REPUBLIC OF BULGARIA

NINTH NATIONAL REPORT UNDER THE CONVENTION ON NUCLEAR SAFETY

Sofia, 2022

TABLE OF CONTENTS

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 the 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 into account the 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 until 2030, with a horizon of 2050 is in the process of 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), as per the licences issued in 2014 and 2016.

The Kozloduy NPP Units 5 and 6 with WWER-1000 reactor type were commissioned in 1987 and 1991, respectively. Based on the performed Periodic Safety Reviews (PSR) in 2017 and 2019, the NRA renewed the licences for the operation of of the units for a 10-year period. Units 5 and 6 operated at an upgraded thermal power level - 104% (3120 MW) since 2019 and 2018, respectively. In 2020 the gradual transition to a new type of nuclear fuel (TBCA-12) was completed for Unit 6. With the purpose of diversification the nuclear fuel supplies for Unit 5 activities aimed at gradual transition for work with an alternative type of fuel are being undertaken.

At the site of Kozloduy NPP there are two spent fuel storage facilities - Wet Spent Fuel Storage Facility (WSF) with a licence for operation until 2024, and Dry Spent Fuel Storage Facility (DSFSF) with a licence for operation until 2026.

Over the last years, actions have been taken to build new nuclear facilities in Bulgaria at the Belene site and at the Kozloduy NPP site.

In February 2020, the Chairperson of the NRA issued an order for the approval of the selected site for the deployment of a nuclear facility - a nuclear power plant, and with this the feasibility phase of the licensing process for the construction of a new nuclear facility at the site of the Kozloduy NPP was completed.

Since 2018, following a decision of the Council of Ministers, activities have been resumed to search for opportunities to build the Belene NPP, together with a strategic investor. At this time, no actions have been taken to continue the licensing process.

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 (ME) 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 (MH) 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 ionising 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 (MEW) manages, coordinates and supervises the development and implementation of the state policy in the field of 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 Ministrythrough the Fire Safety and Civil Protection General Directoratecoordinates 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 ionising radiation.

Content and Structure of the Report

The current ninth National Report was developed with the participation of all 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 eighth report. It provides information on the progress of the activities related to enhancing the safety of the nuclear facilities. The report reflects 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 2019 -2021.

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

B. EXECUTIVE SUMMARY

This ninth 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 eighth report.

Based on the Energy Act a draft Strategy for Sustainable Energy Development until 2030 of the Republic of Bulgaria, with a Horizon of 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 Bulgariathere 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 the European legislation. Regulations have been amended and supplemented, and regulatory guidelines and instructions have been developed, as follows:

- Regulation on the procedure for issuing licences and permits for safe use of nuclear energy;
- Regulation on radiation protection;
- Regulation on the terms and procedure for acquiring vocational qualification and on the procedure for issuing of licenses for specialised training and of individual licenses for use of nuclear power;
- Regulation on ensuring the physical protection of nuclear facilities, nuclear material and radioactive substances;
- Guidelines on the qualification of structures, systems and components important to the safety of nuclear power plants;
- Guidelines on determining the significance of the operational events regarding nuclear safety and radiation protection (the INES scale level);
- Guidelines on deterministic safety analyses of nuclear power plants with PWRs.

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 Units 5 and 6 safety 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;
- commissioning of a new Off-site Emergency Response Centre (ERC);
- installation of measurement channels to monitor and evaluate the water vapours and oxygen concentration in the containment;
- studying the possibilities for reactor core melt confinement in case of a severe accident;
- studying the possibilities for direct water supply to the reactor core from an external source;
- ensuring a possibility for spent fuel pools cooling from an independent external source;
- ensuring a possibility for a direct water supply to the SGs from and external source;
- updating the Units 5 and 6 PSA level 1 for operation at full power, low power and with shutdown reactors. Expanding the PSA scope to include consideration of internal and external hazards characteristic of the Kozloduy NPP site, as well as the reciprocal impact of the units;
- updating the thermal-hydraulic analyses of a set of accidents with coolant leaks from the primary circuit and transients with loss of residual heat removal for the operational states as defined in the PSA for a shutdown reactor of Units 5 and 6.

At the end of December 2021 the National Action Plan after the accident at the Fukushima NPP was updated (UNAP), with 75 of the total 78 measures being completed and 3 in the process of implementation.

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 to be performed; those related to safety are included in the scope of the Integrated programmes of the units.

A Management Plan for the Actions under Measures, Implemented in the Long-term Operation Period of Kozloduy NPP Units 5 and 6 was developed. The plan is subject to updating once a year in order to take into account the results of the proactive life cycle management of components, systems and major equipment in view of their ageing, scheduled maintenance, replacement and modernisation.

Safety significant issues addressed in the previous CNS review

The ninth review under the CNS reports on the progress made in implementing the measures planned in the seventh and eighth 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:

- periodic safety reviews of units 5 and 6 were performed in 2016 and 2018 respectively, which resulted in the renewal of the licences for operation in 2017 and 2019 respectively, for a further 10-year period;
- in 2018, Unit 6 passed to uprated power operation. The similar activities for unit 5 were completed in 2019;

- the staged transition of Unit 6 to the new fuel type TVSA-12 was completed in 2020. Staged transition of Unit 5 to operation with alternative fuel is in process;
- in the end of 2021 the National Action Plan after the Fukushima NPP accident was updated. Seventy-five (75) measures out of a total of 78 measure have been completed, while 3 are in progress. The activities related to the studying of the possibilities for reactor core melt confinement in severe accidents have been completed. The activities for launching the new off-site Emergency Response Centre are expected to be completed by the end of 2022;
- In 2020, an order was issued for the approval of the selected site to construct a new nuclear facility - nuclear power plant at Kozloduy NPP site. In the period under review, no activities related to the licensing process of the Belene NPP project were carried out.

International reviews and outcomes

The Republic of Bulgaria implements a consistent policy for continuous safety enhancement of nuclear facilities based on camparison with the 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 period until 2021, 53 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).

Within the period 2019-2021, five reviews have been conducted, whereof relevant information 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.

Implementation of the principles of the Vienna Declaration on Nuclear Safety, adopted on 09 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 in the national legislation the relevant international conventions and treaties to which Bulgaria is a party, the EU legislation and IAEA safety standards and guidelines.

The conduct of periodic safety reviews (PSRs) is a regulatory requirement and forms the basis for issuance of an operating licence to a nuclear facility. As a result of the PSRs performed on Units 5 and 6 and the additionally conducted stress tests, a number of significant modifications have been made to the existing design of the units, and some new systems have been put in place to prevent the occurrence of severe accidents or mitigate the consequences thereof.

In the main report, under art. 6, 14, 17, and 19, the relevant requirements, technical criteria and standards, performed design improvements and measures from the Updated National Action Plan 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 SUNEA.

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.

Work Management during the Covid-19 Pandemic

In connection with the state of emergency introduced in the country due to the Covid-19 pandemic a number of measures were taken aimed at limiting the spread of the infection and ensuring all the necessary conditions for the safe operation of the nuclear facilities.

In their essence the measures taken by the Kozloduy NPP are focused into two main directions - minimising the possibility of the virus spread among the NPP personnel and ensuring all necessary supplies of goods and services related to the company's activities.

The main measures limiting the spread of the virus are as follows:

- limiting the access to the unit MCRs and the site of the NPP, including work of personnel from home for the positions for which this is possible;
- change in the working hours of the operational and maintenance personnel compared to the other staff in order to minimise contacts when entering and leaving the site;
- operational staff per shift is reduced to the statutory minimum;
- a 14-day statutory leave requirement for employees returning from abroad and temporary suspension of employees with flu-like symptoms and poor health conditions;
- limiting business trips in the country and abroad;
- extraordinary briefings for the operational staff on infection prevention;
- cancellation of organised visits to the territory of the NPP;
- temperature control of the personnel through thermal imaging cameras and infra-red thermometers;
- limited bus transport to and from the NPP site;
- shift work schedule in case of reduced number of operational personnel.

The main measures to ensure supplies are as follows:

- supplies of personal protective equipment (PPE) and medical devices, as well as use of the PPE stock intended for planned activities;
- maintaining stock of items necessary for the normal functioning of the NPP;
- earlier announcement of the procedures for supplies, services and construction and installation works, taking into account the possibility of a longer performance period;
- change in the transport schemes for the delivery of equipment under concluded contracts - use of air transport;
- assured supply of nuclear fuel for a sufficient period in the event of a disruption in the supplies.

In addition to the measures listed above, an emergency plan of the Kozloduy NPP for actions in the event of a pandemic has also been developed. The plan foresees measures to limit the impact in the absence of critical personnel and in the event of a complicated epidemiological situation in the town of Kozloduy.

A number of measures aimed at limiting the spread of the infection and ensuring the necessary personnel to carry out regulatory control were also undertaken by the NRA. The main part of the measures consists of:

- staff work on a rotational basis (50% in the office and 50% at home);
- limiting the number of employees in common areas;
- carrying out regulatory controls through remote access tools;
- conducting inspections during a period of pandemic's weakening abatement;
- conducting workshops, conferences, etc. through specialised platforms for virtual attendance;
- providing the personnel with the necessary personal protective equipment.

Future challenges

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

- sustainable development of the national infrastructure providing the nuclear sector with a sufficient number of qualified personnel;
- securing the supply chains of equipment and services including under conditions of military conflicts;
- gradual transition of Unit 5 to the operation with alternative fuel;
- adapting the national regulatory framework with the aim of applying new technologies such as small modular reactors;
- licensing of a new nuclear power unit.

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. Table 1 provides information on the current status of the nuclear facilities.

Table 1. 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		Licence for operation to 2027
6	Unit 6	1991		Licence for operation to 2029
8	WSF	1990		Licence for operation to 2024
9	DSFSF	2016		Licence for operation to 2026

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), as per the licences issued in 2014 and 2016. The facilities are released from nuclear fuel and procedures and programmes for decommissioning are established.

Units 5 and 6 of Kozloduy NPP with WWER-1000 reactors, model B-320 were put into operation in 1987 and 1991, respectively. In November 2017, the license for the operation of unit 5 was renewed with a validity for a 10-year period (until 2027). In October 2019, the license for the operation of unit 6 was renewed with a validity for a 10-year period (until 2029). A strategic goal of Kozloduy NPP is the safe operation of the two units under long-term operation conditions.

At the site of Kozloduy NPP there are two SNF storage facilities in operation: an interim pool type storage facility for storing SNF from the WWER-440 and WWER-1000 reactors (WSF) and a storage facility for dry storage of SNF from the WWER-440 reactors (DSFSF).

The WSF is operated according to the license for operation issued by the NRA in 2014 with a validity period of 10 years. In 2016, a license was issued for the operation of DSFSF with a validity period of 10 years. The licence holder for the two storage facilities is the Kozloduy NPP.

Review of the issues important to safety

List of events reported to the NRA in the period 2019 – 2021

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 12 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

To ensure the safe and long-term operation of Units 5 and 6 of the Kozloduy NPP during the next license periods, the following programs are in the process of implementation:

- Integrated Programme for Implementation of Safety Enhancements Measures at Unit 5 in the 2017-2027 Period;
- Integrated Programme for Implementation of Safety Enhancements Measures at Unit 6 in the 2019-2027 Period.

The integrated programs combine several groups of measures resulting from the implementation of:

- The periodic safety review of the relevant unit;
- The units long-term operation project;
- Bringing the unit state in line with the provisions of the Regulation on Ensuring the Safety of Nuclear Power Plants of 2016;
- The recommendations from the conducted “stress tests” of the nuclear facilities.

The implementation of the Integrated programmes for continuous enhancement of Units 5 and 6 safety continued, and this resulted in resolving 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;
- commissioning of a new (duplicating) Off-site Emergency Response Centre (ERC);
- installation of measurement channels to monitor and evaluate the water vapours and oxygen concentration in the containment;
- studying the possibilities for reactor core melt confinement in case of a severe accident;
- studying the possibilities for direct water supply to the reactor core from an external source;
- ensuring a possibility for spent fuel pools cooling from an independent external source;
- ensuring a possibility for a direct water supply to the SGs from and external source;
- updating the Units 5 and 6 Probabilistic Safety Analyses (PSA) - level 1, for operation at full power, low power and with shutdown reactors. Expanding the PSA scope to include consideration of internal and external hazards characteristic of the Kozloduy NPP site, as well as the reciprocal impact of the units;
- updating the thermal-hydraulic analyses of a set of accidents with coolant leaks from the primary circuit and transients with loss of residual heat removal for the operational states as defined in the PSA for a shutdown reactor of Units 5 and 6.

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.

As a result of the implementation of the Project, a number of activities (measures) have been identified and planned to be performed; those related to safety are included in the scope of the Integrated programmes of the units.

A Management Plan for the Actions under Measures, Implemented in the Long-term Operation Period of Kozloduy NPP Units 5 and 6 was developed. The plan is subject to updating once a year in order to take into account the results of the proactive life cycle management of components, systems and major equipment in view of their ageing, scheduled maintenance, replacement and modernisation.

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

At the end of December 2021, the National Action Plan was updated (UNAP), and out of a total of 78 measures 75 (96%) have been implemented and 3 (4%) measures are in the process of implementation and are within the scope of the Integrated programmes.

An electronic version of the UNAP can be found on the NRA internet site.

The NRA monitors the implementation of the UNAP by evaluating the reports received every six months from the Kozloduy NPP, as well as by conducting inspections within the framework of the annual inspection plans.

International Review Missions (IAEA, EC, WANO)

Kozloduy NPP is continuously striving to enhance the operational safety of the plant and to use the experience of other NPPs in relation to the best international practices in the nuclear energy field. In this respect within the period 2019-2021, Kozloduy NPP hosted the following international missions and peer reviews:

SALTO Mission of the International Atomic Energy Agency (IAEA), conducted in the period 06-15 July 2021 at Kozloduy NPP

The goal of the mission was to perform a review of the activities for ensuring the long-term operation (LTO) of Units 5 and 6.

A thorough review of the documentation was performed during the mission; the activities in the following areas were also reviewed during working meetings with experts and managers from the nuclear power plant: Organisation of ageing management and LTO activities; Scope setting, plant programmes and corrective action programme; Ageing management of mechanical structures, systems and components; Ageing management of electrical and instrumentation and control structures, systems and components; Ageing management of civil structures, systems and components; Human resources, competence and knowledge management for LTO.

The team, comprising experts from the Czech Republic, Spain, Slovakia, and the United Arab Emirates, as well as three representatives of the IAEA, found good performance of the work, that will be shared with the international professional community. Suggestions were also made for further improvement of the performed activities for safe long-term operation.

European topical peer review "Assessment of the NPP Ageing Management"

In accordance with the Directive 2014/87/Euratom a mechanism has been activated to conduct topical reviews every 6 years of the nuclear power plants in the EU on topics of strategic

importance from the point of view of their safety. The first Ageing Management topical review was launched in 2017.

In this regard in January 2018 the Council of Ministers adopted the National Report of the Republic of Bulgaria on the participation in the European Topical Peer Review (TPR) on the topic 'Assessment of NPP Ageing Management'. The report was prepared by the NRA on the basis of the self-assessment carried out by the licence holder, Kozloduy NPP, taking into account the requirements of the ENSREG Technical Specification.

The report contains a description of both the regulatory activity and the activities of the licence holder regarding the ageing management processes of structures, systems and components of the nuclear units such as: reactor pressure vessel, electrical cables, buried pipelines and concrete structures of the containment.

In May 2018 a seminar was held in Luxembourg to discuss the national reports in connection with the TPR, in which Bulgaria also took part, and at the end of October 2018 the ENSREG report was published with the results of the first topical peer review on 'Ageing Management in Nuclear Power Plants'. A separate report, also available on the ENSREG website, identifies country-specific good practices and areas for improvement. Bulgaria generally meets the expected level of performance, with good practices in some areas and possibility for improvement in others.

In accordance with the ENSREG decision of March 2019, a National Action Plan was prepared, taking into account the ENSREG report with the results of the topical peer review conducted on the topic 'Assessment of NPP Ageing Management' and the country-specific results contained in the report. The national action plan with identified corrective measures was presented in September 2019. When laying out the measures, the defined areas for improvement and good practices indicated in the ENSREG report were taken into account.

Currently, 6 out of 8 measures contained in the national plan have been implemented. Two measures in the Electrical Cables area are still to be implemented, and they are related to the cables qualification, with deadlines consistent with the safety assessments carried out within the project for the long-term operation of Units 5 and 6.

Follow-up Corporate Peer Review (FU CPR) of WANO, conducted in the period 30 September - 04 October 2019

The purpose of the FU CPR was to assess the progress of the plant in relation to the areas for improvement identified during the corporate peer review conducted in November 2016. The review covered the concepts set, the formulated goals and objectives, as well as the paths for the implementation of the relevant activities and ensuring the resources, focusing at the same time on other aspects of corporate-level activities related to nuclear safety.

Based on the WANO Peer Review Final Report in 2016, BEH EAD developed a Corrective Action Plan to address the identified areas for improvement.

Before the start of the peer review, an Advance Information Package was prepared and sent to WANO, which included the Corrective Action Plan of BEH EAD and the Report on the implementation of the corrective measures, with responsible organisational units, achieved results and effectiveness of the actions taken.

At the end of the peer review, a final debriefing was carried out with an assessment of the state of the areas with findings, which became part of the final report from the FU CPR.

Follow-up Peer Review (FU PR) of WANO, conducted in the period 11 - 15 November 2019

After an analysis of the results of the 2017 WANO Peer Review, a corrective action programme was developed based on the 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 2019. The report on the implementation of the measures was included in the Advance Information Package for the FU PR.

In the framework of the conducted WANO Follow-up Peer Review, a team of 6 experts from Slovakia, Russia, Ukraine and Armenia traced the progress in the areas for improvement, and in parallel to this also carried out a verification of the effectiveness of the implemented corrective measures at the plant after the support missions conducted by WANO in the period 2017-2019. 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 documentation of Kozloduy NPP.

Follow-up Corporate Peer Review (FU CPR) of WANO, conducted in the period 25 November - 10 December 2021

Pre-visit by a WANO team in the period 09 – 14 May 2021 in preparation for the upcoming Design-Informed Peer Review (DIR) in the end of 2021

The activities included: Plant tours at Units 5 and 6 site (“white cards”); observations of maintenance activities during the planned annual outage (Outage) of unit 5; interviews with managers at all levels in the company; discussions on the upcoming Design-informed Peer Review and preparation of a report from the visit, including a list of activities and their deadlines to be carried out before the start of the Design-informed Peer Review, an agreed timetable for conducting the Design-informed Peer Review, and necessary information to be sent before the Design-informed Peer Review, including the scope of the advance information package.

Crew Performance Observation (CPO), as part of the WANO Design-informed Peer Review, conducted in the period 13 - 24 September 2021

The object of observation and analysis was the performance of two teams of operators placed in the conditions of different scenarios at the full-scale simulator of the units.

Twenty-two (22) experts from France, USA, Slovakia, Spain, Great Britain, Russia, Ukraine, Hungary, and Finland took part in the missionconducted from 25 November to 10 December, 2021.

Observations were made of activities in different areas, at workplaces, technological compartments, equipment and buildings. In parallel, interviews with the staff were conducted and working documentation was reviewed. The implementation of the recommendations from the Significant Operating Experience Reports (SOER) was examined in detail.

Areas for improvement and strengths were identified during the Peer Review.

The conclusions in the reviewed areas were summarised in a final report and handed over to Kozloduy NPP officially in February 2022. A WANO follow-up peer review by is scheduled in 2023.

Construction of new nuclear facilities

Construction of a new nuclear unit at the Kozloduy NPP site

In May 2012 the project company “Kozloduy NPP - New Build” EAD was established with the main goal of designing, licensing, construction and commissioning of a new nuclear capacity in the Kozloduy NPP area. In pursuance of its obligations, the project company started the licensing procedure for the construction of the new nuclear capacity by submitting an application for the issuance of a permit to determine the location (site selection) of the new nuclear facility.

As a result of the permit received in August 2013, all necessary studies have been carried out and the results have been submitted to the NRA with a request to issue an order approving the selected site. After a review and evaluation of the submitted documents, in February 2020 the Chairperson of the NRA issued an order approving the selected site for the deployment of a nuclear facility - a nuclear power plant. The regulatory review activities are presented in the text under Article 17 (1) herewith. The next step in the licensing process is to request a design permit. As at present no action has been taken by the project company to continue the licensing process for the new nuclear facility.

Belene NPP Project

With the decision taken by the Council of Ministers in June 2018the Minister of Energy was assigned to resume the activities of searching for opportunities to build the Belene NPP, together with a strategic investor. In implementation of this decision, the Minister of Energy organises, coordinates and supervises the conduct of negotiations with potential investors. As a result of the same decision of the Council of Ministers the reason for the termination of the licensing process of the project dropped out and it can be resumed at the request of the licence holder from the stage of approving the technical design. As at present no action has been taken by the licence holder to continue the licensing process.

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. By decisions of the Council of Ministers of 20 December 2008, Units 1 and 2, and of 19 December 2012 - Units 3 and 4, were declared as facilities for radioactive waste (RAW) management and were transferred to the State Enterprise Radioactive Waste (SE RAW). The spent nuclear fuel was removed from the speent fuel pools and transported to the Spent Fuel Storage Facility (SFSF).

In November 2014 and July 2016 the NRA issued licenses to SE RAW for the decommissioning of Units 1 and 2, and 3 and 4, respectively. In accordance with the provisions of the licenses for the decommissioning of the units SE RAW manages the historical RAW.

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

Safe Use of Nuclear Energy Act

The fundamental Act in the field of safety of nuclear installations is the Act on the Safe Use of Nuclear Energy (ASUNE). ASUNE regulates the public relations regarding 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 Chairman who is an independent specialised authority of the executive power and has the competence as specified in the Act. The fully revised Act on the Safe Use of Nuclear Energy was adopted in 2002 and is in line with the current trends in the nuclear legislation including the legislative practices in the EU countries in this area . In 2010 ASUNE was amended and supplemented, taking into account the experience gained in the law enforcement, the adoption of new EU directives on nuclear safety and radiation protection and the amendments in the Convention on the Physical Protection of Nuclear Material. Subsequently, ASUNE was amended and supplemented in view of its aligning with Council Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for the protection against the dangers arising from exposure to ionising radiation and repealing Directive 89/618/Euratom, 90/641/Euratom, 96/29 Euratom, 97/43/Euratom and 2003/122/ Euratom (Directive 2013/59/ Euratom).

The main amendments that were introduced to ASUNE in 2020 are as follows:

- the technical supervision of the facilities of increased hazard on the territory of a nuclear power plant is assigned to a specialised unit of the licence holder under the methodical guidance of the Chairperson of the Nuclear Regulation Agency;
- some of the emergency planning and preparedness requirements related to special statute areas have been moved to their systematic place in the Emergency Planning and Preparedness Chapter.

Related national legislation

According to ASUNE, in addition to the NRA Chairperson, other authorities also carry out specialised control over the facilities and activities associated with the use of nuclear energy and ionising radiation. In this respect, the law explicitly mentions as specialised authorities the Ministers of Health, Environment and Water, Interior, Defence, Agriculture, Transport and Communications, Education and Science, and the Chairperson of the State Agency for National Security, all of whom exercise control as per the authority they have been granted. Such authority is granted mainly through the following acts:

- Environment Protection Act;

- Energy Act;
- Spatial Planning Act;
- Health Act;
- Disaster Protection Act;
- Act on the Ministry of Interior.

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, the 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 and its Ammendment, and the Additional Protocol to the Nuclear Safeguards Agreement 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 a radiological emergency (ECURIE) was signed by 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.

Since 2007, Bulgaria has been a full member of the EU. The national legislation has been harmonised with the European one and Bulgaria has been applying the European good practices. The requirements of Council Directive 2009/71/Euratom on establishing a Community framework for the nuclear safety of nuclear installations, superseded by Council Directive 2014/87/Euratom of 8 July 2014

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

Secondary legislative acts

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

In conformity with the national legal requirements, the NRA policy statement confirms that ‘the NRA will update the normative requirements in accordance with the development of international standards and the EU legislation and will develop regulatory guides and directions in areas where this is necessary’.

In pursuance of this policy, the NRA keeps a programme for review and update of the secondary legislation documents.

In the period 2019-2021, four regulations were amended and supplemented:

- Regulation on the Procedure for Issuing Licenses and Permits for Safe Use of Nuclear Energy;
- Regulation on Radiation Protection;
- Regulation on the Terms and Procedure for Obtaining of Vocational Qualification and on the Procedure for Issuing of Licenses for Specialised Training and of Individual Licenses for Use of Nuclear Energy;
- Regulation on Ensuring the Physical Protection of Nuclear Facilities, Nuclear Material, and Radioactive Substances.

The changes in the regulations reduce the administrative burden for citizens and businesses, as information or documents that are available at the Agency or at another body are provided ex officio for the needs of the relevant proceedings.

The provisions of the secondary legislative acts on the implementation of ASUNE are harmonised with the other provisions of the national legislation (Act on Restricting the Administrative Regulation and Administrative Control over Economic Activity and the Code of Administrative Procedure).

In preparation of draft normative acts the changes made to international conventions and agreements has been considered, as well as the new legislation of the European Union, the new or modified documents of the IAEA, and the experience gathered from the practical implementation of the acts and regulations.

Guides issued by the regulatory authority

The basic requirements on nuclear safety, radiation protection and physical protection of nuclear facilities are laid down in ASUNE and the regulations on its application which define more detailed requirements. If needed, the regulations envisage issuance of regulatory guides with instructions on their application.

In the period 2019-2022 the NRA has developed and updated regulatory guides, as follows:

- Guidelines on the qualification of structures, systems and components important to the safety of nuclear power plants;
- Guidelines on determining the significance of the operational events regarding nuclear safety and radiation protection (the INES scale level);
- Guidelines on deterministic safety analyses of nuclear power plants with PWRs.

In order to ensure broad distribution and easy access to the regulatory guides, they are published in electronic format on the NRA web site. The guides are distributed to all stakeholder organisations with a cover letter.

Activities for harmonisation of nuclear safety requirements

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

NRA is an organisation that is an active participant in international peer review, various database networks, supported by the IAEA, as such at European level, and as of 2021 NRA also participates in the initiatives of the Nuclear Energy Agency (NEA) of the Organisation for Economic Cooperation and development (OECD).

Article 7 (2) (ii) System of Licensing

ASUNE establishes a licensing regime to ensure the safety of facilities and activities, implementing the principles of transparency and equality.

ASUNE defines the scope of the activities, facilities and materials subject to licensing. A license is issued to operate a nuclear facility (a power unit of a nuclear power plant, facility for spent fuel management, facility for radioactive waste management, research reactor), and also for its decommissioning. The maximum term of the licence validity is 10 years. Thus, the operating organisation can plan long-term activities and allocate more resources to safety improvements. Licence renewal is based on periodic safety reviews. The Act lays down very clear requirements to the operator in respect of the conditions and criteria to be met in order to obtain a licence, avoiding to the greatest degree possible subjectivity in decision-making by the regulator.

For given single-time activities the Act envisages permit issuance for the following:

- determining the location of a nuclear facility;
- design of a nuclear facility;
- construction of a nuclear facility;
- commissioning of a nuclear facility;
- making changes, leading to modification of:
    - structures, systems and equipment related to nuclear safety and radiation protection;
    - limits and conditions for the operation of a nuclear facility on the basis of which the licence for operation or decommissioning has been issued;
    - internal rules for the activity, including procedures, programmes, technical specifications and other documents attached to the operating licence or to the decommissioning licence;
- transport of nuclear material;
- transactions with nuclear facilities 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 of appeal before the respective administrative court in accordance with the Administrative Procedure Code.

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 licence or permit applicant has to submit documents confirming compliance with the requirements of nuclear safety and radiation protection, defined mainly in the regulations implementing the ASUNE.

The Law on Normative Acts gives the opportunity to members of the public for public consultation, including comments, proposals for amendments in the normative 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 Act on the Safe Use of Nuclear Energy assigns to the NRA Chairperson the responsibility to carry out regulatory control over the nuclear safety and radiation protection in the use of nuclear energy and ionising radiation and in the radioactive waste and spent fuel management. This control includes:

- preventive control by issuing licences and permits for activities and individual licences;
- on-going supervision of the implementation of 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 control powers, the NRA Chairperson:

- performs periodic and extraordinary inspections through authorised officials;

- informs other specialised control authorities in view of taking actions within their competence range;
- alerts the prosecuting authorities upon evidence of any crime performed;
- amends or revokes issued licences or permits, or individual licences;
- imposes mandatory administrative measures and administrative sanctions as provided 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 from specialised control bodies.

The overall objective of the regulatory inspections and application of mandatory measures is to ensure that the operator performs all the 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 ASUNE and the conditions of the currently effective licences and permits. The inspection activities are planned by taking into account the operational status of the nuclear facilities, the results from previous inspections, and planned modifications, in such a way as to ensure coordination with the activities planned by the operators. 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 KNPP - 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 sublegislative normative documents. Mandatory administrative measures and sanctions provided for by the law are imposed only if all other options have failed. 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 the nuclear safety, radiation protection and the technical condition of the nuclear facilities and the ionising radiation sources;
- require from the respective officials the necessary data, information, explanations, other operational information, including on measurements and tests in order to clarify the technical conditions and the operational conditions of the facility, 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 evidence collected, explanations and results of observations, measuring and/or testing are attached. The improvement notices given by the inspectors implementing their authorities as per this Act are obligatory for fulfilment. 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 general public.

Review and assessment of safety

The NRA 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:

- receipt and registration of the application and its supporting documentation;
- 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;
- the results of expert assessment are summarised and documented, and on the basis of the conclusions a proposal is made to issue a permit or a motivated refusal;
- the responsibility for the final decision on the issuance of a permit or a motivated refusal lies with the NRA Chairperson.

In cases where the documents contain information, the assessment of which requires special knowledge, the NRA Chairpeson 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 documentation submitted, detailed comments are sent to the applicant to resolve these non-compliances. In such cases it is a well established practice to conduct 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 the permit-holder, including 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 about Events in Nuclear Facilities and Sites with 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.

For each event written report is submitted 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 measures, as well as to define the final INES rating of each event. When necessary, additional information is requested or additional analysis 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 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 mandatory administrative measures. ASUNE provides different amounts of 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 Offences and Sanctions Act.

Mandatory administrative measures are imposed for violations of the requirements for nuclear safety and radiation protection, physical protection and emergency preparedness, in which there arises or there is an immediate danger for an accident to occur. Mandatory 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 an individual licence;
- an order to carry out 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 training courses and conducting additional training, including testing of staff knowledge and skills.

Mandatory administrative measures are imposed through an order of the NRA Chairperson, based on a report of the findings of the NRA inspectors. The order imposing mandatory measures determines appropriate time for their implementation. The order for imposing mandatory administrative measures may be appealed before the respective Administrative Court under the provisions of the Administrative Procedure Code. 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 offence whereof a fine or property sanction in an amount determined by the ASUNE is imposed to the person who committed the offence. 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 NRA resorts to mandatory administrative measures and issue of writ of penalty solely when all other possibilities have been ineffective. The effectiveness of the regulator’s policy is confirmed by the small number of writs of penalty issued or mandatory 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 organisation concerned with the promotion or utilisation 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 commissioning of the first two units of Kozloduy NPP in 1975, the Committee was assigned also 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 the functions and the tasks of the organisation, setting up an Inspectorate on the Safe Use of Atomic Energy.

In 2002, the new Act on the Safe Use of Nuclear Energy was adopted, consistent with the current trends in the field of the nuclear law. The Act takes into account the practices of the European Union countries in this area, as well as the recommendations of the IAEA experts who have reviewed the draft. By this Act, the CUAEPP was transformed into an independent regulatory authority – the Nuclear Regulatory Agency.

Legal basis and status of the regulatory authority

The status and responsibilities of the NRA are set by the Act on the Safe Use of Nuclear Energy. The state regulation of the safe use of nuclear energy and ionising radiation and the safe management of radioactive waste and spent nuclear fuel is effected by the Chairperson of the Nuclear Regulatory Agency. The NRA 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 its power, 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 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 ionising 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 for 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 ionising 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 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 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 and the Additional Protocol thereto;
- 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;

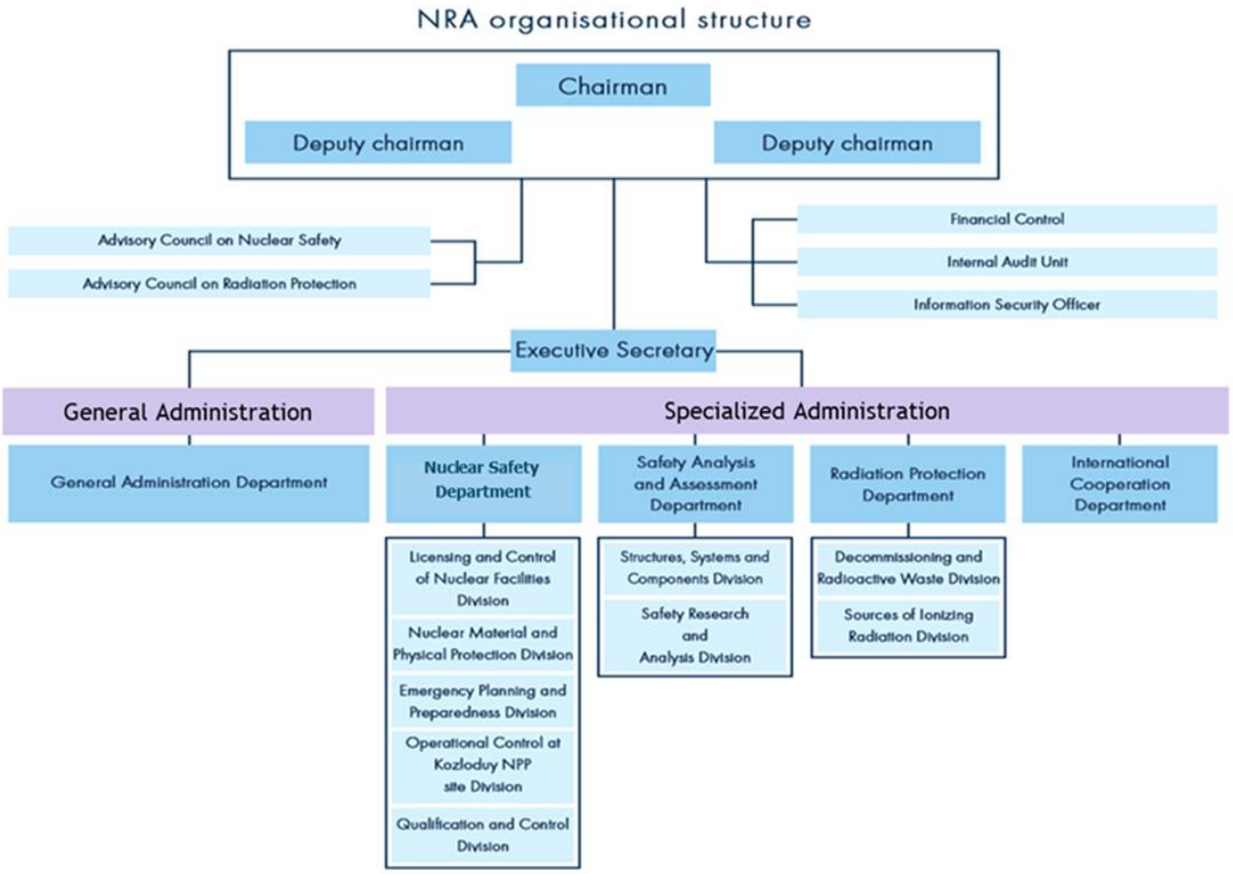
- within the limits of its powers, provides to competent institutions the information intended by the Treaty establishing the European Atomic Energy Community (EURATOM).

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 certificates of legal capacity and international co-operation 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

According to ASUNE, the NRA Chairperson is assisted by an administration organised in a Nuclear Regulatory Agency, which is a legal entity, funded by the state budget and has its headquarters in Sofia. 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 structure is consistent with the Administration Act which sets out uniform requirements to the organisational structure of the state administrations that support the governing bodies and takes due account of all the fields of activity of the regulator in conformity with the powers vested to the NRA Chairperson by the national legislation. The NRA administration is headed by an Executive Secretary. 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 preparednessand 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. Almost all employees of the Agency have long-term professional experience in the field of regulation, design, construction and operation of nuclear facilities and facilities with sources of ionising radiation.

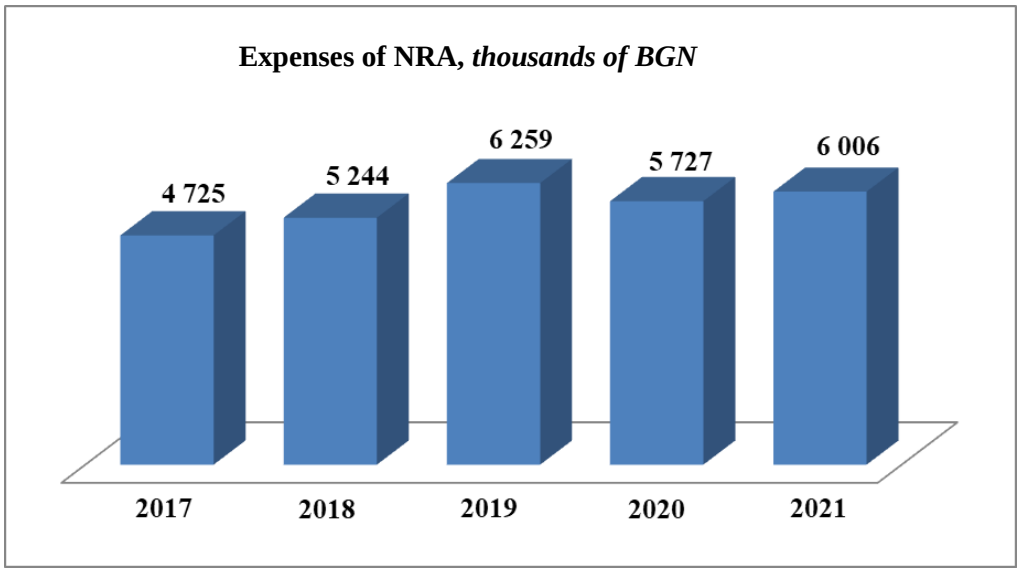
According to the Rules of Procedure, the NRA has 114 statutory positions, with 103 positions actually occupied in the end of 2021. Ninety-two percent of all employees of the NRA are university graduates, and the average professional experience of the specialised administration officers exceeds 20 years.

The NRA has a staff training and qualification system in accordance with the national and international standards. Specialised training is held to maintain and improve the qualifications of the employees, including the acquisition of additional professional knowledge and skills. The specialised training is carried out in accordance with the approved Annual NRA Employee Specialised Training Plan.

As a result, the Agency has continued its policy of employing young people from the universities. An individual training programme is developed for each newly recruited employee on the basis of his/her job description and analysis of the necessary competences and skills; the programme covers theoretical training, practical training and mentoring.

Financial resources

The Act on the Safe Use of Nuclear Energy creates preconditions for the financial independence of the regulatory authority. 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 Act on the Public Finances. As a result, the financing of the Authority in recent years has been steady.



Quality management system

The NRA implements an Integrated Management System 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

organisation are defined to ensure comprehensive control and consistency in the decision-making process.

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 of the IMS functioning and improvement;
- ***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;
- ***support processes*** - they create the conditions for carrying out the main processes and provide technical administrative support activities, e.g. Financial management and control; Human resource management; Management of products and services by an external provider.

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; give detailed instructions to the administration for performing a specific activity; plan the implementation of activities.

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.

In 2019, the NRA implemented an information security management system according to the requirements of the ISO/IEC 27001:2013 standard. The certificate of conformity with the requirements of the standard was issued by an accredited international organisation, International Technical Alliance I.T.A. S.r.l.

Openness and transparency

Public opinion is sensitive to the use of nuclear energy and the problems related to the radioactive waste management. In this respect the open dialogue with all the stakeholders, the transparency of our activities and decisions, and ensuring public access to information appear as the key issues for efficient regulatory activity. The NRA web page provides a lot of divesre information on nuclear safety and radiation protection, as well as the activities of the NRA. There is a free access to the public registers of issued licences and permits for nuclear facilities and sources of ionising radiation, licences to conduct specialised training and individual licences to implement activities with SIR or work on nuclear facilities.

The Annual Reports of the NRA since 2003 until present have been published on the Agency’s website, as well as the National Reports of the Republic of Bulgaria under the Convention on Nuclear Safety, the Reports under the Joint Convention on the Safety of Spent Fuel

Management and on the Safety of Radioactive Waste Management. The publications include also the reports on the implementation of the country's obligations as per the IAEA Codes of Conduct??? and European Directives in the area of nuclear safety and radiation protection.

The NRA's policy is aimed at timely informing the public about the state of the nuclear safety and radiation protection. The NRA regularly updates the public information on its website regarding operational events in nuclear facilities.

External technical support

The NRA organisational and management structure has a separate Directorate for Safety Analyses and Assessments, which is part of the specialised administration. This Directorate works in close cooperation with the rest of the specialised directorates, thus ensuring that experts of the required competence participate in the process of review and assessment. In order to improve the internal expertise in different technical areas, analyses are outsourced to external organisations. The NRA is fully responsible for the regulatory decision-making, and has provided human and financial resources to secure the effective performance of the technical support system through:

- full time experts within the regulatory authority, who are competent and capable to perform regulatory reviews and assessments;
- full time experts that are trained and capable to evaluate reports on contracts awarded to external organisations;
- availability, within the NRA and at the TSOs, of necessary assessment tools and computer codes to carry out the assessments;
- sufficient financial resources to pay for the contracts;
- 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.

Advisory Councils

Pursuant to Article 9, Paragraph 1 of the ASUNE two advisory councils are established in support of the NRA Chairperson:

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

The Advisory Councils have adopted rules for their work, and their meetings are chaired by the NRA Chairperson. The Advisory Councils support the NRA Chairperson by giving opinions on scientific aspects of nuclear safety and radiation protection. Their opinions are advisory in nature, while the full responsibility for the decisions made rests with the NRA.

Pursuant to the provisions of Article 9 of ASUNE the Advisory Councils composition is appointed by an order of the NRA Chairperson. 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 nor 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, Paragraph 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 the activities of the Agency (authority under Article 5, item 10 of the ASUNE). As an independent regulatory body within the system of the executive power, the NRA Chairperson reports directly to the Chairperson of the Council of Ministers.

Article 9 Liability 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 licensee's full 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, 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 related to 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 Act on the Safe Use of Nuclear Energy 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 transferred to other persons' was introduced.

According to the Regulation on Ensuring the Safety of NPPs: '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 authoritiesin 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 protection, quality assurance, emergency preparedness, management of radioactive waste and of nuclear material, notification of regulatory body upon deviations and accidents;
- providing information to the regulator about: the operations, including fulfilment of licence conditions; the procedure for notification in case of change in the circumstances in 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 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 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. 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, the functions, tasks and responsibilities of which are described in Article 10, Safety Management section. Responsibilities and financial obligations of the licence holder to manage radioactive waste and spent fuel, the activities for decommissioning and liability for nuclear damage are described in Article 11 (1).

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

ASUNE unequivocally determines that in the use of nuclear energy, sources of ionising radiation and in the management of radioactive waste and spent 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 law 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 in the application of a permit regime related to the issuance of licences to perform 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 follow-up control, consisting in 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 public communications

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 producer of electricity 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 active media relations through press releases with up-to-date information, conferences and briefings upon any occasion demanding provision of information to the public;
- issuing annual reports presenting the overall activity of Kozloduy NPP;
- conducting Doors Open Day 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 has established a separate department - Emergency Preparedness (EP), which is responsible for maintaining up-to-date the plant emergency plan and the pertaining procedures and instructions; ensuring and maintaining emergency and technical equipment, automated information systems, systems and means of communication in the Emergency Response Centre (ERC); emergency teams and their training; 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 site of Kozloduy NPP for action and management of severe accidents is accomplished by periodically conducting drills, emergency exercises, general national and full-scale 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 - 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 Programme to Maintain and Improve Safety and those of investment character - in the Investment Programme. The two programmes are part of the Business plan of the company and Kozloduy NPP management team applies a uniform policy to management of resourcesto all processes and activities with main priority to ensure safety.

The Act on the Safe Use of Nuclear Energy defines an obligation to maintain property insurance that covers nuclear accident liability, limited to BGN 96 million. Kozloduy NPP maintains a permanent financial guarantee, covering the nuclear damage liability, concluding on an annual base a contract for general third party liability insurance with a national nuclear insurance pool.

The Disaster Protection Act (DPA) has arranged options for financing the activities for recovery after an accident. 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 aid 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 appropriate measures to ensure that all organisations engaged in activities directly related to nuclear installations have adopted a policy which gives the necessary 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

A major provision of the ASUNE is 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. In the use of nuclear energy, nuclear safety and radiation protection take priority over all other aspects of this activity.

The Regulation on Ensuring the Safety of Nuclear Power Plants requires for the operating organisation to adopt a document, Safety Policy, based on which it will give the highest priority to safety in all activities, demonstrate a clear commitment to continuously improve safety, to stimulate personnel for a critical attitude to the work they perform, to support and encourage mindsets and behaviours which facilitate a high level safety culture. The Safety Policy must be communicated to the plant and contractors' staff who perform activities with an impact on safety.

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

- 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.

The licence holder shall develop and implement a safety monitoring system providing for a systematic self-assessment at all levels of the operating organisation. The monitoring 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, then controlled and assessed.

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 Kozloduy NPP management long-term goals are defined in the Kozloduy NPP Management Policy Statement as well as in the Company's Management Policy. Management priorities are developed and substantiated, with specific goals and principles, in separate policies of Kozloduy NPP: safety management policy, environmental management policy, occupational health and safety management policy, security management policy, quality management policy,

business and finance management policy, personnel training and qualification policy, fire safety management policy, human resources management policy.

In the Safety Management Policy, the highest priority is nuclear safety and radiation protection during the entire period of operation of the nuclear facilities in accordance with the regulatory requirements and granted licenses. The plant management is committed to maintaining and developing a safety monitoring and evaluation system with highly qualified, trained and well-motivated personnel, to maintaining and continuously improving the safety culture (SC).

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, staff motivation, risk assessment, etc.

Since the beginning of 2021 a series of training workshops have been held by WANO, aiming to introduce participants to the concepts of leadership and coaching in the nuclear industry adopted by WANO based on the best practices and recommendations of the members of the association:

- Leadership and Safety Culture in Nuclear Energy;
- Managers in the Field;
- Leadership in Nuclear Energy for the Plant Shift Supervisor (PSS), Unit Shift Supervisor (USS) and Shift Supervisor (SS);
- Operational Decision Making.

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

Maintaining and enhancing the level of safety culture is subject to a systematic and long-term approach applied at Kozloduy NPP. This approach involves periodic assessment of the SC status, annual planning of activities to enhance it, active involvement of all staff members in those activities and fostering a responsible attitude. The high level of SC is achieved through the development of the value system, personal example of the leaders and contribution of each member of the staff.

In order to systematise and support the work, the Company has implemented ”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 Council which supports the activities of the Safety and Quality Director. Since 2020 the Company's administrative structure has included the Performance Assessment and Improvement Department a part of which is the Safety Culture and Human Performance Group.

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

The implementation status of the measures to maintain and enhance SC is monitored at meetings of the Safety Culture Council. In addition to the implementation of the plans and programmes for SC enhancement, the meetings also address current information and questions relevant to SC, operating experience in this area – internal and external as well as good practices and information from benchmarking.

Safety culture activities are reported in an annual report which is included in the plant's annual report on the status of nuclear safety and radiation protection and the management review

of the management system. The report is also sent to the Nuclear Regulatory Agency for information.

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, ensuring healthy and safe working conditions, 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 Council, Safety Culture Council and ALARA Council;
- Controls and reports on 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; Emergency Plan of Kozloduy NPP; Radiological Monitoring Programme; Site monitoring programme, etc.;

Monthly reports on the safety status at Kozloduy NPP, biannual and annual reports on the implementation of safety measures are submitted to the NRA.

Safety monitoring and self-assessment measures

Safety enforcement control conducted by the Safety and Quality Directorate enables early signs of safety deterioration and the need for improvement to be identified by analysing the root causes of deficiencies and implementing appropriate corrective actions. When carrying out internal inspections, emphasis is placed on:

- Quality control and management review;
- Adequacy and compliance with work procedures;
- Safety culture and human performance;
- Reliability of systems important to safety;
- Protection of personnel and environment.

At Kozloduy NPP a self-assessment process is in place in order to provide a systematic approach to evaluate and improve the efficiency of the activities performed at the plant as well as to identify, prevent and correct problems that prevent the achievement of the Company's goals with priority on safety objectives. Ongoing self-assessment by managers and targeted self-assessment by senior management, process owners and managers as needed are conducted.

Each self-assessment goes through the following stages: planning, evaluation, analysis and improvement. The targeted self-assessments are planned in advance and for each self-assessment the specific goals, scope, team, criteria and methods are defined. Targeted self-assessments are carried out within the planned scope by a team assigned for that purpose and documented by drawing up a report. The results of the conducted self-assessments are distributed to the interested parties. The results of all conducted self-assessments, including an analysis of strengths and weaknesses, risks and opportunities and justified suggestions for improvement are input information for the review by the management of the Company's BoD. The approved corrective actions resulting from the self-assessments are assigned to a specific person in charge with a deadline for implementation.

A system of indicators has been implemented at Kozloduy NPP, which is part of the management tools for control and management. When determining them, the specifics of the activities, the accumulated experience in the development of the system as well as the experience of other nuclear power plants were taken into account. Limits and target values (planned) are defined for each indicator providing the basis for performance assessment. The system of indicators is built as a five-level pyramidal system. For the first to fourth levels, only a qualitative assessment of the performance level is made. During the execution of the tasks the parameters at the bottom of the pyramid are reached, which are measurable and have quantitative values and evaluation criteria – specific indicators. Reporting and analysis of the indicators are carried out on a quarterly and yearly basis. The reports are reviewed and approved at specialised technical councils. Corrective actions are implemented for the indicators that deviate from the set goals.

Meetings of the Operating Experience Council are held periodically to review internal and external experience and identify corrective actions for improvements applicable at Kozloduy NPP.

Safety culture enhancement measures

One of the approaches to SC development is to conduct a review and assessment of its status. At Kozloduy NPP, a SC 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 based to 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 the period 2018-2019, the third consecutive self-assessment was conducted and a corrective action programme was prepared to improve performance in areas with identified weaknesses. In 2021-2022, the fourth safety culture self-assessment will take place. The analysis of its results is to bring out areas of interest with formulated good performance practices and to outline identified weaknesses for further improvement.

In fulfilment of WANO requirements, self-assessment of the nuclear safety culture is also conducted periodically. The last one was carried out in 2020, for which a questionnaire was prepared based on WANO PL 2013-01 Traits of a Nuclear Safety Culture.

The activities to enhance SC are not limited to the ones defined in the programmes from the conducted self-assessments. One of the functions of the SC Council includes the implementation of current projects and tasks as well as the discussion of emerging cases related to SC and human

performance. Council members are involved in the development and update of training materials, conduct of staff training, focus groups, and staff interview teams.

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 pre-design study, design, construction and commissioning of the latest generation nuclear power facilities at the Kozloduy NPP site.

In the Kozloduy NPP - New Build Management Policy Statement, the management defines its priorities in fulfilling the main goal: ensuring highest level of safety; effectiveness, efficiency and economy in the management of activities; and certified, competent and motivated staff. In implementing the Policy, the management assumes responsibility to develop a value system and safety culture. To achieve the main goal, the management is committed to the implementation, maintenance and continuous improvement of a Management System suitable for the Company's activity.

The company is the holder of a permit to determine the location of a nuclear facility (site selection). It submitted the required documents to the request for issue of an order approving the selected site, as a result of which the Chairperson of the NRA issued an order confirming the location of the new nuclear facility - nuclear power plant.

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

Safety management is a key topic in the scope of topical inspections of the NRA in the Management System field. Inspections are focused on:

- 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 ASUNE, when using nuclear energy, nuclear safety and radiation protection take priority over all other aspects of this activity.

The NRA management Policy Statement stipulates that nuclear safety and radiation protection when using nuclear energy take priority over all other aspects of this activity. Ensuring them is only possible through strict compliance with the fundamental principles defined in the ASUNE, European legislation and IAEA standards.

The authorisation regime stipulated in the ASUNE is one of the guarantors of compliance with the requirement of priority to safety in all regulatory activities and decisions. The work practices established through the NRA management system strictly comply with the ASUNE and its implementing regulations.

Another mechanism ensuring the priority of safety is the independence of the regulatory body. It is guaranteed by the following elements: provision of budget and resources; qualification and training of employees; ensuring non-interference in the work of the regulatory body; enabling international cooperation; use of independent analyses and expertise related to nuclear safety and radiation protection; prescribing corrective actions and imposing coercive administrative measures; conducting regulatory inspections.

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 ASUNE, the Law on Energy and in the special regulations to these laws. 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 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 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 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 Programme on Nuclear Facilities Safety Maintenance and Enhancement is ensured with priority, the costs being integrated into the Annual Plan and Long-term Business Programme. Costs are covered by revenues from electricity sales.

The Investment Programme includes strategic tasks covered in several main directions of the planned activities by priorities, as follows:

- Long-term operation (LTO) in accordance with the Management Plan for the Actions under Measures, Implemented in the Long-term Operation Period of Kozloduy NPP Units 5 and 6.
- Continuous enhancement of safety and ensuring reliable operation of the reactor installations of Units 5 and 6 in accordance with the license provisions and Integrated Safety Enhancement Programmes during the current licensing period;
- 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 2019-2021, investment activities to the total amount of BGN 254 million were carried out. (EUR 130 million). For the period 2022-2026, an investment programme totalling BGN 825 million is planned (EUR 422 million), assuming the projects will be entirely self-funded.

Kozloduy NPP 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 the 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.

From the creation of the funds in 1999 until the end of 2021, BGN 2,498 million have been contributed by Kozloduy NPP. (EUR 1,277 million). About 94% of the money raised in the DNF and RAW funds were contributed by the Kozloduy NPP. The amounts available in the DNF fund as at the end of 2021 are about BGN 1,858 million and make up 92% of the amounts raised in the fund for the period 1999-2021, the remaining 8% are spent on financing activities for decommissioning of nuclear facilities. As of 31.12.2021, the RAW fund has BGN 200 million. For the period 1999-2021, BGN 437 million from the RAW Fund was spent expressly to finance the annual programmes for the operation and funding of SE RAW.

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).

The proceeds and costs of the two funds from their creation until the end of 2021 as well as the estimates of proceeds and costs for the period 2022-2024, are presented in ***Table 1***:

Year	**DNF Fund**		**RAW Fund**	
	Proceeds, BGN	Costs, BGN	Proceeds, BGN	Costs, BGN
1999-2017	1,572,405,486	77,973,941	457,048,932	338,746,956
2018	81,357,118	19,218,582	32,554,146	23,319,990
2019	97,901,520	21,282,000	39,193,693	24,719,141
2020	92,354,949	23,546,100	36,974,842	25,482,809
2021	179,858,987	23,453,587	72,045,817	25,213,668
2022	141,473,064	23,453,000	56,589,226	25,213,000
2023	116,440,407	23,453,000	46,576,163	25,213,000
2024	116,362,318	23,453,000	46,544,927	25,213,000

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 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 until 2051 about BGN 6.5 billion nominal value.

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 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).

In fulfilment of its strategic goals in the period 2019-2021, Kozloduy NPP has financially ensured the costs of safe management of SNF, including costs for carrying out the transportation of SNF from WWER-1000 for processing and storage in the Russian Federation. The planned 2019 and 2020 shipments of SNF from WWER-1000 have not been carried out and in this regard, based on the SNF and RAW Management Strategy, in accordance with the Company's Accounting Policies and International Accounting Standard 37, the current expenses of Kozloduy NPP cover expenses for provisions for the obligation to transport SNF, respectively, for 2019 - BGN 42 million and for 2020 - BGN 38 million. In 2021 2 shipments of WWER-1000 SNF were carried out for storage and processing in Russia.

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 persons 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 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 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 allocation 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

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, oversight and qualification enhancement. The activities in the nuclear facilities and with sources of ionising radiation which have an impact on safety may be performed only by professionally qualified personnel holding individual licenses.

The specific job positions with such functions are defined in the operating licenses 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 License 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 Ionising Radiation Sources. 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 are 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 in relation to the sources of ionising 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-3.5-2009.

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 facilities for training of maintenance personnel, equipped with appropriate mock-ups and hardware and software. 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.

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.

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 contractor's 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 KNPP 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

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 following professional fields: physics, chemistry, power engineering and chemical technologies, in five accredited universities.

Since 2018 Kozloduy NPP has been supporting a scholarship programme for students enrolled in full-time studies in nuclear specialities at Technical University-Sofia and Sofia University St. Kliment Ohridski. Currently the total number of people employed in the nuclear power sector is around 6,500 workers and employees, 58% of them being directly involved in the operation of Kozloduy NPP.

In 2022 a National Strategy for establishment and development of human resources in the nuclear sector is adopted by the Council of Ministers. The main purpose of the Strategy is building of a sustainable system for training, improvement and development of specialists needed for the effective work of the nuclear sector and overcoming the inconformity between the needs and cadres available. An analysis is performed in the Strategy of the human resources status in the nuclear sector. Challenges to be addressed are outlined. Strategic aims are formulated including the means for their achievement, as well as the role of the state institutions and economic entities. The monitoring and financing processes are outlined. The Strategy’s timeframe comprises the period from 2022 to 2032.

Methods used for the analysis of competences, availability and adequacy of additional staff for severe accident management, including hired personnel or staff 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. The identified weaknesses are reflected in amendments to the emergency plan, emergency procedures, SBEOPs and SAMGs.

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 NRA 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.

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 Operating Experience Feedback 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 shall take 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 changes 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 the emergency response centre (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 OLCs, 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;
- 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 minimising the errors of shift staff in the human-machine interaction.

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.

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:

- measures have been implemented to replace the normal operation Instrumentation & Control systems (CIS, TCS and PCS) by implementing a modern digital distributed computer information and control system under the Ovation platform (CICS Ovation);
- measures have been implemented to replace RT and cross cabinets;
- the power supply panels of primary and secondary I&C sensors have been replaced;
- local equipment control panels have been replaced;
- operators' panels and control systems in AB-3 have been replaced.

Through the implementation of the above-mentioned measures for the replacement of RT-cabinets, panels with limiting converters, cross cabinets and power supply panels of I&C sensors on the primary and secondary circuits, the goal of building an integrated system for monitoring and control of normal operation technological processes along the primary and secondary circuits of the Kozloduy NPP Units 5 and 6 has been achieved. The new RT and cross cabinets are fully integrated into the implemented Ovation computer information and control system, which has achieved the construction of a unified monitoring and control system including the equipment for power supply, conversion and multiplication of the signals from the monitoring and control system of primary and secondary circuits.

A number of measures have also been implemented to prevent staff from making errors. Unit equipment and BoP are well differentiated, with clear and unique technological names of the individual equipment parts. The doors of all technological rooms on the site are marked in compliance with uniform plant 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.

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 staff and managers, between the individual administrative units in Kozloduy NPP have been established. The rules for keeping the operating documentation are defined.

Every power unit has an Operations Chief Technologist who does not work in shifts, and who is responsible for the overall unit condition and proper conduct of operations. All important planned switchovers, tests, start-up and shutdown operations, are performed with his/her knowledge.

Self-assessment of managerial and organisational issues by the operator

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

- fitness for duty of the operators;
- observance of the requirements of the established standards, policies, procedures and rules;
- industrial safety accident rate;
- improvement of human performance;
- improvement of safety culture;
- use of the operating experience feedback;
- improvement of the independent assessment process;
- efficiency of fire safety programmes;
- efficiency of radiation protection programmes.

In relation 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 employer. Survey of the motivation of a representative sampling of at least 15% of the staff is made on an annual basis. The survey measures the staff attitude towards 24 factors of the working environment, which are indicators for the staff motivation. An important aspect of the survey is the opportunity for the personnel to voice their opinions and proposals by responding to an open question in the inquiry form: “According to your opinion, what should be changed so that Kozloduy NPP becomes an even more attractive place to work?” 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 conducted surveys are published in the internal information system. Corrective measures are developed if there is a need to enhance the motivation.

Arrangements for operational experience feedback in relation to human factors and organisational issues

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

- improving the training programmes for the staff through updating the existing training materials, creating new ones and updating the training periodicity;
- improving the methods and techniques for reducing human errors - through additional trainings 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 errors;
- improving the ergonomics and the human-machine interface through implementing design modifications;
- introducing the applicable operating experience in the simulator training classes at the full-scope simulator;

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

In order to improve the efficiency of operating experience feedback related to human errors and organisational issues, Kozloduy NPP has introduced the WANO coding system as an addition to the existing tools. This system was developed to facilitate the comparability of messages on events and determine the problematic areas within WANO, and it increases the possibility for studying the trends in the identified causes. The 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 2019 - 2021 show that the indicators identified and coded after WANO coding system that are related to human performance (human factor and management) represent 46,5% of the identified deficiency, 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 system is also used, which provides for two categories (codes) to report events related to human performance/behaviour and organisational factors. In addition to that, to evaluate the level of reporting low level events and near-misses related to human and organisational factors the indicator Ratio between the LLE and NM related to human and organisational factors and the total number of LLE and NM /Relative portion of LLE and NM/ is monitored. The work (including expanding the scope of the organised trainings) with the staff regarding the need for reporting of 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) of non-conformances, including low level events and near misses, recorded as Comments in the Organisation of Operational Activity Information System (IS OOA), 4 levels of review and assessment of non-conformances were introduced in 2017. In 2021 one more additional fifth level was added, to perform better control over the quality of coding and optimising coding, in accordance with the newly recorded information when reporting on work performed or issues that occurred when resolving the non-conformances:

- 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 administrative units;
- level two - daily review, assessment and coding of newly recorded comments from the previous 24 hours; If the comment relates to human performance this is noted;
- level three - re-classification and re-coding of comments is performed every weak for for LLE and NM coded as Low Level Events and Near Misses from the previous weak with the aim of discussing their potential re-classification in category three event (LLE and NM requiring commission analysis under specific criteria (negligible actual implications for the equipment/personnel and/or negligible potential consequences for safety), in order to perform a more profound analysis;
- level four - weakly review of the recorded defects and those that comply with the LLE and NM riteria and are necessary to trend the production activity are recorded as Comments in the IS OOA;
- level five - second review of all the comments recorded, classified and coded over the previous month as low level events or near misses, to assess a potential change in their status (new information when reporting the work performed or issues that occurred

during their resolving). Comments classified at level two for review and assessment as LLE for non-commission analysis or Near Misses over the past month are described in the monthly report on the activity of the Performance Assessment and Improvement Department. The heads of the administrative units where the comments are recorded are notified in order to discuss and undertake additional actions, as necessary.

Regulatory review and control activities

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

- analysis of operational events related to human error, breached or non-fulfilled operating instructions, organisational issues;
- implementation of corrective actions from operational events related to human factor;
- management of organisational changes;
- interaction of different adminstrative units, effectivness of managemant decisions;
- periodic analysis of the safety performance indicators related to human factor;
- performing assessments of the modifications in SSCs as regards the human-machine interface;
- planning and implementing activities related to maintenance and repair as regards work load and the established working conditions.

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

Article 13 Quality Assurance

Every 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

According to ASUNE entities that perform activities related to the use of nuclear energy are obliged to establish and maintain an effective management system (MS) for the activities, which gives priority to safety and ensures high safety culture, as well as to maintain high level of quality of the activities they perform.

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 enhance the safety of the nuclear power plant as well as to promote and support a high safety culture of the staff.

The management system combines all elements of management so that the requirements to protect human health and 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, with account taken of the full responsibility of the operating organisation to ensure safety.

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

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

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

The Kozloduy NPP management system integrates all management aspects and ensures concordance in the implementation of the requirements regarding safety, health and safety at work, environment, security, quality and business activity of the company, so that safety is guaranteed top priority. The management system is in line with the requirements of the IAEA standard GSR Part 2 - Leadership and Management for Safety.

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 long-term intentions of Kozloduy NPP management are set in the Management Policy of Kozloduy NPP and the Management Policy Statement on the Company management. The strategic goal is long-term operation of the nuclear power units with guaranteed safe and reliable operation, in compliance with the licenses. In pursue of the set goal policies have been developed in compliance with the Kozloduy NPP management policy. The management assigns priority to safety and declares its commitment to its maintaining and constant improvement in the Safety Management Policy.

The Management System covers 28 processes (3 management, 4 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 control; maintenance and repairs; nuclear fuel cycle management; purchase and supply of products/services; RAW management; organisational changes 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 leader. 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.

With regard to the external organisations requirements have been defined that ensure:

- the activities they perform are in compliance 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 a well 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 self-assessment on behalf of the managers at all managerial levels are the major mechanisms for early detection of unfavourable trends, timely response in the event or identified non-conformances, as well as for identification of opportunities for safety enhancement and MS improvement .

Once a year Kozloduy NPP senior management perform a review of the MS, whereby they assess the functioning, adequacy, effectiveness of the MS and its capability to achieve the set goals, and identify measures for improvement.

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:

- management’s priorities in the Company management;
- implementation of the five-year plan for conducting audits;
- significance of the audited process/activity;
- specific requirements of relevant normative acts and standards related to the periodicity for conducting audits in certain areas;
- requirements related to conducting audits of management systems of accredited/licensed administrative units acting within the framework of the management system;
- changes that occurred in normative acts and standards relevant to Kozloduy NPP;

- changes to the requirements of the management system in place;
- changes to the organisational structure;
- conclusions and results of previous audits and inspections (recurring non-conformances);
- results of inspections by supervisory bodies, conducted missions/peer reviews;
- operating events;
- status of the performance indicators of Kozloduy NPP effective management self-assessment activities.

In 2020 a separate section, Management System Audits, was set up; its main activity covers the audit programme management, planning and conducting of internal quality audits in the Company.

Audits of vendors and suppliers

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 well defined at Kozloduy NPP.

The requirements for purchasing are defined mainly on the grounds of the significance of the purchased product/service to safety, health, environment, physical protection, and business activity, with safety having the highest priority.

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 involve:

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

In the period 2019-2021 Kozloduy NPP has conducted two audits of service suppliers, during the performance of activities under maintenance contracts for facilities from systems important to safety and two inspections of service suppliers, during acceptance tests of normal operation systems equipment.

Regulatory review and control

NRA carries out preventive control in the process of issuing licences and permits. This includes review of the documents describing the management system of the operating organisation.

Verification of the practical implementation of the management system is carried out during the inspections on the implementation of the issued licence and permit conditions. One of the topical areas for control in the NRA Inspections Programme is the Management System.

During the period 2019-2021 the practical implementation of Kozloduy NPP management system was verified in the following areas: development of goals, strategies and plans at Kozloduy NPP, self-assessment of their implementation at different levels of the organisation; design changes and management of organisational changes.

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 the sources of ionising radiation and to undertake actions and measures for their enhancement, taking into account the internal and international operating experience and scientific achievements in this area. The scope of the assessment shall verify 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 public caused by the impact of ionising radiation.

A licence to operate a nuclear facility is issued or renewed on the basis of an assessment of nuclear safety, radiation protection and the actual condition of the nuclear facility. The period of validity of the licence issued or renewed is limited to 10 years. The requirements for issuance, amendment, renewal, termination, and revocation 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 (hereinafter referred to as the Licensing Regulation). The licences are issued for operation and decommissioning of a nuclear facility.

In compliance with the Act, the activities on siting, design, construction and commissioning of a nuclear facility, as well as modifications in the structures, systems and components (SSCs), internal rules, limits and conditions for the operation of the facility are subject to licensing regime. A site selected for the siting of a nuclear facility shall be approved by an order of the NRA Chairperson based on a review and evaluation of a preliminary Safety Analysis Report (SAR). Technical design of a nuclear facility shall be approved by an order of the NRA Chairperson based on a review and evaluation of an interim SAR. Submission of a final SAR is required for the issuance of a licence to operate the nuclear facility. The minimum scope of a SAR of a nuclear facility is defined in Annex 1 of the Licensing Regulation.

The Regulation on Ensuring the Safety of Nuclear Power Plants sets out the basic rules for nuclear safety and radiation protection, the organisational measures and the technical requirements for ensuring safety at different stages of the life cycle of a modern nuclear power plant. 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 IAEA safety standards updated after the Fukushima accident and WENRA reference levels for safety harmonisation. The requirements of Council Directive 2014/87/Euratom of 8 July 2014 amending Directive 2009/71/Euratom establishing a Community framework for the safety of nuclear installations have also been implemented.

The review and evaluation process for the issuance of licences and permits also uses the regulatory guides of NRA, which provide guidance on the application of regulatory requirements.

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. site selection, design, construction, operation)

According 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 the site selection, design review, construction, commissioning, operation, design modifications and/or operating conditions, conducting PSR and long-term operation beyond the design life.

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 area 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 existing site of Kozloduy NPP carried out, as well as the reassessments made (including reassessments of assumptions used in external hazard identification) in determining the location of a new nuclear unit site adjacent to the existing NPP are provided in parts of the report referred to in Articles 17 (1) and 17 (3).

The design safety assessment aims at confirming that the impacts and the 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 NPP. 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 shall cover the scenarios leading to limit loads on the SSCs with the least margin to meet the acceptability criteria for the results of the deterministic event and accident analysis. The events and accidents taken into account in the design shall be categorised according to their frequency of occurrence and their consequences, demonstrating that the most frequently occurring events lead to minimal consequences.

The SSCs important to safety and their functional characteristics shall be designed with a reasonable margin for the specified boundary 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 implementation of the defence-in-depth concept shall be documented in a preliminary, interim and final safety analysis reports related to the authorisation process under the ASUNE.

According to the Regulation on Ensuring the Safety of NPP 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 SNF pool for each specific unit both for normal operation and emergency conditions.

The operating organisation (utility) shall maintain 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 shall be updated in a timely

manner time and when there is new information on the safety assessment, including one regarding the site and NPP siting area characteristics. The computer programmes and analytical methods used in the safety analysis shall be verified and validated and the uncertainties of the results shall be quantified.

For the purposes of licensing analyses in the SAR, the initiating events for analysis in operational and emergency modes shall be 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 required and performed in order to confirm the effectiveness and sufficiency of the design solutions and the means of site protection, to ensure the defence in depth concept , performance of safety functions by the SSC, to prevent the occurrence and development of fixed equipment accidents.

Carrying out a PSA - levels 1 and 2 is required in connection with the implementation of an integrated approach in the process of NPP safety assessment. The probabilistic safety analyses are used to systematically identify all factors that significantly contribute to the safety and radiation risk to the public and the environment.

To fulfil the requirement to keep the SAR updated, Kozloduy NPP have introduced internal rules for this activity and have established a structural 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.

In the period after the 8th National CNS Report, the SARs of Units 5 and 6 were updated in connection with the implemented modifications as follows:

- design modifications to implement measures from the Comprehensive Programmes for the implementation of measures from the periodic safety review of Units 5 and 6;
- amendments to Chapter 1 General Description of the SAR with the aim of using it as a public stand-alone document;
- update Chapter 15 Accident analysis based on new analyses performed for the transition to 104% operation with a new fuel type;
- alignment of the SAR sections with the new requirements of the Regulation on ensuring the safety of nuclear power plants;
- amendments resulting from the management plan for activities under measures implemented during the long-term operation of Units 5 and 6 of Kozloduy NPP.

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

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, conducted at regular intervals. The results of the PSR are used as a licensing basis in the renewal process of the licences for the operation of Units 5 and 6.

Pursuant to the ASUNE and the current regulatory framework in the Republic of Bulgaria the renewal of operating licences of nuclear facilities is directly related to the conduct of a nuclear safety and radiation protection assessment and an assessment of the actual state of the nuclear

facility. The period of performance of the PSR shall be determined in accordance with the licensing requirements and shall be limited to 10 years.

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: definition and agreement with the NRA of a common methodological basis and action plan; training of the personnel to be involved in the assessment;
- Stage two: carrying out the PSR according to the defined methodology, submitting to the NRA a report with the results of the review and a draft of an integrated programme for the implementation of practicable safety improvement measures, taking into account the interrelationships between the identified deviations;
- Stage three: completion of the PSR and implementation of 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 shall assess the consequences of the cumulative ageing effects, modifications and requalification of SSCs, operating experience, current safety standards and research and development achievements, changed characteristics of the NPP site, and organisational and managerial issues. On the basis of the results and conclusions of the PSR, practically feasible measures and improvements to the SSCs should be defined and implemented to enhance the current level of safety arising from the current safety requirements and standards.

PSR of Unit 5 was performed in the period 2014-2016, and PSR of Unit 6 was performed in the period 2017-2018. The conclusions of the PSRs completed for Units 5 and 6 confirm the relevance of the methods and approaches for conducting deterministic analyses, the validation status and the applicability of specialised computer programmes and the consideration of generally recognised good practices. There are deterministic analyses that take into account the current state of the units in operation at uprated power with fuel assemblies type TVSA and TVSA-12.

As a result of the PSRs carried out for Units 5 and 6, it is planned to update the PSA - levels 1 and 2 of the units taking into account all design modifications, expanding the scope of the external events specific to the Kozloduy NPP site, and reassessment of the external hazards (hazard curves) with a view to implementing the current regulatory requirements. The update of the PSA - Level 1 will be completed in October 2022. The update of the PSA Level 2 is planned.

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

Following the completion of the project for the lifetime extension of Units 5 and 6 of Kozloduy NPP and the renewal of the operating licences of both units, additional technical measures for the structures, systems and components (SSC) are planned to be implemented in relation to:

- recommendations resulting from the activities implemented in the second stage of the Units 5 and 6 lifetime extension project;
- retrofitting or replacement of SSCs reaching the end of their service life;
- revalidation and verification of quantitative estimates of the residual lifetime of main equipment and systems, if necessary.

The planned measures are included in a management plan for the activities to be carried out during the long-term operation of Units 5 and 6.

Introduction of a new type of nuclear fuel at Unit 5

Referring to the need of diversification of the nuclear fuel supply, Kozloduy NPP is implementing a programme for transition to operation with a new type of nuclear fuel. Safety analyses for the deployment of the new nuclear fuel are underway.

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 to the following activities carried out by the licensee:

- carrying out modifications of SSCs important to nuclear safety;
- changes in the operational limits and conditions of the units on the basis of which the operating licence has been issued;
- changes in the internal rules in order to perform works, procedures and programmes applied to the units' operating licences;
- annual update of the SAR, which includes changes and amendments from the previous year;
- PSR of Unit 6 for renewal of the operating licence;
- safety assurance for the long-term operation of Units 5 and 6.

In connection with the renewal of the operating licence of Kozloduy NPP Unit 6, in 2019 the NRA reviewed the documents submitted at the various stages of the PSR to establish the compliance with the legal and regulatory requirements, the IAEA safety standards and the updated WENRA reference levels. In addition, the results of the independent expert assessment of selected aspects of the PSR assigned by the NRA were taken into account. All assessments confirmed the completeness and correctness of the review carried out on the separate safety factors and the conclusions drawn.

The regulatory activity related to the long-term operation of Kozloduy NPP Unit 6 follows the implementation stages of the plant lifetime extension (PLEX) project with the measures planned. The reports submitted under the first stage regarding the completed comprehensive assessment of the actual state of the SSCs and the residual life were reviewed and evaluated by NRA experts. In addition, an independent external expert evaluation was performed by a technical support organisation on selected aspects of the specific surveys carried out. As a result of the performed assessment, recommendations for additional studies in compliance with the methodology for the conduct of comprehensive assessment were given. With regard to the programmes for the preparation of the units for long-term operation submitted at the second stage, independent expertise in specific areas has been fulfilled, given the thematic complexity of the measures of these programmes and the need to confirm the updated safety assessments and the planned preparation activities for the long-term operation.

The implementation of the safety improvement measures of the management plan for activities implemented during the long-term operation of Units 5 and 6 is monitored by the NRA, including within the framework of the licensing regime.

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 NPP, 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 programmes for continuous safety review

During this reporting period, a new procedure has been developed and implemented at Kozloduy NPP covering all activities related to the supervision of the SSCs at Units 5 and 6. The full range of activities and methods related to the supervision of SSCs important to safety has been regulated, as well as the guiding and working documents stipulating the periodicity, scope and responsible parties for the implementation of the relevant activities.

The surveillance activities on SSCs shall include the 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 condition of the SSCs in the period of the long-term operation of Kozloduy NPP Units 5 and 6, to adjust the operating modes and conditionsand the 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 functional 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 checkups 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.

In order to regulate the organisation and the procedure for performing metrological control of the measuring instruments and measuring systems, a Quality Procedure for Metrological Control of Measuring Instruments at Kozloduy NPP was adopted. 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 condition 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 metallographic testing of material samples. Guiding documents are the procedures for operating control of SSC and technical certification procedures that are used to describe 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 regulations and standards.

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

After implementation of design changes, functional tests of the newly installed equipment or of the modified system are carried out, if necessary. Specific functional test programmes are being developed in this regard. The programmes aim to check the compliance between the implementation and the design requirements. On the basis of requirements and experience gained an optimal scope and periodicity of supervision is defined. After each annual outage an analysis is performed of registered and implemented temporary amendments in the design for the past fuel campaign.

Maintenance and repair include a complex of operations to restore the operability and/or the lifetime of the equipment or parts of it and shall be 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 identified on the basis of SSC monitoring data;
- based on 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 effects of ageing on the SSCs. The process includes:

- implementation of an ageing management programme (AMP) for systems and components important to safety and other AM relevant programmes - for maintenance and repair, operation, equipment qualification, water chemistry, surveillance, in-service inspection, monitoring etc.
- establishing AM working groups, including experts from different plant departments;
- 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 the established rules of the management system, for this purpose functional and specific indicators have been developed and included in the performance indicators' system of the effective management in the Company.

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

Kozloduy NPP has established expert committees, including a wide range of specialists, to review and resolve safety related issues. 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 at Units 5 and 6 - a specialised advisory body of the 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 QAP for safe operation of Kozloduy NPP Units 5 and 6, protection of the personnel, the environment and the public;
- Safety Culture Committee - advisory body on safety culture related issues (refer to Article 10);
- ALARA Application Committee (refer to Article 10);
- Operating Experience Feedback Committee (refer to 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.

Regulatory review and control activities

The regulatory control in place, including activities related to the renewal of the operating licences of the units and the issuing of permits for modifications to the design of the facilities, shall focus on ageing management aspects.

A new Ageing Management area has been included in the scope of the NRA's long-term inspection programme and inspections in this area are foreseen in the preparation of 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.

The conditions of the operating licences of Units 5 and 6 require Kozloduy NPP to submit periodic information on the status of nuclear safety and radiation protection. Prior to plant shutdown for outage, the following documents shall also be submitted and revised:

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

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 enhancement measures; functional tests and document modifications; in-service inspection activities performed on the metal of equipment and pipelines; core loading; radiation protection, etc. The unit shall be commissioned after a positive assessment of the inspection.

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 of the facilities.

The scope of the implemented 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 ASUNE, the Regulation on Radiation Protection (RRP) and the Regulation for 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, ionising radiation exposure of personnel and the public shall be maintained at the lowest reasonably achievable level.

The radiation protection regulation 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 for 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 every 1 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 of 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 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 work 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;
- medical monitoring of personnel.

Based on the limit values specified in the Regulation on Radiation Protection Kozloduy NPP have introduced:

- dose limits 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

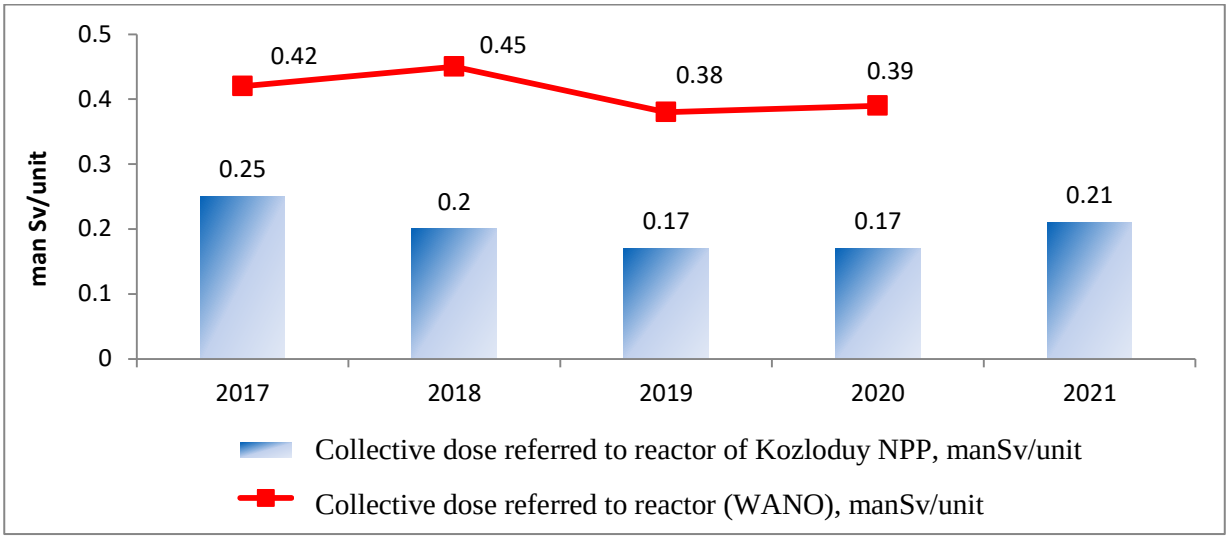
Dose exposure monitoring

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 DSFSF) over the last five years.

No	Indicator	2017	2018	2019	2020	2021
1	Collective effective dose, man Sv	0.50	0.41	0.34	0.34	0.42
2	Maximum effective dose, mSv	6.94	6.45	4.97	3.25	9.14
3	Share of the internal exposure in the occupational exposure, %	0	0	0	0	0
4	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 2021 for the Kozloduy NPP normalised to the number of reactors in operation (WWER-1000) is 0.21 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 rangies from 3 mSv to 9 mSv per year. There have been no cases of exceeding the annual 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 the Safety of Nuclear Power Plants.

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 the 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 have been set for the monitoring of the waste water activity, which are controlled operatively in the drainage process:

- 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/a. The limit values thus obtained are for 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**

As the actual discharges are much lower than the limit values set, the main driving force behind the control of gaseous discharges is the early identification of negative trends in the operation of the units and the optimisation of the radiation protection of the public. For this purpose, 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 day-to-day reference levels are constantly monitored with automated control systems.

In addition, 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 of the monitoring of the gaseous discharges through the ventilation stacks of Units 5 and 6 and the WSFSF for the period 2017-2021. 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	WSFSF	Units 5,6	WSFSF	Units 5,6	WSFSF	Units 5,6	WSFSF	Units 5,6	WSFSF	Units 5,6
2017	0	1.68	0	29.4	0	6.68	0	570	0	523
2018	0	0.912	0	8.40	0.37	89.90	0	537	0	427
2019	0	0.462	0	0.33	0	6.58	0	506	0	402
2020	0	0.657	0	0.74	0.02	1.04	0	594	0	641
2021	0	3.78	0	50.8	0.39	8.95	0	724	0	607

** Values are for 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 waste water 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 reference radionuclides complies with the European Commission Recommendation, 2004/2/Euratom.

Year	**Total activity, MBq (without H-3)**	**H-3, TBq**
2017	155	22.2
2018	203	23.0
2019	38.5	25.6
2020	13.8	23.3
2021	45.3	24.4

During the period 2017-2021, the released radioactive substances with gaseous and liquid discharges from Kozloduy NPP are below 1% of the determined 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/a]				
	Airborne	**Liquid***	**Liquid****	**Total***	**Total****
2017	$7.37.10^{-7}$	$3.52.10^{-7}$	$4.14.10^{-6}$	$\mathbf{1.09.10^{-6}}$	$\mathbf{4.88.10^{-6}}$
2018	$1.17.10^{-6}$	$3.64.10^{-7}$	$4.29.10^{-6}$	$\mathbf{1.53.10^{-6}}$	$\mathbf{5.46.10^{-6}}$
2019	$1.00.10^{-6}$	$4.25.10^{-7}$	$3.92.10^{-6}$	$\mathbf{1.43.10^{-6}}$	$\mathbf{4.92.10^{-6}}$
2020	$7.15.10^{-7}$	$4.14.10^{-7}$	$3.47.10^{-6}$	$\mathbf{1.13.10^{-6}}$	$\mathbf{4.19.10^{-6}}$
2021	$8.33.10^{-7}$	$4.38.10^{-7}$	$3.66.10^{-6}$	$\mathbf{1.27.10^{-6}}$	$\mathbf{4.49.10^{-6}}$

** - 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.

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:

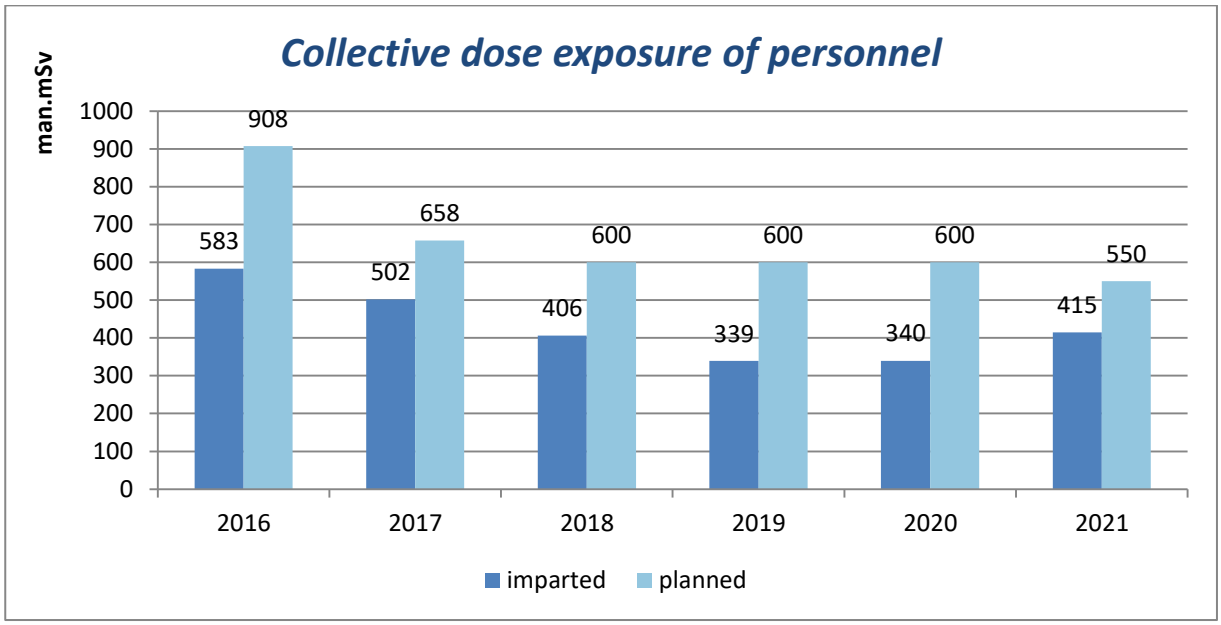
- administrative management of dose exposure optimisation measures;
- integration of radiation protection measures into the generation process, along with other safety measures at work;
- improving radiation risk assessment by workplace and identifying appropriate protection measures;
- conduct of training and briefings to raise workers' awareness;
- detailed planning of activities when carrying out 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 radiation controlled area, for surface contamination and the dose rate in them so that the expected individual effective dose of personnel is kept as low as possible;
- holding committee meetings to discuss the radiation risk associated with certain maintenance 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 exposure of plant personnel in recent years are presented in the figure below. The results show that the actual received collective dose exposure of personnel is lower than planned.



Environmental monitoring and key results

The radio environmental 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 radio environmental monitoring since 2012 is accredited by BAS № 154 LI under BSS according to BSS EN ISO/IEC 17025.

Automated and laboratory control of radiation parameters in the Bulgarian section of the 30 km surveillance 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 surveillance 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 technogenic radionuclides in major environmental components 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 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. There are over 1,200 measurements of radiation gamma background performed at the monitored posts and monitoring routes with portable dosimetry devices and stationary located thermoluminescent dosimeters.

The quality assurance of the of the analyses is carried out by means of analyses of blank, duplicate and labelled samples, control tests of the equipment and regular participation in international laboratory comparisons and competency tests.

The results of the radio-ecological 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.

Regulatory control

Nuclear Regulatory Agency

The issued operating licences of all Kozloduy NPP units 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 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 Nuclear Safety and Radiation Protection Status Reports.

NRA carries out independent regulatory monitoring of radioactive discharges 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 2018–2022, more than 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 on-line monitoring system;
- through a laboratory-analytical system for off-line monitoring.

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 Executive Environment Agency (EEA) administers the National Automated System for Continuous Monitoring of the 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 Protection of the Public and the Nuclear Regulatory Agency - Emergency Centre. Eight automatic stations from the off-site dosimetric 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). Under normal conditions data is sent to EURDEP once a day and, in the case of increased values, every hour.

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 sampling of the river and automatic analysis for gamma-emitting radionuclides. The system did not report elevated levels of technogenic radionuclides such as caesium-137 and iodine-131.

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 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 results of the radiological monitoring carried out are published in the EEA's periodicals – daily and quarterly bulletins and the National Report on the Status and Protection of the Environment.

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 ionising radiation;
- systematic control without prior notification of Kozloduy NPP is carried out through on-going control of compliance with the health requirements established by a normative 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 at the 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 organizations or in case of data on occurrence of incidents with risk to health of personnel and public.

The National Center for Radiobiology and Radiation Protection, through the Department of Radiation Safety and Medical Screening, conducts specialized examinations and studies to evaluate the health status of people working with SIR, including NPP personnel and their suitability to perform specific professional duties in an ionising radiation environment.

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 cesium-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 (0.005-0.007 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 report on the state and protection of the environment, issued by the Ministry of Health and the Ministry of Environment, 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 facilities and cover the activities to be carried out in the event of an emergency. For any new nuclear facility, 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 public and the competent authorities of the States in the vicinity of the nuclear facility are provided with appropriate information for emergency planning and response.

3. Contracting Parties which do not have a nuclear facility on their territory, insofar as they are likely to be affected in the event of a radiological emergency at a nuclear facility 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 specified in the Disaster Protection Act (DPA), the Act on the Safe Use of Nuclear Energy (ASUNE), the Ministry of Interior Act (MIA), the Regulation on emergency planning and emergency preparedness in case of nuclear and radiological emergencies and the Regulation on radiation protection.

DPA establishes a unified approach and organization for planning, maintaining emergency preparedness and response at the national level in case of a disaster. DPA is harmonized with the ASUNE regarding the requirements for the development of emergency plans, their contents, the necessary human resources, material and technical support and others. 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 disaster, approves the National Strategy For Disaster Risk Reduction, the National Programme For Disaster Risk Reduction 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 permanently acting consulting body which ensures the coordination and cooperation during implementation the state policy in disaster. Its main functions are related to development of National Strategy for Disaster Risk Reduction, National Programme for Disaster Risk Reduction, and National Disaster Protection Plan, as well as support in development and implementation of Acts and secondary regulatory legislation related to reducing the risk of disaster.

In the period 2017-2018 the Council had developed a National Strategy for Disaster Risk Reduction 2018-2030. To implement the Strategy, in 2020 a decree of the Council of Ministers adopted a National Programme for Disaster Risk Reduction for the period 2021-2025. The programme focuses on reducing the vulnerability of the public to disasters, improving coordination and efficiency in the implementation of disaster risk reduction activities in individual sections and preventing duplication of activities, as well as increasing the use of innovations and technologies in the field of disaster risk reduction.

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 nuclear or radiological emergency, an External Emergency Plan, which represents an integral part of the NDPP, have 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 public;
- 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 unified rescue system will interact;
- the arrangements for early warning and notification of the executive authorities, the components of the unified rescue system and the public in the event of a hazard or disaster;
- recovery measures.

According to the ASUNE state authorities and persons engaged in commissioning, operation and decommissioning of nuclear facilities are obliged to 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 must:

- immediately inform the public, 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:

- on-site emergency planning zone - sheltering zone (zone №1);
- precautionary action zone with a radius of 2 km (zone №2);
- urgent protective action planning zone with a conditional radius of 30 km (zone №3).

The Kozloduy NPP on-site emergency plan covers zone No 1. The plan also defines the obligations of Kozloduy NPP related to the notification of the public in Zone №1, Zone №2 and part of Zone №3 (within a radius of 12 km), as well as the performance of radiation monitoring in the three zones in the event of an emergency.

A draft of the new Emergency Regulation has been prepared which complies with IAEA requirements included in GSR Part 7 – Preparedness and Response for a Nuclear or Radiological Emergency, IAEA, 2015 and WENRA Safety Reference Levels for Existing Reactors 2020 - Issue R: On-site Emergency Preparedness, WENRA, 2021. At the time of preparing the report, the draft of the regulation is undergoing an interdepartmental conciliation process.

The Radiation Protection Regulation 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 № 28 on the terms and conditions for medical assurance and health standards to protect the individuals in the event of a radiological emergency;
- Regulation for the construction, maintenance and use of collective protection equipment;
- Regulation on the terms and conditions for functioning of the national early warning system and notification of executive authorities and the public during disasters and notification of air hazards;
- Regulation for creating, storing, updating, maintenance, delivery and reporting of stocks of personal protective equipment;
- Regulation No.11 on setting requirements to the limits of radioactive contamination of foods in a radiological emergency;
- Regulation on the terms and conditions for notification of Nuclear Regulatory Agency about events in nuclear facilities and sites with sources of ionising radiation and in the transport of radioactive substances.

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

The National Disaster Protection Plan includes: analysis of possible disasters and a forecast of their consequences; measures to prevent or mitigate the consequences; measures to protect the public and the environment; order of request or rendering international assistance; obligations of the executive authorities and the persons responsible for implementation of protective measures; funds and resources provided for elimination of the consequences; ways of interaction between the executive authorities and procedures for timely notification in case of disasters.

Activities to protect the public in case of disasters are performed by the Unified Rescue System (URS), 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 basic structures of the URS are Directorate General Fire Safety and Civil Protection at the Ministry of Interior (DGFSCP-MI) and regional structures of the Ministry of Interior, Bulgarian Red Cross and Emergency Care centres.

The basic structures of the URS are formed throughout the country in accordance with the administrative-territorial division and are available 24/7 to receive signals in the event of disasters and subsequent response. Additional URS structures provide assistance upon request, according to the relevant disaster protection plan and the armed forces – only with the permission of the Minister of Defence. Coordination of the URS structures is implemented through operational centres of the DGFSCP-MI.

When the NDPP is activated, a National Headquarters are established by an order of the Prime Minister, which: perform analysis and evaluation of the situation; make decisions on the implementation of measures to protect the public and the environment; organise and coordinate the actions of ministries, departments, regional governors and mayors of the municipalities entrusted with functions in the event of a disaster; inform the public through the media on the development of the disaster, the protective measures taken and other actions to mitigate and address the consequences. The interaction and coordination between the URS structures carrying out actions in the disaster's vicinity are performed by the Operations Supervisor defined with an order of the Prime minister.

According to the Disaster Protection Act, the NRA is part of the Unified 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 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.

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 in is to process incoming data, make forecasts for the development of the accident, evaluate the consequences for the public and prepare reasoned proposals to the National Headquarters in order to apply protective measures. 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 NPP 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, the licensee has developed an on-site emergency plan for Kozloduy NPP. When it is activated, the Ministry of Interior, the Chairperson of the NRA, the Ministry of Energy, corresponding regional centres (Vratsa Regional Directorate

Fire Safety and Civil Protection and Montana RD FSCP) are notified and the public in the municipalities within the 12-kilometre zone, which is part of zone №3 (Urgent Protective Action Planning Zone), is notified.

Implementation of emergency preparedness measures by the licensee

Classification of emergency conditions

In the on-site emergency plan, emergency conditions are classified in accordance with the Regulation on Emergency Planning and Emergency Preparedness in Case of a Nuclear and Radiological Emergencies and the IAEA definitions published in Method-2003 - Method for developing arrangements for response to a nuclear or radiological emergency, TECDOC 955 - Generic assessment procedures for determining protective actions during a reactor accident and GSR Part 7 - Preparedness and response for a nuclear or radiological emergency, in terms of the possible consequences and related activities to be implemented:

- 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 measures of Kozloduy NPP are defined in the On-site Emergency Plan, which is the main guiding document for action in case of an emergency at the plant. The on-site emergency plan forms part of the package of documents required for a licence. It is mandatory for implementation by all the plant personnel and personnel of organizations located on the site and in the precautionary action zone. The emergency plan is developed based on the project documentation, the additional analyses and assessments of safety, requirements of the national regulations and international recommendations, established common standards and practices in emergency planning and preparedness, nuclear safety and radiation protection.

Subject to review and classification in emergency plan are nuclear and radiation emergencies and events without direct radiological consequences (non-radiation, conventional accidents) that create actual or potential prerequisites for significantly lowering the safety of plant equipment.

Upon the occurrence of an emergency event, the emergency condition is determined by procedures for initial assessment of the initiating event and by 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 spent fuel repositories (SFSF and DSFSF);
- plant safety status (various events, natural disasters, human activity etc.).

The Plant Shift Supervisor (PSS) is the senior operational manager of the shift. He is responsible for organisation and implementation of immediate actions in case of an emergency and first aid to the injured. The responsible officer for the overall management of activities under EP is the Emergency Response Manager (ERM). Until the formation of the emergency teams, the responsibilities and obligations of ERM are performed by the Plant Shift Supervisor.

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

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

Services have developed their own emergency plans that are jointly implemented and coordinated with the On-site Emergency Plan of Kozloduy NPP.

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 provisions – accumulator batteries, cables, oils and diesel fuel in case of an emergency related to simultaneous events combined with fuel meltdown at different various facilities on-site.

On the availability of sufficient resources (see also Article 9): Description of the mechanism by which the necessary resources are provided (technical, human, financial) and powers of the licensee to effectively manage emergencies on site and mitigate their consequences.

Facilities of the licensee to ensure emergency preparedness

The Emergency Response Centre (ERC) at Kozloduy NPP is designed to ensure the appropriate working conditions for the emergency response team and the emergency personnel working at the ERC. The ERC is established on the site territory and it is equipped with means for communication with the regional and national authorities and workplaces in plant buildings and facilities. Local Early Notification and Warning System and National Early Warning and Notification System, installed at ERC, are used for notification of the personnel and the public. The external power supply of the ERC is backed up. There is an independent electrical supply with two diesel generators. It is fitted with an independent filtering-ventilation system with the possibility to operate in three modes (pure ventilation, filtered ventilation and complete isolation mode) and also with air parameters monitoring, independent water and sewage system with reserve service water and a stock of foodstuffs. Radiological control regime is organised in ERC with monitoring assemblies for surface contamination of the emergency personnel and there is an option for decontamination.

The ERC is equipped with technological, radiation and meteorological monitoring; software and hardware means for assessment, forecast and visualization of the conditions. The radiation monitoring of the premises is carried out automatically and with portable devices, including for aerosol content in the air. Individual dose monitoring of the emergency personnel is done by thermoluminescent dosimeters (TLD) and electronic dosimeters. Each workplace is equipped with the necessary technical, operational and emergency documentation.

The ERC receives information from the following systems:

- automated emergency plan on-call system;
- safety parameters display systems (SPDS) and post-accident monitoring system (PAMS) at Units 5 and 6;
- automated information system for off-site radiation monitoring;
- automated information system for on-site radiation monitoring;
- automated aerological sounding system;

- automated control of gamma background in populated areas of the urgent protective action zone;
- automated monitoring system for the hydraulic dual channel mode for technical water supply of Kozloduy NPP and monitoring of the level of the Danube;
- automated meteorological monitoring system;
- six water stations for monitoring the specific volume activity of liquid discharge and sewage waters.

The data from radiation monitoring system, the meteorological monitoring system (MMS) and the source of discharge are used as input data to software for determining protective measures for the personnel and the public. Data from the mobile laboratory for environmental monitoring are received during an accident. Transmission of data to ERC takes place on-line via Tetra radio channel and GPRS. Monitoring at Kozloduy NPP site is carried out with off-road vehicles equipped for this purpose. All these data are sent to the NRA Emergency Centre.

Kozloduy NPP daily receives data from the National Operational Centre of the DGFSCP about any forthcoming extreme weather conditions two days prior to the event from the National Institute of Meteorology and Hydrology and from the Military Air Forces of the Bulgarian army.

The off-site (duplicating) Emergency Response Centre, located outside the plant site in the town of Kozloduy, has been constructed and is in the process of commissioning.

Inventories of available emergency facilities and equipment at the plant site and a list of emergency personnel are attached to the EP of the plant:

- 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 emergency recovery works;
- inventory of mobile equipment required for the safe cooling of the reactors;
- quantity of diesel fuel available.

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

Systematic approach is applied during training in emergency preparedness and response. Training is divided into initial and continuing training, taking into account the specific functions of the URS units. Training programmes comply with the specific responsibilities of the members of the emergency teams and include both theoretical and practical modules. At national level, the training of the first responders is conducted at the Training Centre of the Ministry of Interior for undertaking actions in the event of a nuclear or radiological emergency. The training of Kozloduy NPP personnel is conducted at the plant Training Centre and in the ERC. The training of the NRA emergency team is conducted at the NRA Emergency Centre in accordance with an approved procedure and programmes.

To maintain the emergency preparedness and to improve emergency response actions, the executive authorities, local authorities and entities conduct periodic emergency drills and exercises. Pursuant to the current requirements, a National exercise to verify in practice the elements of the Kozloduy NPP Off-site Emergency Plan is conducted at least once every 5 years.

The national exercises involve the executive authorities, the operator and the entities with responsibilities for the implementation of the Off-site Emergency Plan as well as the local authorities. The assessment of the national exercises is given by an expert committee, which may include representatives of the NRA, MI, ME, BEH etc.

In the period 2019-2022 the following exercises were conducted:

- National full-scale exercise on Accident at Kozloduy NPP scenario;
- Joint exercises between the NRA and Kozloduy NPP - twice a year on a scenario including a severe accident, four drills a year on scenarios covering design basis accidents and transmission of data from FSS-1000, and once a year - a general emergency exercise on a scenario with a severe accident and participation of all emergency teams;
- International exercises among Kozloduy NPP, WANO-MC and WANO-LO to test emergency notification forms - 10 exercises per year.

National full-scale exercise PROTECTION 2019 was held to rehearse part three of the National Disaster Protection Plan - Off-site Emergency Plan of Kozloduy NPP on 19 and 20 November 2019. 18 ministries and departments and four regional headquarters participated in the exercise. The emergency team of the Regional Crisis Centre of WANO-MC and WANO-LO participated in the exercise too.

The exercise scenario covered an accident during SNF transport operations at the NPP site and a multi-unit accident resulting from total blackout and release of radioactive substances to the environment.

Through the exercise conducted the following were checked and evaluated:

- the existing organisational arrangements, the sufficiency of the emergency teams and the technical means at the Kozloduy NPP site to deal 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 management and executive personnel;
- sufficiency of technical resources on site to deal with simultaneous events involving fuel melting at various nuclear facilities on the site;
- sufficiency of diesel fuel and lubricants.

The implementation of the Kozloduy NPP Off-site Emergency Plan during the exercise was monitored by representatives of the DGFSCP-MoI, WANO, IAEA and the Embassy of Japan to Bulgaria.

The overall assessment of the international observers and of the National headquarters management is that the existing organisational 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 among the plant emergency teams and the emergency teams of the external structures, the need for more frequent training and briefings on the Kozloduy NPP communication plan has been identified.

In the period 2019-2022 the NRA participated in international and national exercises (full-scale, computer-simulated) for response actions in the event of various disasters (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 2021 a general emergency exercise to verify a new revision of the Framework Recovery Plan after an emergency at Kozloduy NPP was held for two days. During the exercisethe existing organisational measures, financial insurance and technical means on the Kozloduy NPP site for recovery of the plant after an emergency were evaluated. The sufficiency of Kozloduy NPP emergency teams and the personnel of the organisations carrying out activities during the recovery works at the site and at the precautionary action zone were assessed.

In 2020 and 2021 four additional surprise joint drills were conducted between the NRA and Kozloduy NPP to verify the notification and attendance of emergency team members at their workplaces in the plant ERC and at the NRA Emergency centre.

Regulatory review and control activities

According to the ASUNE the NRA jointly with the specialised state service 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 entity operating the nuclear facility shall develop an on-site emergency plan and shall submit it for approval 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 ASUNE the NRA provides the public with objective information about the status of the 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 population regarding the emergency planning, informing in case of an emergency, as well as for protective actions implemented is available on the NRA’s internet 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 NDPP, 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 broadcasters with national coverage shall ensure the possibility of

making available airtime at any time of the day for live coverage or broadcasting of early 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.

The information policy of Kozloduy NPP upon activation of the On-site Emergency Plan 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. For the purpose, timely and accurate information about the emergency and about the forecasts for its future evolution is planned to be provided to the general public 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 which 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, booklets, meetings and quizzes with students, 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 Situation. Under both Conventions, the NRA performs the functions of a national contact point with the IAEA (USIE-IAEA). The NRA is a contact point also in accordance with the EU requirements (ECURIE-EU).

Since 2018 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. Through this network, countries that ratified the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, can quickly and efficiently request or provide support in the event of a nuclear or radiological emergency. This facilitates the mechanism of the Convention and reduces significantly the time for receiving or providing assistance.

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 and Ukraine.

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 in 2019 between the governments of Bulgaria and Romania on cooperation in the field of emergencies points out that, in addition to the main objective of providing assistance, the competent authorities of the Contracting Parties shall cooperate 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 relevant site-related factors

Overview of arrangements and regulatory requirements relating to the siting and evaluation of sites of nuclear facilities

The authorization regime for determining the location of a nuclear installation (siting) is established in the Act on the Safe Use of Nuclear Energy. In its nature, the authorization regime is a two-stage regulatory activity: an issue of authorization for site selection activities and approval of the selected site by the NRA Chairperson through issuing the relevant administrative instrument, which is the order for 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 organization of public discussions of the EIA report with the participation of representatives of the local authorities, state and public organizations, the competent authority on environment protection, the general public, and the interested natural and legal persons. In the frames of the procedure for the environmental impact assessment, the Contracting Authority makes proposals for future sites where the investment proposal could be implemented. Subsequentlythe most suitable site in terms of both regional characteristics and minimization of the impact on the components and factors of the environment and human health is selected. Accordingly the decision on the EIA Report includes the relevant conditions and measures mandatory for the Contracting Authority, whose implementation is subject to checks and control.

The procedure for granting of a siting permit for a nuclear installation and issue of a site approval order is established by the Regulation on the procedure for issuing licenses and permits for the safe use of nuclear energy. For granting of a site selection permit, together 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 is required to include the results of the study of the 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 should also include:

- site monitoring programmes, including seismic monitoring, groundwater and surface water and monitoring of other natural phenomena;
- a programme for additional site 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 the 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 is necessary to demonstrate that all the factors that may affect safety are identified and assessed and the requirements and criteria for site selection as defined in the Regulation on ensuring the safety of nuclear power plants of 2016 are implemented. The Regulation specifies the engineering studies and investigations of processes, phenomena, and factors of natural and man-induced origin which may affect the safety of the NPP and which should be performed when characterizing the site for identification of:

- characteristics of tectonic activity;
- characteristics of the initial vibratory ground motions in case of an earthquake with a frequency of occurrence of 10^{-2}/year and frequency of occurrence of 10^{-4}/year at the level of the natural terrain of the site;
- hazards of fault displacement of the slopes, capacities for the development of karst, suffosion, and karst-suffosion processes;
- presence of specific ground layers (biogenic, collapsible, swelling, salted, alluvial, man-induced);
- the areas of water-saturated disconnected layers susceptible to liquefaction during seismic effects, and the boundary values of ground acceleration with potential liquefaction;
- impact on the safety of the NPP due to an increase in the level of groundwaters;
- characteristics of rare phenomena, such as tornadoes;
- maximum water level and duration of potential flooding due to precipitation, intensive snow melt, high water level in water bodies, ice pack of the river, avalanche, and landslides;
- the probability of occurrence and the maximum height of the tsunami or seiche waves, extreme precipitation, icing, storm surges, etc.

For the site selection, the impact of a nuclear power plant on the public and the environment by studying the atmospheric, hydrometeorological, hydrogeological, and geochemical conditions of radionuclide dispersion, migration, and accumulation, as well as 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 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 to be achieved should be determined.

According to the Regulation the evaluation of the external events includes:

- identification of all site hazard sources specific to the site and the region for the location of a nuclear power plant;
- screening based on the established criteria;
- evaluation of the parameters of the effects of the selected external events;
- analysis of external events with deterministic and probabilistic methods.

The design of a nuclear power plant should consider single events of natural origin and a combination of casually related or unrelated phenomena and processes (design events) as well as extreme events, which are identified, evaluated and analysed to determine margins to the occurrence of threshold effects and determination of reasonably applicable actions.

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 support systems and may simultaneously affect multiple units on the same site, site infrastructure, regional infrastructure and off-site supplies.

Review of assessments carried out and criteria used for assessment of all the factors specific for the site 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 for the relevant periods of recurrence of external events that could affect safety are defined. Potential consequences of external events, considered in the design basis of nuclear installations are analysed with deterministic methods to verify the selected concept of protection. For protection against rare phenomena and events including extreme external events and phenomena that could affect simultaneously the whole site, reasonably achieved measures are planned.

The site of Kozloduy NPP and the region have been subject to investigation since 1967 when the site was selected for the construction of the first nuclear power plant in 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 evaluations 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 due to some of the 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 those processes and prevent their effects through applying different methods to improve the bedrock.

In 1992 a re-evaluation of seismic loads was carried out at the site of Kozloduy NPP. For the qualified equipment, Review Level Earthquake (RLE) for the recurrence period of 10,000 years was established. 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 standardized mathematical model and the McGuire 1976 and Toro&McGuire 1988 software products.

The seismic levels, design response spectra for free field 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 floor response spectra and relevant three-component accelerograms with a duration of 20 s were determined.

In addition to the geological, engineering geological and investigations of seismic capacity and tectonics of the site and area of Kozloduy NPP, the meteorological and hydrological conditions were also investigated to determine the design basis of the power plant in relation to external hazards, including flooding, temperature, wind loading, etc. The evaluation of flooding hazards considers an accident with the water control structures along the Danube River with the formation of maximum water with the frequency of occurrence of once in 10,000 years. For all phenomena causing floods and flooding, the water amount in the Danube River and the maximum flooding level, which is compared to the existing level at the site of Kozloduy NPP and the crown of the water control structures providing for the service water supply to the nuclear power plant were defined. A conclusion was made that the site of Kozloduy NPP 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 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 region of the plant, the analyses and investigations for their identification according to the distance screening method and probability level were performed. Applying these two methods the man-induced sources within a 30- km area surrounding the site of Kozloduy NPP were identified. The potential sources of the man-induced hazard were evaluated, as follows:

- explosion at the site of Kozloduy NPP and in the stationary and portable sources of explosion located in the vicinity of the plant;
- emergency release of chemical 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 measures for extreme external events affecting all the facilities at the site as a consequence of an earthquake, 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 conclusions of the second special meeting on the Convention on Nuclear Safety held in 2012, additional assessments and safety improvement measures under extreme external conditions causing failure of all on-site facilities deteriorated infrastructure and a loss of access to the site were planned and implemented. Some of the implemented measures 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, deteriorated infrastructure and difficult access to the on-site facilities.

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 secondary natural disasters (tsunami due to earthquakes, mudslides/sediments due to torrential rains)

The layout of Reactor Buildings of Units 5 and 6 at Kozloduy NPP 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 for the seismic re-qualification and ensuring the seismic capacity of safety system equipment and civil structures taking into consideration the increased seismic interactions were identified and implemented.

According to their intended functions, a list of the structures, systems and components (SSCs) required for plant shutdown and maintaining in a safe state under accident and post-accident conditions (safe shutdown equipment list) was prepared. This list includes the SSCs important to safety whose failure may lead to the failure of a safety function.

From 2006 to 2007 the analyses of the post-tensioning concrete containment structure were carried out applying the finite element method and using data from the post-tensioning system and laboratory testing and assessments of the components. The assessment of the containment strength properties was expanded and clarified in 2012 when updating the PSA, Level 2. 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 pre-stressing system. The containment behaviour under severe accident conditions was also analysed determining the limit of 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 following the Fukushima accident confirmed the availability of sufficient margins of the equipment and facilities before the occurrence of boundary effects. As a result there is no need for the application of 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).

In the process of implementation of the Programme for preparation of Units 5 and 6 lifetime extension the stability and functional capacities of the main buildings at the site for another 30 years in terms of the listed below characteristics 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 performed periodic safety review of Units 5 and 6 (in 2016 and 2018 correspondingly). The characteristics determined in the course of the review do not demonstrate any safety deficiencies or factors that have the potential to affect safety in the planned period of operation of the units. The current status of the reviewed measures related to the assessment of the site characteristics provides for the long-term operation of the plant in compliance with the safety norms and standards. The existing functional structure at the Kozloduy NPP for the implementation of the activities related to the monitoring of the site characteristics provides for compliance with the requirements for the equipment, taking into account its intended functions during the long-term operation of the units.

The document assessment demonstrated several good practices for ensuring surveillance and monitoring of the impact of the typical site phenomena. The results of the detailed analysis, the monitoring activities and identification of the trends in the development of the typical impact meet the company goals and provide for the required engineering basis for further engineering assessments for both scope of implementation of the Level 1 and 2 PSA and implementation of new systems and equipment.

Regulatory review and control activities

Following the implementation of the activities related to the investigation, selection, and evaluation of the selected site for the location of a new nuclear plant, in 2015, Kozloduy NPP New Build submitted to the NRA an application for issuing an order for approval of the selected site supported by the required documents.

In 2016 an independent assessment of the preliminary SAR in the frames of the regulatory review for the approval of the selected site for a new nuclear plant in the region of Kozloduy NPP was performed. The assessment reviewed and evaluated the completeness of the submitted data for the site characteristics for both separate parts of the preliminary SAR and the submitted topic reports. Expert assessment of the accuracy and relevance of the information related to the geological, seismic, hydrological, and meteorological characteristics of the site and the region around the site was performed to confirm the lack of elimination factors. For consideration of the issues from the regulatory review of the safety report, including the external assessment, a second revision of the PSAR was prepared and submitted to the NRA.

In February 2020 an order for approval of the selected site for the location of a new nuclear plant was issued based on:

- the results of the assessments performed from 2015 to 2017, which demonstrate the capacity for the location of a new nuclear plant and a lack of elimination factors in terms of safety;
- submitted new revision of the preliminary safety analysis report, which takes into account the remarks and recommendations of the NRA;
- an effective positive decision of the Minister of the Environment and Waters on the EIA Report.

The order conditions provide for implementing monitoring programmes at the site of Kozloduy NPP, including meteorological, hydrological, seismic, geodesic, non-radiological and radiological monitoring.

To continue the licensing process for the construction of a new nuclear plant a design permit is required.

Article 17 (2) Impact of the installation on the public, society, and 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 assessing the radiological consequences in all operating and emergency conditions in a nuclear power plant and, if required, providing for technical and administrative arrangements for ensuring the safety of nuclear power plants requires the safety of the public. 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 site of a nuclear power plant, is defined in the Regulation on ensuring the safety of nuclear power plants.

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, the regulation requires submitting a programme for monitoring the radiation parameters at the site of the nuclear installation and an environmental radiation monitoring programme during its operation.

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

- monitoring of current ground motions - geodesic 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 signalization system for the control room operators;
- monitoring of the regime of the underground waters and monitoring the regime of the surface waters (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, inventory of long-lived sources of ionising 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 a new nuclear unit at the site of Kozloduy NPP 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 plant in the vicinity of Kozloduy NPP specifying the impacts and evaluating their effects on the environment and the public was developed. The unavoidable and lasting effects resulting from the construction, operation, and decommissioning of a new nuclear unit were analysed and compensatory measures were identified. The analysis covers the Bulgarian own territory and the territory of the Republic of Romania as an affected state, as well as the recommendations and requirements of the Republic of Austria 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 the region of Kozloduy NPP will not have a lasting negative effect on the factors and components of the environment and human health, including biological diversity.

In connection with the requirements for publicity and public participation in the assessment process, several consultations with a significant number of national and international institutions, non-governmental organizations, and natural and legal persons were made. There are five public consultations conducted within the Republic of Bulgaria and three in the Republic of Romania. The requirements of the Republic of Austria were also considered.

Article 17 (3) Evaluation of relevant site-related factors

Activities for re-evaluation of the factors related to siting and mentioned in Article 17 (1), ensuring continuous acceptability in terms of safety of the nuclear installation 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 of the safety margins and effectiveness of preventive measures was performed 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 any nuclear facility on the Kozloduy NPP site is capable of withstanding, without the occurrence of severe fuel damage and radioactive releases to the environment were determined. The summarized evaluation shows that the margin for Units 5 and 6 is 0.13g or 65% according to RLE (PGA=0.2g), i.e the units may survive without any fuel damage the 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 effects demonstrates that the SSCs at Kozloduy NPP are capable of providing plant safety for the most credible seismic interaction at the site.

Based on the re-evaluation of the frequency of occurrence and flooding effects at the site, a new maximum water level was determined and its duration was re-considered. The potential for river blockage by ice 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 site of Kozloduy NPP (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 1 and 2 hydroelectric facilities and maximum values for rain precipitation and wind. A probabilistic analysis with a combination of two events: the natural extreme water levels of low probabilities (from 10^{-5} to 10^{-7}) and rupture of Zhelezni Vrata 1 and 2 hydroelectric facilities, was carried out. The estimated water levels are as follows:

- 32.98 m for extreme levels with the probability of 10^{-5}(once in 100, 000 years) and rupture of hydraulic engineering facilities;
- 33.26 m for extreme levels with the probability of 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 10^{-7}(once in 10,000,000 years) and rupture of the hydraulic engineering facilities.

These results confirm that the potential risk of flooding at the site of Kozloduy NPP, which is located at the 35.00 m elevation may be avoided.

The analysis of the resistance to the extreme meteorological events typical for the site (extreme wind, tornadoes, snowfall and icing, extreme temperatures, and extreme rain rainfall) considers the condition of the structures and the presence of protective measures and administrative arrangements ensuring power supply of the consumers at the site and nuclear fuel cooling. The results demonstrate that the plant 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

In the frames of the project for investigation of the Kozloduy site to define the location for the construction of a new nuclear unit, from 2010 to 2015 the following evaluations and investigations were carried out:

- engineering-geological studies of the potential sites;
- modelling of the migration of radionuclides to the subsoil of the potential sites;
- update of the site seismic hazard;
- 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 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. With the identified loads analysis of a combination of extreme meteorological events for the civil structures at the site of Kozloduy NPP was performed. 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.

The typical extreme meteorological events that may occur in the area of Kozloduy NPP are extreme snowfall, including blizzards and snowpacks, extreme rainfall, extreme low and high temperatures, extreme winds, tornadoes and icing. 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 above 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 the site of Kozloduy NPP is monitored monthly (over 100 boreholes). The data is submitted for processing, analysis, and storage to the relevant water control structures experts.

In the frames of the Project for investigation and selection of a site for the location of a new nuclear unit, additional engineering-geological studies related to the potential sites, modelling the migration of the radionuclides to the subsoil, the definition of the seismic design basis, analysis of geophysical fields and contemporary ground motions, climatology and hydrology were performed. The results of the performed additional studies are also subject to independent verification.

The data for the site of Kozloduy is included in the preliminary safety analysis report of the new nuclear unit and are used for the re-evaluation of external effects while performing periodic safety reviews at Units 5 and 6 of Kozloduy NPP.

Regulatory review and control activities

For nuclear installations at the site of Kozloduy NPP, the regulatory review and control activities for re-evaluation of the site-related factors are carried out in the process of review and assessment of periodic safety review (PSR) reports conducted in connection with the renewal of the plant operating licences. According to the Regulation on ensuring the safety of nuclear power plants, the periodic safety review should include the site characteristics considered in the design, and, if required, their re-evaluation by applying up-to-date methods and data. For the implementation of these provisions in connection with the renewal of the operating licences for Units 5 and 6 of Kozloduy NPP the NRA assessed the results of the periodic safety reviews from 2017 to 2019. As part of the regulatory review, in 2018, the NRA requested the conduct of an independent assessment of selected aspects of the periodic safety review, including consideration of site characteristics which were re-evaluated for the needs of designing a new nuclear unit. The results of the independent assessment performed confirmed the adequacy of the planned measures resulting from the Units 5 and 6 periodic safety reviews.

One of the major measures resulting from the PSR is the re-evaluation of the risk of seismic effects during the update of the Level 1, PSA. The activities also include comparative analyses of the results of the effects of load combinations of external hazards compared to the impact and resistance of SSCs.

The supervision for the implementation of the PSR measures included in the integrated programmes for every unit is performed by the NRA based on the final documentation of every measure. Further, 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.

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 nuclear installation are conducted under the Environmental Protection Act, Regulation on the environmental impact assessment (EIA), and in compliance with the Convention on the environmental impact assessment in a transboundary context to which the Republic of Bulgaria is a party.

Accordingly the Ministry of the Waters and the Environment (MWE) notifies 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 site of Kozloduy NPP. Considering the letter to the Ministry of Waters and the Environment received from Austria with the request to provide information about the investment proposal for the construction of a new nuclear unit at the site of Kozloduy NPP, Austria was notified and informed about the access to the technical specifications for the scope of the EIA, the EIA report, which is available on the website of the Ministry of Waters and the Environment, and written consultations were made. 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 evaluation of the impact of the investment proposal for the construction of a new nuclear unit at the site of Kozloduy NPP on the environment and human health, and preventive actions to limit the transboundary impact 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 Romania, Greece, Turkey and Serbia on early notification of a nuclear accident and exchange of information about nuclear installations. According to these Agreements, the Contracting Parties shall notify each other if they have plans for the construction of new nuclear installations 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

Overview of the arrangements and regulatory requirements concerning the design and construction of nuclear facilities

The main criteria and rules for nuclear safety and radiation protection of nuclear power plants, as well as administrative arrangements and technical requirements for ensuring safety during siting, design, construction, commissioning and operation, are defined in the Regulation on ensuring the safety of nuclear power plants. According to this Regulation, the safety of a nuclear power plant is ensured by the implementation of the defence-in-depth concept, which is the main tool for prevention and mitigation of the consequences of accidents and is ensured by a suitable combination of:

- effective management system with a clear commitment of the plant management to ensuring the priority of safety and development of a high safety culture;
- selection of a suitable site and integration of the conservative design with suitable engineering solutions, which provide for diversity, redundancy and safety margins mainly by use of:
    - design, technology and high-quality material and reliability;
    - control and protection systems, and design features for the reactor installation;
    - a proper combination of inherent plant features and engineered safety features.
- detailed operating procedures and emergency operating procedures.

The defence-in-depth concept is implemented in the design through the provision of multiple physical barriers and multiple levels of protection ensuring protection against the impact of ionising radiation and mitigation of consequences in case of failure of preventive measures. The number of the required physical barriers is defined based on the evaluation of the inventories of the radionuclides which could be discharged to the environment, the effectiveness of the separate barriers, their vulnerability to internal and external effects, as well as potential consequences in the event of a barrier failure.

The design of a nuclear power plant provides for independent physical barriers for every significant source of ionising radiation. The evaluation of the risks due to sources of ionising radiation covers all risks caused by the whole nuclear fuel at the site of a nuclear power plant as well as the risks caused by other sources of ionising radiation.

The levels of protection are designed to prevent as much as reasonably achievable:

- the conditions resulting in compromising the integrity of physical barriers;
- failure of a physical barrier, if there are conditions under the previous subitem;
- failure of a physical barrier as a result of the failure of another physical barrier;

- the potential for adverse consequences as a result of errors during the operation and maintenance of structures, systems and components (SSCs).

When implementing the defence-in-depth, independence and effectiveness at each level of protection are provided so that the loss or inefficiency of a level of defence will not affect the potential for implementation of the defence at the other levels.

The independence of the SSCs performing safety functions at a different level of defence is provided by the simultaneous fulfilment of the following conditions:

- potential to perform the required safety functions will not affect the functionality or non-functionality of the SSCs which are involved in the safety functions at the other levels of defence;
- potential to perform the required safety functions will not affect the consequences of the postulated initiating events, including external and internal hazards, which require the functioning of the relevant SSC.

The design should provide for sufficient effectiveness at the first two levels of defence to avoid progression into accidents of all failures and abnormal operation, which is likely to occur throughout the lifetime of a nuclear power plant.

The systems and engineered safety features to prevent fuel melt accidents and should be independent from the engineered features designed to perform safety functions in postulated severe accidents to a level so as avoid the performance of these functions.

The defence-in-depth concept is applied throughout the entire lifetime of a nuclear power plant. Depending on the performed works, independent levels of defence are defined, which prevent from a single technical, human or organizational error or non-conformity to lead to significant harmful effects, and a combination of such errors or deficiencies is of a very low probability.

The Regulation requires that the design basis defines the required features of a nuclear power plant and relevant SSCs to perform safety functions as follows:

- ensuring safe operation within the justified limits and conditions throughout the plant lifetime;
- confinement of the potential radiological impact at the site of a nuclear power plant so that in all operating states and accidents without fuel melt to avoid reaching the intervention criteria for the application of protective measures for the public;
- prevention of the progression of accidents and fuel melting in the reactor core and spent fuel storage pools;
- prevention of early and large radioactive releases to the environment;
- limitation of the consequences of potential releases in the event of accidents which could not be avoided, localization of the radioactive material for a long period and maximum delay in the time of potential release.

Status with regard to the application of the defence in depth concept for all nuclear installations; ensuring multiple fuel protection levels of the containment primary boundary considering the internal and external events and the impact of the following natural events

The design of Units 5 and 6 at Kozloduy NPP was developed in the early 80s based on the WWER-1000/B-320 Russian design. The safety principles and criteria, on which the original design is based, are included in the technical justification of safety. The basic design principles and safety criteria are defined in compliance with the General provisions for ensuring the safety of nuclear power plants during design, construction and operation (ОПБ-88/97), 1998.

The main principle incorporated in the design basis is ensuring the protection of the personnel and the public against external and internal exposure, and the protection of the environment against radioactive material contamination. The conservative approach was applied to the design, which provides for the 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 normal operation equipment, which may be combined with a long-lasting hidden failure of another item. Simultaneously with the failure of a normal operation item, a failure of an independent active protection item and one of the independent active localization items is considered. The protection and localization equipment perform their safety functions in all design accident conditions considered, including so called "maximum credible design basis accident" and they have features capable of performing its functions, and triple redundancy, including power supply. The primary coolant circuit is located entirely in the containment structure. All penetrations in the containment walls are equipped with localization items, designed 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 main 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 carried out using up-to-date computer programmes show that reliable levels of protection, including maintaining normal operation, preventing accident development and mitigation of the consequences of design basis accidents are ensured. Moreover, the analyses confirm that safety is also ensured during beyond design basis accidents without significant core damage, including anticipated transients without scram. Specific components and systems are installed to reduce the consequences of beyond design basis accidents to protect the personnel and the public.

For the external initiating events of natural origin - in the process of the stress tests conducted at Kozloduy NPP it was demonstrated that the margin of Units 5 and 6 for an earthquake is 0.13 g or 65% compared to RLE (PGA = 0.2 g), i.e. the units are capable of withstanding without fuel damage to an earthquake of 1.65 times higher the RLE. The equipment important to safety and included in the emergency scenarios is analysed for seismic capacity and their fragility curves are defined. The limit values of the peak ground accelerations that nuclear installation at the site may withstand without severe fuel damage and radioactive release to the environment are determined. The analysis and the evaluations of the margins during the stress tests showed that in terms of seismic hazards, the SSCs important to safety withstand a combination of seismic loads of up to 0.26 g without a loss of their safety functions and the threshold effects and a loss of robustness and lifetime may be expected for seismic effects 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 capacity of the SSCs in Kozloduy NPP is capable of providing plant safety for maximum credible seismic effects at the site.

Further, for stress tests the maximum water level (MWL) of the Danube River and the duration of high waters is defined, the potential for ice packs on the Danube River is analysed, and the potential for a combination of MWL and other adverse hazards is evaluated. The analysis results confirm the natural flooding protection of the site of Kozloduy NPP.

In compliance with the layout of Kozloduy NPP, Unit 5 and 6 infrastructure and the buildings are located on solid loess soil, insusceptible to collapse in the region where no mining works have been performed before. In the construction phase, unstable soils were removed and a

waterproofing cover was laid on the loess base, which protects both groundwaters and serves as a barrier, a level of protection against the spread of radioactive products to groundwater.

Use of design principles, such as passive safety or the safe failure, automation, physical and functional separation, redundancy and diversity for different types and generations of nuclear installations

The design of the SSCs important to safety at Units 5 and 6 of Kozloduy NPP incorporates design solutions based on the principles of passive operation, safe failure, and inherent safety features (self-control, thermal inertia and other natural processes). The presence of inherent protection and passive elements of safety systems provides for significant safety margins for a successful shutdown and long-term reactor cooling.

The specific technical solutions, applied to the design of the safety system, are related to the implementation of the requirements of the relevant regulations – redundancy, physical separation and diversity. The multitrain design enables the safety system to perform its functions despite a potential failure of a train (single failure). The automatic equipment is actuated by signals generated through a comparison of several measurements in order to prevent spurious actuation of safety systems in the event of an occasional deviation in measurement. Following safety system actuation, their operation cannot be interrupted until they have fulfilled their functions related to bringing the units to a safe state. The trains are physically separated through their location in a separate room and separate cable routes. The diversity of the physical principles for implementing the safety system functions is applied to the design by using both active and passive devices. The combination of redundancy, diversity and physical separation ensures the robustness of safety systems to 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 overpressure protection system designed for prevention of the overpressure in the containment and maintaining the localization safety function;
- installation of a containment hydrogen recombination system;
- system for monitoring and control of the concentration of water steams and oxygen in the containment in the event of a severe accident;
- installation of high-temperature resistant plugs for prevention of an early containment bypass in the event of severe accidents at Units 5 and 6 of Kozloduy NPP;
- alternative SG make-up system energized by 6 kV or 0.4 kV mobile diesel generators (MDG);
- safety parameter display system designed for ensuring highly reliable information for the operating staff during emergency power and post-accident conditions;
- reactor 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 temperature monitoring sensors for radiation measurement in the containment having the measurement range 10^{9} Bq/m^{3}÷10^{15} Bq/m^{3}; 10^{-2}÷106 Gy/h were 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 storage pool cooling system for redundancy of an off-site source;
- power supply of reliable power supply buses by a mobile diesel generator - 6kV buses are energized with simultaneous failure of the stationary DGs;
- a battery charging diagram for the safety system trains from 0.4 kV mobile diesel generator;
- replacement of the batteries of the three trains of the safety systems with new batteries which have a sufficient capacity to provide power supply of the required consumers for 11 hours;
- power supply from a battery of the primary gas removal valves and main steam relief valve between the primary circuit and hydroaccumulators for severe accident management;
- an additional pipeline for direct water supply to the Wet Nuclear Spent Fuel Storage Facility from an off-site source.

The implementation of specific measures, where necessary, should preserve the containment physical integrity to prevent the continuous external contamination and especially activities undertaken or planned for dealing with extreme weather conditions, which 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 capacity of the containment structure to fulfil the function of confining radioactive material during accident conditions corresponding to fuel melting accident have been improved to a significant extent.

The investigation of the options for localization of the core melt during severe accidents shows that it is necessary to feed coolant at a high rate at the appropriate time to the containment where the melt is located to localize its place of generation. This is combined with all other actions for severe accident management, such as pressure reduction in the core, management of conditions in the containment structure, pressure reduction in the secondary circuit, and water supply to the steam generator depending on the specific situation. These actions are included in the severe accident management guidelines of 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 the equipment important to safety;

- improvement of the upgrading of the SSCs and monitoring of the structure support systems;
- update of the emergency procedures as a result of the implemented accident management measures;
- seismic risk analyses;
- fire risk evaluation and modernization of the fire extinguishing and fire detection systems.

Regulatory review and control activities

The modifications of SSCs important to safety are carried out after granting a permit under the ASUNE and the conditions specified in the Regulation on the procedure for issuing licences and permits for the safe use of nuclear energy. The Regulation defines the documents the applicant should submit for review and evaluation. The review of the submitted information includes the evaluation of compliance with the regulatory requirements for safety and instructions of the regulatory guidelines. The IAEA safety standards are applied. If special knowledge for the performance of the evaluation is required, then the expertise will be requested from external maintenance organizations is requested. The evaluation results are recorded in the statements on which the permit for the implementation of the change is made.

The modification made is subject to follow-up inspections.

Article 18 (2) Incorporation of proven technologies

Measures and regulatory requirements for the use of technologies proven by experience or qualified by testing or analyses

According the Regulation on ensuring the safety of nuclear power plants, the design should provide for the use of qualified components proven in practice or by experimental tests in order to ensure the required reliability, effectiveness and independence of the SSCs important to safety. The design solutions applied in the evolutionary designs of a nuclear power plant are validated in the existing NPPs. When this is not possible, safety is justified by the use of the results of supplementary research programmes or based on the experience gained in other relevant applications. Based on the results and lessons learned from the operational experience, safety analysis and studies conducted, a reassessment is made of the demand and advantage of design improvement beyond the established practice. When innovative or non-validated design solutions are introduced, compliance with safety requirements is demonstrated by an appropriate supplementary programme for advanced trial testing and validation of the relevant features.

All SSCs important to safety are classified by safety classes based on their function and safety relevance. 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.

In 2021 the NRA developed and published a regulatory guide Qualification of structures, systems and components important to the safety of nuclear power plants. It provides guidance on the requirements for qualification, qualification methods, ensuring qualification during operation, qualification recording and arrangement of the qualification activities. The guide also includes guidance applicable during the performance of the safety peer review in terms of the qualification of SSCs.

Measures taken by the licensees to use proven technologies

There is a configuration management system in place at Kozloduy NPP. Every design change is implemented according to a specific technical modification which specifies the requirement to the SSCs taking into consideration their classification and qualification status.

The existing information system for the arrangements of the operating activities ensures that all phases of planning and implementation of the technical modifications are performed after the review of the process owners. Every design change 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 required reliability, effectiveness and independence of the SSCs important to safety, the design should use recognized practices or experimentally tested and qualified components.

The operating conditions of components important to safety and structures are simulated by verification tests and full-scope simulator tests, and, if non-feasible, alternative methods of proven equivalent effects shall be used. According to the regulatory guide for qualification of the SSCs important to safety, internationally recognized methods are applied, as follows:

- testing of an equipment sample;
- analyses including a comparison to already qualified items;
- application of the relevant operating experience with a similar application of the equipment.

Reviews and analyses for compliance with the existing programmes for qualification of systems important to safety were performed in the frames of the planned measures of the integrated safety improvement programmes.

The relevant analyses for confirming their applicability and safety effects were performed for all new digital control systems and instrumentation commissioned at Units 5 and 6 in the considered period. The cables of the reactor temperature control system and pressurized which were part of the emergency and alarm protection trains, safety control systems and normal operation systems were replaced. All modifications related to the new equipment were validated by tests for compliance with the design characteristics, including harsh work environment (LOCA, HELB and fire resistance capacity) and are documented with the relevant certificates, records and reports.

Regulatory review and control activities

The documents for analyses, inspections and tests performed are submitted to the NRA by the licensee as part of the documentation for issuing the relevant permits for the modifications.

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

Overview of measures and regulatory requirements for reliable, stable and easily manageable operation specifically considering the human factor and human-machine interface

The Regulation on ensuring the safety of nuclear power plants provides for 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), emergency control room (ECR), 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 and protection systems are designed to automatically

trigger the required systems, including reactor shutdown, 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 a nuclear power plant is tolerant to human errors as low as practically achievable;

- the actions assigned to the operational staff have been identified to ensure safety and the analyses of operational decision-making tasks 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 operating conditions are designed to take into account the ergonomics principles and allow reliable and efficient task performance;

- all actions that should be performed for a short time shall be automated;

- sufficient and reliable communication between the main control room and emergency 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 detail in Article 12.

Implementation measures taken by the licensee

There is an option for control and monitoring of all process safety systems and systems important to safety, as well as taking measures to maintain the unit in a safe state and restoration to this state in case of any deviation from normal operation from the MCR.

For the past three years measures related to the implementation of the additional warning signalization for control of the condition of safety system items and diagnostics of the fire detection system have been implemented.

In the main control room, there is signalization for monitoring of the SFSF parameters, radiation conditions and process parameters important to safety.

After the modernization of the instrumentation and control systems, a new workstation for control and monitoring of the normal operation systems was installed in the ECR. It enables the

staff to receive access to full information about the condition of the plant's normal operation system equipment. In the normal operation modes, the workstation functions as an information system.

In situations when the MCR is inaccessible, there is an option for full control not only of the safety systems but also the normal operation systems from the ECR. There is a physical, electrical and functional separation between the equipment installed in the MCR and the ECR.

The management and organizational aspects related to human factors are discussed in Article 12.

Regulatory review and control activities

The regulatory review and oversight activities are described in Article 18 (1) and are carried out under the current regulations and internal rules (see also Article 7 (2) (iii).

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 Nuclear Regulatory Agency. 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 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, including scientific ones, analysis of the accumulated operating experience, as well as the data on approved applied technologies, design solutions 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 onsite inspection by the NRA to be performed to confirm the compliance of the set data and circumstances 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 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 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 for Operation) 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 noncompliance 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. All events 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.

If the operational limits and conditions need to be changed, the safety significance of the change shall be assessed. The changes in the operational limits and conditions may result from the implementation of technical modifications of SSCs important to safety, by operating experience, by changes in the status of the nuclear facility, or by the analysis of significant operating events. The proposed changes shall be thoroughly analysed for possible consequences, following an approved plant procedure. The change justification shall be submitted to the NRA accompanied by an application for issuance of a permit for implementing changes of the Technical Specifications.

Regulatory review and control activities

The NRA 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 operational instructions and procedures shall be clearly identified, 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 prepared before 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 that are important to safety and the implementation of new repair technologies. 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.

According 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 shall comprise operating procedures, schedules and testing procedures and control of the systems important to safety, including operating procedure for control of the parent metal and welded joints of equipment and pipelines, a schedule for maintenance and repair of the main equipment and an ageing management programme for the duration of the licence.

Developing of operational 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 design and technical documentation, operational limits and conditions, results of commissioning tests - initial and after each outage, taking into account modifications made of 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;
- programmes and procedures for testing, maintenance, commissioning, decommissioning;
- procedures to perform various activities - procedures for reporting events, design modifications, operational relationships, conduct of operations, etc.;
- emergency procedures and instructions, 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 supervisory authority;
- to be developed by qualified experts 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 controlled documents in terms of format and contents as well as the documents periodic review are specified by quality procedures. The management system allows using only the up-to-date revision 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. There is a practice in place that the most experienced personnel is involved in the process of developing operating or test procedures. The verification and validation of the operational documents is done with the participation 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. The programmes and procedures for maintenance, testing, supervision and inspection shall be implemented when carrying out the relevant activities. Check-lists for step-by-step implementation and recording of the results received are annexed to them.

Incorporation of operational procedures into the management system of the nuclear installation

The document management at Kozloduy NPP is performed by the auxiliary process Management of documents and records of the integrated management system. The process ensures 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 and area of application. The operating procedures occupy the lowest hierarchical level of the working documents, which include specific details, methods and responsibilities for the execution of specific tasks by the personnel.

Regulatory review and control activities

The 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 operational documents, whose changes requires the issue of a permit. The annex include documents such as the Technical specifications and emergency response procedures, metal control, radiation protection, physical protection, RAW management, radiation monitoring.

During the period under review, inspections were carried out for the practical application of the operating, maintenance and testing procedures in the following areas: Implementation of measures related to maintenance and enhancement of safety, localising safety systems, ensuring fire protection, ageing management of cables and power transformers, metrological provision of the measuring devices and measuring channels of the systems important to safety, control on high-risk equipment, organisation of the activities on ensuring, storage and maintenance of spare parts for the systems important to safety, and Units 5 and 6 design modification management.

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 impaired safety functions are defined in the symptom-based emergency procedures, which replace event-based emergency procedures. SBEP are developed for unit operation at power, at low power and a sealed reactor, shut-down and depressurized reactor and include instructions: for response actions in the event of emergency conditions in the spent fuel pool. They are introduced after successful verification, validation and simulator training of the staff.

The SBEP set for practical application includes:

- diagnostic procedure;
- procedure for operation at total 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.

According to Kozloduy NPP internal rules 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. Two types of SAMGs are available - one for MCR/ECR (two-column format) and one for the Emergency Response Centre (ERC) (in graphical text form).

An extensive research and analysis of processes as well as of the introduced design modifications regarding the severe accidents were performed within the SAMG development process. In the end of 2012 SAMGs were implemented corresponding to operation at power, at

low power and shutdown reactor with a sealed primary circuit. Additionally the following SAMGs were introduced in 2015:

- SAMG for station blackout at a shutdown unit;
- SAMG for depressurized reactor;
- SAMG for the underwater refuelling pool at a shutdown unit;
- SAMG for the reactor spent fuel pool;
- SAMG 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

In order to implement the measures of the National Action Plan, following the 'stress tests' conducted, a procedure for actions of the emergency teams in case of simultaneous occurrences at various nuclear facilities on Kozloduy NPP site was developed. The procedure includes organisational measures for the actions of the emergency teams, the mobile equipment located on the site and in the PAZ, 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 licensee related to addressing disruptions 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. In all cases where the licensee requests to make changes to the SSC or operational documents, it is assessed whether the change has an impact on the SBEP or the emergency procedures. 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 divisions - Engineering Support and Maintenance.

The Engineering Support Division focuses on the activities of management of modernisation and reconstruction of SSCs, safety analyses and assessments, scientifically-applied projects and research, analyses of the results of the periodic tests of safety systems and coordination of activities related to long-term operation. All engineering support activities are performed according to procedures and instructions stipulating the order, rules, requirements, responsibilities and interactions between internal organisational structures and external contractors.

The engineering and technical maintenance of the repair activities is carried out by the Maintenance Division. In the case of outsourcing, the Division prepares the technical specifications and terms of references, performs the technical evaluation of the tender documents, supervises activities during the execution and the acceptance of the maintenance works that are carried out. These activities are regulated by internal instructions and procedures.

The resources needed to maintain the nuclear facilities are planned in the Company's Business Plan in order to supply the necessary spare parts or new equipment or to choose contractors.

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 the conventional equipment (turbine, electric generator and pump units) are carried out by specialised external organisations under contracts concluded. For the specific equipment, service contracts have also been signed.

Regulatory review and control activities

The Kozloduy NPP Business Plan 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. 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 Terms and Procedures for Notification of the Nuclear Regulatory Agency for Events at Nuclear Facilities, at Sites and during Activities with Sources of Ionising Radiation and in Transportation of Radioactive Substances (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 notification format and the content requirements 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 licensee shall notify the NRA of other events that are not classified in the three categories when it considers that these events are potentially important for the 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: operational events important to safety, which are included in the Regulation for Notification (deviations, incidents, and accidents);
- Category 2: operational events which are not safety significant but have consequences for the normal operation and/or operability of the SSC;
- Category 3: operational 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.

Kozloduy NPP internal rules specify also the order for reporting and analysis of the different event categories.

12 events (Annex 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:

- 2019 - 4 events;
- 2020 - 3 events;
- 2021 - 5 events.

During the reviewed period (2019-2021), 100 events, which are not subject of reporting to the NRA (category 2, 3 and 4 events) were additionally analysed.

Documentation and publication of reported events and incidents by the licensee 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. Along with the electronic database, the detailed information on the event and additional materials used to perform the analysis are stored also on paper throughout the whole operating period of the nuclear installation.

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 them in the plant information network (intranet).

According to ASUNE and the Regulation for Notification, the NRA publishes information on the reported events that occurred at the nuclear facilities on its web site. Additionally, information on the events is provided in the NRA Annual Report in the section regarding nuclear safety and radiation protection. The reports for the past 10 years are readily available on the NRA website. Events, which are interested in terms of operating experience, are also reported to the International Reporting System of 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 licensee, and the final assessment according to the same scale is determined by the Chair of the NRA. In 2021 the NRA published guidelines defining the significance of the operating events regarding 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 the Procedure for the work of the Events Analysis Group. The Group is convened periodically and carries out independent analyses of the operational events, discusses the corrective actions taken by the licensee 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 published in the International Reporting System of Operating Experience (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 sequence for the events, the analyses performed, the corrective measures adopted and their effectiveness. Inspections are also performed should more significant events occur. Inspections focused on the implementation of the corrective measures undertaken on reported events including those related to human factor are held during the reporting period.

Article 19 (7) Operating experience feedback

Regulatory requirements to the licensee to collect, analyse, and share operating experience

The Regulation on Ensuring the Safety of Nuclear Power Plants requires the licensee 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 measure should be implemented, and good practices should be considered.

The information related to operating experience should be communicated to the relevant staff, to be shared with all interested national and international organisations and to be 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 licensee 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.

Licensee 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 Committee to review and assess the feasibility of operating experience and Council on operating experience (COE) are established at the plant.

The Committee is a permanently acting body, having its meetings not less than once per month. It reviews the information received from external operating experience. If needed, the Committee assigns an additional review by subject-matter experts and the proposals for corrective measures are assessed before being submitted for approval by the COE.

The Council on operating experience 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 (plant) operating experience and the Programme for the use of external (industry) operating experience.

Programme for utilization of the internal operating experience

The internal operating experience sources are operating 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 - defining the direct, indirect and root causes;

- analysis of trends in low-level events and near misses and defining 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 Screening Committee to review and assess operating experience, perform comparative analysis and identify the relevant corrective measures to be presented to the COE for taking the final decision on the implementation;
- implementation and reporting on the corrective measures to prevent recurrence of similar events;
- Assessment of the effectiveness of the implemented corrective measures.

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, for identifying the causes for event occurrence and the relevant corrective actions, which if implemented would significantly lower the possibility of event recurrence.

Significant low level events (LLE) and near misses (NM) are registered as comments in the Organisation of the operating activity information system. These events are reviewed, classified and coded defining LLE and NM and these are further trended and trend analysis is performed.

Events categories 1 and 2 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 performed for category 1 operating events (to be reported to the NRA) and events, which recurrence is identified regardless of their category. Category 1 and 3 category events, which are not defined as recurrent, the requirement for the minimum depth of analysis is as following: Defining the direct cause and contributors - for category 2 events; and defining 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 Committee for review and evaluation of operating experience, 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, correct deficiencies in the written procedures and other documents, and eliminate organisational weaknesses.

Information from operating experience (both internal and external) 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, since their publishing and, thus, the review procedure is specified in a plant procedure.

Regulatory review and control of the licensee'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 organisation and implementation of activities, instructions and procedures, organisation and practice of utilizing external experience, information exchange channels with international organisations (IAEA and WANO), and the means of communication of operating experience among plant personnel and external organisations. The results and efficiency of the system are evaluated.

Every quarter the licensee 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). The current operating licence of the WSFSF was issued in 2014 for a 10-year period.

From the WSFSF, the WWER-440 SNF is transported to the Dry Spent Fuel Storage Facility (DSFSF). The current operating licence of the DSFSF was issued in 2016 for a 10-year period. At the end of 2021 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 temporarily 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 administrative dose limits and radiation protection programmes.

Kozloduy NPP has adopted an approach aimed at transferring all currently generated RAW to the State Enterprise Radioactive Waste for processing and gradually release the facilities from the historically accumulated RAW.

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, prevent the spread of radioactive contamination, and 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 licensee 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 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 by an accredited laboratory, 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 Inspection Plan, 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, fulfilment of the DSFSF operating licence conditions, 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.

Annex 1 - List of operating events at Kozloduy NPP reported for the period 2019 to 2021

Date	Site	Description	INES level
03 July 2019	Unit 6	Disconnection of Unit 6 generator from the national grid	0
01 August 2019	Unit 6	Trip of two main coolant pumps of Unit 6	0
16 November 2019	Unit 5	Trip of one main coolant pump of Unit 5	0
26 November 2019	Unit 6	Disconnection of Unit 6 generator from the national grid	0
15 May 2020	Unit 5	High temperature of a pump bearing of the planned and emergency cooling of primary circuit	0
19 May 2020	Unit 5	Unplanned actuation of automatic incremental loading in a safety system train	0
18 August 2020	Unit 5	Increasing of the temperature of a pump bearing of the planned and emergency cooling of primary circuit	0
22 January 2021	Unit 5	Unit 5 reactor scram triggering	0
25 May 2021	Unit 6	Power reduction up to 50% of the nominal power of Unit 6	0
17 August 2021	Unit 5	Failure of a valve during stipulated testing of Unit 5 safety system train 2	0
11 September 2021	Unit 5	Power reduction up to 45% of the nominal power of Unit 5	0
30 October 2021	Unit 6	Unit 6 reactor scram triggering	0

Annex 2– List of the peer reviews conducted in Bulgaria

1. IAEA Assessment of Safety Significant Events Team (ASSET) Mission, Kozloduy NPP, Units 1-4, November 1990;
2. IAEA Safety Review Mission (SRM), Kozloduy NPP, Units 1-4, June 1991;
3. IAEA Operational Safety Assessment Review Team (OSART) Mission, Kozloduy NPP, Units 5 and 6, July 1991;
4. IAEA Assessment of Safety Significant Events Team Follow-Up Mission (ASSET Follow-up), Kozloduy NPP, Units 1-4, June 1992;
5. IAEA Safety Review Follow-Up Mission (SRM Follow-up), Kozloduy NPP, Units 1-4, April 1993;
6. IAEA Assessment of Safety Significant Events Team Final Mission (ASSET Final), Kozloduy NPP, Units 1-4, September 1993;
7. IAEA Assessment of Safety Significant Events Team (ASSET) Mission, Kozloduy NPP, Units 5 and 6, November 1994;
8. IAEA Safety Review Mission (SRM) – Modernisation Programme, Kozloduy NPP, Units 5 and 6, June 1995;
9. World Association of Nuclear Operators (WANO) Peer Review – Kozloduy NPP, Units 5 and 6, November 1995;
10. IAEA International Physical Protection Advisory Service (IPPAS) Mission, November 1996;
11. IAEA International Regulatory Review Team (IRRT) mission to assess the regulatory infrastructure for nuclear safety and radiation protection, NRA, November 1997;
12. IAEA Assessment of Safety Significant Events Team (ASSET) Mission, Kozloduy NPP, Units 5 and 6, November 1997;
13. Mission under the PHARE Programme for review of the activities associated with Probabilistic Safety Analyses, Level 1 (PSA level 1), Kozloduy NPP, Units 5 and 6, November 1998;
14. IAEA Operational Safety Assessment Review Team (OSART) Mission, Kozloduy NPP, Units 1-4, January 1999;
15. IAEA mission on preparation, validation, and verification of emergency procedures, Kozloduy NPP, Units 5 and 6, August 1999;
16. Targeted review by the Western European Nuclear Regulators' Association of the European Commission (WENRA, EC), Kozloduy NPP, Units 1-4, October 1999;
17. IAEA Safety Review Mission (SRM) – Modernisation Programme, Kozloduy NPP, Units 5 and 6, July 2000;
18. IAEA Safety Review Mission (SRM) – Modernisation Programme, Kozloduy NPP, Units 1-4, October 2000;
19. IAEA Operational Safety Assessment Review Team Follow-Up Mission (OSART Follow-Up), Kozloduy NPP, units 1-4, January 2001;
20. IAEA International Physical Protection Advisory Service Follow-Up Mission (IPPAS Follow-up), February 2002;
21. IAEA Safety Review Follow-Up Mission (SRM Follow-up) - Modernisation Programme, Kozloduy NPP, Units 3 and 4, October 2000;

22. IAEA International Regulatory Review Team (IRRT) mission to assess the regulatory infrastructure for nuclear safety and radiation protection, NRA, June 2003;
23. World Association of Nuclear Operators (WANO) Peer Review – Kozloduy NPP, Units 3 and 4, November 2003;
24. European Commission Atomic Questions Group (EC AQG) Peer Review – Kozloduy NPP, Units 3 and 4, November 2003;
25. IAEA Safety Review Follow-Up Mission (SRM) - Modernisation Programme, Kozloduy NPP, Units 5 and 6, 2008;
26. World Association of Nuclear Operators (WANO) Peer Review – Kozloduy NPP, Units 5 and 6, June 2009;
27. World Association of Nuclear Operators (WANO) Follow-Up Mission – Technical Support – Kozloduy NPP, Units 5 and 6, November-December 2011;
28. World Association of Nuclear Operators (WANO) Peer Review – Technical Support and Preparation for an OSART Mission – Kozloduy NPP, Units 5 and 6, February-March 2012;
29. IAEA Operational Safety Assessment Review Team (OSART) Mission, Kozloduy NPP, Units 5 and 6, November 2012;
30. IAEA International Regulatory Review Team (IRRT) Mission to assess the regulatory infrastructure for nuclear safety and radiation protection, NRA, April 2013;
31. IAEA mission on probabilistic safety analysis (IPSART), Kozloduy NPP, Units 5 and 6, June 2013;
32. World Association of Nuclear Operators (WANO) Peer Review – Kozloduy NPP, Units 5 and 6, December 2013;
33. IAEA Operational Safety Assessment Review Team Follow-Up Mission (OSART Follow-up), Kozloduy NPP, Units 5 and 6, June 2014;
34. World Association of Nuclear Operators (WANO) Follow-Up Mission – Kozloduy NPP, Units 5 and 6, June 2015;
35. World Association of Nuclear Operators (WANO) Peer Review for Technical Support – Kozloduy NPP, Units 5 and 6, March 2016;
36. IAEA International Regulatory Review Team (IRRT) Follow-Up Mission to assess the regulatory infrastructure for nuclear safety and radiation protection, NRA, April 2016;
37. IAEA Pre-SALTO Peer Review to Kozloduy NPP, Unit 5, 26 July – 3 August 2016;
38. WANO Corporate Peer Review (CPR) to Kozloduy NPP and BEH EAD, 31 October – 9 November 2016;
39. World Association of Nuclear Operators (WANO) Technical Support Mission on: Trend analysis in all plant operations areas – Conduct of Operations, Maintenance and Repair, Engineering Support, Monitoring and Analysis, Kozloduy NPP, 3 – 6 April 2017;
40. IAEA Pre-SALTO Mission to Kozloduy NPP, Unit 6, 19 – 27 June 2018;
41. World Association of Nuclear Operators (WANO) Peer Review to Kozloduy NPP, Units 5 and 6, 24 November – 8 December 2017;
42. IAEA Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning, and Remediation (ARTEMIS) Mission to Bulgaria, 10 – 20 June 2018;
43. WANO Member Support Mission on: 'Use of Instructions for Routine Maintenance Works', Kozloduy NPP, 9 – 11 July 2018;

44. WANO Member Support Mission on: ‘Deterministic Assessment Methods’, Kozloduy NPP, 5 – 7 November 2018;
45. First thematic peer review: ‘NPP Ageing Management Review’ pursuant to the requirements for conduct of thematic peer reviews in compliance with Article 8d (3) of Chapter 2a (Peer Reviews and Reporting) of Council Directive 2014/87/Euratom and the ENSREG Plan for participation of the interested countries, completed in November 2018 with the issue of a report.
46. WANO Member Support Mission on: ‘Operator Training Approaches’, Kozloduy NPP, 3 – 6 December 2018;
47. WANO Member Support Mission on: ‘Instructor for admitting to work permit and before switching equipment’, 25 – 28 March 2019;
48. WANO Corporate Follow-up Peer Review (Follow-up CPR) to Kozloduy NPP and BEH EAD, 30 September – 04 October 2019;
49. WANO Follow-up Peer Review at Kozloduy NPP, 11 – 15 November 2019;
50. WANO Peer Review Pre-visit in connection with the organisation by the WANO MC of a Design-Informed Peer Review (DIPP) at Kozloduy NPP in 2021, 09 – 14 May 2021;
51. IAEA Safety Aspects of Long Term Operation (SALTO) Mission, Kozloduy NPP, Units 5 and 6, 06 – 15 July 2021;
52. WANO Design-Informed Peer Review (DIPP) in the Crew Performance Observation (CPO) area in 2021, 13 – 24 September 2021;
53. WANO Design-Informed Peer Review (DIPP), Kozloduy NPP, 25 November – 10 December 2021

List of Abbreviations

ALARA	As Low As Reasonably Achievable
BAS	Bulgarian Academy of Sciences
BEH	Bulgarian Energy Holding
BPS	Bank Pumping Station
CA	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
ICA	Inside Containment Area
IMS	Integrated Management System
INRNE	Institute for Nuclear Researches and Nuclear Energy
KIDSF	Kozloduy International Decommissioning Support Fund
LPZ	Long-Term Protective Action Zone
LTO	Long-term operation
MCR	Main Control Room
ME	Ministry of Energy
MEW	Ministry of Environment and Water
MH	Ministry of Health
MI	Ministry of Interior
MIA	Ministry of Interior Act
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
NIMH	National Institute of Meteorology and Hydrology
NPP	Nuclear Power Plant
NPP	Nuclear Power Plant
NPT	Non-Proliferation Treaty
NRA	Nuclear Regulatory Agency
NS	Nuclear Safety
OMC	Occupational Medical Centre
Outage	Planned annual outage
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
RPCMA	Rules of Procedure of the Council of Ministers and its Administration
SAMG	Severe Accident Management Guideline
SAR	Safety Analysis Report
SBEP	Symptom-based emergency procedures
SC	Safety Culture
SE RAW	State Enterprise ‘Radioactive Waste’
SFP	Spent Fuel Pool
SG	Steam Generator
SIR	Sources of Ionising Radiation
SIS	System important to Safety
SNF	Spent Nuclear Fuel
SS	Safety Systems
SSC	Structures, systems, and components
ASUNE	Act on the Safe Use of Nuclear Energy
TLD	Thermoluminescent Dosimeter
UNAP	Updated National Action Plan
UPZ	Urgent Protective Action Planning Zone
URS	Unified Rescue System
VS	Ventilation Stacks
WCh	Water Chemistry
WSFSF	Wet Spent Fuel Storage Facility
WWER	Water-Water Energy Reactor