THE REPUBLIC OF BULGARIA

FOURTH NATIONAL REPORT

ON COMPLIANCE WITH

THE CONVENTION ON NUCLEAR SAFETY

OBLIGATIONS

Sofia, September 2007

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I. INTRODUCTION

1. Preface

The Republic of Bulgaria is among the Contracting Parties that ratified the Convention on Nuclear Safety (ratified with an Act, passed by the 37th National Assembly 14 September 1995, promulgated in State Gazette No 86/1995, in force for the Republic of Bulgaria since 24 October 1996, promulgated in SG 93 of 01.11.1996). With this Act the country confirmed the national policy for maintaining a high level of nuclear safety, assurance of the necessary transparency and application of highest standards.

As a Contracting Party, the Republic of Bulgaria took part in the three previous meetings on review of the national reports, held in 1999, 2002 and 2005, in compliance with Art. 20 of the Convention and at each of these meetings, in accordance with Art. 5 of the Convention, the country presented the national reports on the fulfilment of the obligations ensuing from it.

The first three national reports have consistently presented the status of conformity with the requirements, and the measures planned by the Government of the Republic of Bulgaria and the Nuclear Operator for fulfilment of the obligations, ensuing from the Convention. According to the adopted rules of the review process, answers of all questions asked on the Reports have been provided in timely manner.

During the discussions on the third national report in Vienna, April 2005, the contracting parties welcomed and supported the priorities in the policy of the Republic of Bulgaria:

- strong and consistent practice to maintain high level of nuclear safety, confirmed by the IRRT and OSART missions of IAEA;
- the establishment of a strong and independent regulatory body;
- harmonization of the legislative and regulatory basis with the best international practices;
- international collaboration in all areas, related to studies, design and operation of nuclear facilities;
- special attitude toward human factor in order to achieve high level of safety culture.

As a result of the discussions during the presentation of the third national report, the following recommendations were given to the country, concerning reporting the accomplishment of the activities planned in the following areas:

- further development of the legislative and regulatory framework, taking into consideration harmonization activities, undertaken by European regulators;
- completion of the safety enhancement programmes of Units 5 and 6;
- maintaining the operational safety level in compliance with the best international practices;
- management of aging and competences preservation for the rest of the operational period;
- safety requirements, concerning the new Belene NPP;

This fourth national report reviews the development in the area of nuclear safety enhancement in the period after the Third Review of National Reports meeting. Information is presented on accomplishments of the country policy priorities as well as on the fulfilment of the recommendations given.

In the period after the third national report the Republic of Bulgaria has implemented:

- all major measures, envisaged in Units 5 and 6 Modernization Programme;
- the commitments to shut down Units 1 – 4 and begin preparations for decommissioning.

The implementation status of the activities, as recommended to be reported in this National report, is reflected in the appropriate paragraphs in texts of Art. 6, 7, 11, 12, 14, 15, 17, 18 and 19. As Attachments to the report, a list and data on existing nuclear facilities, updated information on legislative and institutional framework, Modernization Programmes for the different units as well as the decommissioning programme for Units 1 - 4 were included.

2. Policy of the Republic of Bulgaria in the area of nuclear energy

2.1. Nuclear profile of the Republic of Bulgaria

During the past several years, the Kozloduy NPP (KNPP) has provided more than 44% of the total annual electricity generation in the country (with the maximum of 47.36%, reached in 2002) with all six units of the plant in operation. This percentage decreased to 40% with the shutdown of Units 1 and 2 on 31 December 2002 and to 34% with the shutdown of Units 3 and 4 on 31 December 2006, respectively.

The Bulgarian energy sector used to cover approximately 45% of the constant deficit in the total energy balance of the Balkan region, but with Units 3 and 4 shutdown the country is no longer able to maintain this kind of major input to the economical stabilization of the region.

The nuclear generating capacities of Bulgaria are presently concentrated at the Kozloduy NPP site. The existing nuclear facilities are presented in Attachment 1 and data, concerning them – in Attachment 2.

In order to fulfil the obligations for preservation of the environment and reducing the emissions of CO_2, SO_2, NO_x and ashes, Bulgaria plans to continue to rely on the nuclear energy and to develop it according to the current requirements for nuclear safety, radiation protection, efficiency of expenses and reliability in operation.

Starting in 2003, in accordance with the announced basic economical priorities of the Government and with the National Assembly approved Strategy for Development of the Energy Sector until 2010, measures have been taken to restart the construction of a nuclear power plant (NPP) at a second nuclear site in the country – Belene. At this site, in the period 1987 – 1990, a NPP based on Russian design with WWER-1000 was being constructed. In 1990 the construction was frozen due to the economical situation in the country.

In 2004, after performance of the necessary preliminary and feasibility studies of the recent nuclear technologies and the requirements of the regulatory documents in force in Bulgaria, a principal decision at the Governmental level has been taken for the construction of a new nuclear facility at this site.

In 2006 the process of selection of technology and Main Contractor of the new plant was finalized and now the problems on organization for execution of the construction and its funding are to be solved. In 2007 the process of developing the design of two units for the Belene site was initiated.

2.2. Legislative Framework in the Republic of Bulgaria

The only change in the legislative framework of the Republic of Bulgaria, related to nuclear safety of nuclear facilities and radiation protection of personnel and public, is the enforcement of a new Disaster Protection Act (promulgated 19.12.2006), comments made in texts of Art. 16.

The Act on the Safe Use of Nuclear Energy (ASUNE), in forced as of June 2002, [Reference 1] is based on the fundamental principles of independence and competency of the regulatory authority, definition of clear and predictable regulatory environment through the development of obligatory for implementation requirements on nuclear safety, radiation protection, physical protection and emergency planning and preparedness as well as implementation of the strict licensing regime, based on the in-depth evaluation of all safety aspects, regulatory inspections and implementation of administrative measures**.** The Act on the Safe Use of Nuclear Energy rules the public relationships regarding the state regulation of safe use of nuclear energy and ionising radiation and safe management of radioactive waste and spent nuclear fuel as well as the rights and obligations of the entities performing these activities for ensurance of nuclear safety and radiation protection**.**

The Environmental Protection Act, in force as of September 2002 amended and supplemented in September 2005 requires preparation of Environmental Impact Assessment for investment proposals on the following:

- Nuclear power stations and other nuclear reactors, including dismantling and decommissioning of such power stations and reactors, except installations for production and processing of fission or enriched materials, which maximum power does not exceed 1 kW;
- Installations for reprocessing of spent nuclear fuel;
- Installations, designated for:
  - production or enrichment of nuclear fuel;
  - processing of spent nuclear fuel or highly active radwaste;
  - final disposal of spent nuclear fuel;
  - solely for final disposal of radioactive waste;
  - solely for storage, planned for not more than 10 years, of spent nuclear fuel or radioactive waste on a site, different from the one, on which they have been generated.

The provisions for performing Environmental Impact Assessments are defined in Regulation on the Order and Conditions for Performing the Environmental Impact Assessment, promulgated in State Gazette No 25 of 18.03.2003 amended and supplemented, SG No. 3/2006.

The Energy Efficiency Act governs the public relationships in the energy sector related to the state management, regulation and effective use of energy and energy resources as well as the rights and obligations of legal entities in performance of activities on generation, import, export, transmission, distribution and realization of electrical and thermal energy and natural gas, increasing energy efficiency and promoting the use of renewable energy sources.

2.3. Institutional framework in the Republic of Bulgaria

The Republic of Bulgaria has organized the necessary institutions for definition and implementation of the national policy in the field of nuclear energy and for performance of state control and regulation. In compliance with the Act on the Safe Use of Nuclear Energy, the system of institutions responsible for the implementation of the legislative framework in Bulgaria is as follows:

- The Chairman of Nuclear Regulatory Agency (NRA) – regulatory authority on nuclear safety and radiation protection, responsible for the implementation of the national policy on safety in the process of nuclear energy utilization;

- The Minister of Economy and Energy is a central executive authority monocratic representative implementing the government policy in the area of energy to perform activities related to production or generation, import, export, transmission, distribution and realization of electrical and thermal energy and natural gas, increasing energy efficiency, efficient utilization of energy resources and promoting the use of renewable energy sources;

- The State Energy and Water Regulatory Commission (SEWRC) – promotes the state policy for price control of electricity generated and issues licenses for the production of electrical and thermal energy according to the Act on Energy;

- The Minister of Health Care, as a central monocratic authority, promotes the state policy in the area of health protection. Through his institutions performs specialized functions in the area of health protection in the process of utilization of nuclear energy and ionizing radiation. Such specialized bodies are the National Centre of Radiobiology and Radiation Protection and the divisions "Radiation control" to the Regional inspectorates on protection and control of public health. The Minister of Health sets up mandatory health norms and requirements and health rules on all issues of hygiene, radiation protection and epidemiology;

- The Minister of Environment and Water: manages, coordinates and controls the development and implementation of the state policy in the area of environment protection, protection and use of water and underground resources; manages the National System for Environment Monitoring through the Executive Environmental Agency; the Minister is the competent authority for taking decision on an Environmental Impact Assessment performed;

- The Minister of Internal Affairs – ensures security of nuclear facilities and utilities related, their physical protection specified as of particular importance;

- The Minister of the State Policy for Disasters and Accidents - a central authority of control to coordinate activities on protection of population and the national economy in cases of disasters and accidents, including the conduct of risk assessment, preventive measures, rescue and emergency-restoration works and rendering international aid;

- The Minister of Transport and Communications and the Minister of Defence perform specialized functions in the area of utilization of nuclear energy and ionising radiation. For example the Act on Safe Use of Nuclear Energy obliges the Minister of Transport and Communications together with the Chairman of BNRA to suggest to the Council of Ministers the order and conditions for transportation of nuclear material, radioactive waste and radioactive substances.

2.4. Main guidelines in the field of nuclear energy of the Republic of Bulgaria

The main guidelines in the field of nuclear energy and nuclear safety, as specified in the Energy Strategy of Bulgaria from 2002, are:

- harmonization of the national legislation with the European one in the field of nuclear energy;

- development of nuclear energy in compliance with the latest requirements on safety, efficiency, reliability, nuclear safety and radiation protection;

- clearly comprehensive legislation in the area of nuclear safety and radiation protection, strict licensing regime, availability of sufficient resources and technical support of the regulatory body;

- operation of the existing nuclear facilities in accordance with the requirements for high level of safety and implementation of the internationally recognized operational experience.

Assuming that utilization of nuclear energy for peaceful purposes contributes to the development of the Republic of Bulgaria and to the enhancement of the standard of living, and confirming that the health and the environment protection through the safe management of nuclear energy are of primary and highest priority, the key principles for the development of nuclear energy are**:**

- maintaining the highest safety standards in the process of nuclear energy utilization;

- providing to the public comprehensive and timely information on safety of nuclear facilities;
- taking into consideration public opinion in the energy policy formulation;
- development of the safety culture of the management and other personnel;
- international cooperation in science, design, applicable and operational areas of nuclear energy.

On this basis in the period since the third national report:

- the operator continued to implement the programmes for modernization of Units 5&6, decommissioning of Units 1&2 and preparation of the Units 3&4 decommissioning; Attachments 4 and 5 present detailed information on the implementation status of these programmes.
- In the context of nuclear energy development in the Republic of Bulgaria, on April, 8th, 2005 the Council of Ministers adopted a decision to be continued the construction of the Belene NPP.
- The Nuclear Regulatory Agency continued its activities on harmonization of the national requirements to nuclear safety, radioactive waste and spent fuel management with the reference levels of the Western European Nuclear Regulatory Association (WENRA).

In this period important projects such as the Belene NPP, the reconstruction of the research reactor and a Dry Spent Fuel Storage Facility have been in the process of licensing.

II. REVIEW OF THE CONVENTION ARTICLE BY ARTICLE

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.

1. Brief Review of the Information Presented on this Article within the Previous National Reports

In the previous three national reports the activities planned and accomplished on Kozloduy NPP units were comprehensively presented. In compliance with the previously announced plans Units 1&2 were in operation till the end of 2002 and afterwards were consecutively shut down and transferred to cold standby state. In the beginning of 2004 operation licences were issued, according to which Units 1 and 2 cannot be used for the generation of electricity and the activities are limited to the storage of irradiated and spent nuclear fuel in the reactor pools.

Complete information has been presented on the implementation of the complex modernization of Units 3&4, IAEA and Enconet assessment of the safety level achieved and the licences issued by the NRA. The programmes on implementation of additional measures, focusing on management of severe accidents were declared. On the basis of the new design state of Units 3&4 and the effective operational practice, reflected in SAR and Technical specifications and operational procedures, operating licences were issued. The unit 3 licence was issued on 22 June 2003 with an 8-year term of validity and the licence of unit 4 was issued on 26 February 2003 with a term of validity of 10 years.

Information has been presented on the implementation status of activities under Units 5&6 Modernization Programme, according to which at the end of 2004, 67.9% of the measures were completed. The issuance of operating licences of both units with the main provisions in them has been mentioned.

The activities on the Spent Fuel Storage Facility have been commented on separately as well as activities on the Facility for Treatment and Storage of RAW.

During the discussions on the third national report, support has been expressed for the implementation of the modernization programmes as announced, and their completion as scheduled.

2. Kozloduy NPP Units 1 & 2

In compliance with the operating license provisions in the end of 2005, an overall decommissioning plan for Units 1&2 was developed based on the approved program of activities for safe decommissioning. The implementation of this programme as well as of individual projects is coordinated by a separate engineering unit on decommissioning, established at Kozloduy NPP in 2000. Its functions and responsibilities are presented in more details in

Attachment 4 to this Report. The Attachment also presents the major projects, implemented as a preparation for the next steps of the program.

In order to provide conditions for the implementation of Units 1&2 decommissioning plans, in 2006 changes in the operational licences were made to allow beginning of dismantling of equipment from non safety related systems of spent fuel storage or radiation protection at the present state of the Units.

In the period after the third national report, the team of BNFL and EDF experts continued to perform projects management functions, financed by the International Decommissioning Support Fund (KIDSF), administered by the European Bank for Reconstruction and Development (EBRD). From the activities planned within the framework of these projects the following has been completed or is in the course of implementation to this date:

- Construction of the Dry Spent Fuel Storage Facility (DSFSF) – technical design developed, currently in the process of licensing;
- Supply and installation of a facility for treatment of low level liquid radioactive waste from hot showers and laundry - technical design developed, currently in the process of licensing
- Physical separation of Units 1&2 from the units remaining in operation – completed in 2004;
- Supply of equipment for decontamination of pools and big tanks and cleaning the water in them – the equipment was delivered in the middle of 2007;
- Supply and installation of a facility for treatment of solid radioactive waste with high volume reduction factor and retrieval and conditioning of spent ion exchange resins - in the process of Contractor selection;
- Supply of measurement equipment for clearance – completed in 2006;
- Supply of a mobile facility for redressing and contamination monitoring outside the RCA - completed in 2006;
- Supply and installation of equipment and devices for fragmentation of equipment dismantled from the units - Contractor selection process underway;
- Supply and installation of equipment for retrieval and treatment of the solid phase of the still bottoms – technical specification developed;
- Supply and installation of equipment to provide industrial steam and heating at the site of the shutdown units – preliminary inquiry.

3. Kozloduy NPP Units 3 & 4

In compliance with the requirements of the Units 3&4 operating licences, issued in 2003, in the period after the third national report the implementation of measures envisaged on the further enhancement of level of safety, included in long-term programmes has been completed:

- Programme for continuation of the activities on PSA;
- Programme for continuation of the activities on modernization of the Accident Localization System;
- Programme for qualification of the non-destructive examination of the components important to safety;
- Programme for development and extension of the scope of the symptom-based emergency operating procedures;

- Programme for further activities on seismic qualification;
- Programme for continuation of the activities on modernization of the I&C systems;
- Programme for implementation of measures for management of severe accidents and development of Severe Accidents Management Guidelines;
- Programme for activities on rest lifetime management.

In the framework of these programmes a strategy has been developed on the management of severe accidents, this being the next important step towards enhancement of safety level of units and in line with the best practices worldwide. This includes the development of guidelines for management of severe accidents and implementation of technical measures on control of fuel cooling and radiological releases in case of core damage. The localization systems of units are equipped with hydrogen recombiners and built-in forced filter ventilation systems.

With a decision of the Government, in compliance with the commitments of Republic of Bulgaria ensuing from the Accession Treaty with the EU, Units 3&4 of Kozloduy NPP were disconnected from the grid on 31 December 2006. In the last three months, the units were put in one of the operational states as envisaged in technological regulations, at which the fuel has been moved from the reactors into the reactor pools of each unit.

Taking into consideration the relatively long duration in the 'spent fuel storage' mode, additional operational procedures, supervision and maintenance procedures as well as other specific regulations, with regard to the peculiarities of the mode have been developed in advance. Additional technical means are also implemented for technological control and monitoring of parameters, featuring safety during fuel storage, and the computer systems for operator support are extended in relation to the automatic registration and visualization of parameters on the main control panel.

On these grounds, in the middle of 2006 the NRA permitted changes in the operational licences of both units. According to these changes Units 3 and 4 cannot be used for the generation of electricity and the activities are limited to storage of irradiated and spent nuclear fuel in the reactor pools and preparations for decommissioning of the units.

Further activities are in correspondence with the experience gained from Units 1&2 preparations for decommissioning in the previous years by the plant and the NRA, as well. Information on plans and actions, concerning decommissioning of Units 1 – 4 is presented in Attachment 4.

4. Kozloduy NPP Units 5&6

In the period after the third national report the final stage of Units 5&6 Modernization Programme has been completed - the implementation of the main package of technical measures, combined in several groups, as follows:

- Replacement of mechanical equipment of the basic production and safety systems;
- Modernization of electrical equipment and systems for reliable power supply;
- Replacement of monitoring and control systems with state-of-the-art digital control systems;
- Improvement of fire protection and seismic resistance;
- Optimisation of the equipment working conditions.

The status of implementation of the modernization programme measures by 30.06.2007, is presented in the following table.

Total	Completed	Being implemented	To be implemented
212	201	11	0
100.0%	94.8%	5.2%	0.0%

Some of the most important measures implemented in the period are:

- Completion of thermal insulation replacement on equipment and pipe works in the containment;
- Improvement of the reliability of the 6 kV circuit breakers, relay protections and automation of the main diagram and diesel generators;
- Replacement of the control and management system of the processes (UCTM) on the primary and secondary circuit;
- Installation of a cold pressure test system;
- Restriction of consequences from steam and water pipelines rupture on the secondary circuit within the reactor building and ensuring the sustainability of the main steam pipelines and feed water pipelines on the external wall of room A820;
- Commissioning of a system for fast detection and localization of primary circuit leakages;
- Improvement of seismic resistance of equipment, pipelines and bearing structures;
- Extension of the lifetime of SG pipelines blowdown system (reconstruction of the SG blowdown system);
- Improvement of fire resistance of the fire-proof doors.

In the process of the Programme implementation certain changes had to be made, regarding the sequence of measures executed which resulted in an extension of the Programme schedule. After re-planning, the consent of EUROATOM was requested for the closing date of the programme to be shifted to 31 December 2007.

Measures to be completed are related to:

- Introduction of critical parameters control systems in emergency and post-emergency conditions and tracking safety functions;
- Installation of an automated radiological control system on each safety system channel;
- Introduction of a system for continuous control and maintenance of main indicators of the WCR of primary circuit;
- Optimisation of test frequency, maintenance time and outage time of safety systems;
- Development of a system for daily operational risk assessment;
- Additional analyses on possibilities of limitation and localization of incidents, related to a bypass of the containment;
- Additional quantitative analyses on reliability of electric equipment of back-up systems.

Implementation of the Modernization Programme is being performed within the planned budget and in compliance with the terms and conditions of operational licences of the units. Detailed information on measures implemented is presented in Attachment 5 and in the licences issued – in the information on article 9 in this report.

5. Facilities related to the ensurance of the safety of spent nuclear fuel and radioactive waste

As is shown in the first and second national report on the Joint Convention on the Safety on Spent Fuel Management and on the Safety of Radioactive Waste Management, the management of the spent fuel is carried out in accordance with a special plan, approved by the Minister of Economy and Energy.

As a piece of information it might be noted that the activities on the construction of a new dry spent fuel storage facility, designated for continuous interim storage of spent fuel on site of Kozloduy NPP are ongoing. The capacity of the new storage facility considers the total amount of spent fuel to be generated till the end of operation of all units on site. To this moment activities on the new storage facility are at the stage of approval of detailed design and safety analyses.

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 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.

1. Brief Review of the Information Presented on this Article within the Previous National Reports

The legislative and regulatory framework in the field of safe use of nuclear energy in the Republic of Bulgaria has been described in detail in the Third national report under the Convention. In July 2002 the Act on the Safe Use of Nuclear Energy (ASUNE) entered into force and thus repealed the previous law in force, the Law on the Use of Atomic Energy for Peaceful Purposes (LUAEPP). The new act settles the social interactions related to the state regulation over the safe use of nuclear energy and ionising radiation and the safe management of radioactive waste and spent nuclear fuel. In the period starting from the date of entering into force of the ASUNE until the end of 2004, were developed and adopted the secondary legislative acts (regulations) related to its enforcement (Attachment 3). The act and the regulations related to its enforcement introduce the national requirements towards the safety of the nuclear facilities and establish a uniform and complete regulatory framework in accordance with the modern tendencies in the field of nuclear legislation, the good international practices (IAEA documents), practices in the EU countries in this field, as well as the experience of the leading countries in the field of nuclear safety and radiation protection.

The third national report describes in detail also the policy and procedures on issuing licenses and permits, as well as the main types of licenses and permits. The licensing process is being carried out in an atmosphere of transparency and equal standing and is based on the main principles of safety, the participation of the general public being secured and a legal procedure envisaged for appealing the decisions taken. The third report describes in detail the inspection requirements and practices, rights and obligations of the inspectors and the procedure for imposition of enforcement measures.

During the discussion over the third national report, an opinion was expressed that a strong and independent regulatory body has been established in Bulgaria, as well as decisive and permanent policies and practices for maintaining the highest level of nuclear safety. The establishment of a uniform regulatory basis has been noted as a good practice, which is harmonised with the international requirements on nuclear safety and the best international practices. Attention was called upon the challenges before the NRA in the course of developing regulatory guides.

2. Review of the development of the legislative and regulatory basis following the third review of national reports pursuant to the CNS

As it was mentioned earlier, in the period between 2002 and 2004 a new Act on the safe use of nuclear energy was adopted and entered into force as well as the regulations for its enforcement in the republic of Bulgaria. Following the third national report, the development of the last regulation on the enforcement of the ASUNE was completed, namely the Regulation on the conditions and procedure of transport of radioactive material**.** For the purpose of its development as early as 2004 an interinstitutional working group comprising of experts from the NRA and the Ministry of transport and communications was formed. The proposed draft of the regulation was adopted by the Council of Ministers in July 2005. The regulation delineates the conditions and order for ensuring the radiation protection and safety during transportation of nuclear material, radioactive waste and other radioactive substances on the territory of the Republic of Bulgaria. It also introduces into the national legislation the requirements ensuing from international treaties for transportation of dangerous goods category 7 (radioactive substances). The provisions are in accordance also with the IAEA documents for safe transportation of radioactive substances - TS-R-1. The new regulation introduces the requirements of the European legislation in the field of radiation protection during transportation of radioactive waste determined by a Council Directive 92/3/EURATOM for surveillance and control over the transportation of radioactive waste between EU member states as well as in case of import or export from the Community.

3. Experience received as a result of the implementation of the new legislation and planned amendments in the ASUNE

The year 2007 marks the fifth anniversary from the entering into force of the Act on the safe use of nuclear energy. In fulfilment of the NRA policy for periodic review of the legislative requirements on nuclear safety and radiation protection, it was decided to prepare a draft for amending and supplementing the act, taking into account the accumulated regulatory experience in the course of implementation of the act, the adoption of new EU directives in the field of radiation protection, as well as the amendment of the Convention on physical protection of nuclear material. The main amendments and supplements proposed in the draft are in the following fields, namely:

- Physical protection of nuclear material:
  - Taking into account the amendments in the Convention on physical protection of nuclear material;
- Radiation protection:
  - Relaxing the licensing regime in import and export of radioactive substances;
  - Introduction in the national legislation of the concept of clearance/exemption levels;
  - Improvement of the national system for management of orphan sources of ionising radiation, including the financing of these activities;
- Emergency planning and preparedness:
  - Areas of special statute;
- Transport of radioactive substances and nuclear material:
  - Establishment of a section “Licensing of transport of nuclear material and radioactive substances” which should determine the types of permits ands licenses for transport throughout the territory of the country as well as in transit transportation;
- Decommissioning of nuclear facilities.

According to the activities programme of the NRA, the draft act for amending and supplementing the ASUNE is expected to be ready for discussion with the respective institutions, the licensees and the general public in October 2007.

4. Activities on the harmonisation of regulatory requirements in the WENRA member states

The Western European Nuclear Regulators Association (WENRA) was established in 1999 as a non-governmental organization comprising of the chairmen and management staff of the regulatory authorities on nuclear safety of the European countries operating nuclear power plants.

The adoption of the ASUNE and the accompanying package of regulations established the regulatory basis for development of the social relations in the field of safe use of nuclear energy. The further development of the legislative basis in this field is related to the EU legislation and obligation of the Republic of Bulgaria to transpose the European directives. The elaboration of the documents developed by international organizations such as the International Atomic Energy Agency (IAEA) and the WENRA represents also a precondition for review of the adopted legislative acts as well as for the development of new ones. For the purpose of harmonisation of the approaches to safety in the European countries, WENRA created two working groups – on safety of nuclear power plants (Reactor Harmonization Working Group) and on safety in decommissioning and management of radioactive waste and spent fuel (Working Group on Waste and Decommissioning). The purpose of the creation of these groups is the constant enhancement of safety and diminishing the differences between the countries.

Right after the acceptance of the NRA as a member of WENRA (March 2003) began the participation of Agency experts in the activities of the working groups of the organization for comparison and harmonisation of the requirements for safety in nuclear power plants and of the requirements for safe management of radioactive waste, spent fuel and decommissioning. The NRA representatives in the working groups participate actively in the meetings and activities on development of reference levels for safety and comparison and evaluation with the national requirements and practices. Measures for harmonisation of the new secondary legislative acts were implemented in the field of nuclear regulation with the reference levels for safety, in accordance with the undertaken obligations by WENRA member states.

The working groups analyse the existing situation and the different approaches to safety, compare the different national regulatory approaches with the IAEA safety standards, determine the differences and propose directions for their possible elimination, without any negative impact upon the final attained level of safety. The proposals are based on good practices and the modern requirements for the existing nuclear power plants and facilities for management of radioactive waste. The developed common “reference levels” have the purpose to attain a common approach towards nuclear safety in Europe.

The working group on safety of nuclear power plants prepared revised reference levels for safety as a result of the comments received from operating organizations and other respective persons. In 2006 the NRA developed an initial version of the National action plan which undertakes the obligation to begin measures for approximation of the regulatory requirements to be completed by 2010.

The working group on safety in decommissioning and management of radioactive waste and spent fuel continues its work on drafting positions on the correspondence with the reference levels for harmonisation. The results will be used for preparing action plans until 2010. More detailed information on the reference levels, as well as on the actions undertaken by the Republic of Bulgaria can be found on the NRA web page.

5. Review of the activities on development of regulatory guides

The main state requirements are specified in the ASUNE. To ensure the safety of facilities and activities the NRA has developed and the Council of Ministers approved a set of regulations, establishing more detailed safety requirements to the licensees and applicants. The Act on the Safe Use of Nuclear Energy (ASUNE) and the regulations for its enforcement assign to the Chairman of the Nuclear Regulatory Agency (NRA) the responsibility to implement the Act and give interpretation and guidance on fulfilment of the legal requirements. One of the possible tools for doing this is the issuance of regulatory guides (RG).

In many cases, the regulations give just general requirements and allow much flexibility in design solutions and decision making. That is why in some cases the regulations' requirements are further explained in RGs with the aim to assist licensees to better understand the regulatory criteria by which the NRA will judge the adequacy of their safety cases. In addition, these same documents form a standard for NRA assessors in the performance of their work. The RGs are not mandatory in nature and the criteria set up in the guides are not necessarily constraining. RGs are a useful tool to achieve common approach in design and safety justification of more than one licensee operating similar type of facilities or carrying out similar activities. As a result of the decision for recommencing the construction of a new nuclear power plant in the country the NRA decided to issue a set of RGs in the area of safety of nuclear facilities in order to apply the principle of equality among different licensees.

The regulatory guides shall describe and recommend possible ways to implement the legal and regulatory requirements and clarify the details that are expected to be included in the licensees' safety submissions of the installations. The NRA understanding is that RGs are to be followed by applicants/licensees although they are not mandatory and would not lead to legal sanctions and penalties. It is the benefit of the licensee to strictly comply with the guides as this will allow the NRA staff to better understand the safety justifications and result in reduction of review and assessment period and respectively will shorten the authorisation time. Of course, licensees are allowed to apply other approaches and criteria when they believe that this will result in higher level of safety. In such cases, they should convince the regulatory authority that all requirements of the regulations have been considered and strictly complied with, and that safety has been adequately and properly justified.

NRA is dedicated to develop RGs in all areas it deems such will be useful, without putting additional unjustified burden to the licensees. It is envisaged to allocate all the necessary human and financial resources to provide licensees with adequate advice and clarification of legal requirements. To complete this objective in an effective and efficient manner the NRA will apply the following guiding principles:

Justification: Regulatory guides are issued only when their existence will lead to improvement of safety, based on and conforming to existing legal requirements.

Best practice: RGs correspond to the best international practices, taking into account WENRA reference levels and applicable safety standards and guides of the International Atomic Energy Agency.

Consensus: RGs are discussed with all state authorities and licensees concerned, prior to their issuing, to assure that they will be followed without creating undue obstacles.

Transparency: RGs are made public and open to anyone interested. As a part of the preparation work, statements will be requested from external experts, as well as from all organisations concerned. Comments are at any time welcomed by both the public and the licensees.

Updating: RGs are evaluated and revised on a regular basis taking into account international developments in science and technology.

Expertise: In the preparation of a selected guide, the NRA will involve its best experts in the respective area. If necessary, external experts will be used in the preparation and review process.

A regulatory guides development programme (RGDP) has been developed and maintained up-to-date in accordance with NRA identified priorities and available resources and expertise. RGs included in the programme are selected on the analyses of proposals made by the NRA departments. Proposals are based on the particular department needs and include a list of the proposed regulatory guides with the relevant justification of the need for development of any of the guides and with the indicated priorities and responsible officers (only NRA experts – one for each guide). All proposals are grouped in a joint RGDP in table format, which shall indicate for each of the listed RGs:

- the priority for development;
- the RG responsible officer;
- the expected deadlines for drafting.

RGDP is coordinated and agreed with by the directors of the respective departments, confirmed by the Executive Secretary and approved by the NRA Chairman. The Programme is reviewed on an annual basis and updated concerning the new proposals for RGs, changes in priorities, changes in the legal basis, etc.

RG preparation may be assigned to an NRA expert, to an expert group, or may be contracted outside the Agency, on a proposal of the respective department. In some cases, drafts of RGs are prepared under international projects, in which case they should comply with all other stages of the process – review and approval, publishing, review.

It is the NRA understanding and expectations that NRA experts are proactive and dedicated in the process of developing of RGs in the area of their competence. Any findings, observations and information, which may require response or corrective actions shall be communicated to and discussed with the respective supervisor.

Results of the application of a regulatory guide shall be reviewed on a biannual basis. The order for enforcement of the guide will appoint the officer responsible for the review. All interested parties may be invited to provide inputs for the review. In case of significant changes in the laws and regulations, the responsible officer shall make an assessment whether changes are necessary in the respective RG. Amendments and modifications of existing guides may be initiated by a report of the responsible officer to the NRA Chairman. The process of making changes to the documents shall follow the procedure for drafting.

To ensure wide distribution and easy access regulatory guides are published in a printed booklet, electronically on NRA web page and electronically at NRA intranet appliance. Printed booklets of the guides are distributed to all organisations concerned. NRA intention is to translate all regulatory guides and publish the English version at the NRA web page.

Article 8. Regulatory Body

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

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

1. Brief Review of the Information Presented on this Article within the Previous National Reports

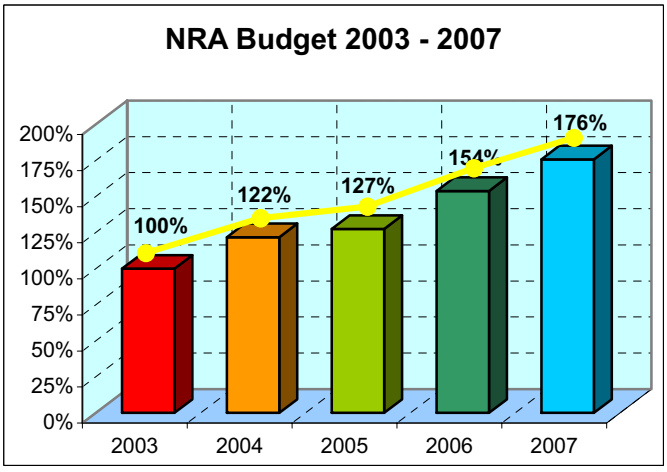
The regulatory functions implemented by the NRA as a service to the society determine the mission of the organization, namely: **"Protection of the individual, the society, future generations and the environment from the harmful effects of ionising radiation".** For attaining this mission, the NRA is guided by the internationally adopted principles for nuclear safety and radiation protection and is striving constantly to improve its effectiveness through implementing the internationally recognized good regulatory practices.

In the framework of the third national report the statute, functions, structure as well as the financial and human resources of the regulatory body have been described in more detailed manner. In accordance with art. 4 of the ASUNE, the state regulation of the safe use of nuclear energy and ionising radiation is carried out by the Chairman of the Nuclear Regulatory Agency (NRA), which is an independent specialized body of the executive power. The act in a systematic way stipulates the idea of independence (political, financial and organizational).

The statute and organization of the NRA activities were highly acclaimed by the carried out in June 2003 IAEA IRRT mission: "The Republic of Bulgaria has established an effective regulatory framework. The regulator reports directly to the Prime Minister through a designated deputy prime minister and possesses authorities equal to those of the ministries."

2. Financial resources

The Act on the safe use of nuclear energy creates preconditions for financial independence of the regulatory body. According to the Act, the NRA activities are financed from the state budget and from revenue from the taxes collected pursuant to the ASUNE. The NRA is a primary distributor of state budget funds, i.e. prepares its own budget which is co-ordinated directly with the Ministry of Finance. As a result of this there is a noted stability in the financing of the authority. The diagram shows the increase in the NRA budget in the last years, covering also the third national report.

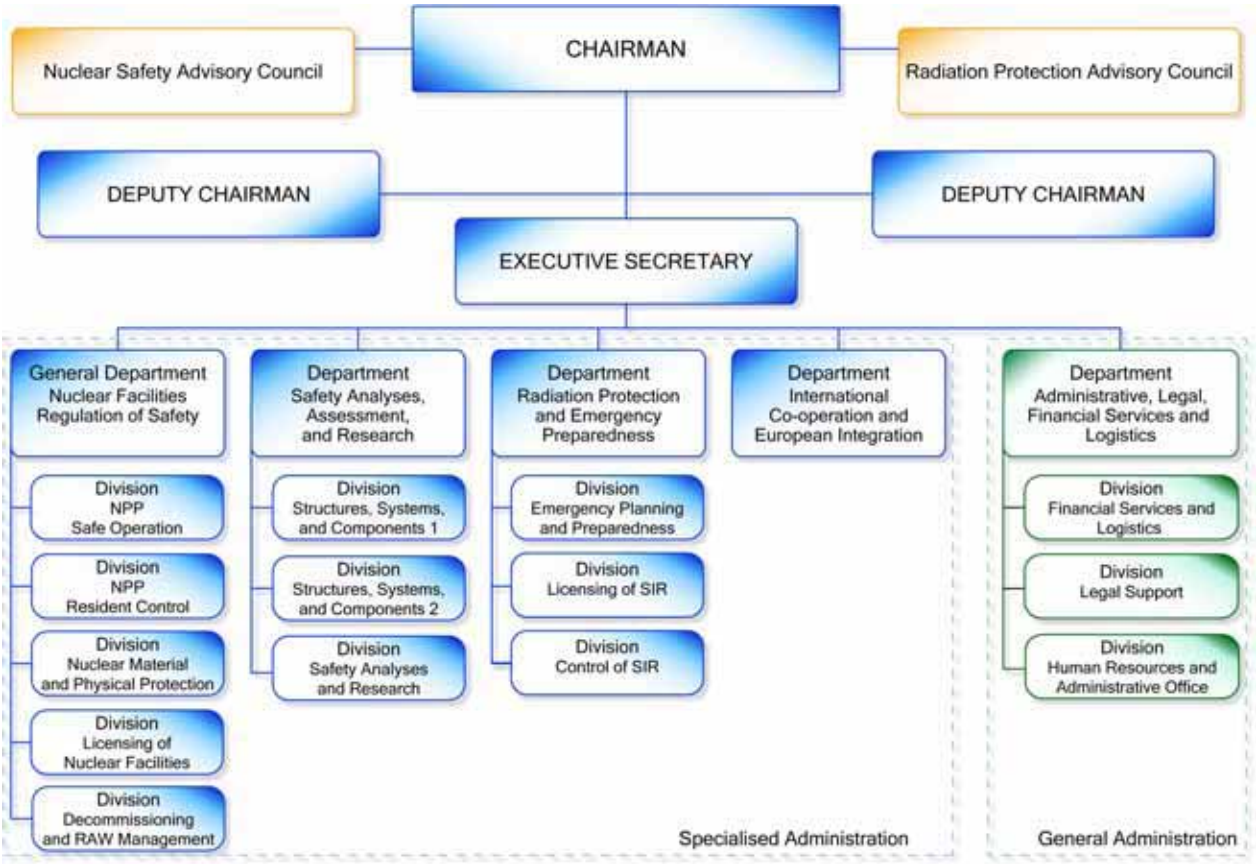


The stability in the financing of the NRA allows the organization to plan and implement effectively and with quality all of its major functions including licensing activities, analyses and assessments of safety, inspection activities, development of the legislative basis, as well as to participate actively in international projects related to the enhancement of safety.

3. Development of human resources following the third review

A specific feature of the Bulgarian legislation is that the job positions of the state authorities as well as their structure are determined by a legislative act. The structure, activity and organization of the work at the NRA are determined by the Rules of Procedure of the agency, adopted by a Council of Ministers Decree on a motion by the chairman of the NRA.

On the basis of the analysis carried out of the competencies and future challenges before the regulatory authority, the NRA has prepared and is applying a strategy for step by step increase of the personnel and enhancement of their qualification. By August 2007 the NRA has already 114 job positions, and additionally there is a possibility for hiring personnel on a labour contract. The enormous responsibilities of the NRA employees before the society justify the higher requirements towards their qualification and experience, which have been exactly and clearly delineated for each separate job position. Almost all employees of the agency have higher education, master level and long-term professional experience in the field of regulation, design, construction and operation of nuclear facilities and sites with SIR. The management of the NRA ensures permanent enhancement and maintaining of the professional qualification and competency of the employees. In the course of implementation of the regulatory functions at the NRA, a uniform, successive and approved by the Quality Management System approach is being applied.



The structure of the NRA is in accordance with the Act on administration, which determines uniform requirements with regard to the structure of administrations assisting the executive bodies and takes into account all areas of activity of the regulatory body in accordance with the authorities granted to the Chairman by the national legislation. The employees in the NRA are distributed into general and specialized administration. The general administration ensures technically the activity of the specialized administration and carries out activities related to the administrative service rendered to the general public and legal entities. The specialized administration is organized in four departments, implementing specific functions of the institution. The organizational and management structure of the NRA is presented in the chart.

4. Review of the development of the system for technical support to the regulatory body.

Regardless of the increase of the expert potential of the NRA, the organization seeks security in covering all possible fields of regulation of the life cycle of nuclear facilities. Even all international review teams visiting Bulgaria for the last few years have unanimously concluded that *"during the last years, the NRA own capabilities of carrying out regulatory reviews and assessments have been significantly increased"*, one of the NRA priorities is the establishment and maintaining of a well structured system for providing the regulator with an independent expert advice on important safety issues.

The expert knowledge in nuclear issues in the country is concentrated in limited number of organizations, such as national scientific institutes, universities, private companies and of course the operating organizations and the regulator. Additionally, there are individuals that are not part of one of the organizations mentioned above, who have the necessary knowledge and capabilities to make valuable contributions in specific areas of safety concern.

NRA has its own internal department for review and assessment of safety submissions. This department works in close cooperation with the licensing and inspection department, as people from both departments take part in the process of review and assessment, depending on the required competencies for the review. Both departments are formed of experienced and skilful staff, most with PhD or Master of Science degree in nuclear engineering, physics, metal sciences, chemistry, etc. Since 2003, the NRA own capabilities of carrying out regulatory reviews and assessments have been significantly increased as more than 20 new experts and inspectors were employed.

In the last years NRA started to get an increased number of license applications. This resulted in NRA allocating a lot of efforts and resources, during these years, in establishing a well-structured, complete and effective system for technical support. The first step of the process included the collection of the necessary information and establishment of a database of companies and individuals with competencies in the field of safety of facilities and activities, covering the whole lifecycle of a nuclear installation. Companies' data was collected through filling up a specifically designed by NRA questionnaire, requiring detailed data on company profile, available competencies, expert work (contracts) done by the company in the nuclear field, irrespectively for the operator, government authority, third party or internationally.

Based on the data collected, analyses of companies and own competencies and capabilities and assessment of regulatory challenges in mid-term, in 2003 NRA signed framework contracts for cooperation and expert support with 13 Bulgarian engineering companies and scientific organizations and in 2004 with three more. The main goal of the contracts is to keep the regulator informed about changes in company competencies and capabilities and avoid conflict of interests. According to the framework contracts, TSOs shall inform the NRA about any change in their staff composition (hiring new or loosing staff, retirements) that may lead to loss of knowledge and skills inside the company or acquiring new areas of professional competence that may be of technical support to the regulator.

One of the main objectives of the framework contracts is to avoid conflict of interests. This means that the TSOs working for the NRA shall be effectively independent of the operator or the company working for the operator for the specific task. In small countries, with limited number of technically competent organization, all of those companies in different tasks and periods and with different frequency do some work for the operators of nuclear facilities. It is the NRA understanding, that effective independence in this case means "The TSO is not part of the operator structure or a daughter company and did not participated as a company or with experts in the analyses or development of the safety submissions. According to the framework contracts, all TSOs are obliged to inform the NRA on any work they do for operators of nuclear facilities in the country. Additionally, operators should indicate in the safety submissions the companies being involved in the development or review of the documents.

When an external contract is needed the Department on assessment, analyses and research" (DAAR) has the responsibility to develop terms of reference for the contract (shall be approved by the chairman) and based on analyses of the work to be done the department should propose one or more TSO which to be contracted for the work.

Usually, the final output of the work done under the contract is a detailed written report. Those reports are reviewed by the DAAR and accepted or returned back for additional work. When accepted, reports of TSOs (outside contractors) are evaluated by the DAAR experts, who prepare a proposal how to use the received information and advice provided. Finally, NRA experts' evaluations, with consideration of TSO reports are documented as a safety evaluation report. Based on this report, the NRA chairman takes the regulatory decision. The chairman may also ask for advice the advisory councils on nuclear safety and radiation protection.

NRA bears all the responsibility for making regulatory decisions and has allocated the necessary human and financial resources to secure the effective operations of the system for technical support and ensure:

- 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 assessments performed by the TSOs;
- availability within the organisation and at the TSOs of necessary assessment tools and computer codes to do the assessment;
- sufficient financial resources to pay for the contracts;
- access to new developments in science and technology to NRA staff and TSOs;
- continuous improvement of own and TSO expertise, trough training and education programs, as well as participation in international research and exchange programmes, etc

5. Development of the Quality management system (QMS)

The change in the statute and structure of the NRA, the new IAEA documents as well as the change in philosophy of ISO 9001:2000 in comparison with that of ISO 9001:1994 imposed a complete review of the quality management system and the development of a new modern and covering all aspects system. The objective of the QMS is to enhance the effectiveness of the activities implemented by the NRA as well as to satisfy the requirements of the end users of these activities. The basic documents necessary for development of the system are the internationally adopted IAEA standards with relation to effectiveness and the international standards for quality of the series ISO 9000 "Standards for quality management and quality assurance" for ensuring the efficiency of these activities.

The QMS documents are distributed in four basic levels as follows:

Level 1 –Documents determining the policy and objectives of quality, as well as the methods for their attaining;

Level 2 –Procedures determining the NRA policy and the basic principles in implementation of the activities;

Level 3 –Working instructions giving detailed directions on the methods for planning and implementation of the activities;

Level 4 –Guides for assistance in the implementation of the procedures and instructions or for the implementation of the tasks set and related documents.

The system is in a process of permanent development and improvement. To this moment the larger part of the basic documents and more than 30 documents of level 3 and 4 have been developed.

Article 9. Responsibility of the Licence Holder

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

1. Brief Review of the Information Presented on this Article within the Previous National Reports

Presented consecutively in the framework of the previous three reports, is the process of Operator responsibility transfer from the National Electric Company to Kozloduy NPP Plc, which took place in 2001, as well as the scope of the responsibilities of the licence holder according to the Law on Use of Atomic Energy for Peaceful Purposes in force at that time.

The established organizational structure for ensurance of the fulfilment of the responsibilities of the Operator – Kozloduy NPP and the results of international reviews of its organizational structure were presented.

No specific recommendations, concerning this article, were given in the previous reports in discussions on fulfilment of the obligations of the Republic of Bulgaria.

2. Responsibilities of the Licence Holder

In the period after the third national report no changes in the responsibilities of the license holder have taken place. As it was stated in the third national report the responsibilities of the license holder are provisioned by the Act on the Safe Use of Nuclear Energy; the latter remained unamended in the period between the third and the fourth national reports. The Act regulates the responsibilities of each entity in performing activities for use of nuclear energy, radioactive waste management or spent nuclear fuel in regard to:

- meeting the requirements, limits and rules for nuclear safety and radiation protection, ensurance of high quality of performance of the activities, taking measures for prevention and mitigation of the consequences of incidents and accidents;
- implementation of all necessary measures for the safe storage of nuclear materials, spent fuel, radioactive substances and waste, including physical security, control and monitoring of the parameters that characterized the nuclear materials and radioactive substances, systems for control and accounting, etc.;
- making assessments of nuclear safety and radiation protection and taking measures for improvement, considering their own and international experience and scientific developments and using systems, equipment, technologies and procedures that correspond to these developments and internationally recognized experience;
- ensurance of necessary financial and human resources, including systems for personnel qualification, insurance and nuclear indemnity liability;
- performance of monitoring of the radiological characteristics of working surroundings and environment and ensurance of the objectivity of information provided to the public, governmental bodies and the public organizations regarding the status of nuclear safety and radiation protection.

In addition, the Regulation on Ensuring the Safety of Nuclear Power Plants contains the following requirement: '*Art.5(3) The operational organization bears the complete responsibility to ensure safety, including in cases when other persons or entities perform works or render*

services to the power plant, as well as in relation to specialized control authorities in the filed of use of nuclear power and ionising radiation.'

In order to obtain a permit/licence in compliance with the ASUNE the applicant is required to prove, that he is in command of the necessary financial, technical, material and human resources and organizational structure to maintain high level of safety, and has ensured compliance of the equipment and activities stated with requirements, standards and regulations on nuclear safety and radiation protection, and has developed a system for maintaining high safety culture and organization of works, permitting the exposure dose for the personnel and the public to be maintained at the lowest reasonably achievable level.

Each issued licence or permit defines the scope of the activities, general requirements for performance of the activities, responsibilities for maintaining the necessary financial, human and other resources as well as specific requirements that need to be ensured in relation to:

- nuclear safety, radiation protection, physical protection, quality assurance, emergency planning and preparedness, management of spent nuclear fuel and radioactive waste, elimination of deviations and accidents;
- submitting the information required, including that required for the fulfilment of license conditions, required if change of circumstances occurs, and required for changes and extensions of license terms of validity;
- the obligations of the licensee in regard to performance of regulatory reviews, applicable legislation, relations with licenses and/or permits, etc.

Kozloduy NPP has adopted a specific organization of control and implementation of provisions in licences and permits by means of appointing responsible structural units to perform theses activities and the use of computerized database. Reporting fulfilment of provisions to the NRA is performed in the terms as specified within the licences and permits as well as by means of summary reports on activities implemented on regular basis.

The activities concerning access to the site and the working place, the control of performance and accepting of works or services, performed by outsourcing organizations are a subject of detailed procedures at Kozloduy NPP.

In addition to the licensing and permit regime, by means of which the fulfilment of the regulatory requirements is assessed, the NRA uses regulatory inspections as a mechanism to review implementation of internal regulations and procedures, established at the Kozloduy NPP. Continuous control of the status is performed by the NRA inspectors on site of the KNPP. The NRA also performs supplementary topical reviews in various areas of safety management.

Article 10. Priority to Safety

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

1. Brief Review of the Information Presented on this Article within the Previous national reports

The previous three Reports determined the priority to nuclear safety, defined in basic statements of the enforce at that time Law on the Use of Atomic Energy for Peaceful Purposes and the new Act on the Safe Use of Nuclear Energy, correspondingly by the policy of the regulatory body and the Operator for assurance of this priority.

The main characteristics of safety culture and its development are discussed, the assessments received by the international missions and also some other factors with impact on this process – in particular the broad international cooperation. There was detailed information in the previous report on the results of the independent reviews conducted on the compliance of Kozloduy NPP practices with the international requirements by OSART mission in 1999, first follow-up in 2001 and second follow-up in 2002 within the Safety Review Mission of IAEA.

The findings of these missions for the status maintained to ensure the safety priority and the lack of processes with lower attention in any operational area are an evidence of the efficient and well-realized system for priority of aspects, having definite attitude to safety culture maintained in the plant.

During the discussions of the previous report on the fulfilment of the obligations on this article by the Republic of Bulgaria, the approach of good and consecutive practice in maintaining the high safety level approved by the IRRT and OSART missions of IAEA, was welcomed.

2. Policy of the Operator

The policy of Kozloduy NPP Plc. as Operator is expressed in a form of Management Statement on the Safety Policy. The statement is developed in compliance with the requirements of the Convention on Nuclear Safety, the Act on the Safe Use of Nuclear Energy, the National Strategy for Development of Energy Sector and Energy Efficiency and is in line with the INSAG-3 and INSAG-13 reports, published by IAEA related to that subject.

The statement is regularly updated in order to take into consideration the specific changes in the priorities and objectives, dictated by newly established normative requirements, good international practices or specific challenges, related to the changes in the Operator's organization.

The statement is distributed to the personnel as a fundamental document, defining the goals of the plant staff and is available through the local computer network (Intranet), posters at the working places, plant information bulletin and by other means.

Notwithstanding the statement, the policy of the operator for the priority to safety has been introduced as an indispensable part of the organizational rules for the activities of the main departments in the plant and is included in the programmes for personnel training.

The achievement of the Kozloduy NPP management aims and expectations, defined in its statement, are subject to thematic reviews on behalf of NRA in terms of safety management,

conducted in 2005 and 2007. The recommendations of the INSAG–13 report were used as a basis for these reviews. The findings of the commissions were that a lot of the components of a safety management system had been applied at Kozloduy NPP. Instructions were given for formulating these components in the future in order to have a complete safety management system.

3. Safety culture at the Kozloduy NPP

In order to guarantee priority to safety during the units operation, the following aspects are demonstrated by Kozloduy NPP to the NRA in the process of issuing of operational licence:

- the Operator should have an established organizational structure for safe and reliable operation with clearly defined responsibilities, authorities and communication lines of the personnel that perform activities related to ensurance and control of safety;
- during the plant operation, conditions should be ensured for performance of the necessary studies and consultations prior to taking decisions related to safety;
- the necessary resources and conditions of the personnel for performing activities in a safe manner should be ensured, and the performance should be adequately controlled;
- there should be an established and functioning system for the systematic analysis of its own and international operational experience, as well as scientific and technical developments in the area of nuclear industry aiming at continuous performance improvement;
- the available number of personnel with adequate qualification, knowledge and understanding of the design basis, safety analyses, design and operational documents of the units in all operational modes and emergency conditions.

The internal documents of Kozloduy NPP have the following requirements defined:

- Performance of necessary recruitment, training, qualification and retraining of the personnel for each activity having impact on safety;
- Strict keeping of discipline with clear distinction between the personal responsibilities of management and staff;
- Development of and strict compliance with the requirements of the procedures in force for performance of the activities and their periodical updating considering its own and internationally recognized operational experience;
- the order and rules for outsourcing contractors performing activities important to safety, control of implementation of activities and accepting the implementation;
- the arrangement and rules for suggesting, classification and preliminary assessment, acceptance, procurement, implementation and follow-up analysis of the modifications of safety related structures, systems and components (SSC);
- planning, analysis of the impact of safety, and implementation of organizational changes;
- the arrangement for agreement with NRA and the manner of implementation of tests or experiments of safety related SSC, that are not included in the technological regulations for the units operation or in the operational instructions for the units.

The implementation of the requirements mentioned above is a subject to periodic reviews by the NRA, as well as subject to internal and external independent audits for the plant.

To maintain the level of safety culture of the personnel working at the closed units 1-4, as well as keeping the attitude to their operation in this mode as though those were units in operation is one of the great challenges before the Kozloduy NPP management. A review has been conducted of all the organizational and operational documentation and the new rules required for surveillance and control of the units in this operational mode have been established, new procedures for normal operation and termination of any possible accidents, including the modernizations made on some systems for safety enhancement and control of units.

It is a serious challenge to maintain the motivation, being one of the main factors of the high safety culture, for the personnel of units 1-4 in this mode. The most significant measure is the accepted policy of no personnel redundancies at these units. An organization is established to direct the surplus personnel to be trained at the operating units 5 and 6, to stimulate unforced retirement of plant workers on achieving the provisions required, as well as to give advantages to the personnel of units 1-4 in recruitment for vacant jobs in some other plant departments.

As a result of these and some other specific measures the personnel working at units 1-4 have retained the level of motivation, which was confirmed by the system for self-assessment of operational activities, where some specific assessment indicators for separate safety culture aspects were included.

4. Continuation of international co-operation activities

In the period since the third national report, the Republic of Bulgaria continued the active policy of the exchange of information on technical and organizational questions and issues, related to the control of the technological process, resources and safety culture. The Republic of Bulgaria has hosted several international meetings and workshops organised by the IAEA. For example Kozloduy NPP hosted the following, namely:

Workshops:

- Identification of vital areas of physical protection in nuclear facilities;
- Methods for assessment and enhancement of Safety Culture (SCART);
- Physical protection of NPP against sabotage.

Working and technical meetings:

- Preparation of personnel included in decommissioning activities at Kozloduy NPP units.
- Working meeting with the Director of Division for Europe, West Asia and Latin America as well as the country officer in charge of Bulgaria in IAEA.
- Presenting the report of IAEA on the assessment of the program for operation and closure of units 3 and 4 by the Head of Economic Planning Department of IAEA.

Expert missions of IAEA:

- Review of activities on knowledge management;
- Review of the progress of activities on physical protection system in Kozloduy NPP.

Scientific visits through IAEA:

- of Iranian specialists;
- of Armenian specialists.

The following activities give some other examples of international cooperation:

- Workshops, training and workshop meeting under DTI projects – 32 events;
- Meeting of WANO–Moscow Center (MC) of chief engineers of NPP;

- Mission of WANO –MC on technical maintenance;
- Regional Meeting of WANO–Moscow Centre (MC) of NPP deputy directors on economic issues;
- Meeting of the Board of Directors WANO–MC;
- Working meeting with representatives of the Japanese International Cooperation Centre, JEPIC–ICC;
- Workshop of GRS–Germany for licensing and control in the preparation and decommissioning of nuclear installations;
- Working meeting with representatives of BNG, EURATOM, World Energy Council (WEC), Slovakian regulatory authority, Representative of the European commission in Bulgaria, European Parliament, EDF and the economic commission in the Embassy of the Republic of France;
- International workshop on vibration measurements, analyses and diagnostics.

The traditional annual Bulgarian-Russian workshops on issues related to WWER fuel continued to be organized in Bulgaria.

Article 11. Financial and Human Resources

1. Each Contracting Party shall take the appropriate steps to ensure that adequate financial resources are available to support the safety of each nuclear installation throughout its life.

2. Each Contracting Party shall take the appropriate steps to ensure that sufficient numbers of qualified staff with appropriate education, training and retraining are available for all safety related activities in or for each nuclear installation, throughout its life.

1. Brief Review of the Information Presented on this Article within the Previous national reports

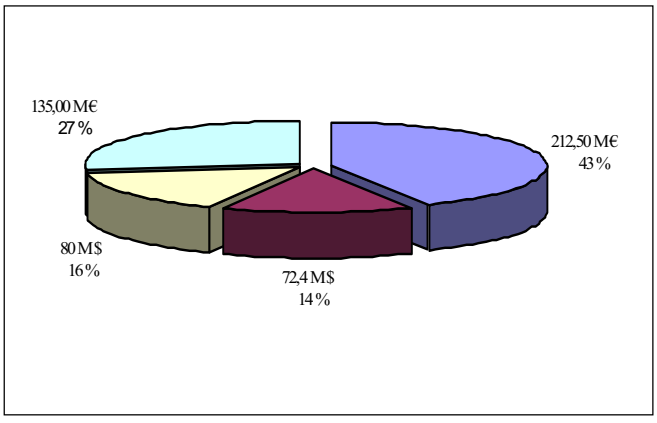
In the framework of the previous national reports the mechanisms for financing the measures to improve safety, the decommissioning of nuclear facilities and radioactive waste treatment were presented. The sources for financing the modernization programmes of the particular Units were also presented.

In separate sections of the Reports, the personnel training system was presented, including the qualification requirements for different groups of personnel as well as the policy for ensuring adequate human resources.

2. Financing of the safety enhancement measures

After the third national report issuance, the implementation of programmes with measures for safety enhancement included in the operational licences for Units 3 and 4 was completed. The Programme was financed mainly from Kozloduy NPP's own investment programme resources. Within the period, projects under the PHARE program of EU started and were completed, related to Phenomena Investigations and Severe Accident Management of units 3 and 4 as well as preparation for decommissioning of units 1 and 2. For the implementation of the activities a total amount of 28 million EUR was spent, 91% of it were own investments and the other part - under the EU PHARE programme.

Within he same period the major part of the Modernization programme for units 5 and 6 started, the overall funding of which was provided for as follows:



- EUR135 million – Kozloduy NPP own resources:
- EUR 212 million - EURATOM Loan;
- EUR 80 million - EURATOM Loan;
- USD 72 million - Citibank Loan.

In 2005 the investment expenses realized on the Modernization Programme of units 5 and 6 amounted to EUR 74.5 million. The financial resources disbursed for the implementation of the Modernization Programme in 2006 amount to EUR 24.857 million. For the financial year 2007 the resources planned to be used amount to EUR 10.7 million.

3. Financing of the decommissioning activities and radioactive waste treatment

Nuclear Facilities Decommissioning and Radioactive Waste Funds

There was information presented in the previous reports on the organization and collection of means in the two specialized funds established. In the period since the Third national report the Regulations for the amount of the payments due, collection, expenses and control of the resources in the Nuclear Facilities Decommissioning and Radioactive Waste Funds have been updated in order to ensure that:

- Adequate financial resources are available to ensure safety of the spent nuclear fuel and radioactive waste management facilities for the entire period of operation and decommissioning;
- Adequate financial resources shall be collected for the decommissioning of units of Kozloduy NPP as well as for the long-term storage of radioactive waste (including their disposal);
- Adequate financial resources shall be collected through payments made by organizations generating radioactive waste, as a result of their activity, for long-term management of radioactive waste (including their disposal);

These Funds are independent; the financial resources available shall be controlled in a transparent and profitable manner and shall be judiciously spent in accordance with the instalments paid to funds. Currently, the Kozloduy NPP is paying to the two funds around 10.5% of the income from sold electricity, which is a high percentage compared with the practices of other countries. The policy of Bulgaria in this area suggests a very high rate of accumulation of resources in the funds, and at present the resources accumulated in the two funds amount to BGL 980 million (EUR 490 million).

Financing of the decommissioning activities of units at Kozloduy NPP

As it has already been stated in the previous national reports, the financial resources required are provided for by a number of sources:

- Kozloduy NPP own resources;
- Nuclear Facilities Decommissioning Fund;
- Grant of the European Commission (KIDSF), and some other donors.

The sum donated by the European Commission is directed to the units decommissioning and up to the present moment amounts to approximately EUR 115million. It is used for financing of projects for delivery of facilities and technologies, necessary for the preparation and implementation of decommissioning activities.

After the closure of units 3 and 4 at the end of 2006, some difficulties have been experienced in the providing of own resources for decommissioning activities, resulting from the decreased electricity generation of the plant and, correspondingly, the revenues from its main activity. The expenses for maintenance of the closed units remain comparatively high in the transition period in the spent nuclear fuel storage mode, while at the same time the plant has investments planned to complete the programme for Modernization of Units 5 and 6.

Because of that, Kozloduy NPP management has undertaken the necessary steps to receive additional funding for the closed units both from the Nuclear Facilities Decommissioning National Fund and the international KIDSF Fund.

Financing of activities on RAW management

No changes have been made within the financing framework for the activities on RAW management since it has been described in the third national report. Detailed information on the

current status of all activities, related to RAW management is presented in the two national reports for implementation of the commitments made by the Republic of Bulgaria under the Joint Convention for Spent Fuel and Radioactive Waste Management. (References 3, 4).

4. Providing adequate human resources

In compliance with the requirements of article 64 of ASUNE the activities having impact on nuclear facilities' safety are performed only by professionally qualified personnel, having a certificate. The certificates are issued after a successfully passed examination before a qualification examining board. The regulation issued on the basis of ASUNE on the arrangement and order of acquiring professional qualification and for the arrangement for issuing of licenses for specialized training and certificates of authority to utilize nuclear power, established the order for taking exams before qualification boards and specified the requirements for education, qualification, and experience for taking different job positions in the operating organization.

In compliance with the Regulation, the certificates of capacity of the personnel, directly involved in safety ensurance and control, are issued by the NRA Chairman after an examination of the knowledge by the specially appointed commission. In line with art. 98 of ASUNE, the NRA Chairman exercises preventive control prior to the issuing of certificates of capacity and ongoing control on the implementation of the provisions of the certificates issued.

Kozloduy NPP has implemented the requirements regulated in the legal documents to the personnel through a System for Personnel Qualification and Training. The system includes organization, management, implementation and control of activities on training and qualification of personnel, functional responsibilities of job positions of NPP structures, levels of authorities and system interactions in the implementation of activities.

In order to ensure qualified and competent personnel, a system is applied for internal and external recruitment. The system ensures:

- Verification of the correspondence of the applicants to the qualification requirements of the positions;
- Verification of the health status of the candidates, and subsequent evaluation for granting permission for work in an ionising radiation environment;
- Verification of the psycho-physiological characteristics of personnel having direct relation to the radioactive waste and spent nuclear fuel management and subject to qualification exams by the regulatory body - the NRA.

As a result of the closure of two more units at the Kozloduy NPP at the end of 2006 and the policy of the Operator to keep the qualified personnel of the plant, the management has undertaken some specific measures to retrain the personnel from the closed units for operation at 5 and 6 and to ensure opportunities to train the qualified personnel that will be necessary for the Belene NPP in the future.

Kozloduy NPP pays specific attention to the accumulation and transfer of the specific knowledge about the technology to its personnel. The main aspects of this activity are the following:

- Keeping and transfer of knowledge in times of unit modernization

Implementation of large-scale modernization projects for all units in the last ten years and the depth of reassessment of safety made with the contemporary methods led to a larger scope and detailed transfer and preservation of the knowledge of the personnel in charge of the design modifications approval, their implementation and introducing into work.

- Participation of specialists in specific activities

The task of knowledge preservation and transfer is also facilitated by participation of KNPP specialists in the processes of safety analysis report (SAR) updating, developing of probabilistic safety assessment (PSA), Symptom-based Emergency Operating Instructions, thorough revising of the operational documentation, implementation of the new computer information and control systems as well as in the ensuing changes in the respective simulator and training facilities.

- Improving of the engineering organizations and services

The modernizations implemented and the comprehensive all-round safety assessment and analysis made with the participation of leading foreign companies in the field are also factors that strongly encourage the establishing of a specific scientific and engineering services sphere in the country, currently working jointly with West European contractors on the modernization measures. As a result, Bulgarian engineering companies and scientific organizations are now participating in a number of international and regional projects including projects for upgrading of foreign nuclear power plants. This also includes growth of the national education including the maintenance of specialists necessary for technology development, which by means of various technical universities ensures the supply of higher education staff for nuclear power plants, and performance of studies and projects on subjects related to nuclear power plants.

In 2006, a licence was issued to the KNPP training centre permitting it to carry out specialized training in conformity with the NRA Regulation provisions cited above. The more important documents accompanying the application for specialized training licence issuance are subject to evaluation by the NRA, as follows:

- Documents on the numbers, level of education and qualification of the trainer staff;

- Curricula compliant with the functional characteristics of the corresponding job positions for which the training is intended;

- Procedures for development of curricula for support training and for individual training;

- Training courses (modules), corresponding to the curricula;

- Procedures for issuance and revoking of certificates of capacity and for presenting information to the operator and the NRA concerning the issued, suspended and revoked certificates of capacity;

- Procedures for checks on the knowledge and skills acquired, documents on the systems ensuring compliance of the technical training tools with the equipment at the work place;

- Quality assurance programme.

The training programmes (curricula) for the initial specialized training are established for each job position. The programmes take into consideration the results from the analysis of functions related to the position and the characteristics of the specific work place.

The enhancement specialized training programmes are established one year in advance and consider the results from the annual analysis (performed jointly with the operation organization and the training organization) on the following:

- operational experience, performance of the personnel and their level of competence over the reporting period;

- changes made to the regulatory requirements, related to the nuclear safety and radiation protection, and to the operational documents;

- the implemented or forthcoming changes in the structures, systems and components important to safety, as well as the changes related to any specific work place;

- deviations, incidents and accidents from which lessons can be learned in order to prevent their occurrence in the future;

- the emergency preparedness level and preparedness for implementation of the emergency plan and procedures.

Individual training programmes are developed on the basis of the curricula, taking into account:

- the trainee's education and professional experience;

- the results from the preliminary appraisal of the trainee's knowledge;

- the trainee's individual needs as to improving the performance quality and the safety culture.

Once the specialized training has been completed, one or several internal exams are held to check the acquired knowledge skills. Concerning the MCR operators, this will mean successful participation in the emergency scenarios with the full-scale simulator of WWER-1000.

As provided in the licensing agreements, the NRA shall receive information periodically on the specialized training conducted. During the regulatory inspections prior to commissioning of a unit after the annual outage, the NRA shall check MCR personnel availability and training and carry out topical inspections of the system for staff selection and qualification.

Article12. Human Factor

Each Contracting Party shall take the appropriate steps to ensure that the capabilities and limitations of human performance are taken into account throughout the life of a nuclear installation.

1. Brief Review of the Information Presented on this Article within the Previous National Reports

In the previous three Reports, the overall policy for considering the human factor in the operation of nuclear facilities was presented. The organization and managerial issues related to human factor management, ensurance of appropriate working conditions to the personnel as well as different studies performed on the role of the human factor and its management were described.

The plans of Kozloduy NPP for introduction of methodology for analysis of human factor as a cause for operational events, for updating of internal procedures and for extension of the computer databases for event analyses with possibilities for additional human factor analyses were discussed.

2. Enhancement of the system for analysis and management of the human factor

On the basis of the own experience gained in human factor analyses and as a result of exchange of information between operating organizations concerning human factors, a review was conducted and additional procedures developed to regulate activities in the operational experience feedback system. In order to increase the effectiveness of the process of root cause analysis and aiming to identify the role of the human factor, a Methodology for Analysis of Events, Caused by the Human Factor was developed and is being implemented, based on the HPES method of the Institute of Nuclear Power Operation (INPO), the USA. The methodology is enforced and is used in operational events analysis in parallel with ASSET methodology applied in Kozloduy NPP since 1997 as well as in analyses of insignificant events and diversions in operation and the so called ‘near misses’.

The existing events database is amended and extended in a way, allowing storage and retrieval of all information on operational experience feedback in common information environment for all units in operation.

Regular training is conducted for the management as well as for the operational staff planned to be involved in analyses of events and deviations in order to increase the numbers and broaden the categories of staff trained on root cause analyses and comprehension of methodologies of event prevention.

As a result of the feedback efficiency analyses from implementation of various activities a specific guidebook has been developed and introduced for proper execution of operations. The guidebook treats models of human behaviour during execution of different operational activities and introduces methods to prevent human errors not only in individual performance, but also in teamwork. The guidelines are mostly used by main control room operators not only in immediate planning and performance of specific activities, but also for after performance self-assessment in relation to identification of weaknesses and potential possibilities for making errors.

The plant has developed an effective system for collection, reviewing and implementing of corrective measures, taking into account operational experience of other plants. Efficiency is

warranted not only by the managers involved and leading experts at the analyses of external experience, but also by the control and performance accountancy system in this activity, as regulated in different procedures and guide documents.

3. Human factor considerations in the Modernization Programme of Units 5 and 6

The wide scale modernization of Units 5 and 6 permitted the implementation of the most up-to-date requirements, concerning safety and industrial standards. In the process of performance of the studies necessary and during the design phase, the required attention was paid to interfaces between old and new equipment, the location of the control panels, the scope and type of information submitted to the operators, the general access and access for maintenance of the new equipment. In the assessments of the technical decisions proposed, the operational staff takes part also in assessing mainly the aspects of the man-machine interfaces The technical reliability features of a great part of the newly installed equipment allow its operation without preventive maintenance and long intervals between maintenance works. A large number of diagnostic systems have been installed, the information of which allows the operators to perform precise diagnosis of the technical condition of the main equipment and to trace the trends of its behaviour. The algorithms of some of the new systems increase the time for decision-making of operational decisions, while others reduce the frequency of occurrence of postulated initiating events. Some of the measures of the Modernization programme are related to maintenance activities and the development of specific procedures on the technical service and supervision of SSC, important to safety.

Article 13. Quality Assurance

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

1. Brief Review of the Information Presented on this Article within the Previous National Reports

The preceding three national reports present the development of the quality assurance system, the quality policy for nuclear installations operation, and the establishment of the quality management system at the Kozloduy NPP. As pointed out in the second national report, Kozloduy NPP has developed and implemented a quality management system in conformity to EN ISO 9000:2000, taking into account the recommendations provided in the IAEA 50-C/SG-Q documents. Following the second national report issuance, the quality assurance system has evolved following the IAEA recommendations and the trends imposed by the new ISO 9001:2000 standard. The third national report identifies the various methods used for assessment of the efficiency of the NPP QA systems, such as internal and external audits, independent assessments performed by the regulatory authority or international missions. The regulator's role in this process has been demonstrated. A separate section of the third national report deals with the quality management system during the realization of the Modernization Programme of units 5 and 6. Some components of the quality management system for personnel training, in-service control activities implementation, and commissioning of the radwaste processing facility have been described. Comments have been provided on the new system of self-evaluation indicators applicable to the level of Company management. Outlines have been made on the continued long-term activities for implementation of the configuration management system, establishing of quality management programmes for decommissioning and for radioactive waste management.

2. The Quality Management System at Kozloduy NPP

As discussed in the third national report, the quality assurance system implemented at the Kozloduy NPP incorporates all the activities, graded according to their importance to safety, including for, as follows:

- determination of the organizational structure, responsibilities, authorities, interfaces and management processes;
- enhancement and retaining the qualification of the personnel carrying out activities for ensuring safety control;
- procurement, construction, installation, operation, maintenance, repair and changes of SSC important to safety;
- ensurance of sufficient resources for accomplishing the safety requirements.

The safety ensurance system has been established in four levels:

Level 1 –Kozloduy NPP Safety Management Manual, quality assurance programmes, quality manuals of structural units, guidelines for administrative management (Rules of Procedure of Kozloduy NPP Organization and Functions, structural units' rules of procedure, job instructions and job descriptions);

Level 2 –Guideline documents (rules, manuals, quality instructions), plans and programmes for performing of key processes;

Level 3 –Work documents describing the order for implementing of separate activities (instructions, technologies, methods, procedures);

Level 4 –Reporting documents reflecting the results from activities performed (quality records, protocols, statements, reports, papers, forms, log books).

Following the issuance of the third national report the quality management system has continued to evolve mainly through development of procedures for maintenance and repair activities, functional testing procedures, and operation manuals of new systems and equipment. The efficient performance of the self-assessment indicators adopted in the plant has continued, including at plant management level. The necessary changes are being introduced to the system structure and the indicators context on the basis of accrued own experience and the good practices of companies that have already implemented such systems (Iberdrola from Spain and CEZ from the Czech Republic).

In 2006 implementation was completed of a unified computerized system for control of the main documentation of the plant. This system provides the opportunity for each document uploaded in it to be reviewed and used from any workstation. The necessary organization has been established for records updating through timely and mandatory introducing of changes to the electronic copies of the documents as well.

During the KNPP preparatory period for transition to the integrated document management system as recommended in the IAEA document GS-R-3, the Management System for Facilities and Activities, in late 2006, Kozloduy NPP purchased part of the analysis software package ARIS, intended for business processes analysis and management. A group of specialists has been trained and with some consultancy assistance the experimental use of ARIS has started. A high level process model of Kozloduy NPP has been prepared and also detailed models of five business processes:

- Management of organizational change;
- Documents control;
- Environment management;
- Work of contractors;
- Licensing conditions management and control.

Work will proceed with setting up of the remaining business processes. Some other parts of the software product are planned to be purchased to ensure the possibility for analysis and optimisation of the organization management structure and of the business processes.

Periodic topical inspections by the NRA control the implementation of the quality assurance requirements and the ensured priority of safety. From 2005 to 2007 two (2) such regulatory inspections have been conducted.

3. Quality Assurance of the Belene NPP Design

A document entitled Rules of Procedure of Belene NPP Organization and Functions defines the functions and duties of the main structural units, the rights and responsibilities of the heads of these units, their interactions with external organizations, control and surveillance bodies. The functions assigned to the company are related to the stages of designing, construction, commissioning and operation of Belene NPP.

In view of quality assurance in the designing activities on Belene NPP, the Belene NPP Company at the National Electrical Company has developed and put into effect the Quality

Assurance Programme of the Belene NPP Construction Project. Taking into account the provisions of this programme, the contractor and the designer have prepared their own quality assurance programmes. The project management organization, the processes for management and implementation of the functional relations among the various participants are regulated in a Project Management Manual, comprising of 35 procedures. This Project Management Manual covers not only the designing activities, but also the construction and commissioning ones. The procedures are allocated in four priority categories of development and three levels of approval; the ones referring to designing are in the process of approval.

A Procedure of the Joint Evaluation Committee Activities for Integration of the Existing Buildings and Structures in the Belene NPP Project, and a Procedure of the Joint Evaluation Committee Activities for Integration of the Existing Equipment on the Belene Site have been issued and approved for the purpose of determining the present condition and future use of the constructed buildings and structures as well as the equipment available on site.

Article 14. Safety Assessment and Verification

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.

1. Brief Review of the Information Presented on this Article within the Previous National Reports

The first three national reports have consistently laid down the approach and the efforts the Republic of Bulgaria has made toward a phased updating of the safety cases of each unit in view of bringing them in conformity with modern requirements. The units' design basis documents have been validated or modified on the grounds of the specific studies performed, the deterministic and the probabilistic analyses. Detailed information has been reported regarding specific activities such as analysis on the condition of stressed pipelines and facilities, reactor pressure vessels, development and implementation of a specific system of indicators based on the IAEA approach, as well as on the organization of the internal safety control, the supervision of fire and emergency safety status, etc. Completion has been demonstrated of the Safety Analysis Report (SAR) update for units 3 and 4; plans for SAR development for units 5 and 6 have been submitted.

Data has also been provided on the continuing progress of activities related to Probabilistic Safety Assessment (PSA), evaluation of units 3 and 4 rest lifetime, qualification of in-service inspection methods and installation of supplementary leakage detection systems based upon various principles of operation.

2. Regulatory requirements related to nuclear facilities safety assessment

The regulatory requirements regarding safety assessment of existing nuclear facilities have been specified in the Act on the Safe Use of Nuclear Energy, and particularly the Regulation for Ensurance of the Safety of Nuclear Power Plants. A special section of this regulation identifies the essential requirements to safety assessment, the scope of the deterministic and the probabilistic methods of analysis, the requirements to the objectives of the respective analyses, and to the analytical tools used (computer codes, input data, assumptions, etc.). The regulation also establishes the rules for performing of periodic safety assessments, their scope and the methods to be used in their implementation.

3. Safety Assessment of Operating Nuclear Facilities

3.1. Units 3 and 4

The updated safety case of Units 3 and 4 that reflects the new design condition following the completion of the Integrated Modernization Programme has been prepared to scope and content that meet the modern safety requirements. The completion of Units 3 and 4 SAR, in accordance with the current requirements and using the IAEA periodic safety review methodology, ends the

safety review process of these units initiated in 1994 with the preparation of the PRG'97 Integrated Modernization Programme for these units.

After the third national report was issued, the available Probabilistic Safety Assessment (PSA) continued to be updated on periodic basis and their scope expanded. At present, for each unit there is one updated, specific PSA, Level 1, for all power levels including a seismic PSA and a fire hazard analysis. For the purpose of practical implementation of the available PSAs as tools for operational risk evaluation, applications have been developed for probabilistic assessment of operational events and risk assessment in non-standard configurations of the units' systems. Training in operating and using these applications was provided to the respective specialists of the units' engineering staff. Over the reporting period, the PSA, Level 2, has also been completed. The results from it demonstrate the appropriateness and advisability of the implemented technical measures for severe accidents management and preparation of manuals for their management.

In connection with the shutdown of the two units in late 2006, and pursuant to the modified operating licences of Units 3 and 4, additional safety cases have been developed for a specific set of initiating events, characteristic of the operational mode in which the units are planned to be kept over the coming years until all the fuel is extracted from them.

3.2. Units 5 and 6

The third national report notes that each individual document package about design changes shall be submitted to the Bulgarian Nuclear Regulatory Agency (NRA) together with a special section of the SAR dealing with the structures, systems and components concerned. The operator shall be assisted by an external engineering consultancy team in the course of reviewing these documents, and the NRA - by experts of the West European supervising authorities pursuant to a special, PHARE funded programme of EU.

The modernization programme has envisaged a special measure to prepare a complete SAR for each unit on the basis of the SAR sections dedicated to the design changes and the analyses performed on the transient and the emergency modes. Due to the stepwise implementation of the modernization measures, the SAR preparation was also planned as a staged process, the final step of which was completed in late 2006. The new SAR is compliant with the national regulatory basis, the applicable current Russian and American standards, and the respective IAEA guidelines. The main document used was PNAEA G-01-036-85, entitled Requirements to SARs for NPPs with WWER Reactors

The first Probabilistic Safety Assessment, Level 1, for fully operational units was completed in 1995. It assessed the risk of internal initiating events including fires and floods, as well as the seismic impact. This PSA has been updated and the input data consider all design changes that had been implemented by the beginning of 2001 when the modernization programme commenced. A separate modernization measure was the development of PSA, Level 1 for operation at low power and shutdown modes. The document evaluates only the risk of internal events using conservative conditions and assessments of failures.

4. Belene NPP

The ensuring of safety is the main priority in the overall development of the concept for construction of Belene NPP. The work on the choice and preparation of the site in the 80ies of the 20th century has been carried out in accordance with the legislative basis in force at that time. Later on special IAEA and other organizations missions confirm the correspondence of the decisions taken with the internationally adopted safety standards.

The activities undertaken following Council of Ministers Decision No. 260 dated 8 April 2005 for continuation of the construction of the Belene NPP are strictly in conformity with current documents for ensuring of safety. The candidates for contractors have been obliged to submit

detailed data on the qualitative and quantitative safety indicators in their respective proposals. These indicators are included in the methodology for assessment of the proposals.

Each of the offers submitted by the chosen candidates contains an extensive section entitled "Safety Substantiation" presenting the concept of safety, the envisaged safety systems and the results from preliminary safety assessment analyses during normal operation and in emergency conditions. The results from the review of this section play a key role in the final selection of a contractor.

Further below are listed details on the safety assessment from the already completed stage of the development of the project for construction of the Belene NPP.

4.1 Assessment of safety in the process of choice of design for implementation

For the purpose of carrying out a detailed evaluation of the submitted offers, an international team comprising of 90 experts was convened. The team is divided into separate groups according to specific areas, including nuclear safety and radiation protection. The procedure on selection includes review and discussion of the respective sections of the technical proposals, namely:

- Concept for ensuring safety;
- Design of the safety systems;
- Preliminary analysis of postulated accidents;
- Preliminary results from the Probabilistic Safety Assessment (PSA).

4.2 Assessment of safety in the initial design

The initial design presents the concept for radiation protection, which effectiveness is confirmed by conservative calculations, as follows:

a) Discharges of radioactive substances into the environment under normal operation and deviations from the normal operation (incidents)

The safety assessment of the reactor installation is carried out through comparison of the results from the analysis with the criteria for acceptance. According to this criteria, the dose limits for an individual from the population during normal operation and in case of accidents should not surpass 50 μSv/a, as a result of the impact from radioactive substances (liquid and gaseous) discharged by the NPP into the environment. This value is equal to one third of the permissible limit for this indicator, as defined in the requirements pursuant to the Regulation for ensuring the safety of nuclear power plants and is pertaining to all installations on the site.

For normal operation and incidents the quantity of liquid and gaseous discharges from one unit are limited to the following values, namely:

Annual discharges	Target values
Liquid discharges • Liquids excluding tritium	 6.67 Gbq
Gaseous discharges • Noble gases • Halogens and aerosols	 33.3 TBq 0.67 GBq

- Dose from direct exposure

The dose from direct exposure of the surrounding population under normal operation and incidents is 0,1 mSv/a, regardless of the nominal power of the unit.

- Dose from external exposure

The dose from external exposure for an individual from the population as a result of Design basis category 2 (DBC2) in whatever period of the year and at the same time from internal exposure due to inhaling and absorbing of radioactive materials is 0,1 mSv.

- The limits of the effective dose for the personnel under normal operation and deviations from the normal operation are in accordance with the Regulation on Basic Norms of Radiation Protection (BNRP 2004)": The limit of the effective dose for personnel is 100 mSv for a period of 5 consecutive years and the maximum effective dose for each year cannot surpass 50 mSv.

Additionally for the Belene NPP design, the following targets for annual effective doses under normal operation and incidents have been set up, including the doses due to the respective activities such as maintenance, repair works, replacement of equipment, refuelling, inspection during operation and others.

- The target for the individual effective dose is 5 mSv/year.
- The target for the annual average collective effective dose during the life cycle of the power plant is 0,5 mSv/unit.

The cited targets serve as criteria for acceptance of the design with regard to radiation protection.

b) Radiation consequences from Design Basis Accidents

For regimes where there is untightness of the cladding of the fuel rods without heating the fuel, the value of 100% discharges of noble and radioactive gases and volatile fission products is accepted and 30% for Cesium from the accumulated quantity under the fuel rods cladding in the protective confinement construction. For a loss of coolant accident, the untightness of 100% of the fuel rods in the reactor core is postulated. For the cases with fuel heating a conservative assessment of the discharged fission products from the fuel will be carried out.

The legislative radiological limit for design basis accidents has been complied with, due to the fact that the exposure doses of the critical group of the population are lower than 5 mSv/year at a distance bigger than 0,5 km from the nuclear power plant.

For the Belene project, additional targets and criteria for acceptance of the radiological consequences from design basis accidents have been set up through discharges of reference isotopes.

The following design objectives have been set up, namely:

(1) No intervention should be necessary at a distance greater than 800 m from the reactor in case of a design basis accident;

(2) Extremely limited economic consequences off the site of the power plant in case of a design basis accident.

For the completion of the first objective, criteria for acceptance are introduced controlled through a linear combination of three isotopes (^{133}Xe, ^{131}I и ^{137}Cs).

The implementation of the second objective is verified through comparison of the target values set up for discharges at ground level and in the atmosphere for two reference isotopes ^{131}I и ^{137}Cs as follows:

Isotope	Target for discharges at ground level, TBq	Target for discharges in the atmosphere, TBq
^{131}I	10	150
^{137}Cs	1.5	20

c) Radiation consequences from Beyond Design Basis Accidents

For severe accidents a limit for permissible discharges has been defined (art. 10, par.3 of the Regulation for ensuring the safety of nuclear power plants): the limit for discharges of ^{137}Cs in the atmosphere is 30 TBq. The combined discharge of other radionuclides different from the Cesium isotopes should not cause in a long term period starting 3 months following the accident a higher risk than the risk determined for the discharges of Cesium in the stipulated limit. The frequency of large radioactive discharges in the environment during which it is necessary to undertake immediate protective measures for the population should not be higher than 1.10^{-6} events per NPP per year.

Additionally for the Belene NPP design, objectives and criteria have been defined for acceptance of beyond design basis accidents, in analogy to the objectives and criteria for design basis accidents, as follows:

(1) Lack of actions for emergency protection at a distance greater than 800 m from the reactor

The criteria for acceptance of this objective for beyond design basis accidents is defined for a linear combination of 9 isotopes (^{133}Xe, ^{131}I, ^{137}Cs, ^{131m}Te, ^{90}Sr, ^{103}Ru, ^{140}La, ^{141}Ce and ^{140}Ba).

(2) Lack of delayed activities in whatever moment outside the area with a radius of 3 km from the reactor

The criteria for acceptance for this objective for beyond design basis accidents is defined for a linear combination of the same 9 isotopes.

(3) Lack of long term activities at whatever distance bigger than 800 m from the reactor

The criteria for acceptance for this objective for beyond design basis accidents is defined for a linear combination of the same 9 isotopes.

(4) Limited economic consequences off the site area

The implementation of this objective for beyond design basis accidents is verified through comparison of the total sum of discharges at ground level and such in the atmosphere throughout the whole period of discharges with each of the three reference isotope values as follows:

Isotope	Limit (TBq)
^{131}I	4,000
^{137}Cs	30
^{90}Sr	400

The analysis of the radiation consequences from beyond design basis accidents shows that the envisaged in the design safety systems ensure the safety of the population and the personnel of the NPP in accordance with the Bulgarian standards and the internationally accepted criteria.

4.3 Future safety assessments

The steps which remain to be performed in the systematic safety analysis and which have to be developed and submitted to the NRA are as follows:

- Interim safety analysis report – basis for issuing permission for construction. According to the legislative requirements an independent review of the Interim safety analysis report is required;
- Final safety analysis report – basis for issuing a license for operation.

As far as the terms of the licenses for operation are limited within a time period – up to 10 years, the next systematic safety assessment will be in fact the periodic safety review, which is a basis for renewal of the term of the license for operation. According to the legislative requirements in the

scope of the periodic safety review should be included as a minimum requirement the following fields, namely:

1. Site characteristics, taken into consideration in the design and in case of necessity their re-evaluation on the basis of received new data and new methods used;
2. The NPP design and its state at the moment of commissioning and the actual state of the SSC taking into consideration the carried out modifications, the effects of aging and other effects which have impact upon safety and the design lifetime of operation;
3. The existing analytical methods for analysis of safety and the applicable new safety requirements;
4. Operational experience and effectiveness from feedback in the period in question;
5. Organization of operation;
6. Safety indicators and effectiveness management of safety and quality;
7. Quantity, levels of training and qualification of the personnel;
8. Emergency preparedness;
9. Radiological impact of the NPP upon the environment.

The periodic safety review should be prepared according to a systematic and documented methodology, which includes deterministic and probabilistic methods. The conclusions should substantiate practically the possible measures for improvements, taking into consideration the common links between the detected deviations.

5. Inspection System and Parameters

Following the issuance of the third national report, implementation continued of activities related to the technical maintenance, inspections and diagnosis of SSC important to safety including in-service control in the following basic areas:

- development of WWER-1000 SSC maintenance and surveillance procedures in view of optimising the reliable operations (implemented within the framework of the Units 5,6 Modernization Programme - see Attachment 5);
- realization of the programmes and methods for operational control of both types of reactors including modernization of the existing systems for control and procurement of new equipment;
- implementation of the programme for qualification of the control methods and equipment, including personnel training and certification.

The accumulated experience and the outcomes from the developing of methods for non-destructive and diagnostic inspection have been used to update the operational control programmes and methods. The system for applying of thermovision, densitometry and vibrodiagnostics has been expanded as a reliable tool for timely detection of any deterioration of the equipment and prevention of failures.

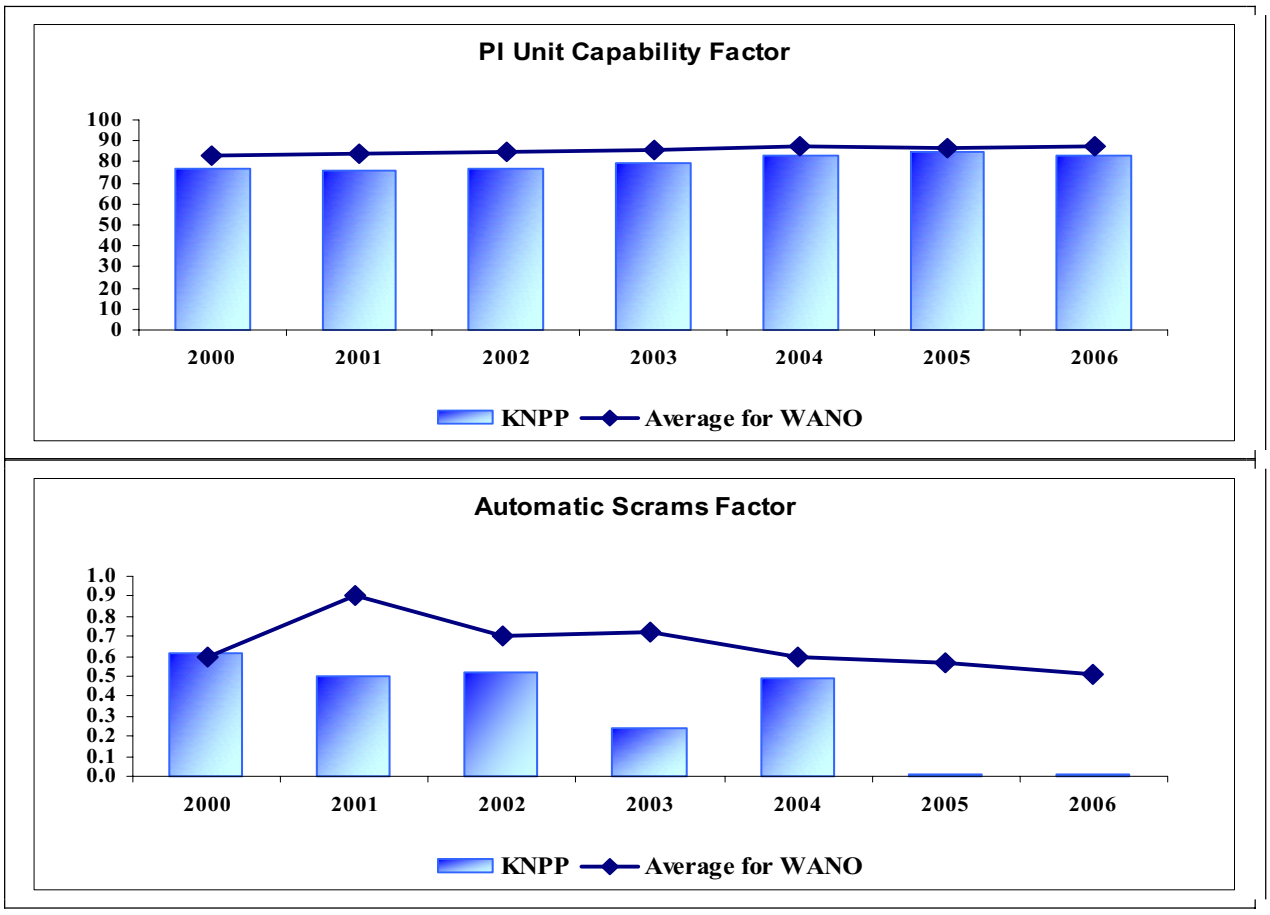
Implementation has been completed of the special programme for qualification of non-destructive control of items important to safety, which started in 2002. The achieved qualification criteria of detecting and sizing of critical defects of a given item match the recommended practices of ENIQ (European Network for Inspection and Qualification). The work on the qualification procedures was fulfilled under the supervision of a British qualification company acting as a consultant of NRA on control qualification.

Over the reporting period, systematic practical application continued of the methodology developed in a project jointly funded by DTI and some UK companies, dedicated on periodic training of Kozloduy NPP (KNPP) inspection personnel, examining of the capabilities of this personnel to work under conditions of limited access and time, as well as specific training for work with new inspection systems and methods. The bilateral sharing of experience with countries such as the UK, Spain, Croatia, Russia, Czech Republic, etc., has been evaluated as an effective approach for ensuring the required current level of implementation of this activity.

Implementation has been in progress of the programme, launched in 2002, for life cycle management of the structures, systems and components of units 3 and 4. The programme draws on the current experience in preparation of similar projects by leading German and Russian engineering companies. The results have been submitted to the NRA as part of the documents attached to the request for issuance of operating licence for these units.

Over the time period following the issuance of the third national report, further progress has been made on the development of the system of indicators used by the Koloduy NPP. This system was founded on the IAEA documents, and has been updated on periodic basis taking into account the practical experience of its operation. The indicators have been examined periodically, their development trends have been put to analysis, corresponding action has been taken and the strong and weak points of the activities assessed. The outcomes from implementing of the indicators have been made available to the entire personnel through the computerized information system.

Results from analysis of the indicators demonstrate the operational reliability of the power units over the reporting period. This can be best illustrated by the following indicators:



Over the past few years there has been no scram at any of the units of the Kozloduy NPP. In 2006, unit 6 registered ten years of operation without any scram. Unit 5 has operated for 14 years (1994 - 2007) with only one scram occurring in 2001. These results point to a permanent trend of high reliability level of the Kozloduy NPP operation.

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

1. Brief Review of the Information Presented on this Article within the Previous National Reports

The previous three national reports describe the national policy in the area of radiation protection of nuclear power plants operation, the legal and the regulatory basis, the structure and functions of the control authorities and the established system for in-plant control of the Kozloduy NPP.

These documents comment on the Basic Norms of Radiation Protection (BNRP - 2000) based on the international safety standards and introduced in 2001, as well as on the plans of the Republic of Bulgaria for further development of the laws and regulations in view of their harmonization with the European Union legislation. The third national report comments upon the Regulation on Basic Norms of Radiation Protection, and the Regulation for Radiation Protection during Activities with Sources of Ionising Radiation (effective as of 2004), developed on the grounds of international safety standards (BSS) and introducing the requirements set out in Directives Nos 96/29/EURATOM, 90/641/EURATOM and 84/466/EURATOM.

2. Organization of Radiation Protection and Radiation Monitoring in the Republic of Bulgaria

As already noted in the preceding national reports, the requirements for radiation protection and radiation control have been formulated by the Act on the Safe Use of Nuclear Energy (ASUNE), the Environmental Protection Act and the Act on Public Health, regulations of the NRA and the Ministry of Environment and Water (MEW), the issued licences and the technical regulations for nuclear facilities. Article 3 of ASUNE provides that exposure of the personnel and the public to ionising radiation shall be kept as low as reasonably achievable. According to Article 16 of the same Act, the individuals performing activities involving use of nuclear energy shall observe the radiation protection requirements, standards and rules.

The operational licences for the Kozloduy NPP units have been issued on the grounds of sufficient evidence that the legal entity:

- possesses the necessary technical means and has established the appropriate organization to maintain as low as reasonably achievable the radiation doses to the personnel and the public;
- have got approved emergency plans for action in case of an accident;
- has ensured compliance of the facility and its declared activity with the requirements, standards and rules of nuclear safety and radiation protection.

The radiation limits for the public, resulting from radioactive substances released to the environment in case of accidents, are identified in the Regulation on Emergency Planning and Emergency Preparedness in case of Nuclear or Radiation Accident.

The Technical Specifications providing operational limits and conditions include also limits for releases of radioactive substances to the environment under normal operational modes. These limits have been periodically updated to match the trends for continuous decrease of the actual releases to the environment. At the end of 2006, KNPP submitted to the NRA a request for permit to change the gaseous discharge limits of the on-site stacks. Justification that the new limits will ensure annual doses to the public not-exceeding 50 μSv have been provided (where legislative annual limit is 250 μSv, as an impact of liquid and gaseous discharges during normal operation of the nuclear power plant). The corresponding permits for each KNPP unit will be issued by the end of 2007. The specific values of these limits and the approach used for their determination will be reported at the review meeting in 2008.

The gamma radiation background within the 3-km zone surrounding KNPP has been continuously measured by the automated Berthold radiation monitoring system (ARMS). This system has been on-line integrated into the national system of the Ministry of Environment and Water.

The radiological monitoring in the country is performed by the National Automated Environmental Monitoring System. The system monitors the radioactive contamination of the atmosphere, soil, surface and ground waters and other components of the environment.

The continuous monitoring of the equivalent dose rate on the territory of the Republic of Bulgaria has been realized through the National Automated Gamma Radiation Background Continuous Monitoring System. This system comprises of 29 monitoring stations covering the entire area of the country. The common database is kept at the central monitoring station, located in the Environmental Executive Agency at the Ministry of Environment and Water. Information is re-transmitted in real time to the NRA Emergency Centre and to the National Response Centre at the National Civil Protection Service Directorate General of the Ministry of State Policy on Disasters and Accidents.

3. Radiation Protection during the Operation of the Kozloduy NPP

3.1 Radiation impact on the personnel

The previous national reports have described the in-plant structure providing radiation protection control of KNPP Plc. Independent control of the occupational exposure is carried out by the Health Physics Control Centre - a type C body, as provided by the Bulgarian State Standard EN ISO/IEC 17020.

The table below presents data about the occupational exposure at Kozloduy NPP Plc. over the past five years.

N	Indicator	2002	2003	2004	2005	2006
1	Collective effective dose [manSv]	3.7	3.1	4.2	3.0	1.6
2	Internal exposure percentage of the occupational exposure [%]	2.8	2.9	1.4	1.0	0
3	Exceeding of the occupational exposure annual limit of 50 mSv (BNRP 2000)	0	0	0	0	0
4	Mean individual effective dose of individuals from controlled practices [mSv]	0.65	0.49	0.80	0.63	0.45
5	Highest effective dose [mSv]	19.91	18.21	19.93	13.42	13.02

The collective effective dose at Kozloduy NPP Plc. incurred in 2006 was 47% lower than the one registered for the preceding year. Figure 1 shows the trend for the collective dose over the past five years.

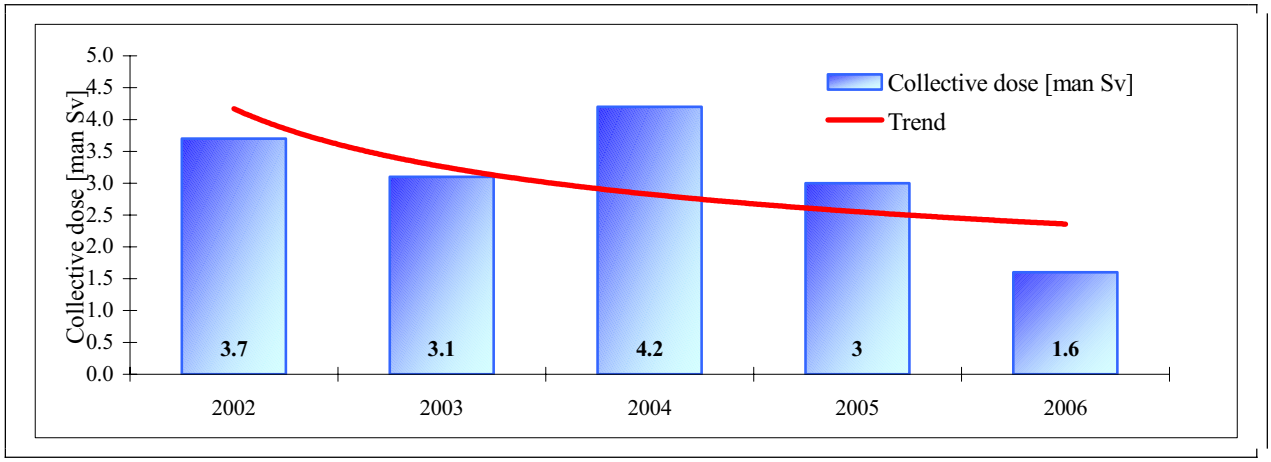


Figure 1. Collective effective dose at Kozloduy NPP Plc., 2002-2006

The 2006 collective dose at Kozloduy NPP Plc. standardized to the number of reactors was 0.27 manSv/unit. This value is lower than the indicator value averaged for 259 PWR reactors over the year 2005, which was 0.65 manSv/unit as set forth in the WANO'2005 Performance Indicators (Figure 2). The same indicator in 2005, with value averaged by ISOE for 263 PWR reactors was 0.77 manSv/unit. The collective dose in 2006, standardized to the number of operating reactors was 0.17 manSv/unit for the WWER - 400 units, and 0.43 manSv/unit for the WWER - 1000 units.

The averaged indicator values for 2004 deviate from the decreasing trend observed for Kozloduy NPP Plc. over the past five years, which is due to the implemented main scope of maintenance activities incorporated in the modernization of units 5 and 6 in the same year.

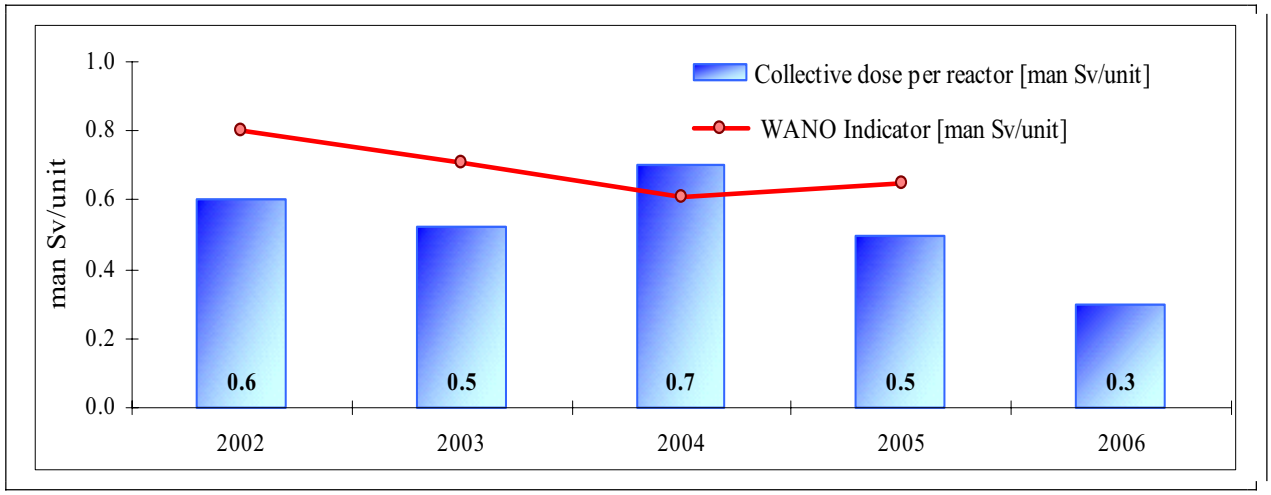


Figure 2. Collective dose per reactor at Kozloduy NPP Plc., 2002-2006

The mean annual individual dose incurred by individuals of controlled practices at KNPP in 2006 was 0.45 mSv, which is by 29% lower than the preceding year and reached the level of 2003 (Figure 3). The comparatively high mean individual dose for 2004 is essentially due to the large number of external organizations personnel participating in the modernization of units 5 and 6 in the same year.

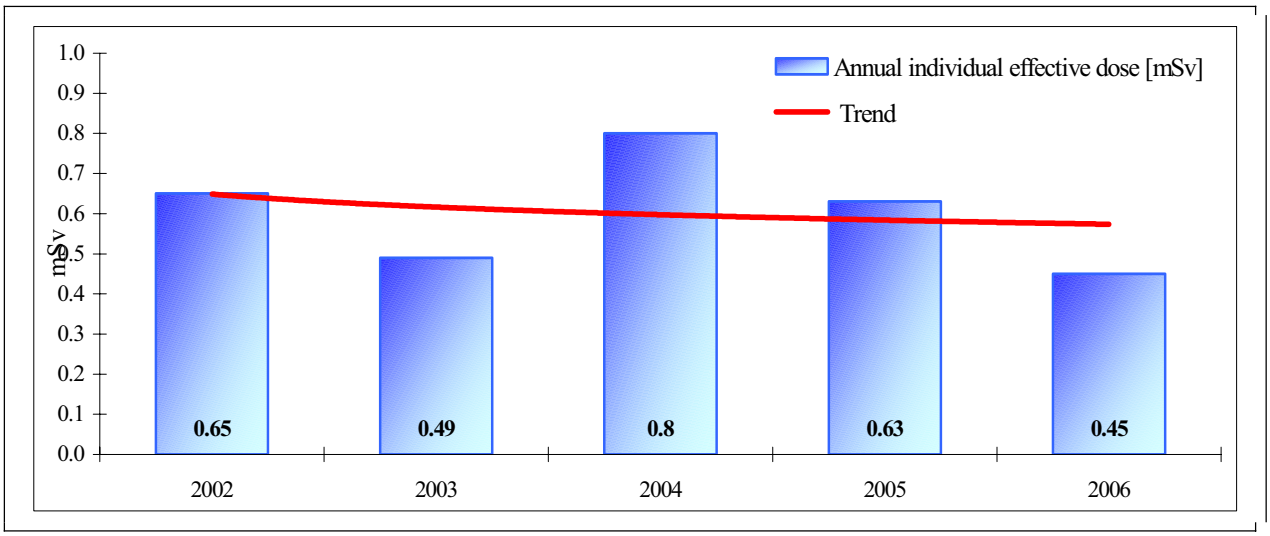


Figure 3. Mean individual effective dose at Kozloduy NPP Plc., 2002-2006

Over the past five years no individual effective dose has been registered at KNPP exceeding the occupational exposure limit of 50 mSv, as set out by the BNRP - 2004.

3.2. Radiation impact on the public and environment

The activity discharged through the stacks of KNPP from 2002 to 2006 has been as shown below:

Standardized indicators	Dimension	2002	2003	2004	2005	2006
Radioactive noble gases	TBq/GW.a	115.8	128.5	37.3.	13.1	3.1
Iodine – 131	GBq/GW.a	1.27	1.31	0.68	0.15.	0.12
Radioactive aerosols	GBq/GW.a	0.74	0.67	0.07	0.03	0.03

After 2004 the discharges are significantly smaller than those in the preceding years and are under 1% of the technological norms for the site. The reasons for this reduction are the termination of operation of first and second units, the application of updated procedure for calculation and reporting of the results, as well as the systematic application of the ALARA principle in the every-day's activity of the plant.

Over the same period, 2002-2006, a quantity of 524532 m^3 controlled water discharges have been channelled to the Danube river, having the following total activity:

Standardized indicators	Dimension	2002	2003	2004	2005	2006
Liquid discharges, without tritium	GBq/GW.a	0.85	0.86	1.00	0.88	0.5
Tritium	TBq/GW.a	8.83	9.82	6.8	8.19	9.06

From 2002 to 2006 the activity released from Kozloduy NPP gaseous aerosol and liquid discharges was within the range up to 1.2% of the effective limits in the Republic of Bulgaria and it was comparable with the normal practice of other countries operating WWER reactors. The tritium activity in the liquid discharges was below 11% of the respective norms.

The maximum individual effective annual dose within the 30-km zone caused by the gaseous aerosol discharges from KNPP was within the range from $3.28.10^{-8}$ to $3.76.10^{-7}$ Sv/a in 2002-2006. This irradiation value is less than 0.02% of the background radiation typical for the KNPP region, and lower than 0.2% of the authorized standard quota of 200 μSv.

The maximum standardized collective effective annual dose to the public within the 30-km zone resulting from gaseous aerosol discharges from KNPP was estimated within the range from $3.28.10^{-4}$ to $3.12.10^{-3}$ manSv/GW. These values are fully comparable to practices worldwide concerning PWR reactors, as shown by data of UNSCEAR-2000.

The exposure of a member of the critical group of the public from liquid discharges is calculated by new CREAM programme, that is used in many European countries. The calculated doses are from $2.47.10^{-6}$ to $3.91.10^{-6}$ Sv/a. The standardized collective effective dose for the public within the 30-km zone incurred from the liquid discharges was estimated from $1.60.10^{-3}$ to $2.69.10^{-3}$ manSv/GW.a.

The exposure dose data for the period 2002-2006 measured in the 30-km zone of Kozloduy NPP are fully comparable to the data from previous years and confirm the conclusions about the negligible impacts on the environment and the public. The dose estimates correspond to the good practices worldwide.

Over the period 2002-2006, the gamma radiation dose rate at the site boundaries and all the control points within the 100-km zone around KNPP remained within the range of the natural background radiation of 0.07-0.15 μSv/h, and is thus fully comparable to the values measured for other towns in the country.

At a total of 36 control points within the 100-km surveillance zone samples are collected for laboratory assays of technogenic radioactivity in major components of the environment, such as air, water, soil, vegetation, etc. Outside these points, analyses have been conducted on water from the Danube and inner water basins, as well as of agricultural and food products typical for the region. Annual assays have been made of more than 2400 samples, subjected to over 3800 analyses. Standard modern radioanalytical techniques approved in practice have been used, such as gamma spectrometry, low background radiometry of the total beta activity and radiochemically isolated strontium, liquid-scintillation tritium spectrometry enabling the detection of the smallest deviations of the analysed radiation parameters from their typical natural levels.

The results from the analysis performed on the major environmental components, such as air, water, soil and vegetation, as well as of the foods typical for the Kozloduy NPP region have been within the normal ranges characteristic for these latitudes. The measured concentrations were many times lower than the regulatory norms, and were fully consistent with the data obtained in previous years and in the pre-commissioning period, 1972-1974. As has been the case over the preceding years, in 2006 no change was registered in the radioecological parameters, as a result of the KNPP operation. The radiation conditions within the 100-km zone have remained stable and favourable.

4. Requirements towards radiation protection for the Belene NPP design

The design for radiation protection for the Belene NPP should ensure compliance with the obligatory dose limits for the personnel and population determined in the NRA regulations.

The additional targets towards the design do not contradict with the legislative limits and only ensure additional conservatism with view of the best achievements in this field.

The targets for normal operation, the deviations from normal operation and emergency conditions have been discussed in detail in Article 14. The values mentioned there have been set for the purpose of the design.

The design of the Belene NPP has to show with a high level of security that the radiological indicators (discharges of radioactive materials, doses for the personnel and the population) are as low as reasonably achievable (ALARA) and that they will remain below the set limits. For this purpose the Designer has to submit technical and economical substantiation of the achieved values of the radiological indicators and to apply the principle of optimisation.

The design and the placement of the units should envisage appropriate means for minimization of exposure and contamination from all sources of radioactivity. Such means should include appropriate design of the systems and components with regard to low exposure during maintenance and inspection, screening from direct radiation, minimization of the activation of the fission products through specification of appropriate materials, means for monitoring, access control to the power plant, minimization of the time period for stay in contaminated or radioactive areas and appropriate installations for decontamination.

The administrative procedures should ensure access control to the radiation and contaminated areas and to contain measures for minimization of the contamination as a result of transportation of radioactive materials and personnel inside the plant. The placement of the equipment in the plant should ensure effective operation, inspection, maintenance and replacement in case of necessity for minimization of the exposure.

Attention should be paid also to the actions, which could be required for implementation by the Operator during or following Emergency conditions, or beyond design basis emergency conditions. Access to equipment and exact assessment of the power of the exposure dose should be provided for the places where the presence of operators is required.

Concept for radiation protection of the Belene NPP

For the purpose of ensuring the protection of the Belene NPP personnel and the population from radiation, the organization of radiation protection is envisaged based on the following principles, namely:

1) The exposure dose received by an individual (for the personnel as well as for the population) should not exceed the permissible limit doses in accordance with the Bulgarian standards. As acceptance criteria of the radiation protection should be used the defined targets with regard to the exposure dose of the personnel and population;
2) All collective and individual doses should be kept at the utmost possible low level (ALARA), taking into consideration both economic as well as social factors.

These targets will be achieved through designing of systems and materials (selection of materials with an appropriate chemical content with the purpose of diminishing the radioactive sources, decreasing the radioactive fields, appropriate placement, zoning and limiting the personnel access in relation to the different zones, purification, ventilation and deactivation), operation and technical servicing of the power plant (envisaged means for facilitating the technical servicing, decreasing the technical servicing) and others.

The complex of organizational and technical measures for decreasing the exposure includes the following, namely:

- active and passive systems for diminishing/elimination of iodine and aerosols from the intermediate space between the containment and other premises before discharging into the atmosphere through the ventilation stacks;
- organization of biological protection;
- structure of the closed circuits for radioactive mediums;
- structure of the closed circuit for the components cooled by water;
- organization of the control over radioactive leaks, collection and purification of the possible radioactive leaks;
- organization of the control, collection and temporary storage of generated at the power plant solid and liquid waste;

- maintaining through special systems for ventilation, normal radiation climatic conditions in the technological compartments in case of leakage of radioactive substances;
- organization of the maintenance activities through usage of special tools (nutrunner for the main seal of the reactor, sealing of SG and pressurizer);
- organization of the radiation control in the NPP compartments and outside of them;
- separation of buildings and equipment related to the implementation of the technological process into areas of controlled and free access;
- the delineation of areas around the NPP has been presented in relation to the expected radiation fields and the level of contamination throughout the whole term of operation of the NPP;
- implementation of activities related to individual radiation protection.

For the purpose of receiving information on the radiation condition of the compartments in the power plant, the design has envisaged radiation control in an automated regime with the help of installed fixed monitors measuring the level of irradiation and contamination of the air with radioactive substances and also in some cases periodic control and selection of samples carried out manually by especially trained for this purpose personnel. Means for automated control of the condition of the barriers have been envisaged, as well as technical means for automated control of the quantity of liquid and gaseous discharges from the NPP.

In view of the received values of the doses outside the plant, the boundary of the NPP site can be used for the purposes of boundary of the radiation protection area.

The radiation impact upon the personnel and the population under normal operation of the Belene NPP is expected to be within the legislative requirements in Bulgaria and in most of the cases the actual radiation impact will be considerably lower than these requirements. In all cases the radiation risk for the population is negligible.

Article 16. Emergency Preparedness

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

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

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

1. Brief Review of the Information Presented on this Article within the Previous National Reports

The previous national reports have described the common emergency planning system set up in our country for maintaining emergency preparedness and response, together with its legal and institutional framework.

The organization and interaction among the various structures, the existing emergency plans and in particular the KNPP Emergency Plan have been represented through interaction diagrams. The national exercises and training conducted with the objective of enhancing the emergency preparedness, as well as the participation of our country in international exercises have been described in detail.

The established legal framework and the practical results thereof particularly concerning the participation in international exercises have been mentioned within the discussion on the report in 2005.

2. Changes in the legal and regulatory basis of emergency planning and preparedness

Over the reporting period a new Disaster Protection Act came in force (promulgated on 19.12.2006). This act regulated the establishment of the Ministry of State Policy on Disasters and Accidents (MSPDA) that unites the existing organizations engaged in the prevention, response, management and reconstruction in cases of disaster, emergency or catastrophe. Within this Ministry, the National Civil Protection Service Directorate General was established and it incorporates all the central and regional structures of the former Civil Protection State Agency. The Disaster Protection Act sets up a stable hierarchy in the establishing and keeping of a common system for protection of the public and the national economy in times of disaster or emergency. Moreover:

- The National Assembly shall implement the legal formation of the system for protection of the public and the national economy. Parliamentary control is effected through a Standing Committee on the Disaster and Emergency State Policy, set up for the purpose at the National Assembly;

- The President of the Republic shall receive the full information in case a threat or an emergency should occur on the territory of the whole country;
- The Minister of State Policy on Disasters and Accidents is a central governing body that shall:
  a) co-ordinate the planning of protection activities in case of disaster;
  b) co-ordinate and control the implementation of the National Programme for Protection against Disaster as well as the annual plans for its implementation, the disaster protection plans and the plans for carrying out rescue and urgent emergency-and-reconstruction works;
  c) organize the development of disaster risk evaluation methods;
  d) supervise the implementation of preventive measures for public defence from potentially hazardous sites or practices;
  e) analyse the effectiveness of the common rescue system;
- The district governors and the mayors shall bear the responsibility for management in case of disaster or emergency.

The system for protection of the public and the national economy allocates a key function to the arrangements for monitoring, early warning, fast response and management in case of disaster, emergency or other crisis situation, including the emergency call system with the common number '112'.

The ministries and departments, each within their competence, shall develop and realize co-ordinated strategies and programmes for the most efficient use of the state granted resources for protection of the public and the national economy. To ensure the protection of the public and the national economy, as well as to improve the living conditions in the affected areas, a reserve has been built up of material, technical and financial resources together with a regulatory basis ruling the order and manner of their use.

The National Civil Protection Service Directorate General, which incorporates 28 regional units, is entrusted with the task of developing and co-ordinating with other ministries and departments a National Plan for Carrying out Rescue and Urgent Emergency Reconstruction Works in case of Disaster, Emergency or Catastrophe. The Plan shall be approved by the Prime Minister of the Republic of Bulgaria. An integral part of this Plan is Part III. Off-Site Emergency Plan, which deals with activities in case of a nuclear or a radiation emergency. The Off-Site Emergency Plan shall be accepted by a decision of the Council of Ministers, following a motion made by the MSPDA.

The state budget funds the development of the off-site emergency plan, its material and technical support and staffing, the maintenance of emergency preparedness and implementation of the measures.

The terms and conditions for emergency plans preparation, the individuals engaged in implementing these emergency plans, their obligations, the measures for limiting and remedying the consequences, the public outreach and notification, and the emergency preparedness verification measures are determined by the Regulation on Emergency Planning and Emergency Preparedness in case of Nuclear or Radiation Accident and the Rules for organizing the activities for prevention and remedying the consequences from disaster, emergency or catastrophe.

3. Emergency Plan of Kozloduy NPP

The KNPP Emergency Plan is in line with the requirements of the Regulation on Emergency Planning and Emergency Preparedness in case of Nuclear or Radiation Accident.

In 2005 Kozloduy NPP took part in the international ConvEx-3 exercise for action in case of trans-boundary radioactive contamination resulting from a nuclear accident occurring abroad, organized by IAEA and hosted by Romania. During this exercise some omissions were found in the KNPP Emergency Plan. For instance, criteria were missing for action in case of trans-boundary radioactive contamination; the Emergency Management Centre (EMC) information system had a continuous working capacity of only 24 hours after which it needed restarting; some inaccuracies were established in the notification and data transmission forms. To correct these deficiencies a proposal was prepared to modify the emergency plan (No E-02-1198/27.09.2005). Specific criteria were developed and listed in an annex to the emergency plan, entitled "Protection arrangements, personnel activities and deplanting at Kozloduy NPP in case of trans-boundary radioactive contamination". In the instance of a trans-boundary radioactive contamination, the KNPP Emergency Plan will be introduced by the KNPP Executive Director (or, if absent, - by the person authorized to act on his behalf). A new version of the EMC information system has been developed that automates the input data information exchange, data processing and submission as output information to the emergency teams at the EMC. The programme modules permit the use of the information system for training scenario preparation, conducting of emergency response drills, and responding in case of an actual emergency. The notification and data transmission forms have been improved to avoid unclear points or the possibility of making mistakes while filling them in.

Updating was performed on the emergency response plans in case of accidents related to transport of fresh and spent nuclear fuel.

4. Participation in Emergency Drills

Following the presentation of the third national report, our country has taken part in six national and international drills, namely:

- Kozloduy NPP emergency response drills (2004, 2005, 2006) with scenarios on different topics;
- international drill for off-site action in case of a nuclear accident (trans-boundary contamination) at Cherna Voda NPP, in Romania (2006);
- EMERCOM international drill of IAEA, for verification of the emergency communication systems in case of a radiation emergency occurring at an NPP (2005, 2006).

Article 17. Site Selection

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.

1. Brief Review of the Information Presented on this Article within the Previous National Reports

The preceding three national reports have provided consistent description of the legal and regulatory basis in force up to 2004, together with the results from the studies conducted on the two sites, Kozloduy and Belene, assigned for construction of nuclear facilities in the Republic of Bulgaria.

They also report on the supplementary site-study activities, including after the start of construction work on these sites. Detailed information has been provided on the latest assessments for compliance that also take into account the independent studies organized by IAEA.

The reports have also presented the existing agreements signed with the governments of the neighbouring countries: Romania, Greece and Turkey, on the subject of notifying about nuclear accidents and information exchange about existing or planned nuclear facilities.

2. Regulatory Requirements Effective in the Republic of Bulgaria

The new Act on the Safe Use of Nuclear Energy has modified the licensing regime for site selection for a nuclear power plant. Essentially, the modification consists in a two-stage regulatory activity - issuance of a permit to conduct site selection activities and approval of the selected site by the NRA Chairman.

The procedure for issuance of a site-selection permit has been determined in the Regulation on the Procedure for Issuance of Licences and Permits for Safe Use of Nuclear Energy. The specific requirements to the site and the scope of the engineering studies, and investigation on the processes, phenomena and factors of natural and technogenic origin have been defined in the Regulation on Ensuring the Safety of Nuclear Power Plants.

In order to issue a site-selection permit, the applicant has to submit a conceptual description of the nuclear facility and provide the site acceptance criteria, as well as an assignment plan for the site studies, description of the actions and methods for implementing of the studies, and the results thereof.

For the approval of the selected site, the applicant shall present the preliminary safety analysis report that has to include:

1. General description and characteristics of the nuclear facility;

2. Main safety objectives, principles and criteria that shall be applied in safety substantiation;

3. Types and quantities of radioactive waste which is anticipated to be generated in the course of operation, the manner of their management until final disposal;

4. Comparison of the proposed sites in terms of nuclear safety and radiation protection and selection of an option considering:

- the impact of technogenic and natural factors on the safety of the facility;
- the radiological impact of the nuclear facility on the public and the environment;
- the specific site characteristics that are significant for migration and accumulation of radioactive substances;
- the possibilities for implementing of protection measures for the public in case of a nuclear facility accident;
- the boundaries of the special-statutory areas (radiation protection and surveillance zones) and the emergency planning zones.

5. Results from the study on the characteristics of the selected site, including the:

- geographic, topographic and demographic conditions;
- technogenic factors;
- hydrometeorological conditions;
- geological, hydrogeological, seismic and engineering-geological conditions;
- specific characteristics of the site and the area for the purposes of emergency planning, emergency management and physical protection.

The documents for approval of the selected site have to include also the following:

- site monitoring programmes, including: seismic monitoring, ground and surface water regimes, and monitoring of other natural phenomena;

- a programme for further studies of the selected site when the submitted safety analysis report proves the need of such studies;

- a decision on the environmental impact assessment.

The NRA Chairman shall approve the selected site if it satisfies the adopted requirements and there is evidence proving that the characteristics have been determined of the site, events and phenomena that may exercise an impact on the designing. Also should be demonstrated that under normal operating conditions and design basis accidents the exposure to the personnel and the public will be as low as reasonably practicable and shall not exceed the limits adopted.

3. Kozloduy Site

From 2004 to 2006, intensive implementation continued of activities related to completion of the seismic qualification of units 3 and 4, and the measures for enhancing the seismic stability of units 5 and 6, as part of the modernization programme.

The units 3 and 4 seismic qualification activities have been fulfilled through a separate programme which included low-priority seismic reinforcement of the systems and facilities on

units 3 and 4. The programme was carried out in stages and the process was supervised by the NRA, as a condition for the units' operating licences.

Within the Modernization Programme for Units 5 and 6, all the analyses have been completed for evaluation of the capacity of the equipment and structures subject to qualification. The conclusion for the majority of the investigated items is that the required capacity has been ensured, taking into account the updated seismic assessments. Concerning the remaining items, appropriate projects have been developed and completed during the latest annual outages in 2005 and 2006 (see Attachment 5).

4. Belene Site

Background information on site selection

The development activities on Belene NPP began with the site selection in 1970, identifying of the site characteristics in 1980-81, and issuing a decision for start of work in 1981. The original project envisaged the construction of four WWER/V-320 reactors with a capacity of 1000 MWe each and a possibility for extension up to six units. Approval for construction of reactors 1 and 2 was granted in 1984. In 1991 the building process was terminated due to financial difficulties. Nearly 50% of the construction activities on unit 1 have been completed. The greater part of the equipment for the first reactor has been supplied and stored on-site of Belene NPP. The excavation work of unit 2 ground base has been accomplished and that site is ready for laying of foundation.

From 1990 to 2000, the Ministry of Economy and Energy undertook the task to corroborate that the site characteristics conform to international standards (IAEA) and that the original design of WWER V-320 requires improvements. Further studies conducted since 1990 have confirmed that the Belene site is suitable for construction of a nuclear power plant. The degree of use of the structures available on-site and the supplied equipment has been defined on the grounds of technical and economic criteria.

The methods, sequence and results of these studies have been described in the Environmental Impact Assessment Report [1], approved by the Ministry of Environment and Water, and in the Pre-design Study [2], approved by the expert’s council at the National Electricity Company.

Site approval

Following the carried out procedure on Environmental Impact Assessment (EIA), the Minister of Environment and Water upon an EIA decision No. 18-8/2004 approved the implementation of an investment proposal for construction of Belene NPP at the site Belene.

The National Electricity Company filed an application at the NRA for issuance of a site selection permit, on 10.06.2004, and this permit was granted on 14.12. 2004.

The application of the National Electricity Company for approval of the selected site was submitted at the NRA on 12.08.2005, while the appropriate order, issued by the NRA Chairman, is dated 21.12.2006.

Site-specific parameters

Owing to the high public interest in the Belene site seismicity, the information below will deal only with this component of the site characteristics.

Both the seismic and tectonic parameters of a site form one of the key factors in the site assessment for design, construction and operation of a nuclear installation. The unfavourable tectonic and seismic characteristics may directly classify a site as unsuitable for locating a nuclear installation on it. The Bulgarian and the international regulatory basis provide

unambiguous definition of the tectonic and seismic characteristics that will classify a site as unsuitable for construction of a nuclear power plant: the availability of capable faults in immediate proximity to the site, and maximum accelerations of the anticipated seismic impact (recurrence period) greater than 0.4g. The IAEA effective documents offer clear definitions of the criteria for locating of capable faults and the methods for probabilistic assessment of the site seismic risk.

The tectonic conditions around the Belene site have been subject to detailed surveys both in the 80s (during the initial site-selection process), and in the late 90s, in the course of which all the modern seismo-tectonic investigation methods have been used. The latest most detailed surveys for availability of young capable faults in the Belene NPP site area implemented the methods of quaternary geology and geomorphology, remote distance methods and specialized geophysical studies. They were conducted in 1998-1999 by a team from the Geology Research Institute at the Bulgarian Academy of Science, led by D. Evstatiev (1999; 2000). The conclusion of all the conducted surveys, as confirmed also by IAEA experts, is that the nuclear power plant local zone falls in a homogeneous block. This block is structurally uniform and is characterized by a very quiet tectonic structure. No data have been found to indicate availability of faults with horizontal amplitude (strike-slip faults) in the Belene NPP area. The earth faults located in the subregional zone are older than 650 000 years, they lack manifestations in the quaternary cover layer and do not belong to the capable faults category.

The analysis of the seismic conditions in the area around the Belene NPP site shows that it falls within the seismically most tranquil part of the Central Balkans, characterized by absence of historic and current seismicity, with $M \geq 4.0$. The strongest earthquake registered in the years after 1976 (a period of reliable instrumental monitoring) had a magnitude of $M=3.6$ and occurred 150 km away from the Belene NPP site.

The Belene NPP local zone (30 km) has a seismic activity lower than the average for the stable part of the Misia platform. There are no data of any earthquakes with a magnitude of $M > 2.5$ throughout the period of instrumental monitoring, 1976 - 2003.

The heaviest earthquake on the Belene NPP site, rated level 7 according to the MSK-64 scale, was generated by the strongest earthquakes in the Vrancha seismic zone. The other seismic sources located within 320 km around the Belene NPP site (Gorna Oryahovitsa, Shabla, etc.) have had a registered impact on the Belene site of level 6 according to MSK-64 scale.

The analysis of the Belene NPP seismic hazard points to an anticipated absolute acceleration of 0.24g for the safe shutdown earthquake (with a recurrence period of 10000 years). Thus, the Belene NPP design has to ensure plant safety for this level of earthquake impact while implementing a conservative approach for evaluation of its seismic capacity.

The results from the studies on the tectonic and the seismic conditions around the Belene NPP site show that it meets the requirements of the IAEA and the Regulation for Ensuring the Safety of Nuclear Power Plants, and is, therefore, fully appropriate for the construction of a nuclear power plant.

Article 18. Design and Construction

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

(i) the design and construction of a nuclear installation provides 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 to mitigating their radiological consequences should they occur;

(ii) the technologies incorporated in the design and construction of a nuclear installation are proven by experience or qualified by testing or analysis

(iii) the design of a nuclear installation allows for reliable, stable and easily manageable operation, with specific consideration of human factors and the man-machine interface

1. Brief Review of the Information Presented on this Article within the Previous National Reports

The first three national reports have described in detail the original design basis data of the KNPP units (1-2, 3-4 and 5-6), as well as the initial design basis of Belene NPP.

Additionally, in response to queries, information has been provided on a number of essential elements of the units 1-4 design changes resulting from modernization activities, particularly the significant differences of units 3 and 4 from their original design basis. Data has also been reported on the main modernization plans regarding units 5 and 6.

The third national report provides exhaustive comments on the provisions set forth in the Regulation on Ensuring the Safety of Nuclear Power Plants, especially the requirements to the design of systems important to safety and the design as a whole. It has been confirmed that the Regulation has been developed in conformity to the INSAG-12 recommendations and the reference levels developed by the WENRA, in a project for harmonization of the nuclear safety requirements.

2. Units Design Basis Changes Resulting from the Modernizations Implemented

2.1. Units 3 and 4 Design Basis Changes

The third national report points out that the integrated approach for modernization of the WWER-440 units at Kozloduy NPP, which has been systematically applied over the past decade in close co-operation with IAEA, WANO and other international organizations has resulted in the complete change of the units' design basis and bringing them in compliance with the effective regulatory documents. The new design basis has been proved within a scope that corresponds to the current international practices and standards, using the latest computer models and methods of deterministic and probabilistic safety analyses.

In the period following the third national report the planned activities for severe accidents management have been completed, with which (see item 3.3 below) the design basis of units 3 and 4 has been further supplemented with the management of severe accidents, which satisfies the current nuclear standards requirements.

2.2. Main Enhancements in the Modernization Programme of Units 5 and 6

The main package of technical measures of the Modernization Programme for units 5 and 6 has been implemented in the time following the issuance of the third national report. Information on the main measures realized is provided in article 6 of the current report. Attachment 5 contains

detailed data on the whole scope of activities in the Programme. The realized activities have resulted in the following enhancements of the units:

Performance Enhancement and Implementation of Novel Technologies

The replacement of the condenser pipes has resulted in the following positive effects:

- minimization of the corrosion rate of the entire secondary circuit equipment;
- minimum transfer of corrosion products leading to minimum quantities of deposits in the steam generator;
- vacuum enhancement in the turbine generator;
- increased heat-exchange surface area;
- enhanced efficiency coefficient of the units.

Novel technologies and equipment have been implemented to monitor the facilities' condition and preventively detect and eliminate any defects:

- The diagnostics system for identification, localization and analysis of leakages at the primary circuit has high sensitivity, limits further damage and decreases potential downtime periods;
- The system for monitoring of the metal fatigue limits the impact of the thermal cycles on the pipelines and equipment;

A new computer information system, Ovation (individual indication system), has been installed:

- with additionally installed nuclear applied programmes for monitoring of the basic parameters of key equipment;
- with practically unlimited capabilities to store and archive data about the technological processes of the unit.

A new digital control system (UCTM) has been installed to manage the processes at the unit, improve the operator's interface and the functional reliability and availability of the system through:

- implementing a modern digital technology;
- use of a design with distribution functions;
- redundant configurations;
- easy maintenance owing to self diagnostic capabilities and modular design principle;
- flexibility for future modernizations and extensions without necessarily shutting down of the unit.

A new turbine control automated system has been implemented. It offers expanded access to data of the unit and possibilities for analysis of the technological processes and events by using a common platform and communication network with the other information-and-control systems (Ovation and UCTM).

Environmental Protection

A new, more precise system for continued and accurate monitoring of the gaseous aerosols discharged of the nuclear power plant has been introduced.

The standard thermal insulation of primary circuit pipelines and equipment has been replaced with new, cassette type one. The new thermal insulation prevents clogging of the EBT filtration grids with mineral wool, and thus precludes any failure in the work of the low pressure injection system (active part). Moreover, it leads to decrease of the solid radioactive waste resulting from annual replacement of old or mechanically damaged insulation material. The cassette design of the thermal insulation reduces the installation/dismantling time and, therefore, the dose uptake of the maintenance personnel. A fact of particular significance is that by excluding aluminium from the new insulation the possibility of hydrogen generation is practically eliminated (which might otherwise result from interaction between aluminium and boric acid in case of a loss of coolant accident).

The halone fire extinguishing system has been substituted by a new system. The selected fire extinguishing agent is the FM200 gas. This choice has the advantages of:

- cleanness and harmlessness of the fire extinguishing agent in terms of protection of the environment and the health of the workers;
- safety during use.

Safety Assessment and Improvements

More than fifty studies have been performed on various units' safety aspects, including neutron-physical, thermohydraulic, radiological, and mechanical strength analyses. These analyses were performed using modern methods, conservative assumptions and computer codes, in accordance with the internationally approved requirements. The analyses demonstrated the units' safety, as follows:

- the reactors of units 5 and 6 have a guaranteed lifetime of at least 35 and 39 fuel cycles, respectively;
- the improved algorithms of protection and interlock systems enhance the unit's stability during transients, thus reducing the probability of an initiating event;
- the intrinsic safety of the reactor core has been proved under low probability hypothetical accidents;
- the capability of the existing safety systems to deal with loss of coolant accidents and removal of residual (decay) heat following a reactor trip.

To reduce the risk of nuclear accidents and improve the capabilities for their management, which the initial design of the units does not envisage, new systems have been installed, as follows:

- System for continuous control and recombining of hydrogen, precluding the possibility of explosion inside the containment in case of a design basis accident;
- System of protective measures to strengthen the main steam and feed water pipelines against breaking;
- System for reactor vessel level measurement and control, ensuring reliability of indication in case of loss of coolant accidents, leakages from the primary to the secondary circuit, or cooldown with inoperative main circulation pump;
- Automated system for protection against cold overpressure of the reactor vessel;
- System for filtered ventilation under beyond design basis accidents conditions, aiming to protect the containment from leakage and minimization of the radioactive discharges to the environment;

- System for continuous monitoring of the insulation status of 6 kV motors.

Seismic qualification and re-qualification was performed as well as reinforcement of the equipment and the systems important to safety.

Improving the Reliability of Systems and Equipment

Replacements were carried out of limited design lifetime or frequently malfunctioning equipment:

- the system ensuring uninterrupted power supply features multiple improvement of the performance parameters (100 000 hours, on average, until interruption of functioning of the new equipment against 8000 hours with the old one);
- the availability and reliability of relay protection and instrumentation of the main distribution circuit have been improved by installation of two redundant protection sets as well as a new microprocessor equipment of increased lifetime;
- the 6kV switchgears of the safety systems have been replaced, which resolved the problems with the old switchgears' unreliable performance;
- the new generator breaker enabling interruption of short circuited currents ensures:
- safeguarding of expensive equipment from damages;
- quick separation of faulty components from the scheme;
- continued power supply for the unit's in-house needs in the event of generator failure.

3.3. Severe Accidents Management Activities

As noted in the third national report, management strategies for severe accidents have been developed as an important step for the enhancement of the units' safety level in conformity with the current trends worldwide. This includes development of instruction manuals for management of severe accidents and implementation of a series of technical steps to control fuel cooling and radiological discharges in case of reactor core destruction.

The Severe Accident Management manuals have been developed within the framework of a special international project entitled Process Study and Development of a Severe Accident Management Instruction. The project has resulted in the performance of the following activities:

- Comparison of the different approaches for Severe Accident Management and selecting the appropriate approach for the Kozloduy NPP;
- Defining a plant specific database for preparation of SAMG;
- Development of comprehensive SAMG for WWER-440 (units 3 and 4) and WWER-1000 (units 5 and 6) of Kozloduy NPP;
- Review of the existing documents and operative emergency structures for compliance with the new SAMG.
- Verification and validation of the developed SAMG.

The activities on the project have been performed in conformity with the applicable West European standards and on the basis of similar projects realized in West European countries, while taking into account the specificity of the WWER-440 and WWER-1000 reactors and the identified plant-specific features and vulnerability in terms of severe accidents.

Currently, each unit has its accident localization systems equipped with hydrogen recombining units and filter ventilation systems. The remaining technical measures will be completed within reasonable deadlines by 2012.

3.4. Principal Characteristics of the Project Selected for Belene NPP

The decision for the Belene site to select the proposal of Atomstroyexport, Russia, for construction of two units of 1000 MW each, according to project A92, with V-466 reactor installation, was taken on the basis of the following considerations:

- important improvements in the safety characteristics and safety margins, such as secondary containment structure surrounding the reactor, four channels of the active safety systems, enlarged capacity of the passive systems;
- lower risk of unforeseen construction time-limits extension, licensing complications and further improvements related to safety;
- implementation of the best available technologies with longer operational lifetime and certification from the European operating organizations, which place project A92 on an equal level with the other new-build nuclear projects across the world.

The main differences of A92 project from the existing nuclear power plant designs with WWER reactors of older generations (Y-87), which permit resolving of the above tasks are as follows:

- ensuring of quick interruption of the chain reaction in the core, by means of two fully independent, fundamentally distinct systems for rapid reactor shutdown;

- ensuring of lasting residual heat removal and maintaining the reactor in safe state through the functioning of a set of active and passive systems;

- localization of the radioactive products in case of accidents by means of a double containment structure: internal pre-stressed one and external, monolith one, designed for a broad range of external and internal events.

The A92 project has taken an evolutionary approach to implementation of technologies, units, systems and experience in designing, construction and operation of several generations of nuclear power plants with pressurized water reactors.

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.

1. Brief Review of the Information Presented on this Article within the Previous National Reports

The previous three national reports have described the existing organization for Kozloduy NPP operation and the system of documents to regulate it. Comments have been provided on the requirements set forth in the Regulation on Ensuring the Safety of Nuclear Power Plants regarding operation and more particularly the availability of a document defining the safety policy and a strategy for its implementation, the basic elements of the safety management system and the system for personnel selection and training.

A description is provided of the system of permits for commissioning of nuclear installations and for introducing design changes, as provided in the Act on the Safe Use of Nuclear Energy and the Regulation for the Procedure for Issuance of Licences and Permits for Safe Use of Nuclear Energy.

Comments are made on the practices adopted for developing and retaining the operating limits and conditions set in the Technical Specifications of the individual nuclear facilities, their link to the other operational documentation and their updating.

A specific element of the operational documentation, as identified in the second national report, is the exhaustive description of the status of the activities for developing a new type of emergency procedures based on a symptom-oriented approach.

Explanation is given on the requirements in the Regulation of the conditions and procedure for notification of the Nuclear Regulatory Agency about events in nuclear facilities and sites with sources of ionizing radiation**,** and also in the existing events reporting system and operational experience analysis, including information on the nature, classification and number of registered operational events.

Data is presented on the generated radioactive waste types and quantities, their management system and programmes for minimization.

2. Organization of the Kozloduy NPP Operation

As pointed out in the third national report, since the ASUNE came in force all the KNPP units have gone through a licensing procedure in accordance with the provisions of the new act, and have obtained operating licences meeting the requirements therein (see the section on Article 9 in this report).

During the licensing process the following were presented and assessed:

- the plant organizational structure, the internal rules established, the QA and self-control system;
- the actions for personnel preparation, qualification updating and planning of the necessary key skills;
- the system of operating procedures, operational restrictions, response procedures during abnormal operation and emergency procedures;
- the system for assessment of the operational experience feedback, notification, and analysis of direct and root causes;
- the processes of maintenance, operation, engineering support, operating activity analysis, and keeping abreast of the international and national experience.

Considering the planned long-term E-mode operation (with spent fuel storage) for units 1-4, a thorough review was made of the procedures for operation, surveillance and maintenance, and also specific rules were developed to account for the particular features of the envisaged operational mode. Additional technical solutions have been realized to perform process control and monitoring of the parameters characterizing the spent fuel storage safety. The operator's support computer systems have been upgraded to perform automated registration and visualization of these parameters. Alternative schemes for spent fuel cooling have been envisaged in case of failure of the standard schemes; on units 3 and 4 extra seismic reinforcement has been made of the inlet and outlet pipelines to the reactor pools, and in addition an emergency spent fuel cooling system has been implemented. These technical modifications permit decreasing of the MCR operating personnel number.

The changes in the operations organization, taking into account the implementation of specific projects in connection with the preparation for decommissioning of units 1-4, are presented in the section on Article 6 in this report.

Following the issuance of the third national report, the separate engineering unit for integrated management of the units 5 and 6 modernization programme continued to function efficiently. In the project management, KNPP has been assisted by a consultancy contracting team, permanently based on site. The special system developed for configuration management ensured conditions for the smooth and correct introduction of the large number of design changes. More data on the arrangements made is presented in the section on Article 6 in this report.

As pointed out in the third national report, over the past five years the organization of plant operation and the implementation of the integrated modernization measures on the units have been subjected of the international assessment (SRM and OSART Follow-up Missions of IAEA) and peer reviews (WANO, AQG of EU). The outcomes of these missions have demonstrated that all recommendations concerning the operational area have been fully addressed, and that the plant approach and understanding have ensured maintenance of high operating standards.

3. Operational Experience Analysis

The leadership and responsibilities, the assessment and analysis methods used, the procedure for decision-making on corrective actions and evaluating of their efficiency, referring to the operational experience feedback, have been defined in the system of procedures that forms part of the documentation submitted to the regulator for issuance of operating licenses for the units. The licences identify the responsibilities and the scope of reporting of operational events as well as the obligations of the licence holder to ensure adequate depth of events analysis.

The system includes both internal and external operating experience, analysis of deviations, trends, near misses and operational parameters. In order to improve the root cause analysis process, and in view of identifying the role of human factor, a document was developed - Methodology for Analysis of Events Caused by Human Factor, based on the HPES methods of INPO (USA).

In view of decreasing the threshold level for selection of events for root cause analysis, they are subjected to analysis not only with regard to events, but also for deviations from procedures or programmes, and personnel errors that obviously fall below the reporting criteria. An electronic database has been developed to analyse and store all the events occurring on-site the plant.

Concerning the foreign operational experience, the plant makes ample use of the contacts with other nuclear power plants operating WWER reactors, and experience is exchanged by e-mail and at the seminars of IAEA, and of the WANO centre in Moscow.

The Republic of Bulgaria participates, through the NRA, in the IAEA information system INIS. Kozloduy NPP takes part in the IAEA information system for incident reporting occurring in nuclear power plants (IAEA-IRS). Kozloduy NPP is a direct participant in the WANO system for reporting of events in nuclear power plants.

In 2004 the total number of operational events reported at Kozloduy NPP was 79. Of these, 51 were assessed as 'safety related' and rated as level '0' according to INES. The remaining 28 events were not safety related. Similarly, these figures for 2005 and 2006 were, respectively, 88, 38, 50 and 70, 33, 35. In 2006 one event was rated level 1 (anomaly) and one event - level 2 (incident), according to INES.

The level 2 event consisted in as follows:

On 01.03.2006, following the shutdown of the main circulation pump at unit 5 and lowering the unit's power it was found that 22 of the control rods could not be moved from their top end position. The reactor installation was put in ‘cool shutdown’. The event was assigned level 2 due to general cause failure and lack of periodic surveillance procedure. A detailed report on the event was circulated through the international information exchange channels, and presented at a seminar of IAEA held in 2006.

The level 1 event consisted in the following:

On 26.03.2006, under nominal power of the unit 4, the level regulator at one of the steam generators (SG) failed to perform. The SG level decreased below the operational limit. During the event no breach of the operational safety limits was established, and it did not produce any actual consequences on the SG safe operation. A detailed report on the event was distributed through the international information exchange channels.

4. Radioactive Waste Generation and Treatment

The radioactive waste (RAW) management activities at Kozloduy NPP include collecting, sorting, preliminary processing and temporary storing of solid and liquid RAW and they are carried out on-site the plant. The Integrated RAW Management Programme at KNPP defines the organization and responsibilities of the structural units in RAW management, classification, minimization of the RAW generated, the types of RAW streams, the manner of their treatment, the places for temporary storage, and the requirements for their accounting and transfer for further management. There are functional and organizational links in place for transfer of the preliminary treated RAW to the local branch of the State Enterprise RAW established on-site. The gaseous radioactive substances generated in the process of operation of the nuclear installations on-site are subject to preliminary decontamination and then released to the environment as emissions permitted by the regulatory authority. The data on gaseous aerosol emissions is presented in the section on Article 15 in this report.

Details on the processing of radioactive waste and spent nuclear fuel, data about their quantities, and processing and storage facilities have been presented in the two national reports dedicated on the Joint Convention on the Safety on Spent Fuel Management and on the Safety of Radioactive Waste Management [References 3, 4].

Attachments to the Report

Attachment 1 List of the nuclear facilities

Attachment 2 Nuclear facilities data

Attachment 3 List of secondary legislative acts on the ASUNE application

Attachment 4 Measures for decommissioning of units 1-4

Attachment 5 Status of Units 5 and 6 Modernization Programme Measures

References

A. Main references

1. Act on the Safe Use of Nuclear Energy

2. Report of the Expert Mission to Review the Results of Safety Upgrading Activities of the Kozloduy NPP Units 3&4. IAEA-TCR-00142. Vienna, June 2003

3. National Report on Fulfilment of the Obligations of the Republic of Bulgaria on the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. Sofia, April 2003

4. Second National Report on Fulfilment of the Obligations of the Republic of Bulgaria on the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, Sofia, September 2005

B. References concerning Belene NPP

- Environmental Impact Assessment Report of the Investment Proposal for Construction of Belene NPP. March 2004 and EIA decision No. 18-8/2004 of the Minister of Environment and Water
- Pre-design Study for Construction of Belene NPP. April 2004
- Belene NPP Tender Proposals. 2005
- Preliminary Safety Analysis Report on a Nuclear Installation. October 2006
- Terms of Reference for the Construction of Belene NPP, Revision 2. March 2007
- Conceptual Design of Units 1 and 2 at Belene NPP. March 2007

Abbreviations

ASUNE - Act on the Safe Use of Nuclear Energy
BNRA – Bulgarian Nuclear Regulatory Agency
EIA – Environmental Impact Assessment
IAEA – International Atomic Energy Agency
KIDSF – Kozloduy International Decommissioning Support Fund
KNPP - Kozloduy NPP
LUAEPP – Law on the Use of Atomic Energy for Peaceful Purposes
MCR – Main Control Room
MSPDA – Ministry of State Policy on Disasters and Accidents
NRA – Nuclear Regulatory Agency
PSA – Probabilistic Safety Assessment
QA – Quality Assurance
QMS – Quality Management System
RAW – Radioactive Waste
RCA – Restricted Control Area
RG – Regulatory Guide
SAMG – Severe Accident Management Guide
SAR – Safety Analysis Report
SSC – Structures, Systems and Components
TSO – Technical Support Organisation
UCTM – Unified Complex of Technical Means
WCR – Water Chemistry Regime
WENRA - Western European Nuclear Regulatory Association

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Attachment 1

LIST OF THE NUCLEAR FACILITIES

1. Kozloduy NPP

Location : North – West of Bulgaria, 3.5 км South-East of town of Kozloduy

1.1. Power units 1 and 2, WWER-440 (switched off the power network, in the operation mode "storage of fuel in the reactor pool");

1.2. Power units 3 and 4, WWER-440 (switched off the power network, in the operation mode "storage of fuel in the reactor pool");

1.3. Power units 5 and 6 WWER-1000 (in operation mode without restrictions of the operation modes);

1.4. Spent nuclear fuel storage (in operation);

2. Belene NPP

Location : North Bulgaria, 4 км East of town of Belene.

2.1. Power units 1 and 2, WWER-1000 (construction stopped in 1990, in procedure of resumption of the construction of the site from 2006);

Attachment 2

NUCLEAR FACILITIES DATA

Kozloduy NPP

1. Principal characteristics of nuclear facilities.

The principal characteristics are presented in the Annex 1 of the Second National report of the Republic of Bulgaria for the execution of the obligations of the Convention on nuclear safety.

For the next period there is no modifications in the principal characteristics of the facilities.

2. New data for the nuclear power units

Unit.	Type	Date of start of operation	License No	Validity	Comments
Unit 1	WWER440	October 1974	E-00707	20.02.2009	From 2003 - in mode "storage of fuel in the reactor pool "
Unit 2	WWER-440	November1975	E-00613	15.01.2009	From 2003 - in mode "storage of fuel in the reactor pool"
Unit 3	WWER-440	December 1980	E-00174	22.03.2011	From 2007 - in mode "storage of fuel in the reactor pool "
Unit 4	WWER-440	June 1982	E-00008	26.02.2013	From 2007 - in mode "storage of fuel in the reactor pool "
Unit 5	WWER-1000	November 1987	E-00429	09.10.2009	
Unit 6	WWER-1000	August 1991	E-00419	03.10.2009	

Attachment 3

LIST OF SECONDARY LEGISLATIVE ACTS ON THE ASUNE APPLICATION

1. Rules of Procedure of the Nuclear Regulatory Agency

The Organizational Statute determines the structure, activity, organization of work, functions and number of personnel of the Agency and its administrative units. According to the Organizational Statute, since 01 January 2003 The Chairman of the Agency is a primary administrator of budgetary credits.

2. Regulation for the procedure for issuing licenses and permits for safe use of nuclear energy

The regulation defines all matters related to the procedures for issuing, changing, renewing, cancelling, revoking and controlling the licenses and permits demanded by the Safe Use of Nuclear Energy Act. The structure of the regulation takes into consideration the specifics of the types of nuclear facilities, activities and sites with sources of ionising radiation. The scope and contents of the required documents is specified taking into account the necessary measures for providing the nuclear safety, radiation and physical protection. For activities with certain types of ionising radiation sources, based on the lower risk for the population and the environment, alleviations of the required documents is provided.

3. Regulation for the conditions and procedure for transfer of radioactive waste to the state enterprise "Radioactive Waste"

The entities, which generate radioactive waste as a result of their activities, are obliged to transfer the waste to the State enterprise, which is responsible for the management of the radioactive waste after the deposit.

The regulation defines the conditions and procedure for transferring the radioactive waste to the State enterprise "Radioactive Waste" and the terms for the transfer, as well as the radioactive waste not eligible for transfer. Specific procedures are defined for transferring radioactive waste generated from previous activities, radioactive waste with unknown owner, or which has been imported to the country and cannot be returned.

The radioactive waste becomes state property at the moment of its transfer to the State enterprise.

4. Regulation for ensuring the safety of nuclear power plants

The regulation settles the matters related to the basic criteria and rules for the safety of nuclear power plants based on the concept of in-depth defence.

Subject to regulation are the organizational measures and technical requirements for providing of the safety during site selection, design, construction, commissioning and operation of nuclear power plants. The regulation contains detailed instructions related to the determination of the design basis and safety evaluations, the characteristics of the site and the safety requirements for the nuclear power plant and its systems.

The regulation is developed based on the IAEA safety standards and the reference levels for harmonization of the safety requirements for nuclear power plans, defined by the West European Nuclear Regulators' Association (WENRA).

5. Regulation for radiation protection during activities with sources of ionising radiation

The regulation defines the basic requirements and rules for radiation protection during activities with sources of ionising radiation and the condition and the procedure for accounting of the

sources of ionising radiation. The regulation puts in place requirements for radiation monitoring during activities with sources of ionising radiation.

The regulation specifies technical and organizational rules for conforming to the established in Bulgaria basic norms for radiation protection.

6. Regulation of the conditions and procedure for notification of the NRA about events in nuclear facilities and sites with sources of ionising radiation

The regulation defines the obligations of the licensee or the holder of a permit for creation of a system for collecting, registration, investigation, analysis and evaluation of events and determination of corrective measures.

Also defined are the requirements for usage of the information about events, including for analysis of the operational experience, determining of the importance of the events for safety, as well as the procedure and terms for providing information to the citizens for events of different importance.

7. Regulation of the conditions and procedure for exempting small amounts of nuclear material from the Vienna convention for civil liability for nuclear damage

According to the Vienna convention for civil liability for nuclear damage the operator of a nuclear facility is responsible for nuclear damage caused by a nuclear accident and is obliged to maintain an insurance or other financial guarantee, covering his liability.

Every agreeing country has the right to exempt small amounts of nuclear material from the application of the convention, up to a maximum limits defined by the managing board of the IAEA. According to Article 135 of the Safe Use of Nuclear Energy Act the Council of Ministers is delegated the authority to accept a Regulation, in which the conditions and procedure for exempting small amounts of nuclear material from the application of the Vienna convention to be determined.

The regulation was developed in accordance with the decision of the managing board of the IAEA dated 14-15 September 1978 for establishing the maximum limits for exempting small amounts of nuclear material from the application of the Vienna convention and with the IAEA safety standards for transportation of nuclear materials.

8. Regulation for safety of spent nuclear fuel management

The proposed draft for the regulation defines in detail the matters related to the basic criteria and rules for providing nuclear safety and radiation protection in the management of spent nuclear fuel according to the provisions of the Safe use of nuclear energy act, as well as the specific organizational measures and technical requirements for providing the safety during site selection, design, construction, commissioning and operation of facilities for spent nuclear fuel management.

Matters related to the technical safety, fire and physical protection, emergency planning and emergency preparedness of the spent nuclear fuel management facilities are defined in the draft of the regulation, to the extent that follows from the in-depth defence concept.

9. Regulation for safe management of radioactive waste

The Regulation defines the requirements, regulations and rules for safety during site selection, design, construction, commissioning and operation of facilities for radioactive waste management.

The regulation also defines the obligations of the entities carrying out radioactive waste management activities. The entities which generate radioactive waste as a result of their activities are responsible for its safe management from the moment of generation of the radioactive waste

to the moment it is transferred to the State enterprise "Radioactive waste" or until it is released from regulatory control.

10. Regulation of the conditions and procedure for acquiring professional qualification and for the procedure for issuing licenses for specialized training and certificates for qualification for use of nuclear energy

The regulation defines the conditions and procedure for acquiring professional qualification for execution of activities in nuclear facilities, and facilities with sources of ionising radiation, the positions for which qualification is required, the procedure for issuing licenses for specialized training and certificates for qualification, as well as the conditions and procedure for carrying out exams for acquiring qualification.

11. Regulation for emergency planning and emergency preparedness in case of nuclear and radiation accident

The regulation defines, in accordance to the provisions of the Safe Use Of Nuclear Energy Act, the conditions and procedure for developing emergency plans and the obligations of the persons who apply them.

The actions and measures for limitation and liquidation of the consequences of nuclear or radiation accident are also defined as well as the criteria for decision taking for their activation and the methods for informing the population. Subject to definition is also the maintenance and control of the emergency preparedness and the interaction between the executive authorities and the licensees or holders of permits according to the Safe Use of Nuclear Energy Act.

12. Regulation for the provision of physical protection of nuclear facilities, nuclear material and radioactive substances

In the Regulation, according to the Safe use of nuclear energy Act and the convention for physical protection of nuclear material, the matters related to physical protection of nuclear facilities, and during use, storage and transportation of nuclear materials and radioactive substances are defined.

The provisions of the Regulation take into consideration the specifics of the different kinds of nuclear facilities, nuclear materials and radioactive substances, which demand different levels of physical protection, depending on the category of nuclear materials and radioactive substances and the degree of risk.

13. Regulation on basic norms of radiation protection

The regulation reflects the requirements of the 96/29/EURATOM Directive, setting the basic standards for protecting the health of personnel and population from the damaging influence of ionising radiation. The basic principles of radiation protection are developed, and the dose limits for personnel and population are set.

In accordance with the provisions of the Directive, the concept for releasing from control of radioactive substances due to permitted activities, and the concept for limitation of irradiation are introduced.

The Regulation sets requirements for monitoring of the working quarters, and the individual irradiation, as well as for the registration of the results of this monitoring.

The requirements of Directive 90/641/EURATOM for operational protection of outside workers from the damaging influence of ionising radiation during their activities in the controlled areas are introduced.

In relation to the engagements of the Bulgarian side in the negotiations with the European Union, the Regulation introduces the basic principles and requirements for radiation protection from

medical irradiation, taking into consideration Directive 84/466/EURATOM for health protection from the damaging influence of ionising radiation from medical irradiation.

14. Regulation for the conditions and procedure for establishing of special-statutory areas around nuclear facilities and facilities with sources of ionising radiation

In the regulation the criteria for determining the size and boundaries of the zones with special status, the procedure for creating the zones and for exercising the powers of competent state authorities according to the law are established.

The regulation sets requirements for the activities of licensees and holders of permits, according to the Safe Use of Nuclear Energy Act, in the zones with special status, including for, provision of radiation monitoring of the environment and the population. Criteria are defined for the compensations for damages suffered from restrictions over usage of private real estate in the zones.

15. Regulation for the conditions and procedure for gathering and submitting of information and keeping records of the activities subject to guarantees according to the Non-proliferation of Nuclear Weapons Treaty

According to Article 126 of the Safe Use of Nuclear Energy Act, the Regulation specifies the conditions and procedure for gathering and submitting of information and keeping records of the activities subject to the Agreement between Bulgaria and the IAEA for applying the guarantees related to the Non-proliferation of Nuclear Weapons Contract and the Additional Protocol to the Contract.

According to the provisions of the Safe Use of Nuclear Energy Act, the entities carrying out activities subject to the Agreement and the Additional Protocol develop and apply internal rules and instructions for registration and Control of the type, quantity, location and movement of the nuclear material and its transportation. They present to the Chairman of the NRA the information necessary to comply with the obligations of the Republic of Bulgaria, due to these international contracts and grant access to the sites to the IAEA inspectors, and the NRA inspectors accompanying them, in accordance with the provisions of the Safe Use of Nuclear Energy Act.

16. Regulation for the safety of the decommissioning of nuclear facilities

The regulation provides that the safe decommissioning of nuclear facilities to be implemented trough preliminary and interim panning, determination of a concept and developing of a plan for decommissioning, while for each stage of the planning, the safety of the decommissioning activities must be validated.

The Regulation defines the basic safety requirements during decommissioning for the maintenance of the safety related systems and equipment, for the deactivation and dismantling of the equipment, for the radiation protection and for the radioactive waste management. It is foreseen that with the completion of each stage of the decommissioning of the nuclear facility, the holder of the permit should develop and present to the regulator an actualised report on the safety evaluation of the completed stage.

17. Regulation for the procedure for paying the fees ensuing by the Safe Use of Nuclear Energy Act.

The Regulation determines the procedure for paying the fees for consideration of applications and for issuing of licenses and permits for activities, in accordance with the provisions of the Safe Use of Nuclear Energy Act.

18. Tariff for the fees collected by the NRA in accordance with the provisions of Act on the Safe Use of Nuclear Energy

The tariff determines the size of the fees collected by the NRA for consideration of applications and for issuing of licenses and permits for activities, in accordance with the provisions of the Safe Use of Nuclear Energy Act. The sizes of the initial and annual license fees, as well as the fees for issuing of permits are determined depending of the complexity and the range of the regulatory control, and of the specifics of the relevant activity subject to state regulation in accordance with the provisions of the Safe Use of Nuclear Energy Act.

19. Regulation for the procedure for assessment, collection, spending and control of the financial resources and definition of the amount of contributions due on the "Nuclear facilities decommissioning" Fund.

The regulation determines the procedure for assessment, collection, spending and control of the financial resources and definition of the amount of contributions due on the "Nuclear facilities decommissioning" Fond under auspices of the Minister of Energy and Energy Resources. The Fond is managed in a manner to assure implementation of the annual program of the permit holder for decommissioning of a nuclear facility. The revenues of the Fond are collected mainly from contributions from nuclear facility operators and national budget resources, allocated annually pursuant to the National Budget Act for the relevant year.

20. Regulation for the procedure for assessment, collection, spending and control of the financial resources and definition of the amount of contributions due on the "Radioactive waste" Fund.

The regulation determines the procedure for assessment, collection, spending and control of the financial resources and definition of the amount of contributions due on the "Radioactive waste" Fond under auspices of the Minister of Energy and Energy Resources. The Fond is managed in a manner to assure implementation of the activities for radioactive waste management. The revenues of the Fond are collected mainly from contributions from legal and physical entities, which generate radioactive waste, due for transfer to the state enterprise "Radioactive waste", as a result of their activities as well as from national budget resources, allocated annually pursuant to the National Budget Act for the relevant year.

21. Regulation on ensuring the safety of research nuclear installations

The regulation specifies basic criteria and rules for the safety of research nuclear installations. Subject to regulation are the organizational measures and technical requirements for providing of the safety during site selection, design, construction, commissioning and operation of research nuclear installations. The regulation contains detailed instructions related to the design basis and safety evaluations, the characteristics of the site and the safety requirements for the research nuclear installations.

22. Regulation on the conditions and procedure of transport of radioactive material

The regulation delineates the conditions and order for ensuring the radiation protection and safety during transportation of nuclear material, radioactive waste and other radioactive substances on the territory of the Republic of Bulgaria. It also introduces into the national legislation the requirements ensuing from international treaties for transportation of dangerous goods category 7 (radioactive substances). The provisions in the regulation are in accordance also with the IAEA documents for safe transportation of radioactive substances - TS-R-1. The new regulation introduces the requirements of the European legislation in the field of radiation protection during transportation of radioactive waste determined by a Council Directive 92/3/EURATOM on the supervision and control of shipments of radioactive waste between Member States and into and out of the Community as well as in case of import or export from the Community.

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Attachment 4

MEASURES UNDERTAKEN WITHIN THE FRAMEWORK OF THE PREPARATION FOR DECOMMISSIONING OF KOZLODUY NPP UNITS 1 THROUGH 4

In accordance with individual decisions of the council of ministers of Bulgaria, NPP Kozloduy Units 1 and 2 were shut down from the grid at the end of 2002 and Units 3 and 4 – at the end of 2006.

The initial plan for decommissioning applies only to Units 1 and 2 of NPP Kozloduy. It has been developed in the Technical Design for decommissioning of NPP Kozloduy Units 1 and 2, April 2000. The plan includes the following stages:

- Final termination of operation - term 3 years;
- Preparation for safe conservation - term 2 years;
- Safe conservation - term 35 years;
- Deferred dismantling – liquidation of the safe conservation – the term has not been estimated due to the big remoteness in time (per expert assessment if the current dismantling and building demolition techniques are used the duration of this stage could be 10 years).

In connection with the shutting down of Units 3 and 4 it became necessary to have these plans adequately modified.

In June 2006 at a NPP Kozloduy Safety and Quality Council (Protocol № СБиК-2/21.06.2006) an "Updated Strategy for Decommissioning of NPP Kozloduy Units 1-4", KPMU/DCS/001 was approved.

In accordance with the approved Updated Strategy for Continuous Dismantling, the decommissioning of NPP Kozloduy Units 1-4 will be performed in two stages, which are:

- Stage 1 (2011 – 2018) – Starts after the clearing the Spent Fuel Pool of nuclear fuel and includes a period of preparation and safe conservation of primary side and dismantling of non-radioactive equipment, Turbine Hall and the Auxiliary Buildings;
- Stage 2 (2018 -2035) – Includes dismantling of the equipment in the Reactor Building, the reactors and sanitary equipment, and radioactive waste treatment installations.

The necessary documentation for Stage 1 of the decommissioning will be developed based on the following schedule:

1. Activities related to the obtaining of permission for decommissioning of Units 1 and 2

Activity	Start	End
Development of a Plan for decommissioning of Units 1 and 2, Stage 1	06.2006	06.2007
Development of a Program for management and minimizing of Radioactive Waste	10.2007	04.2008
Development of a Concept for radiation protection	04.2006	03.2007
Development of a Quality Assurance Program	04.2006	06.2007

Preparation of a preliminary working plan for dismantling	04.2006	03.2007
Update of the Emergency Plan	03.2007	10.2007
Update of the Physical Protection Plan	03.2007	10.2007
Approval by KNPP of the Plan for Decommissioning	08.2007	12.2007
Report from Safety Analysis	06.2008	03.2009
Technological Regulations	10.2008	01.2009
Report on the Environmental Effect Assessment and public discussion	01.2008	12.2008
Issuance of permission for decommissioning of Units 1 and 2, Stage 1	03.2009	03.2010

2. Activities related to the obtaining of permission for decommissioning of Units 3 and 4

Activity	**Start**	**End**
Development of a Plan for decommissioning of Units 3 and 4, Stage	06.2008	06.2009
Development of a Program for management and minimizing of Radioactive Waste	09.2010	04.2011
Development of a Concept for radiation protection	04.2008	12.2008
Development of a Quality Assurance Program	04.2008	07.2009
Preparation of a preliminary working plan for dismantling	04.2008	04.2009
Update of the Emergency Plan	03.2009	10.2009
Update of the Physical Protection Plan	03.2009	10.2009
Approval by KNPP of the Plan for Decommissioning	08.2009	12.2009
Report from Safety Analysis	06.2010	12.2010
Technological Regulations	10.2010	12.2010
Report on the Environmental Effect Assessment and public discussion	01.2010	10.2010
Issuance of permission for decommissioning of Units 3 and 4, Stage 1	04.2011	04.2012

Until obtaining permission for decommissioning, the units remain with licenses for operation in condition “E”. In accordance with the updated strategy, mainly preparatory activities for the real decommissioning are planned for that period, for the implementation of which no changes to the existing organizational structure of the plant are necessary.

Currently the existing organizational structure at Kozloduy NPP clearly distributes the activities on Units 1-4, as follows:

- EP-1 – provides for the operation and maintenance of the Units in accordance with the operative licenses;

- Decommissioning Department – performs organization and coordination of the decommissioning activities and manages the decommissioning projects funded by external sources;

The Kozloduy NPP Decommissioning Department was established in 2000 as a separate unit for provision of safety in the management and implementation of all necessary activities related to the preparation for decommissioning and the decommissioning initially of Units 1 and 2 and currently also of Units 3 and 4. The Decommissioning Department has the statute of a structural unit directly subordinate to the NPP Kozloduy Executive Director and has the following sections:

- Technology and Radiation Protection;
- Deactivation and Radioactive Waste;
- Engineering and Quality Assurance.

The initial establishment for the department is 20 people. It will be increased on a stage-by-stage basis in accordance with the increase in the scope of work performed by the department in relation with the decommissioning of the Units.

Managers and experts from the Decommissioning Department, as well as other specialists from Kozloduy NPP passed training on decommissioning of nuclear installations in Brussels and Mol – Belgium and in Greifswald – Germany.

The Statute for the organization and activity of the Decommissioning Department determines the activities, the functions and the tasks of the structural units, as well as the rights and the responsibilities of the officials in the department.

The updated strategy proposes several options for the organizational, administrative and financial separation of the decommissioning activities. In order to implement any of the options it is necessary to make thorough technical, economic, financial and legal analyses.

At the present time it is clear that in order to have organizational and financial separation of the activities related to the decommissioning of the units, changes to the Bulgarian legislation will be necessary, hence the organizational changes would be feasible in the distant future.

With the purpose of having safe operation of the units in condition “E” and in order to assure the implementation of the activities planned under the updated strategy for decommissioning, the NRA issued in 2006 some specific changes to the licenses for operation. These modifications include all aspects related to ensuring the safe operation in the particular state of the units as well as all aspects related to the safe implementation of the activities on the preparation for decommissioning.

A number of activities on the technical preparation and initiation of works related to the final termination of operation of the units have been completed or are in their final stages:

1. The structure for management of the decommissioning in NPP Kozloduy has been created and is being developed. The special training of the personnel has been started and continues.

2. The following fundamental designs have been prepared:

- Conceptual technical design for decommissioning of NPP Kozloduy Units 1 and 2 – Contract under the PHARE Program BG 9608-01-01-L001, completed in 2000;
- Detailed technical design for decommissioning of NPP Kozloduy Units 1 and 2 – Contract under the PHARE Program BG 9809-02-03, completed in December 2001.
- Project BUL/4/008, funded by IAEA – Information system for management of the NPP Kozloduy Units 1 and 2 decommissioning activities, completed in January 2004

3. In pursuance of the Agreement between the European Commission and the Bulgarian Government from 29 November 1999 and the Framework Agreement between the Republic of Bulgaria and the European Bank for Reconstruction and Development (EBRD) 15 June 2001 an International Fund "Kozloduy" was established with the purpose to support the decommissioning activities - KIDSF. The European Bank for Reconstruction and Development manages KIDSF and the granting of gratuitous funds to the Recipient for financing and co-financing of the preparation and the implementation of selected projects.

Within the framework of the KIDSF financing activities a Project Management Unit (PMU) was established. The PMU should manage, coordinate and supervise the projects and the provision of goods, activities and services funded by KIDSF. The PMU should establish the proper organizational structures for the implementation of specific engineering, supply and other services. The PMU is constituted of consultants engaged in accordance with the procedures enforced by EBRD and KIDSF and also appropriate qualified specialists provided by NPP Kozloduy. Via "Technical Assignment for additional services to PMU Kozloduy for the period April 2006 – March 2007" the Project Management Unit was assigned tasks related to the implementation of the Updated Strategy. The tasks include the preparation of a new plan for decommissioning which should be in accordance with the updated strategy and the planning and performance of preparatory activities for the decommissioning of the units.

4. An annual expenditure plan is being prepared for the expenses from the "Decommissioning of Nuclear Installations" Fund. This ensures the financing of the activities planned for implementation during the respective year. The expenditure plan is being approved by the signing of a yearly contract between the Managing Committee of the fund and NPP Kozloduy.

For the financing of the activities related to decommissioning of nuclear installations a "Decommissioning of Nuclear Installations" Fund to the Minister of Economy and Energy was established with the Act for Safe Use of Nuclear Energy. The revenues on this fund are being collected, accounted for and centralized in the system of the united budgetary account using separate transit account opened to the Ministry of Energy and Energy Resources in the Bulgarian National Bank. The revenues on this fund come from the following sources:

1. Payments from entities operating nuclear installations, to the amount determined by the Council of Ministers;
2. Funds from the State Budget determined annually with the State Budget Act for the respective year;
3. Interest from the management of the revenues collected in the fund and from overdue payments under item 1;
4. Donations;
5. Other income resulting from the management of the fund's resources.

The careful planning is fundamental for the implementation of the decommissioning activities in a safe and financially efficient way.

The activities, the sources for funding and the resources to cover the expanses related to the decommissioning of the units are being planned in updated programs for decommissioning of the pairs of units for the respective stage and activities.

NPP Kozloduy collects, processes and keeps all of the documentation necessary for the planning and implementation of the decommissioning activities:

- complete design documentation and the respective design changes related to reconstructions and modernizations;
- documents and data for the changes in the state and the conditions of the site;

- results from engineering and technical surveys, check and investigations for the functional condition of the constructions, systems and equipment;
- reports on the condition of the nuclear material, its disposition and the state of the installations for its storage;
- information on the types and quantities of radioactive and other hazardous waste and substances, the places for their disposal and storage;
- list of the systems, equipment and components which are sources of ionizing radiation and their radiological characteristics;
- documentation and data related to the condition and the maintenance of the systems and equipment which are important to safety etc.

Currently the following has also been completed within the framework of the preparation for decommissioning:

- assessment of the condition and the functions of all existing systems for the period after the final shutdown of the units until obtaining permission for decommissioning;
- determination and implementation of the design modifications and adjustments of the existing systems to the new required conditions;
- determination of the need of new systems, conservation of systems, construction and dismantling activities, including analysis of the expenses and benefits;
- determination of the necessary activities for control and supervision, checking and maintenance of the systems and constructions during the preparation for the first stage of the decommissioning.

In order to ensure the radiation protection of the personnel and the population during the preparation for decommissioning and the implementation of the units decommissioning, the same organizational and technical measures are utilized as the ones used by the personnel during operation of the plant on and outside the site.

Within the framework of the Technical Design for decommissioning of Units 1 and 2 Preliminary Report for Environmental Effect Assessment and Preliminary Concept for Radiation Protection have been developed and approved. The latter are being updated in accordance with the modifications to the decommissioning strategy approved in 2006 as stated in the plans for development of the necessary documentation above.

The following main aspects have been reviewed in the updated Concept for Radiation Protection:

- Preparatory activities – they include all engineering, technical and administrative preparatory tasks which have to be completed before the implementation of decommissioning activities in the restricted area;
- Monitoring activities, including surveillance of the environment;
- Assessment of the individual and collective personnel doses and radiation protection during the different stages of the units decommissioning;
- Assessment of the releases in the environment and short-term and long-term radiation protection of the population.

The Concept includes description of approaches and measures, of organizational and technical means and methods to ensure the application of the ALARA principle in the radiation protection of the personnel and the population.

The application of the ALARA principle is being guaranteed via the resolution of the following key issues in the radioactive waste management and the observance of the below limitations:

- With regards to the radiation protection of the personnel:
  - Detailed preparation of the activities which will be performed in the restricted area;
  - Monitoring of the individual and collective doses during the execution of the tasks and application of corrective actions in case of deviations from the preliminary set goals.
- With regards to the radiation protection of the population and the environment:
  - During the preparation for safe conservation – maintaining the releases to levels lower than these during normal operation of the units;
  - During the implementation of the safe conservation – maintaining the releases to levels ≤ 5% (conservative assessment) of the ones during normal operation of the units;
  - Minimization of the amount of the conditioned radioactive waste generated during the stages of preparation and implementation of the safe conservation and limitation of their activity to values lower than the acceptability criteria.

The management of the radioactive waste generated during the NPP Kozloduy Units 1-4 decommissioning activities until their transfer to the Radioactive Waste Facility for treatment, conditioning and storage includes:

- Performance of radiological survey of the units in order to prepare inventories and maps of the radioactive contaminations;
- Description of the radioactive waste and identification of the different waste flows;
- Training of the management and executive personnel on topics related to the radioactive waste management;
- Purchasing of the necessary equipment for deactivation, manipulation and preliminary treatment of the radioactive waste generated during the decommissioning activities;
- Development of procedures for deactivation, manipulation and preliminary treatment of the radioactive waste, as well as procedures for minimization and control of the waste;
- Development of packing for transportation and storage of the waste generated during the decommissioning;
- Approval of criteria, requirements and procedures for storage, transportation and transfer of the radioactive waste to the Radioactive Waste Facility.

The emergency readiness during the units decommissioning is organized within the framework of an emergency plan which is common for the whole NPP Kozloduy site, taking into consideration the specifics of the decommissioning process and stages.

A Guideline in the NPP Kozloduy personnel policy is to keep the existing personnel (especially the highly qualified) during the transition from operation to decommissioning of the nuclear installations. The approach taken by the plant management is to implement the decommissioning with the plant's own human resources and where necessary to hire outside experts. This approach has a social aspect but also no less than two practical reasons: to use the experience of the existing personnel to a maximum extent; some of the decommissioning activities are similar to the maintenance activities for which there are procedures approved. The approach is combined with the updated strategy for decommissioning based on the concept for continuous dismantling. This allows the use of the existing personnel to a maximum extent for the preparatory activities and later for the real decommissioning of the units, the preservation of the knowledge about the

systems and the equipment and helps to avoid the social consequences from the eventual discharging of a large number of personnel.

A Program for management of the social consequences from the decommissioning of NPP Kozloduy Units 1-4 has been developed in order to deal with the management of the processes related to the personnel. This program provides for measures to compensate people for early retirement, possibilities for re-qualification, and options for transfer to other departments of the plant or to work on the decommissioning.

The management team for the decommissioning includes personnel that have the skills, the qualification and the experience necessary to perform the respective assignments. Specialists who worked on the operation of the units are also included in the management team.

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Measure Number	Measure Title / Description	Responsible		Measures' Status	Start	Finish	Remarks/Notes
		Cont	Prtnr				
10111	Replacement of Borometers Type NAR-B with those of the other Type to Ensure Continuous Measurement with Required Accuracy, Speed & Automatic Calibration	ECK	AEE	Completed			
10121	Replace neutron monitoring system with a more sophisticated/sensitive system	KNPP	AEE	Completed			
10221	Install an integrated, continuous reactivity measuring system	KNPP		Completed			*Merged w/ 10121*
10222	Install a core subcriticality measurement system	KNPP		Completed			*Merged w/ 10121*
10231	Replace group 5 control rods - with long, full length absorption control rods	KNPP		Completed			
10233	Replace control rod assemblies with 18 absorption rods assemblies	KNPP		Completed			
10312	Ensure primary circuit boron make-up system (TK, TB10) availability - for all conditions	KNPP		Completed			*Merged w/ 31321*
11211	Ensure actuation of planned & emergency core cooling - without hydraulic shock	KNPP		Completed			
11311	Install a steam-gas mixture detector in the reactor vessel (AEE lead + FGER Support)	ECK	AEE / FGER	Completed			AEE+FGER
11321	Replace thermal insulation of equipment and piping located in the reactor building	ECK	FFRA	Completed			
11322	Upgrade EFWT filtering system GA 201 to guarantee availability of the latter in any accident condition	KNPP		Completed			*Superseded by 11321*
11323	Provide redundancy of heat exchangers (TQn0W01)	KNPP		Completed			*Superseded by 11321*
11332	Provide redundancy of cleaning water for LP safety injection pumps (Tqn2) seals	KNPP		Completed			
11341	Change electric power supply to RL50, UA20 aux. FW pumps	KNPP		Completed			*Merged w/ 31321*
11342	Provide conditions for TX system operation for 24 hours	ECK		Completed			
11343	Enhance the reliability of SG safety valves	ECK	FGER	Completed			
12111	Develop a system for continuous neutron fluence measurement on Reactor Pressure Vessel structure	KNPP		Completed			
12132	Heating water for high and medium pressure safety injection above 55^{o}C	ECK	AEE	Completed			
12133	Optimize the core refuelling chart (for Proposed 3-year fuel cycle)	KNPP		Completed			
12211	Quick detection & localization of leakage from primary to secondary circuit	KNPP		Completed			
12331	Ensure continuous measurement of main (primary) coolant pumps vibrations	KNPP		Completed			
12332	Ensure detection of loose parts	ECK	FGER	Completed			
12333	Implement a system for detection & localization of leakage from the reactor upper block (FLUS)	ECK	FGER	Completed			
12334	Improve detection of minor primary circuit leaks	ECK	FGER	Completed			*Merged w/ 12333*
12362	Reduce the impact of thermal cycles on coolant system piping (FAMOS)	ECK	FGER	Completed			
13011	Install hydrogen detection and recombination systems	ECK	FGER	Completed			
13012	Use of normal ventilation for hydrogen extraction	ECK		Completed			
13021	Modernization of TF system to exclude residual effects of intersystem leakage	ECK	AEE	Completed			
13041	Install equipment for measuring activity of gas releases	WES		Completed			
13051	Improvecontainment test procedure and install measuring devices and computation facilities	ECK	AEE	Completed			
14111	Implement a critical parameters monitoring system for accident and postaccidents (PAMS)	ECK / KNPP	FFRA / KNPP	Ongoing	2002	2007	Contract signed for Detail Design, Supplies and Implementation
14121	Implement a safety parameter display system (SPDS)	WES/ KNPP		Ongoing	2002	2007	Contract signed for Detail Design, Supplies and Implementation
14131	Replacement and Upgrading of the Existing Computer Information System ("Titan") (CIS)	WES		Completed			
14151	Replace the "Hindukush" (CM-2M) system with a more efficient one	ECK	AEE	Completed			

Measure Number	Measure Title / Description	Responsible		Measures' Status	Start	Finish	Remarks/Notes
		Cont	Prtnr				
14161	Replace MCR recorders	KNPP		Completed			
14190	Replacement and Upgrade of the Universal Control System - YKTC	WES		Ongoing	2003	2007	U5&6 partial
14191	Replacement of the Turbine Control System - ASUT	WES		Completed			
14211	Replace pressure drop sensors "Sapphire"	ECK	AEE	Completed			Installation by KNPP
14311	Modernize ECCS valves' control circuits	KNPP		Completed			
14411	Replace actuator end switches	KNPP		Completed			Completed during BEP
15111	Upgrade electrical power supply systems	KNPP		Completed			
15211	Improve the reliability of relay protection and automatics of the main distribution circuit	ECK	FGER	Completed			
15231	Mark cable raceways of the safety systems	KNPP		Completed			
15241	Improve the control of pressurizer electrical heaters	KNPP		Completed			
15251	Improve the reliability of 6 kV breakers (replacement)	ECK	FGER	Completed			
15411	Improve the control of batteries (UPS)	ECK	FGER	Completed			Separate Contract
15413	Install state-of-the-art troubleshooting facilities for direct current power syst	ECK	FGER	Completed			Separate Contract
15421	Modernize electrical power suply system Cat. I by replacing the existing and installing additional inverters, and back-fitting other UPS equipment	ECK	FGER	Completed			Separate Contract
15511	Enhance reliability of electrical power supply to radiation monitoring system	KNPP		Completed			
18111	Upgrade the resistance of fire doors	KNPP		Completed			
18121	Check fire propagation through air ducts. Install fire dampers and provide automation of the ventilation system	ECK	FFRA	Completed			
18122	Modify the gas fire extinguishing system	ECK / KNPP	FGER / KNPP	Completed			
18123	Ensure smoke removal	KNPP		Completed			
18124	Improve the starting speed of diesel fire pumps	KNPP		Completed			
18131	Quality fire alarm facilities for conformance with seismic stability requirements	ECK	FGER	Completed			
18311	Limit the effect of secondary circuit water or steam piping breaks in containment	ECK	FGER	Completed			
19121	Enhance the seismic stability of carrying structures (buildings)	KNPP		Completed			
19122	Implement the proposals to enhance the seismic stability of mechanical equipment	KNPP		Completed			
19123	Implement the proposals to enhance the seismic stability of piping	KNPP		Completed			
21111	Carry out Fire Hazard Analysis	ECK	FGER	Completed			
21121	Carry out an analysis of the consequences of internal flooding	ECK	FGER	Completed			
21231	Analyze the behaviour of safety systems' equipment in the event of an earthquake	KNPP		Completed			
21241	Study the seismic stability of buildings with the site seismicity of 0,2g	ECK	FGER	Completed			
22121	Change over to three-year refuelling cycle	KNPP		Completed			
22211	Study the shutdown subcriticality margin	ECK	FGER	Completed			
23111	Rank NPP equipment according to its Importance to safety in conformity with OPB-88, considering NUSS ranking and other international norms	ECK	FGER	Completed			
23121	Analyze documentation concerning safety important equipment qualification available in Kozloduy NPP, applying internationally accepted procedures	ECK	AEE	Completed			
23130	Qualification of computer codes for accident analysis (FGER part)	ECK	FGER	Completed			
23131	Qualification of computer codes for accident analysis (FFRA part)	ECK	FFRA	Completed			

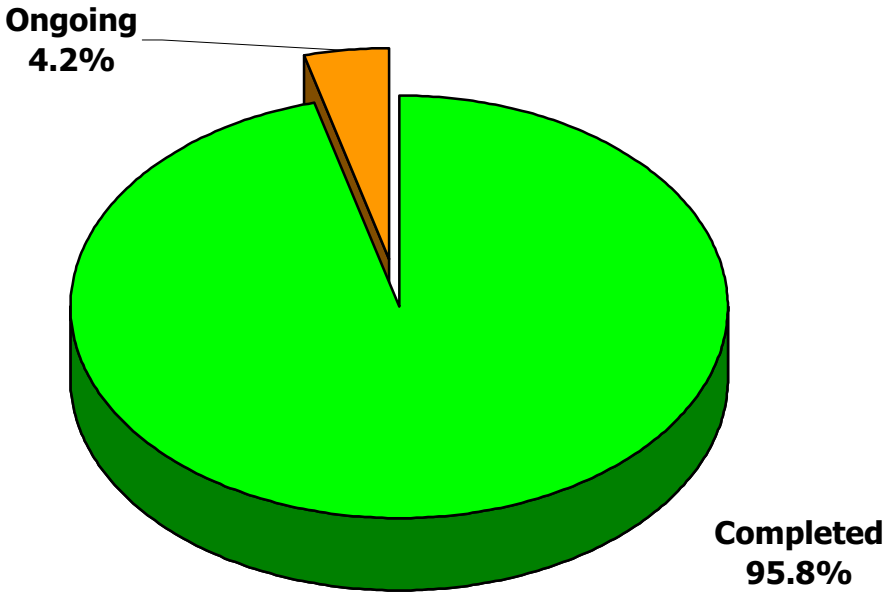
Measure Number	Measure Title / Description	Responsible		Measures' Status	Start	Finish	Remarks/Notes
		Cont	Prtnr				
23212	Develop a program for studying reactor metal samples and determine critical brittleness temperature	ECK	FGER	Completed			
23213	Study the irradiation resistance of reactor vessel during the implementation of new refuelling cycle	ECK	FGER	Completed			
23231	Mechanical substantiation of the welds on reactor upper block air duct pipe bend	KNPP		Completed			
23240	Pressure Thermal Shock Analysis (FGER part)	ECK	FGER	Completed			
23241	Pressure Thermal Shock Analysis (AEE part)	ECK	AEE	Completed			
23251	Study the risk of primary circuit cold over pressurization and the necessity for installing of an automated device for cold over pressurization protection	ECK	FGER	Completed			
23311	Study of the mechanical behaviour of the connection between primary circuit piping and SG heater	KNPP		Completed			
23321	Enhance leak-tightness of steam generator header flanges	KNPP		Completed			
23411	Mechanical analysis of the pressurizer vent line	ECK	FFRA	Completed			*Covered by 23251*
23421	Mechanical substantiation of supports of safety important piping	KNPP		Completed			Linked to 19123
23431	Mechanical analysis of primary circuit piping subjected to specific thermal loads	ECK	FFRA	Completed			
23441	Study and install a valve on piping upstream of SD-A facility (BRU-A lines)	ECK	FGER	Completed			
23461	Clarification of mechanical composition of primary circuit water filtering systems (TC)	KNPP		Completed			
23531	Study the mechanical composition of bimetal joints of primary circuit equipment	ECK	FFRA	Completed			
24211	Check the seismic stability of the wall between reactor compartment and turbine hall	ECK	FGER	Completed			
24221	Mech analysis of penetrations in compartment 820 taking into account the new seismic evaluation	ECK	FGER	Completed			*Covered by 24211/BEP*
24231	Qualification of cable penetrations and provisions for replacement thereof	KNPP		Completed			
24241	Analysis of containment bypass	KNPP		Ongoing	2005	2007	Linked to 27311, Contract signed
25221	Study of implementation of additional protective functions for 6kV and 0.4kV motors	ECK	FGER	Completed			
25241	Study the upgrading or replacement of 6kV and 0.4kV equipment	ECK	FGER	Completed			
25261	Study diesel generator auxiliary protection	ECK		Completed			
25311	Study loading scheme for consumers supplied by batteries	KNPP		Completed			
25321	Study the necessity of upgrading or replacing the 220 VDC equipment (UPS)	ECK		Completed			
26111	A complete list of analyses of design and beyond design accidents should be compiled	ECK	FFRA	Completed			
26120	Bring the safety analysis report in conformity with international practice (Siemens part)	ECK	FGER	Completed			
26121	Bring the safety analysis report in conformity with international practice (FFRA part)	ECK	FFRA	Completed			
26122	Update SAR based on PNAE G (FGER lead + FFRA support)	ECK	FGER	Completed			Shared FGER+FFRA
26211	Accident analyses using validated computer codes	ECK	FGER	Completed			*Merged w/ 23130 & 31*
26221	Analysis of Emergency Feed Water System (TX)	ECK	AEE	Completed			
26231	Study processes which may lead to unmanaged accident in the event of safety control system failure	ECK	FGER	Completed			
26250	Carry out safety analysis to additional scenarios (non-LOCA accidents)	ECK	FGER	Completed			
26251	Carry out safety analyses of additional scenarios (including additional beyond design basis accidents - LOCA)	ECK	FFRA	Completed			
26260	Study the core cooling after a design basis accident	ECK	FGER	Completed			
26261	SG Behaviour in case of SLB, FWLB and LOCA	ECK	FFRA	Completed			
26271	Study of radiological consequences of in event of heat exchangers de-pressurization	ECK	FFRA	Completed			Linked to 27311
26281	Carry-out studies of possible causes of leaks from the primary to the secondary circuit, and propose solutions for localizing the accident	KNPP		Ongoing	2003	2007	Linked to 27211, Lev.2, contract signed

Measure Number	Measure Title / Description	Responsible		Measures' Status	Start	Finish	Remarks/Notes
		Cont	Prtnr				
26311	Carry on a study of feed and bleed mode using pressurizer vent line or YR to YP 20 line	ECK	FFRA	Completed			
26321	Carry out a study of consequences of dilution of boron solution in the primary circuit in the event of a break of heat exchangers TQ/10/20/30W01	ECK	FFRA	Completed			
26331	Initiating event identification and analyses of a primary coolant dilution mode	ECK	FGER	Completed			
26341	Provide substantiation for each accident of the impossibility of formation of critical mass	ECK	AEE	Completed			
26351	Analyze the case of a total loss of electric power supply	ECK	FGER	Completed			
26361	Analyze the case of a total loss of heat sink (VC,VB)	ECK	FGER	Completed			
26371	Analyze the case of a total loss of SG feed-water and emergency feed-water	ECK		Completed			*Merged w/ 26311*
26381	Analize the case of Anticipated Transients Without Scram	ECK	FGER	Completed			
26391	Study the possibility of providing filtering ventilation in case of severe accidents	ECK	FGER	Completed			
26411	Analyze consequences of a break of suction pipe from high pressure make-up tank to TQ pumps and a loss of high pressure make-up tank water	ECK	FFRA	Completed			
26431	Evaluate capabilities of design system to manage beyond design accidents	ECK	FFRA	Completed			
26441	Study hydrogen generation and accumulation process	ECK		Completed			
26511	Study the risks of shutdown accidents	ECK	FFRA	Completed			Related to 27210
27111	Determine test frequency, maintenance periods, safety systems acquisition & repair times	KNPP		Ongoing	2003	2007	Linked to 41311
27121	Develop a system for daily evaluation of operating hazards	KNPP		Ongoing	2003	2007	Related to PSA
27210	Update of PSA Level 1	KNPP		Completed			Related to 26511
27211	Carry-out a Probabilistic Safety Analysis (PSA), Level 2	KNPP		Completed			After 27210
27311	Carry-Out a Probabilistic Safety Analysis (PSA), Level 3	KNPP		Completed			Shall be carried out of the PM scope
28112	Quantitative reliability analysis of emergency electric power supply system, Category II	KNPP		Completed	2003	2007	Linked to 27210
28311	Breakdown, analysis and qualif. of ventilation system according to seismic requirs and rules for NPP	KNPP		Completed			
28411	Improvement of the reliability of diesel generators	ECK	FGER	Completed			
29111	Study the optimization of the radiation monitoring facilities	KNPP		Completed			
31121	Introduce methods and means to determine the service life of cables	KNPP		Completed			
31132	Ensure uninterruptible control of winding insulation of the turbine generator stator	ECK	FGER	Completed			
31141	Ensure uninterruptible control of 6 kV motors stator windings	ECK	FGER	Completed			
31151	Ensure the control of operating temperatures for the windings of main and house transformers	ECK / KNPP	FGER / KNPP	Completed			FGER Supplies, KNPP implementation
31212	Modify TTV 1000 excitation transformers to eliminate 3rd harmonic	KNPP		Completed			
31213	Replace power breakers KAG24	ECK	FGER	Completed			
31311	Enhance reliability of generator excitation	ECK	FGER	Completed			
31321	Install one additional DG per each unit for unit consumers	ECK	FGER	Completed			
32021	Enhance reliability of turbine/generator vibration control system	KNPP		Completed			
33111	Enhance main (primary) circulating pump thermal protection	KNPP		Completed			
33112	Enhance reliability of main circulating pump anti-reversing gear	KNPP		Completed			
33212	Improve quality of neutron monitor chamber & temperature control system seals	KNPP		Completed			
34113	Provide methods & means for efficient steam generator second stage washing	KNPP		Completed			

Measure Number	Measure Title / Description	Responsible		Measures' Status	Start	Finish	Remarks/Notes
		Cont	Prtnr				
34121	Extend remaining life of SG blow-down system pipes	ECK / KNPP	AEE / KNPP	Completed			AEE design, KNPP implementation
34131	Maintain minimum permissible temperature in TX system	KNPP		Completed			
34211	Reduce vibration level of turbine/generator bearings	KNPP		Completed			
34231	Redesign turbine high pressure vessel first stage	KNPP		Completed			
34311	Reduce condenser high pressure heater & moisture separator/reheater vibration level/eliminate hydraulic shocks	ECK	AEE	Completed			*Merged w/ 34312*
34312	Extend residual life of secondary circuit pipes operating in two-phase medium	ECK	AEE	Completed			
34322	Enhance reliability of pipe bundles LP superheaters	KNPP		Completed			
34323	Enhance operation of HP superheaters level regulators	KNPP		Completed			
34324	Improve service life of I/O Regulators of HP superheaters spirals	KNPP		Completed			
34325	Improve HP superheater tube protective screen resistance to steam inlet temp.	KNPP		Completed			
34326	Improve maintenance conditions for heat exchanger VK	KNPP		Completed			
34333	Modernize RN70 pumps' flow passages	KNPP		Completed			
34342	Replace condenser tube bundles with bundles manufactured from stainless steel	KNPP	AEE	Completed			Separate Contract
34431	Reduce Unit 5 steam lines' vibration levels	KNPP		Completed			
34441	Change type and replace steam bleed III valves	KNPP		Completed			
34442	Replace the cast iron valves in turbine hall	KNPP		Completed			
34511	Install separator on steam bleed I to moisture separator reheater	ECK	AEE	Completed			Separate Contract
34512	Upgrade of SPP and modernization of ISSRS	ECK	AEE	Completed			Separate Contract
34513	Implement a moisture separator reheater preservation system	ECK	AEE	Completed			Separate Contract
34521	Improve spillway operation for moisture separator reheater condensate stage I	ECK	AEE	Completed			Separate Contract
35211	Reconstruct booster pump for main turbine feed pump	KNPP		Completed			
35213	Replace turbine feed pump seals with face seals	KNPP		Completed			
35312	Improve the reliability of circulation water filter of turbine condensers – Unit 6	ECK	FGER	Completed			
35321	Study & take measurements to reduce vibrations of VB pumps	KNPP		Completed			
35421	Reduce pump & piping vibrations to T/G rotor hydraulic lifting system	KNPP		Completed			
35431	Enhance reliability of hydrogen & nitrogen receivers' safety valves	KNPP		Completed			
35432	Study measures to reduce regulation oil feed pump SC50 vibration levels	KNPP		Completed			
40211	Develop an information system	KNPP		Completed			
41111	Revise technical specifications for Units 5 & 6	KNPP		Completed			
41311	Develop symptom-oriented procedures	KNPP		Completed	2003	2007	
42211	Develop a periodic tests programme for equipment in accordance with technical specifications and considering the guidelines of IAEA, ASME, ENJQ and others	KNPP		Completed			
43111	Develop procedures for repairs, policy and organization	KNPP		Completed			
43121	Classify equipment for residual life & develop rest life time evaluation system	KNPP		Completed	2002	2007	Contract for analysis signed
43211	Design ultrasonic and eddy current inspection equipment for SG & primary circuit	KNPP		Completed			
43213	Delivery visual and TV equipment inspection facilities	ECK	FGER	Completed			
43221	Provide SG tube leak detection facilities	KNPP		Completed			

Measure Number	Measure Title / Description	Responsible		Measures' Status	Start	Finish	Remarks/Notes
		Cont	Prtnr				
43311	Design special tools for reactor head channel (temp control sensors) repairs	KNPP		Completed			
43313	Develop transportation/handling facilities & test equipment for circulating pumps (VC)	KNPP		Completed			
43314	Improve quality of tightening of main circulating pump studs	KNPP		Completed			
43315	Enhance facilities for primary circuit SG isolation during repair	ECK	AEE	Completed			
43321	Design, manufacture and install equipment for providing high quality reactor seal	KNPP		Completed			
43411	Develop maintenance instructions based on IAEA recommendations	KNPP		Completed			
43412	Develop methodology and techniques for replacement of small diameter piping sections provided with protection sleeves	ECK	AEE	Completed			
43414	Develop methodology for repair SG headers	KNPP		Completed			
43511	Develop post-maintenance tests & acceptance criteria according to technical spec's	KNPP		Completed			
44111	Install an adequate VVER 1000-320 simulator for Units 5 & 6	KNPP		Completed			
45111	Design and implement a system for monitoring radio-nuclide releases through air ducts	WES		Completed			
45121	Install automated independent radiation monitoring f/each safety system channel (I, II, III)	KNPP		Ongoing	2000	2007	Contract signed for detailed design, supplies and implementation. Installed in Unit 5.
45131	Implement and operate a metrological station	KNPP		Completed			
45221	Install automated systems for control of emergency exits from restricted zone	KNPP		Completed			
45231	Develop and implement a centralized radiation monitoring computer system	KNPP		Completed			
45311	Develop training systems (training grounds) to train personnel in principles of dose load reduction	ECK	AEE	Completed			
45312	Develop programmes for reducing Received Doses with subsequent amendment of repair procedures	KNPP		Completed			
45411	Provide more alpha, beta and gamma radiometers and equipment for extreme measurement of radio-nuclide content in human body	ECK	FGER	Completed			
45421	Provide meteorological lab equipped with ionizing radiation measuring facilities	KNPP		Completed			
45431	Develop and implement a radiation monitoring system for severe accidents	WES		Completed			
45441	Upgrade AKRB detectors	ECK	AEE	Completed			
45511	Upgrade lighting of industrial areas	KNPP		Completed			
46111	Take analyses of beyond design basis into account in internal emergency plan	KNPP		Completed			
46211	Develop an accident management center	KNPP		Completed			
47111	Implement connection between spent fuel pool (SFP) cooling system and the Emergency Boron Make-up tank (EBMT) tc ensure emergency cooling of the SFP through the EBMT	KNPP		Completed			
47121	Provide facilities for implementing a tightness control system for fuel rods	KNPP		Completed			
47151	Design and build a spent nuclear fuel storage loading/ unloading equipment	KNPP		Completed			
47211	Develop a spent fuel storage scheme	KNPP		Completed			
48112	Implement a design for radioactive waste treatment	KNPP		Completed			
49111	Implement a system for continuous monitoring and maintenance of the main primary circuit water chemistry	KNPP		Ongoing	2002	2007	Contract signed
49113	Implement a SG blow-down water continuous monitoring system	KNPP		Completed			
49121	Install systems and facilities for primary circuit sampling under accident conditions	KNPP		Completed			

Measure Number	Measure Title / Description	Responsible Cont	Responsible Prtnr	Measures' Status	Start	Finish	Remarks/Notes
49131	Design an automated information system for water treatment of units	ECK	FGER	Completed			
49221	Modify water treatment system and reagent inventories	ECK	FGER	Completed			
50111	Draft a decommissioning programme	KNPP		Completed			linked with 26122
51111	Development of design for replacement of steam generators	ECK	AEE	Completed			



Total	Completed	Ongoing	To be done
212	203	9	0
	95.8%	*4.2%*	*0.0%*