not lead to operational states and accident conditions that have not been analysed in the interim safety analysis report.

Commissioning Programmes

Each commissioning programme shall be based on the technical design of the SSC considering the results of the analyses conducted (in the interim safety analysis report) and additional studies, analysis of the operating experience gained, as well as the data on approved applied technologies, design modifications and engineering practices.

The programmes for each stage shall include:

- the sequence, timing and logical connections between the separate activities at the stage;
- the initial and final status at the respective stage;
- the organisation for implementation and the required staff;
- the preconditions for implementation of the tests;
- the requirements on the technological preparation and provision of power sources and fluids;
- the criteria for acceptance and an assessment of their fulfilment;
- the conditions for transition to the next stage.

The programmes are aimed at ensuring the completion of all tests required to demonstrate the compliance of the constructed nuclear power plant with the design requirements as well as:

- the tests have been performed in a logical and documented sequence;
- the "hold points" have been defined in the commissioning process;
- the operating staff have been trained and the instructions have been validated.

Regulatory review and control activities

The Regulation on the procedure for issuing licences and permits for safe use of nuclear energy requires prior to issuing the commissioning permit at each separate stage, an on-site inspection by the NRA to be performed to confirm the compliance of the data and circumstances declared and the readiness to complete the stage. The scope of the inspection shall include:

- assessment of the acceptance criteria and procedures;
- review of the application of these procedures;
- direct inspection of the implementation of key tests;
- assessment of the tests' results;
- verification of the integrity of each engineering barrier.

A permit for implementation of the next stage is issued based on the NRA inspection conclusions.

Article 19 (2) Operational limits and conditions

Regulatory requirements to identify the safe boundaries for operation

The Regulation on Ensuring the Safety of Nuclear Power Plants requires the operation of nuclear power plant to be performed in compliance with the operational limits and conditions with the aim of maintaining the levels of defence in depth in a standby mode. The operational limits and conditions shall be identified and based on the technical design, the safety analyses and the commissioning tests. The operational limits and conditions shall be reviewed periodically to reflect the operating experience, modifications of safety related SSCs made, new safety analyses, and research and technological development. Changes of the operational limits and conditions shall be justified based on analyses of the safety margins and independent review of those analyses.

The operational limits and conditions shall cover all the normal operating modes, including power operation, subcritical reactor, refuelling, and all the transients between those states, operating modes, or temporary conditions resulting from maintenance works and testing and shall include as a minimum:

- safety margins;
- safety system actuation limits;
- operational limits and conditions;
- tests, inspections, surveillance, and on-line monitoring of safety related SSCs;
- minimum number of shift staff for the operating modes, including the certified and qualified main control room (MCR) operators;
- actions to be taken in case of deviations from the operating limits and conditions.

The operating limits and conditions collected in a single document (Technical Specifications) shall be easily accessible to the MCR staff, who shall be knowledgeable of them and their technical basis. The management of the operating organisation shall be well aware of their significance for safety.

Application of operational limits and conditions, their documentation, training on them and their availability at the workplaces of the staff directly involved in safety related activities

As part of the operation of a nuclear power plant, a system for continuous monitoring of limits and conditions ensuring the safety shall be developed and implemented. The on-line monitoring of the adherence of the limits and conditions and their documentation is done be the personnel complying with the established values and limits of the technical specifications.

The administrative control on the application of the operational limits and conditions shall be exercised by the managers of the structural units-owners of the equipment. The adherence of the operational limits and conditions and the deviations from the normal operational states are discussed during the daily operational meetings. In all cases of non-compliance with the operating limits restrictions, immediate actions shall be taken to restore the normal operation. The deviations from the limits are reported every month using also self-assessment indicators. The deviations are documented in compliance with the operating procedures and are reported to the NRA.

The adherence to the operational limits and conditions is a characteristic of the personnel safety culture. Therefore, the personnel completes the required training. Briefings are conducted in the event of a change of the operational limits and conditions and, if necessary, additional training is delivered.

Review and change of the operational limits and conditions if necessary

The operational limits and conditions are justified in the Safety analysis report for each nuclear facility.

The changes may result from modifications made to SSCs important to safety, operating experience, changes in the status of the nuclear facility, or analysis of significant operating events. If the operational limits and conditions need to be changed, the safety significance of the change shall be assessed. The assessment shall be submitted to the NRA accompanied by an application for issuance of a permit for implementing changes to the Technical Specifications.

Regulatory review and control activities

The NRA on-site inspectors carry out daily control on the performed activities and the adherence to the operational limits and conditions.

The impact of the change on the SBEP or emergency instructions shall be assessed in all cases when the licence holder submits applications for changes in the SSC or the operating documents.

Changes to the operational limits and conditions are subject to authorisation, which requires their comprehensive assessment. The submitted assessment of the the impact of the modifications on the existing operational limits and conditions is revised while reviewing the documents, submitted to the NRA with the application for authorisation.

Article 19 (3) Procedures for operation, maintenance, inspection and testing

Overview of the arrangements and regulatory requirements on procedures for operation, maintenance, inspection and testing

Pursuant to the Regulation on Ensuring the Safety of Nuclear Power Plants, the operating personnel shall operate the NPP in accordance with written operating instructions and procedures, developed on the basis of the design and technical documentation, the operational limits and conditions and the commissioning results. The operating instructions and procedures shall be clearly identified, current, distinguishable according to their intended purpose and easily accessible for the personnel. The specified instructions shall be clear and concise, verified, and validated. The procedures and instructions shall be available ate the commissioning stage and the operating personnel shall be familiarised with and trained on them. The final revision of these procedures is considered the results and experience of the commissioning.

The operating organisation shall develop testing, maintenance and repair, surveillance and inspection programmes to ensure compliance of the important to safety SSCs' operational, reliability and functionality with the design requirements throughout the entire NPP lifetime. These programmes shall take into account the operating limits and conditions and shall be reviewed considering the operating experience. The maintenance programmes take into account the results of the ageing management programme and include the replacement of obsolete SSCs or those with expired operational lifetime, re-qualification of SSCs important to safety and the application of new maintenance and repair technologies. The maintenance and repair programmes shall provide for the application of a graded approach for the direct and independent quality control during activities implementation. The implementation of the periodic inspection, surveillance and testing programmes shall confirm that SSCs that are important to safety fulfil the requirements for further safe operation or that recovery measures are required.

The control of the condition of the parent metal and the welded joints shall be carried out following specially developed procedures, at intervals the duration of which shall be determined taking into account the finding of any deterioration of the most loaded component before the failure occurs.

Control activities and tests that are not described in the Technical Specifications or operating procedures, shall be implemented using specially developed programmes and procedures, which shall be developed for each particular case.

Pursuant to the Regulation on the Procedure for Issuing Licences and Permits for Safe Use of Nuclear Energy a part of the set of documents submitted to the NRA for issuance of an operating licence comprise operating procedures, schedules and procedures testing and control of the systems important to safety, including operating procedure for in-service inspection of the base metal and overlayed surfaces of equipment and pipelines, a schedule for maintenance and repair of the main equipment and SSC ageing management programme (rules).

Developing of operating procedures, their implementation, periodic review, modification, approval and documentation

Kozloduy NPP Units 5 and 6 are operated in accordance with operating instructions and procedures, developed on the basis of the design and technical documentation, operational limits and conditions, results of units' commissioning - initial and after each outage, taking into account the modifications made to SSCs and/or the operating conditions.

The operating documentation includes the following:

- operating procedures for SSCs, describing the composition and design functions of the technological systems, including operating procedures for start up and shutting down for maintenance of equipment and systems, including safety systems, complete procedures for scheduled switchover, for unit start-up and shut down;
- testing programmes and procedures, maintenance and repair procedures, commissioning and decommissioning procedures;
- procedures to perform specific activities - procedures for reporting events, design modifications, operational relationships, conduct of operations, etc.;
- emergency procedures and instructions, response procedures in the event of internal and external hazards, severe accidents management guidelines.

The following requirements shall be complied with when developing, implementing, checking and updating the operating procedures and instructions:

- to cover all aspects and activities ensuring safe operation;
- to comply with the operational limits and conditions and the requirements of the relevant specialized supervisory authority;
- to be developed by experts with the required qualification in accordance with the quality assurance requirements;
- to be kept up to a clear and understandable level, avoiding ambiguous interpretation;
- to be drawn up in accordance with the objectives of the design and in such a way as to ensure that work is carried out without difficulty in the necessary sequence and without further supervision.

The requirements for the documents in terms of format and contents as well as the documents periodic review are specified by quality procedures. The management system of Kozloduy NPP EAD allows using only the up-to-date revisions of the documents.

The operating procedures and programmes for maintenance, testing, supervision and inspection are developed by personnel with the required competence and knowledge in compliance with a quality procedure. The verification and validation of the operating documents is done with the involvement of the interested operating personnel.

The operating instructions and procedures are clearly identified; they are easily accessible in the main control rooms as well as in the other operating rooms. The administrative heads determine the scope of the necessary operational documentation and ensure its availability at the relevant working places. The personnel shall be familiarised in detail with the contents of the instructions and procedures and the modifications thereto and this is documented as specified in a quality procedure. The programmes and procedures for scheduled switchovers, taking equipment out of service, maintenance, testing, supervision and inspection are used when carrying out the relevant activities. Standard forms, check-lists and other specific documents for step-by-step implementation and recording of the results received are annexed to them.

Prior to performing the procedures, the individual responsible for the switchover and the maintenance team leaders conduct just-in-time briefings regarding activities related to safety systems, systems for normal operation important to safety, and systems important for electricity generation. Standard training is provided for the other technological systems.

After completion of the activities on SSC important to safety, the managers of the respective teams discuss the results (Post-Job Debriefs) and document the results in accordance with the requirements set out in the procedures.

The management system of Kozloduy NPP EAD includes a supporting process “Document and Record Management” ensuring that the personnel on all workplaces uses the necessary documents for their activities that are updated, clear, unambiguous, identified, have undergone the respective checks, and are approved through the established order. The documents are structured in hierarchical levels depending on their function, area of application and level of details specified. The operating procedures occupy the lowest hierarchical level and include specific details, methods and responsibilities for the execution of specific tasks by the personnel.

Regulatory review and control activities

The Act on the Safe Use of Nuclear Energy (ASUNE) requires a permit to be issued for changes leading to a modification of the internal rules and documents for performing the activities of the licence holder. Permits are issued if the proposed changes are not contrary to statutory requirements and the conditions of operating licences issued.

The operating licences include an annex, which lists all operating documents, whose changes require the issue of a permit as: Technical specifications; emergency response procedures, radiation protection, physical protection, RAW management, radiation monitoring, etc.

During the period under review, inspections were carried out for the practical application of the operating, maintenance and repair procedures in the following areas:

- management of Units 5 and 6 design modifications;
- management of qualified equipment;
- organisation and management of activities related to chemical and radiochemical control;
- metrology assurance and certification of the measurement devices;
- current status, lifetime and operation of the safety control systems and supporting safety system and the auxiliary building-3;
- organisation and performance of activities related to the visual inspection of primary equipment status;
- systems for diagnostics; maintenance of Units 5 and 6 ventilation systems;
- ageing management of electrical equipment, equipment of the instrumentation and control systems, and primary mechanical equipment;
- activities related to new type of nuclear fuel delivery and storage.

Article 19 (4) Procedures for responding to incidents and accidents

Overview of the regulatory requirements on procedures for responding to anticipated operational occurrences and accidents

The Regulation on Ensuring the Safety of Nuclear Power Plants requires that instructions and procedures are developed to determine the actions of personnel in normal operation, deviations from the operational limits and conditions, anticipated operational occurrences and accidents, that shall provide an adequate level of safety.

The actions of the personnel in emergency situations occurring in all operating states are defined in the emergency procedures and in the severe accident management guidelines (SAMG).

The emergency procedures cover design basis accidents and scenarios at which significant fuel damage in the core or in the spent fuel pool could be prevented. The emergency procedures must be symptom-based emergency procedures (SBEP) and compatible with the SAMG. The emergency procedures for design basis accidents should provide guidance for reaching a stable safe state of the NPP, while and emergency scenario procedures that can prevent significant damage to nuclear fuel should provide guidance for recovery or mitigating the lost safety functions and for actions to prevent damage to nuclear fuel in the core or in the spent fuel pool.

SBEP must include diagnostics of the state regarding optimal recovery in transient modes and emergencies, status monitoring, restoration of safety features as well as conditions for transition to SAMG.

SAMG should mitigate the consequences of severe accidents in the cases when the staff actions, including the measures as defined in the SBEP were not successful to prevent core damage or fuel damage in the spent fuel pool. SAMG are based on scenario management strategies identified within the analysis of weaknesses and capabilities of the unit in case of severe accidents, and the possible management measures, including for containment protection. In the SAMG, priority shall be given to the operation of the qualified equipment and measuring devices.

The requirements regarding the format, structure and content of SBEP and SAMG are specified. The requirements regarding using specific data for the unit for which they are being developed are formulated. Emergency procedures shall be verified and validated by a team of independent experts. Procedures must be validated analytically using verified computer programmes and performance models for operator actions efficiency. The implementation of operators' actions shall be validated by means of simulators. Procedures shall be updated regularly, and after each modification they shall be re-validated.

Development of symptom-based emergency procedures

Staff actions to diagnose the state of Kozloduy NPP units in all possible emergency conditions and scenarios at which significant fuel damage in the core or in the spent fuel pool could be prevented as well as recovery or compensation of violated safety functions are defined in the symptom-based emergency procedures. SBEP are developed for unit operation at power, at low power and a sealed reactor, shut-down and depressurized reactor and response actions in the event of emergency conditions in the spent fuel pool. The procedures are implemented following successful verification, validation and simulator training of the personnel.

The SBEP sets for practical application include:

- diagnostic procedure;
- procedure for operation in the event of total loss of power (blackout);
- optimal recovery procedures;
- functional recovery procedures based on control of the critical safety functions and trending their degradation;

- procedures regarding operation with a damaged barrier.

Introducing SBEP was preceded by a significant analytical work, justifying the critical safety functions and their degradation, as well as main and alternative operator' actions, incorporated into the procedures.

Pursuant to the internal rules of Kozloduy NPP, SBEPs are regularly reviewed and updated. When performing safety analyses and safety assessments, as well as when implementing design modifications related to SBEP, the respective changes shall be introduced in them.

In addition to the SBEP in order to eliminate disturbances in normal operation and emergency states which do not result in reactor scram or safety system activation, emergency procedures are developed.

Development of procedures and guidance to prevent severe accidents or mitigate their consequences

Kozloduy NPP has developed severe accident management guidelines (SAMG), which follow the SBEP format and, under certain criteria, are implemented with a transition from SBEP.

The process of SAMG implementation in practice includes the development of the guidelines, their verification and validation by an independent team of table-top experts and follow-up training for operators. There are two types of SAMGs available - one in a two-column format for the MCR/SCR and one in a graphical text form for both Emergency Response Centres (on-site and off-site ERCs). A comprehansive research and analysis of the processes as well as of the introduced design modifications regarding the severe accidents were performed within the SAMG development. The following SAMGs have been introduced:

- for full power operation;
- for lower power operation;
- for shutdown reactor with a sealed primary circuit;
- for total loss of power at a shutdown unit;
- for depressurized reactor;
- for the underwater refuelling pool at a shutdown unit;
- for the spent fuel pool;
- for the containment structure at a shutdown unit.

Development of procedures and guidelines for the management of emergency situations on sites with several nuclear installations and/or nuclear facilities

A procedure for actions of the emergency teams in case of simultaneous occurrences at various nuclear facilities on the Kozloduy NPP site is developed and approved. The procedure includes organisational measures for actions of the emergency teams, the mobile equipment located on the site and in the precautionary action zone, as well as the logistics - provision of batteries, cables, oils and diesel fuel in case of an emergency.

Regulatory review and control activities

All documents of the licence holder related to eliminating violations of normal operation and accidents are part of the documents on the basis of which an operating licence is issued and are subject to control by the NRA. The impact of the amendment on the SBEP or emergency procedures are assessed in all cases when the licence holder submits applications for modifications to SSC or amendments of the operating documents. The SBEPs and SAMGs are annexed to the operating licences of Units 5 and 6 and each change and/or implementation requests action by the NRA.

Article 19 (5) Engineering and technical support

Availability of necessary engineering and technical support of the licence holder

Activities related to engineering and technical support are carried out mainly by two of Kozloduy NPP organisational units - Technical Support Division and Maintenance Division.

The Technical Support Division focuses on the activities for management of refurbishment and reconstruction of SSCs, safety analyses and assessments, scientifically-applied projects and research, analyses of the results of the periodic tests of safety systems, SSC ageing management and coordination of activities related to long-term operation. All technical support activities are performed in compliance with the procedures and instructions stipulating the order, rules, requirements, responsibilities and interactions between internal organisational structures and external contractors.

The management of the process and coordination of maintenance and repair activities is carried out by the Maintenance Division. If contractors and suppliers are used, the experts within the division prepare the technical specifications and terms of references, perform technical evaluation of the tender documents, perform safety briefings and arrange the access to the plant site, supervise activities during the execution and the acceptance of the maintenance works carried out and modifications made. These activities are regulated by internal instructions and procedures.

The resources and high-priority activities needed to maintain the nuclear facilities are planned in the Company's Business Programme in order to supply the necessary spare parts or new equipment or to choose contractors for the implementation of specific activities.

The specific activities of scientific support, consultancy assistance and service delivery are carried out by specialised technical organisations and scientific institutes. Part of the maintenance activities of conventional equipment (turbine, electric generator, power transformers, and pump units) are carried out by specialised external organisations under contracts concluded. For the specific equipment, service contracts have also been signed

Securing supply chains for equipment and services

The essential part of the main equipment and components of the technological systems of units 5 and 6 were designed and manufactured in the Russian Federation. In this regard, some of the contracts for the supply of goods and services related to ensuring the reliable and safe operation of the main equipment involve the participation of Russian contractors. This includes absolutely necessary goods directly related to the operation, maintenance, and safety of the nuclear facilities, which cannot currently be provided by other contractors.

Referring to the restrictions imposed by Regulation (EU) No 833/2014 and the need to secure goods and services critical to the safety of units 5 and 6, the Council of Ministers of the Republic of Bulgaria has introduced exemptions related to the provision of absolutely necessary goods and services.

With regard to some of the equipment, studies have been or are being carried out to find alternative suppliers of goods and services. In this regard, suitable alternative suppliers have been identified for the maintenance of some of this equipment, or the equipment has been replaced with similar equipment that meets the design technical requirements..

Regulatory review and control activities

The Business Programme of Kozloduy NPP EAD is submitted to the NRA every year in pursuance of the units' operating licences and to exercise regulatory control over the planned engineering and technical maintenance activities in the production, maintenance and investment programmes.

The NRA long-term investment programme includes four main areas related to the engineering and technical support: “Engineering Support”, “Maintenance”, “Structures, systems and components important to safety”, and “Ageing Management”. Regulatory control in these areas covers the management of activities and their effectiveness, internal procedures and records, the condition of the SSC, the provision of spare parts and materials, interaction with external organisations, etc. Control and evaluation of the planned maintenance activities of SSC is carried out during the inspections regarding the preparedness of the units for start-up after outages as well as in the implementation of the activities included in the integrated programmes for units safety enhancement.

Article 19 (6) Reporting of incidents important to safety

Overview of the regulatory requirements to report events significant to safety

The Regulation on the Conditions and Procedure for Notification of the Nuclear Regulatory Agency of Events in Nuclear Facilities, at Sites and in Activities involving Sources of Ionising Radiation, and during Transport of Radioactive Materials (Regulation for Notification) defines the requirements for notifying the NRA for safety significant events. The Regulation classifies the events for which notification to the NRA is required in three categories - deviations, incidents and accidents. The requirements for the notification format and the content of the information provided are defined. The Regulation sets out requirements for carrying out the event investigation, which aims at collecting and systematising the information necessary for analysis and assessment of the event, identification of its root causes and the implementation of corrective measures. The event significance in terms of nuclear safety and radiation protection is determined by the INES scale.

The licence holder may notify the NRA of other events that are not classified in the three categories when it considers that these events are potentially related to safety of the nuclear installation and/or are of public interest.

Established reporting criteria and reporting procedures for events important to safety, near misses and incidents

Pursuant to the Kozloduy NPP rules, events are classified into 4 categories depending on their safety significance:

- Category 1: operating events important to safety, which are included in the Regulation for Notification (deviations, incidents, and accidents); They are obligatory reportable to the NRA;
- Category 2: operating events which are not safety significant but have consequences for the normal operation and/or operability of the SSC; as well as those related to violations of occupational health and safety;
- Category 3: operating events that are not included in categories 1 and 2. These events are not related to normal operation but impact the operability of SSC of the normal operation systems;
- Category 4: low level events and near misses.

The procedure for reporting and analysis of the different event categories is described in the plant internal rules and procedures.

13 events (Appendix 1), which occurred at Kozloduy NPP units 5 and 6 are reported for the review period. They were all rated as Below Scale/Level 0 in compliance with the International Nuclear and Radiological Event Scale (INES). Those are distributed in the years as follows:

- 2022 - 4 events;
- 2023 - 4 events;

- 2024 - 5 events.

In the period 2022-2024, 60 events, which are not included in the scope of the Regulation on the Conditions and Procedure for Notifying the Nuclear Regulatory Agency of Events in Nuclear Facilities, Sites and Activities involving Sources of Ionising Radiation and the Transport of Radioactive Substances were additionally analysed. These are events that, according to the plant internal rules and procedures, are classified as categories 2, 3 or 4.

Documentation and publication of reported events and incidents by the licence holder of the regulatory body

Kozloduy NPP stores the entire information on operational events in a joint electronic database. The information contains a detailed description of the event, the causes, safety consequences, analyses, and corrective measures undertaken. This information is stored through the entire life of the nuclear facilities.

For all registered events, which occurred at Kozloduy NPP that are of public interest, Kozloduy NPP distributes press releases to the electronic media and information agencies and publishes information on the plant website.

Pursuant to the ASUNE and the Regulation on the Conditions and Procedure for Notifying the Nuclear Regulatory Agency of Events in Nuclear Facilities, Sites and Activities involving Sources of Ionising Radiation and the Transport of Radioactive Materials, the NRA publishes information on the reported events that occurred at the nuclear facilities on its website. Additionally, information on the events is provided in the NRA Annual Report in the section regarding nuclear safety and radiation protection. Annual reports are published on the Agency's website. Events, which are interested in terms of operating experience, are submitted for publishing in the International Reporting System for Operating Experience (IRS).

Policy for use of the International Nuclear and Radiological Event Scale (INES)

Pursuant to the Regulation for Notification, the significance of the event regarding safety and the level of the event are determined by the International Nuclear and Radiological Events Scale (INES), initially by the licence holder, and the final assessment according to the same scale is determined by the Chairperson of the NRA. Additional guidance on the use of the INES scale is contained in the NRA Regulatory Guide for determining the significance of operational events in terms of nuclear safety and radiation protection.

At Kozloduy NPP, the algorithm to determine the level on INES is entered into the electronic database for event analysis. Each event analysis record comprises a standard form reflecting the INES assessment and additional information, such as impact on the site and the environment, degradation of defence in depth. The events distribution according to the INES is used as one of the main indicators for safe operation of the plant.

Regulatory review and control activities

An Events Analysis Group was set up in the NRA, whose activity is specified in a procedure. The Group is convened periodically and carries out independent analyses of the operational events, discusses the corrective actions taken by the licence holder and determines the final assessment on the INES. If necessary, additional information is required and meetings with the plant staff are held. A database for operational events is maintained at the NRA. Events considered to be of interest to other countries are to be published in the IRS.

Regulatory inspections, before unit start-up after outage includes the implementation of the corrective measures for events, which occurred from the previous fuel cycle and during the actual outage. The NRA's Inspection Programme includes the Operating Experience Feedback area, which governs the reporting procedure for the events, the analyses performed, the corrective actions

adopted and their effectiveness. Inspections are also performed when events of greater significance to safety occur. Inspections focused on the implementation of the corrective actions undertaken on reported events including those related to human factor are carried out during the reporting period.

Article 19 (7) Operating experience feedback

Regulatory requirements to the licence holder to collect, analyse, and share operating experience

The Regulation on Ensuring the Safety of Nuclear Power Plants requires the licence holder to develop and systematically use a programme for collection, analysis and documenting of internal and external operating experience, as well as of operational events at the NPP. The appropriately trained staff should be appointed to identify the adequate improvement measures. It shall receive support and resources from the NPP management. The assessment of the operating experience shall detect all hidden flaws, potential preconditions and possible trends for the deteriorated performance of the activities that have an impact on safety or result in decrease of safety margins.

The safety significant operational events, including near misses and low-level events, shall be reported and investigated in consistence with the established procedures and criteria. In order to prevent re-occurrences and to counteract undesired trends, timely and appropriate corrective actions should be implemented, and good practices should be considered.

The information related to operating experience should be communicated to the relevant staff, shared with all interested national and international organisations and used in the training of staff performing activities with impact on safety. Periodic reviews of the effectiveness of the operating experience feedback based on certain indicators or criteria shall be implemented within the self-assessment process or by an independent team.

The Regulation for Notification requires the licence holder to perform an operating experience analysis taking into account the operational data, information on deviations, incidents and accidents, including statistical analyses of the safety indicators previously agreed with the NRA. The operating experience analysis identifies trends in the behaviour of the staff and of equipment performance and conclusions and recommendations for improvement are made.

Licence holder’s programmes for the use of feedback of internal and external operating experience

Requirements, basic principles, responsibilities and obligations regarding the use of operating experience at Kozloduy NPP are specified in the procedure “Safety rules. Operating experience feedback system”. Operating Experience Screening Committee and Operating Experience Committee are established at the plant.

The Operating Experience Screening Committee is a permanently acting body, having its meetings not less than once per month. It screens the information received from external operating experience. If necessary, the Operating Experience Screening Committee assigns an additional review by subject-matter experts and the proposals for corrective actions are assessed before being submitted for approval by the Operating Experience Committee.

The Operating Experience Committee is a specialised advisory body to the Production Director assisting in matters related to the improvement and development of the operating experience feedback system.

The feedback system consists of two main programmes, the Programme for the use of internal operating experience and the Programme for the use of external operating experience.

Programme for utilization of the internal operating experience

The internal operating experience sources are operational events that occurred at Kozloduy NPP, including low-level events and near misses. The internal operating experience includes the following activities:

- reporting and recording the event in the Organisation of the operating activity information system;
- analysis of causes – identification of the direct, indirect and root causes;
- analysis of trends in low-level events and near misses and identifying common causes (programme and organisational);
- determining corrective actions to prevent recurrence of events and reducing the frequency of event occurrence;
- implementation and control on the corrective actions approved;
- assessment of the effectiveness of the implemented corrective actions;
- periodic review of the effectiveness of the use of internal operating experience.

Programme for utilization of the external operating experience

Sources of external operating experience are operational events published in the information networks of WANO and IRS-IAEA and also the recognised good international practices. The main activities to be performed for the use of external operating experience feedback, include:

- initial examination (screening) of the applicability of the information published in relevant international information networks (WANO, IRS);
- review of the feasibility of the selected information by the Operating Experience Screening Committee, conduct of comparative analysis and identification of the relevant corrective measures to be presented to the Operating Experience Committee for taking the final decision on the implementation;
- implementation and reporting on the corrective actions to prevent recurrence of similar events;
- assessment of the effectiveness of the implemented corrective actions.

Procedures to analyse internal and external events

Procedures for the analysis of internal events

A graded approach is implemented related to safety specifying the different requirements for the minimum depth of analysis depending on the event impact on safety in the assessment and analysis of the operating events. The analysis is performed in compliance with an approved methodology for analysis of events and operating experience, as well as for identifying the causes for event occurrence and the relevant corrective actions, which if implemented would significantly lower the possibility of event recurrence.

Low-level events (LLE) and near misses (NM) are registered as comments in the Organisation of the operating activity information system. These events are subject to review, classification and coding, further trending and trend analysis.

Categories 1 and 2 events are analysed in compliance with an approved ASSET methodology and human performance enhancement system (HPES) techniques, as described in the “Methodology for analysis of events and operating experience”. The analysis is carried out by a committee set up for each event, which obligatory involves a root cause analysis expert. The deadlines for the

analysis, as required, are 25 days for Category 1 events and 45 days for Category 2 events and Category 3 events, respectively.

Root cause analysis is mandatorily performed for operating events subject to reporting to the NRA (Category 1) and events, for which recurrence has been identified, regardless of their category. For Category 2 and 3 events, which are not defined as recurrent, the requirement for the minimum depth of analysis is as following: Identifying the direct cause and contributors - for Category 2 events; and identifying the direct cause for Category 3 events. Category 4 events (low level events and near misses) are subject to daily review (screening), classification, and coding. Keeping up with trends is done monthly and trend analysis on the code categories is done on an annual basis.

Procedures for the analysis of external events

Review (screening) and analysis of external events at Kozloduy NPP is carried out according to the Procedure for exchange and dissemination of operating experience. The assessment of the applicability of external operating experience, which is carried out by the Operating Experience Screening Committee, applies the following criteria:

- use of identical equipment or components;
- similar design in case the design is identified as a basic factor of the issue;
- identical working methods leading to increase of the possibility of occurrence of an analogous issue;
- similar conditions increasing the possibility of occurrence of an event (e.g. water resources, algae, adverse meteorological conditions, or critical ambient temperatures);
- similar event, which has occurred at Kozloduy NPP;
- similar management methods, personnel behaviour, or processes can be observed at the Kozloduy NPP.

Procedures for deriving useful experience and implementing modifications in the nuclear installation or in the programmes for staff simulator or continuing training

The main objective of the use of operating experience is the enhancement of safety and reliability at Kozloduy NPP by means of timely implementation of effective and efficient corrective actions resulting from analysed operating events - both internal and external for Kozloduy NPP. Corrective measures are aimed at restoring, enhancing or creating new technical and/or administrative barriers in order to prevent significant events and their recurrence. Such measures include design modifications, improvement of the human performance enhancement programmes, correction of deficiencies in the written procedures and other documents, and elimination of organisational weaknesses.

Information from operating experience is disseminated among the Kozloduy NPP staff in accordance with the established procedure. Internal events and operational experience from external events are published in the internal information system of Kozloduy NPP and are available to the entire plant personnel. Operating experience is included in the pre-job briefings, programmes for periodic and continuing training, and simulator training.

Mechanisms for sharing experience with other operating organisations

The major mechanisms to share important experience with other operating organisations are, as follows:

- publication of significant events, which have occurred at Kozloduy NPP in the WANO information system;

- publication of events, which have occurred at Kozloduy NPP in the IAEA information system (IRS);
- providing information on operating experience via the WANO technical request system;
- providing information on operating experience (presentations) during international seminars and exchange experience work meetings (benchmarking).

Use of international information databases on operating experience

The WANO database and IAEA - IRS are checked for new publications. SOERs (Significant Operating Experience Report) and SERs (Significant Event Report) are reviewed as soon as possible after publication and, thus, the review procedure is specified in a plant procedure.

Regulatory review and control of the lecence holder's programmes and procedures

The Operating experience feedback area is included in the NRA inspection programme. The operating experience feedback system is subject to periodic regulatory inspections regarding management of activities; instructions and procedures; organisation and practice of utilizing external experience; information exchange channels and the effectiveness of the corrective actions identified.

Every quarter the licence holder submits to the NRA information on the safety performance indicators including the indicators related to operating experience feedback. Additionally, Kozloduy NPP submits to the NRA its annual reports.

Article 19 (8) Management of spent fuel and radioactive waste on the site

On-site storage of spent fuel

At the Kozloduy NPP site, spent nuclear fuel (SNF) is stored underwater in the reactor pools of Units 5 and 6 for a specified period, according to the supplier's requirements, which is specified in the Technical Specifications and operating procedures. After the specified period, the SNF is transported to the wet spend fuel storage facility (WSFSF). SNF storage requirements include compliance with operating conditions in terms of chemical indicators, activity, tightness of the fuel rods of the fuel assemblies and the temperature of the coolant. The control over the operating conditions is carried out by the operating staff of Kozloduy NPP. The WSF stores SNF from the shut down units 1-4 (WWER-440) as well as from units 5 and 6 (WWER-1000). In connection with the amendments made to the ASUNE in 2024, the licence for the operation of WSFSF was renewed in 2024, whereby it is not limited by time.

From the WSFSF, the WWER-440 SNF is transported to the Dry Spent Fuel Storage Facility (DSFSF). In connection with the amendments made to the ASUNE in 2024, the licence for the operation of DSFSF was amended and it is not limited by time. At the end of 2024, there were 19 CONSTOR 440/84 containers loaded there.

Treatment, conditioning and storage of radioactive waste

Radioactive waste (RAW) activities are carried out in accordance with a RAW Comprehensive Management Programme. The Programme envisages collection, sorting, processing and temporary storage of solid RAW. Liquid RAW treatment consists of separate flow collection, chemical correction, settling, pre-treatment (evaporation, filtration) and temporary storage of the concentrate. Operational RAW, unprocessed or processed, are stored in the designated areas. Thus, the possible options for their subsequent treatment, exemption from regulatory control or disposal are not limited. Activities are carried out in compliance with dose limits and radiation protection programmes.

Kozloduy NPP has adopted an approach aimed at transferring all currently generated RAW and historically accumulated RAW to the State Enterprise Radioactive Waste for processing.

Activities to keep the amount of waste generated to a practicable minimum, in terms of activity and volume

The main activities to minimise the generated RAW are aimed at assessment and planning of the waste volumes, which are generated during the implementation of separate activities; sorting and separate waste collection in terms of type of waste and radioactive characteristics; ensuring interrelation between the generation activities and the subsequent stages of RAW management.

Despite the control over the activities, which are directly related to RAW generation, Kozloduy NPP pays special attention to all other activities, which implementation is an important prerequisite for minimising the waste volumes such as improving the equipment operation with the aim of limiting leakages; implementation of organisational and technical measures to minimise waste during equipment repair; reuse of materials; exemption from regulation and recycling; enhancing the safety culture.

Existence of procedures for materials exemption from regulatory control

The radioactive materials originating from licensed practices for which disposal, recycling or reuse is envisaged are subject to the ASUNE regulation. Radioactive material shall be exempted from regulation on a case-by-case basis by an order of the NRA Chairperson, in case the licence holder or permit holder has submitted documents proving the compliance of the material radiation characteristics with the regulatory exemption criteria.

The Regulation on Radiation Protection requires that the specific activities of the radionuclides contained in the materials are determined by an accredited testing laboratory or an accredited inspection body.

Materials to be disposed of, recycled or reused shall be unconditionally exempted from regulation, provided that at any time for all radionuclides the sum of the ratios of their specific activities to the unconditional release levels of the respective radionuclides is less than or equal to one. If the specific activities of individual radionuclides are greater than the respective release levels, the material may be conditionally released. To this end, a preliminary justification is required as to the intent, method and area of use of the relevant materials. The NRA assesses compliance with the dose criteria on a case-by-case basis.

The release of materials from regulatory control at Kozloduy NPP is performed on a case-by-case basis, including pre-sorting of materials, preliminary activity assessment, determination of radionuclide composition, and validation of the results by an accredited authority. The results are documented and submitted to the NRA for release of regulatory control.

Regulatory review and control activities

The SNF and RAW management at the Kozloduy NPP site is subject to continuous control by the NRA inspectors. In accordance with the NRA Inspection Programme and the Annual Inspection Plans, for the reviewed period the inspections are performed in the following areas:

- radiation protection;
- management of radioactive waste and the authorised liquid and gaseous discharges during the operation of the NPP;
- SNF management;
- ensuring nuclear safety during the transport of nuclear fuel.

In compliance with the operating licences, the NRA shall be furnished with periodic information on the RAW reporting data and the status of the temporary storage facilities, the implementation of the personnel radiation protection programme and the site environmental radiation monitoring programme, and the implementation of the Comprehensive RAW Management Programme by Kozloduy NPP EAD. The NRA revises and assesses the submitted information.

Appendix 1 - List of operating events at Kozloduy NPP reported for the period 2022 - 2024

Date	Site	Description	INES level
10 May 2022	Unit 5	Unplanned actuation of Safety Systems Train 2	0
22 June 2022	Unit 5	Reactor scram	0
14 October 2022	Unit 6	Foreign material intrusion in the reactor core baffle	0
29 October 2022	Unit 6	Disconnection of Unit 6 generator from the national grid	0
23 January 2023	Unit 6	The diesel generator of Safety Systems Train 2 was off stand-by mode	0
22 June 2023	Unit 6	A pump from the emergency boron injection system in the primary circuit failed to switch off from the control switch	0
16 October 2023	Unit 6	Unplanned actuation of Safety Systems Train 3	0
08 November 2023	Unit 6	Coolant was accidentally released into the containment structure	0
11 March 2024	Unit 5	Leak of a fire extinguishing system valve of Train 1 of the Safety Systems	0
20 May 2024	Unit 5	RPS control rod deformation	0
19 September 2024	Unit 6	The diesel generator of Safety Systems Train 3 was off stand-by mode	0
19 November 2024	Unit 6	Unplanned actuation of the safety system first train	0
03 December 2024	Unit 5	Planned taking out of service of Safety System Train 3	0

Appendix 2 – List of the peer reviews conducted at Kozloduy NPP in the last 5 years

1. WANO Member Support Mission on: Safety briefings before admission as per a permit-to-work, and prior to switch-over of equipment, 25 – 28 March 2019;
2. WANO Follow-up Corporate Peer Review (Follow-up CPR) of BEH EAD and Kozloduy NPP EAD, 30 September – 04 October 2019;
3. WANO Follow-up Peer Review at Kozloduy NPP, 11 – 15 November 2019;
4. Pre-visit of the WANO team in preparation of the Design-Informed Peer Review (DIPP) at Kozloduy NPP in 2021, 09 – 14 May 2021;
5. IAEA Safety Aspects of Long Term Operation (SALTO) Mission, Kozloduy NPP, Units 5 and 6, 06 – 15 July 2021;
6. WANO Design-Informed Peer Review in the Crew Performance Observation (CPO) area in 2021, 13 – 24 September 2021;
7. WANO Design-Informed Peer Review, Kozloduy NPP, 25 November – 10 December 2021;
8. WANO Follow-up Peer Review, Kozloduy NPP Units 5 and 6, 13 – 17 November 2023 after the WANO Design-Informed Peer Review, Kozloduy NPP, 25 November – 10 December 2021;
9. International Atomic Energy Agency's Technical Safety Review (TSR): Probabilistic Safety Assessment (PSA) for the Level 1 PSA study for units 5 and 6 of Kozloduy NPP, 20 – 31 March 2023;
10. ENSREG Topical Peer Review in the area of fire protection;
11. WANO Corporate Peer Review (CPR) to Kozloduy NPP and BEH EAD, 16 – 26 October 2023;
12. IAEA Operational Safety Assessment Review Team (OSART) Mission, Kozloduy NPP, Units 5 and 6, November – December 2024.

List of Abbreviations

ASUNE	Act on the Safe Use of Nuclear Energy
ALARA	As Low As Reasonably Achievable
BAS	Bulgarian Academy of Sciences
BEH	Bulgarian Energy Holding
BPS	Bank Pumping Station
CA	(Radiologically) Controlled Area
CM	Council of Ministers
CNS	Convention on Nuclear Safety
CPPNM	Convention on the Physical Protection of Nuclear Material
DG	Diesel Generator
DGFSCP	Directorate General for Fire Safety and Civil Protection
DGS	Diesel Generator Station
DPA	Disaster Protection Act
DSFSF	Dry Spent Fuel Storage Facility
EC	European Commission
ECR	Emergency Control Room
EEA	Executive Environment Agency
EIA	Environmental Impact Assessment
EO	External organisation
EP	Emergency Plan
EPA	Environmental Protection Act
ERC	Emergency Response Centre
ERM	Emergency Response Manager
EU	European Union
EWRC	Energy and Water Regulatory Commission
FSS	Full-Scope Simulator
IAEA	International Atomic Energy Agency
IMS	Integrated Management System
IRS	Integrated Rescue System
KIDSF	Kozloduy International Decommissioning Support Fund
LPZ	Long-Term Protective Action Zone
LTO	Long-term operation
MCR	Main Control Room
MoE	Ministry of Energy
MoEW	Ministry of Environment and Water
MoH	Ministry of Health
MoI	Ministry of Interior
MP	Modernisation Programme
MS	Management System
MWL	Maximum water level
NAP	National Action Plan
NCRRP	National Centre of Radiobiology and Radiation Protection
NDPP	National Disaster Protection Plan

NF	Nuclear Fuel
NF	Nuclear facilities
NPP	Nuclear Power Plant
NPT	Non-Proliferation Treaty
NRA	Nuclear Regulatory Agency
NS	Nuclear Safety
PAZ	Precautionary Action Planning Zone
PIE	Postulated Initiating Events
PSA	Probabilistic Safety Analysis
PSAR	Preliminary Safety Analysis Report
PSR	Periodic Safety Review
PSS	Plant Shift Supervisor
QA	Quality assurance
QMS	Quality Management System
RAW	Radioactive Waste
RB	Reactor Building
RP	Radiation protection
SAMG	Severe Accident Management Guideline
SAR	Safety Analysis Report
SBEP	Symptom-based emergency procedures
SC	Safety culture
SERAW	State Enterprise Radioactive Waste
SFP	Spent Fuel Pool
SG	Steam generator
SIR	Sources of Ionizing Radiation
SIS	System important to Safety
SNF	Spent Nuclear Fuel
SS	Safety Systems
SSC	Structures, systems, and components
TLD	Thermoluminescent Dosimeter
UNAP	Updated National Action Plan
UPZ	Urgent Protective Action Planning Zone
VS	Ventilation Stacks
WCh	Water Chemistry
WSFSF	Wet Spent Fuel Storage Facility
WWER	Water-Water Energy Reactor